Government of **Western Australia**
Department of **Health**

The 13th Report of the Perinatal and Infant Mortality Committee of Western Australia for Deaths in the Triennium 2005–07

Delivering a **Healthy WA**

The 13th Report of the Perinatal and Infant Mortality Committee of Western Australia for Deaths in the Triennium 2005–07

December 2010

Department of Health Western Australia

The Perinatal and Infant Mortality Committee of Western Australia is a statutory Committee of the *Health Act 1911*. This Report was prepared by Dr Catherine Douglass on behalf of the Committee.

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Foreword:

Chairman's report

On behalf of the Perinatal and Infant Mortality Committee of Western Australia, I have pleasure in submitting the 13th Report of investigations of deaths in the years 2005-2007.

This is the third Report of the re-established Committee. The Committee was re-established in October 2001 and has previously submitted Reports for the periods 2000-01 and 2002-04. A policy has been pursued of maintaining consistency in assessment and classification of cases, now enabling effective comparisons between reporting periods and evaluation of trends.

The purpose of the work of the Committee is primarily educational and aims to contribute to improvements in clinical care. Cases are investigated in detail by one of three appointed investigators, each of whom has skill and clinical experience in perinatal care. The Committee deliberates on each case and classifies each death using the standardised system developed by the Perinatal Society of Australia and New Zealand. Any preventability is determined and scored using a published system. Each medical practitioner involved in care of the case is then written to by confidential letter, often including suggestions as to how the care may have been improved, where appropriate. This Report describes the outcomes of these deliberations and includes Recommendations as well as Educational Papers on topics that address contemporary challenges in clinical care.

The outcomes of perinatal care in Western Australia continue to compare favourably with outcomes from Eastern Australia, with rates of perinatal death amongst the lowest in the country. Overall numbers of births have risen reflecting increases in the population and the birth rate. Outcomes after birth continue to improve and the infant mortality rate for the period was 3.6 per 1,000 births. The stillbirth rate however remained generally unchanged at 7.0 per 1,000 births. Most perinatal and infant deaths were related to preterm birth and rates of this complication in Western Australia and elsewhere have continued to rise. Substantial improvements in the rates of stillbirth and preterm birth are awaiting discovery of preventative, diagnostic and treatment strategies that will likely come from innovative scientific research.

As for previous reporting periods, outcomes for Aboriginal Australians were considerably worse. The stillbirth, neonatal and post-neonatal death rates were all higher than in the non-Aboriginal population, with the greatest difference being in the post-neonatal death rates. The Committee is keen to support strategies that may reduce the disparities in clinical outcomes that continue to afflict many Aboriginal people.

The Committee is of the view that the proportion of deaths that result from preventable medical factors is continuing to decline. In the three-year period, 97.6% of deaths were considered unlikely to be avoidable and nearly 90% of deaths occurred in the presence of medical care deemed to be appropriate.

Such reassurance could not be found in review of some of the cases of home birth. Of the 658 planned home births in the period, the Committee reviewed seven deaths, six of which occurred at term or post-term gestational ages. From the information available, three of these deaths were considered to be possibly avoidable. The perinatal death rate for term home births was 3.9 times higher than for hospital term births. It is with concern that the Committee notes this rate is not declining. During the first two reporting periods, the Committee observed the perinatal death rate for term home births to be approximately three times that for term hospital births, and this finding led the Committee to recommend an independent review. The Review has been conducted and many improvements in care recommended. In view of the apparent continuation in poor outcomes for some cases, the Committee now recommends that an independent audit be conducted of the implementation of the recommendations of the Review.

The members of the Committee commit their time and expertise as volunteers. As Chairman, I would like to extend my appreciation to all Members for their commitment and wise counsel. The preparation of this Report, as for its two predecessors, has been led by Dr Catherine Douglass (nee Buccilli). We thank Dr Douglass for her tireless and expert work, and her ability to interpret findings within a state-wide perspective. I would also to like to extend our appreciation to Mrs Vivien Gee who is the Principal Consultant Statutory Mortality Committees and supports the daily activities of the Committee; Dr Margaret Stevens and Dr Revle Bangor-Jones, delegates of the Executive Director of Public Health; Peter Somerford and his team for biostatistical support; and the many health care providers throughout Western Australia who provide the Committee with details of each case.

Respectfully submitted

Professor John Newnham
Chair

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1 Executive summary

Overview

The Perinatal and Infant Mortality Committee of Western Australia[1] (PIMC; 'The Committee') is a privileged statutory Committee described by the *Health Act 1911*. The role of the PIMC is to enquire into and report to the Executive Director of Public Health (EDPH) on perinatal and infant mortality.

This is the 13th Report of the PIMC, containing data related to deaths in the years 2005 to 2007 inclusive.

There were a total of 85,723 births and 85,125 live births in WA in 2005-07. There were 598 stillbirths (>=20 weeks gestational age or >=400g birthweight), 195 neonatal deaths (in the first 28 days of life), 793 perinatal deaths (stillbirths and neonatal deaths combined), 115 post neonatal deaths (deaths between 29 and 365 days of life) and 310 infant deaths (deaths in the first year of life) in the triennium. The average annual numbers were: 28,375 live births, 199 stillbirths, 65 neonatal deaths, 264 perinatal deaths, 38 post-neonatal deaths and 103 infant deaths in the 2005-07 triennium.

The EDPH directed the Committee to investigate stillbirths and infant deaths resulting from pregnancies of at least 26 weeks gestational age, with the exception of known pregnancy terminations. In WA, pregnancy terminations after 20 weeks gestational age must be approved by a Ministerial panel.[2] This led to the Committee investigating 458 of the total 908 stillbirths and infant deaths in 2005-07. A published six-point scale for grading medical preventability was applied to each investigated case.[3] Using this preventability scale, there were 411 deaths (89.7%) with no identified preventable factors and 47 deaths (10.3%) with potentially preventable medical factors ('medical preventability'). Of these 47 deaths with medical preventability, eleven (2.4% of all investigated deaths) were graded with a high level of medical preventability and considered avoidable. Similar figures were reported in the 12th PIMC report for the years 2002-04.[4]

The main contributing causes or categories of stillbirth in the triennium were congenital abnormalities (29.8%), unexplained antepartum death (18.2%) and spontaneous preterm birth (10.4%).

The main contributing causes or categories of infant death were congenital abnormalities (30.0%), extreme prematurity (19.7%) and sudden infant death syndrome (SIDS)(14.2%).

Socially disadvantaged groups, particularly Aboriginal Australians, were observed to have increased risks of stillbirth and infant death. Compared with non-Aboriginal mothers, the stillbirth rate was double in Aboriginal mothers, the neonatal death rate three-fold higher and the post-neonatal rate six-fold higher.

More than one quarter (25.4%) of stillbirths and infant deaths occurred in mothers who were smokers, whilst 17.0% of all mothers who gave birth in 2005-07 were smokers. In addition to the known harmful effects of smoking, in the investigated deaths other potentially adverse maternal or familial behavioural factors were noted. In 24.5% of investigated deaths (18.7% of investigated

stillbirths and 31.4% of investigated infant deaths) negative maternal (or paternal) behavioural factors such as poor compliance with recommended medical care, alcohol and illicit substance use, and domestic violence, were recorded.

Home births represented 0.8% of births in the triennium, but were over-represented in numbers of term stillbirths and infant deaths, particularly deaths due to peripartum hypoxia, and over-represented in the proportion that were considered potentially avoidable.

Commentary

Whilst stillbirth rates have been relatively static for two decades and infant mortality rates have continued to fall, there has been an increase in the birth rate which has led to an increase in the absolute numbers of births, stillbirths and infant deaths in WA in the last few years.[5] WA compares favourably with national indices. In 2007 WA reported the lowest perinatal mortality rate of the states and territories (AIHW data)[6] and the lowest infant mortality rate (ABS Deaths data).[7]

The vast majority of investigated stillbirths and infant deaths in 2005-07 met the Committee's expectations of appropriate medical care. These low levels of medical preventability reflect high standards of medical care in the State. The main areas where improved outcomes may have been achieved related to the management of labour, identification and management of fetal growth restriction, management of maternal diabetes, hypertension, peripartum sepsis and the sick neonate.

Local research has shown measurable benefits of outreach obstetrics training for medical and midwifery staff.[8] It is recommended that similar training initiatives are well resourced, and accessible for all staff in both metropolitan and rural areas.

Preterm birth and congenital abnormalities account for the majority of stillbirths and infant deaths, along with major morbidity in surviving infants. Congenital abnormalities remain a major problem, despite widely accepted prevention and screening programs. Preterm birth rates are high and continuing to increase over time.

Despite a high postmortem rate, almost one in five stillbirths remain unexplained in WA. Unexplained stillbirths represent a significant burden of disease, particularly third trimester losses.

The problems of preterm birth and unexplained stillbirths are particularly difficult to address because their aetiologies are not well understood. Further research into these areas is required.

For many years WA has been served well by an accepted 'in utero' transfer policy for women at high risk of preterm birth. The Committee reminds practitioners that improved neonatal outcomes are observed when very preterm babies are delivered at an appropriate tertiary unit.

Modern problems in our affluent country are increasing prevalences of obesity, diabetes mellitus and physical inactivity. In particular, morbid obesity has increased. The burden of these diseases, and their impact on perinatal outcomes, are poorly understood because of insufficient data collection in Australia. Improved collection of data is necessary for informed public health policy making, and this may be achieved through modification of midwifery notification forms.

The PIMC observed that significantly more investigated stillbirths and infant deaths in WA in the years 2005-07 had maternal/parental behavioural risk factors (24.5%) compared with 10.3% of cases with preventable medical factors. The main identified problems were lack of compliance with medical care, and alcohol and substance use. This illustrates the negative effects of social problems on health outcomes.

There has been a striking reduction in sudden infant death syndrome (SIDS) since 1991, following identification of the risks of a prone sleeping posture and excessive bedclothes, and appropriate educational intervention programs. However, an increase in the number of SIDS cases in 2005-07 compared with the previous triennium was observed in WA. In addition, there was a strong association of co-sleeping and sudden infant death, especially in the presence of other risk factors (maternal smoking, fetal growth restriction, low birth weight and maternal sedation). Educational efforts should continue to dissuade mothers from smoking, and encourage breastfeeding and safer sleeping practices. Co-sleeping should be discouraged, particularly in the presence of additional risk factors. Families should be advised that room-sharing with parents, rather than co-sleeping, is the safest sleeping place for small babies.

There were seven investigated deaths amongst planned homebirths in the triennium, with six of these occurring in term or post-term pregnancies. As seen in the previous triennium, planned homebirth was associated with increased risks of term stillbirth and infant death. The Committee has noted with concern that potentially preventable deaths continue to occur in planned home births. An audit to assess the implementation of the recommendations of the Review into Home Births in WA is advised.[9]

Improved perinatal and infant health outcomes in WA may require different approaches to maternal health, focusing on social factors, assisting mothers in making healthier lifestyle choices, improving nutrition, and compliance with recommended medical care.

Findings:	Key Points:
Overview: In WA in 2005-07 there were 85,723 births and 908 perinatal and infant deaths (598 stillbirths, 195 neonatal deaths and 115 post-neonatal deaths). There were 7482 preterm births, with a preterm birth rate (<37 weeks) of 8.7%, compared with 8.4% in 2002-04 and 6.4% in 1990.	The birth rate has increased, leading to an increase in total numbers of births and stillbirths in WA.
The stillbirth rate was 7.0 per 1,000 births. The neonatal mortality rate was 2.3 per 1000 livebirths. **The perinatal mortality rate was 9.3 per 1,000 births, compared with 9.5 per 1,000 births in 2002-04.** The post-neonatal mortality rate was 1.4 per 1000 livebirths. **The infant mortality rate was 3.6 per 1,000 livebirths, compared with 3.5 per 1,000 livebirths in 2002-04.**	Since 1990, stillbirth rates have been relatively static, whilst infant mortality rates have declined.
The majority of stillbirths and infant deaths occurred in preterm births. **Preterm deliveries (<37 weeks) accounted for 81.8% (n=489) of stillbirths, 71.8% (n=140) of neonatal deaths and 37.4% (n=43) of post-neonatal deaths.** 83.0% (n=1934) of preterm births prior to 34 weeks gestation occurred at KEMH. This was a similar proportion to 2002-04 (82.2%).	Preterm birth is associated with the majority of stillbirths and infant deaths, and is increasing.
Multiple pregnancies were associated with 8.5% of stillbirths (n=51), 20.0% (n=39) of neonatal deaths and 7.0% (n=8) of post-neonatal deaths. Stillbirth and infant death rates were significantly higher amongst those with markers for lower socioeconomic status, in smoking mothers and in Aboriginal families. Families living in rural areas had generally higher perinatal and infant mortality risks, compared with metropolitan residents. In particular, the perinatal mortality was two to three times higher and the post-neonatal mortality rate more than five-fold higher for women living in the Wheatbelt and Kimberley areas. The perinatal mortality was doubled and the post-neonatal mortality rate trebled for those living in the Pilbara and Goldfields regions compared with the metropolitan rate.	Other important risk factors for stillbirth and infant death included: - Congenital abnormalities - Low socioeconomic status - Rural residence - Multiple gestation - Adverse lifestyle factors including smoking, poor compliance with medical care and other harmful substance use. Aboriginal people continue to show considerably higher birth and death rates.

Findings:	Key Points:
The prevalence of smoking in pregnancy continued to decline. 17.0% of births were to smoking mothers in 2005-07 compared with 18.7% in 2002-04. 25.4% of stillbirths and infant deaths in 2005-07 occurred in smoking mothers. The perinatal mortality rate was 13.0 per 1,000 births in smoking mothers and 8.7 per 1,000 births in non smoking mothers. The infant mortality rate was 6.5 per 1,000 births in smoking mothers compared with 3.1 per 1,000 births in non smoking mothers.	The stillbirth rate was double, the neonatal death rate three-fold higher and the post-neonatal rate six-fold higher in Aboriginal compared with non-Aboriginal families.
Causes of Death: The main contributing causes of stillbirth by the Perinatal Society of Australia and New Zealand Perinatal Death Classification system (PSANZ PDC) in the 2005-07 triennium were congenital abnormality (29.7%), unexplained antepartum death (18.2%) and spontaneous preterm birth (10.4%). These proportions have remained similar since 2000-01. The leading categories of neonatal death by PSANZ PDC were prematurity (38.5%) and congenital abnormality (26.7%), with perinatal infection and 'no obstetric antecedent' each representing 7.2% of the total. There have been no major changes in the proportions since 2000-01. The leading categories of post-neonatal deaths by PSANZ Neonatal Death Classification (PSANZ NDC) were congenital abnormality (34.2%), SIDS (30.7%), infection (13.2%) and 'other' which include injuries and indeterminate causes of death (7.9%). These proportions differed to the previous triennium (2002-04) when SIDS was equal leading cause of death (23.4%, which had reduced from 31% in the years 2000-01), congenital abnormality (23.4% in 2002-04, and 19% in 2000-01) and 'other' which represented a significantly greater proportion of 27.7% in 2002-04 and 21% in 2000-01.	The leading caegories of stillbirth were congenital abnormality, 'unexplained' and prematurity. The leading categories of infant death were congenital abnormality, prematurity and SIDS.

Findings:	Key Points:
INVESTIGATED DEATHS: The Committee investigated 458 of the 908 deaths, comprising 251 of the 598 stillbirths, 96 of the 195 neonatal deaths and 111 of the 115 post-neonatal deaths. **Preventable medical factors** A six-point preventability scale was applied to assess the standard of medical care provided for each case.[3] The scale gives a preventability score of '1' where the medical care is considered of an appropriate standard. Preventability scores of '2' and '3' reflect 'low levels' of potentially preventable medical factors in deaths that are considered unavoidable in a medical context. Preventability scores of '4' and higher code for significant levels of medical preventability in deaths that are considered avoidable. 47 (10.3%) of the 458 investigated cases were considered potentially preventable (preventability score >=2). Of these 47 cases, eleven (2.4% of all investigated deaths) were considered avoidable (preventability scores >=4). 411 (89.7%) of the 458 investigated deaths had no identified preventable medical factor (preventability score=1). Overall 97.6% (447 of 458) of investigated deaths had no identified preventable medical factors, or low levels of medical preventability (preventability score <4) and the deaths were considered unlikely to be avoidable. These figures were similar to the findings in 2002-04 when there were similar criteria for selection of cases for investigation (96.0% preventability score<4 and 86.7% preventability score=1 in 2002-04). Of the 47 cases in 2005-07 with **potentially preventable medical factors** (24 stillbirths, 19 neonatal deaths and 4 post-neonatal deaths),11 cases had 'systems' factors only identified, 31 cases had 'medical care' factors only identified and five cases had both 'systems' and 'medical care' factors identified (total n=47 cases).	**INVESTIGATED DEATHS:** The Committee investigated stillbirths and infant deaths in pregnancies of at least 26 weeks gestational age. 89.7% of deaths met the Committee's expectations of appropriate medical care, and 97.6% of deaths were considered unlikely to be avoidable.

Findings:	Key Points:
The main **'systems factors'** identified were: ■ Delays in management or transfer: 8 cases ■ Problems with follow-up of abnormal test results: 5 cases The main **'medical care factors'** identified related to: ■ Sub-optimal antenatal and intrapartum medical management: 21 cases ■ Failure to identify abnormal fetal heart rate patterns on cardiotocograph (CTG) traces: 9 cases ■ CTG monitoring not performed when indicated: 5 cases ■ Sub-optimal medical care of the neonate: 5 cases ■ Earlier referral indicated: 6 cases **Deaths with 'preventable factors',** by Cause of Death: In those stillbirths where preventable medical factors were identified (n=24), the causes of death by PSANZ PDC were: ■ Maternal conditions including diabetes mellitus: 7 cases ■ Maternal hypertension: 4 cases ■ Hypoxic peripartum insult: 5 cases ■ Fetal growth restriction: 5 cases ■ Specific perinatal conditions: 2 cases ■ Unexplained antenatal death: 1 case In the neonatal deaths where preventable medical factors were identified (n=19), the causes of death by PSANZ PDC were: ■ Hypoxic peripartum insult: 8 cases ■ Perinatal infection: 4 cases ■ Congenital abnormality: 3 cases ■ Maternal hypertension: 1 case ■ Antepartum haemorrhage: 1 case ■ Fetal growth restriction: 1 case ■ No obstetric antecedent: 1 case In the post-neonatal deaths where preventable medical factors were identified (n=4), the causes of death by PSANZ NDC were: ■ Hypoxic ischaemic encephalopathy (3 cases) ■ Congenital heart disease (1 case)	Key areas were identified where improved medical management may have improved outcomes: ■ Avoidance of delays in treatment or transfer ■ Improved management of diabetes and hypertension in pregnancy ■ Improved detection and management of fetal growth restriction ■ Improved identification and management of intrapartum fetal distress. ■ Prompt management of the sick neonate.

Findings:	Key Points:
Lifestyle factors: Adverse behavioural factors such as substance use and poor compliance with medical care (excluding smoking) were associated with 24.5% (n=112) of all investigated deaths in 2005-07 (18.7% of stillbirths, 22.9% of neonatal deaths and 38.7% of post-neonatal deaths). This was an increase from 22.0% in 2002-04. Of the investigated deaths (n=458), 16.2% (n=74) of mothers had poor compliance with recommended medical care, 6.1% abused alcohol (n=28), 7.2% (n=33) were found to use marijuana and 4.1% (n=19) used intravenous or other 'hard drugs'. In the group of 112 cases with maternal behavioural factors, 58.0% were smokers (n=65) and 57.1% were Aboriginal (n=64). Domestic violence was recorded in 4.8% (n=22) of investigated deaths. Non-accidental injury caused two neonatal and four post-neonatal deaths (1.3%; n=6 investigated deaths).	Maternal or family lifestyle factors such as substance abuse or poor compliance with medical care were documented in 24.5% of investigated deaths.
Sudden Unexpected Infant Deaths In the 2005-07 triennium, sudden unexpected deaths in infancy (SUDI) cases were examined as a specified group, with 62 cases identified, which included 44 sudden infant death syndrome (SIDS) cases (n=12, 27.3% in Aboriginal infants). This showed an increase from 23 SIDS deaths in 2002-04. In the SUDI group, 50.0% of deaths occurred to smoking mothers (n=31) and 64.5% were associated with co-sleeping (n=42). Of the 44 SIDS cases, infants were found prone in 22.6% (n=14), supine in 6.5% (n=4), on the side in 11.3% (n=7) and the position was unknown in 59.7% (n=37). Infant deaths which occurred whilst co-sleeping were also examined as a separate group. In 2005-07 there were 42 deaths which occurred whilst co-sleeping. Of these, 34 cases were found to be associated with adverse maternal behavioural factors. By comparison, in 2002-04 there were 33 unexpected infant deaths that occurred whilst co-sleeping, and 27 of these were considered to have maternal/familial behavioural factors.	The incidence of SIDS increased in this triennium. The majority of sudden unexpected infant deaths occurred in association with co-sleeping.

Findings:	Key Points:
Home births: In WA in 2005-07, there were at least 658 planned home births, 559 actual home births, 84,365 planned hospital births (including birth centre births) and 137 births in which the intended place of birth was unspecified. Six hundred and forty (640) of the 658 planned home births, and 75,650 of the 84,365 planned hospital births (including birth centre births)were at term or post term (>= 37 weeks gestational age). Of the 658 planned home births, there were seven deaths (n=3 stillbirths; n=4 infant deaths) with six of these occurring at term or post-term gestational ages. Three of these term deaths may have been avoidable. There was a 3.9 times increased perinatal mortality risk amongst planned home births in pregnancies of at least 37 weeks gestational age (n=5 perinatal deaths in 640 planned home births; n=155 perinatal deaths in 75,650 planned hospital births). The increased perinatal mortality risk in planned home births was similar to that seen in 2002-04. Deaths due to hypoxic peripartum insult were analysed by intended place of birth for the first time in the 2005-07 cohort. There was a 21.5 times increased risk of stillbirth, and an 18.2 times increased risk of infant death due to peripartum hypoxia in planned home births at term compared to planned hospital births at term (n=2 stillbirths and n=2 infant deaths in 640 planned homebirths; n=11 stillbirths and n=13 infant deaths in 75,650 planned hospital births, at >=37 weeks gestational ages). Some caution must be exercised in interpreting home birth data due to small absolute numbers.	Planned home births were associated with preventable stillbirths and infant deaths. The risk of hypoxic peripartum stillbirth was 21 fold higher in planned home births compared with planned hospital births.
Investigations for Cause of Death: 543 of the 908 deaths (59.8%) had an autopsy examination. In the investigated cases in which autopsy was performed, the autopsy confirmed the clinical diagnosis in 21.4%, gave the diagnosis in 20.4%, provided additional information in 22.4% and was inconclusive in 35.5%.	Almost 60% of deaths had an autopsy examination performed. Autopsy examinations were demonstrated to provide useful information in the majority of cases.

Recommendations:

Recommendation 1:

Support Statewide Planning:

The statewide initiatives of the Women's and Newborns' Health Network, the Statewide Obstetric Support Unit, and the WA Neonatal Network should be adequately resourced, to optimise coordination of obstetric and neonatal care in WA.

Recommendation 2:

Deliver very preterm babies (<32 weeks gestational age) in a tertiary centre

a) Priority in utero transfer to a tertiary centre is recommended in the presence of threatened preterm labour.

b) Transport services should be adequately resourced.

Recommendation 3:

Improve Aboriginal care:

Culturally appropriate initiatives to reduce the high mortality rates in Aboriginal people are sought. Specific programs working to 'close the gap' between Aboriginal and non-Aboriginal people should be adequately resourced.

Recommendation 4:

Improve Social care:

Additional support is required to assist families in difficult social circumstances.

a) Equitable access to antenatal and infant health care is recommended.

b) Additional social work staff for antenatal clinics may be beneficial.

c) Additional resources for the Department of Child Protection to protect babies and assist families with serious social problems should be considered.

Recommendation 5:

Improve access to mental health care:

Additional support is required to assist families affected by addiction and other mental health disorders.

a) Routine screening for depression, substance abuse, and domestic violence is recommended in the antenatal and postnatal periods.

b) Equitable access to outpatient/inpatient mental health services is recommended.

Recommendation 6:

Maintain Professional Training and Standards:

a) Medical practitioners and midwives should maintain knowledge and skills through continuing professional education activities, including mock procedural and resuscitation training to maintain clinical skills, build teamwork and improve communication skills.

b) Suitable obstetric and neonatal training programs should be adequately resourced and delivered throughout the State.

Recommendation 7:

Improve monitoring for fetal wellbeing in labour.

It is recommended that all staff providing intrapartum care avail themselves of educational resources for the use and interpretation of CTG traces.

Recommendation 8:

Reduce congenital abnormalities

Minimise congenital abnormalities and improve maternal health:

a) Optimise conditions for conception with good nutrition and periconceptional folic acid and iodine supplementation

b) Avoid excessive alcohol and other harmful substances

c) Optimise periconceptional glucose control in those with impaired glucose tolerance

d) Avoid obesity

e) Improve access to first trimester genetic screening

Recommendation 9:

Reduce and manage obesity:

a) Obesity should be considered a high risk factor in pregnancy

b) The development of guidelines for the management of obesity in pregnancy is recommended.

c) Additional resources for diet and exercise programs for obese women are recommended.

Recommendation 10:

Improve Data collection:

Routine collection of data about number of antenatal attendances, maternal weight and alcohol and substance use via Midwifery notification forms is recommended.

Recommendation 11:

Reduce Preterm Birth:

Minimise preterm birth:

a) Reduce multiple gestation pregnancies through increased care with fertility techniques

b) Delay birth until at least 38-39 weeks gestational age where possible.

c) Support research initiatives to identify causes and possible interventions to reduce preterm birth.

Recommendation 12:

Reduce SIDS:

a) In addition to current 'safer sleeping' education, there should be public education about the increased risks of infant death related to co-sleeping, especially in known higher risk situations:
   - impaired/intoxicated adult
   - preterm and growth restricted babies
   - babies under the age of 4 months
   - co-sleeping on a couch

b) Parents should be advised that there is a decreased risk of SIDS where parents room-share with their babies in a separate cot for the first few months of life, compared with the baby sleeping in a separate room to its parents.

c) Parents should be advised that WA Department of Health policy advises avoidance of co-sleeping of mother and infant in hospital.

Recommendation 13:

Reduce deaths in planned home births:

a) Home births are associated with preventable stillbirths and infant deaths. Midwives offering home birth services should obtain informed consent from women to acknowledge that they have been informed of the increased risks of perinatal death associated with home birth.

b) A formal independent audit of implementation of the Recommendations of the Review into Homebirths should be performed. This audit of practice should encompass all home births, whether the midwife is under the auspices of the Community Midwifery Program (CMP) or is independent.

c) There are insufficient data about morbidity associated with homebirth in WA. A *prospective* cohort study to assess mortality and morbidity outcomes for women with planned home births in WA should be arranged as a priority. This cohort study should be performed by an independent group of researchers.

Recommendation 14:

Investigate cause of death:

Detailed clinical history and review, pathology investigation and autopsy are recommended for all deaths, even where the cause of death may appear to be obvious.

2 Committee members

The following Committee members attended meetings where cases from the years 2005-07 were presented.

Permanent members

Professor John Newnham	Chair, Professor Obstetrics & Gynaecology, The University of Western Australia (October 2001 – present)
Professor Karen Simmer	Deputy Chair, Neonatal Paediatrician (October 2001 – June 2008)
Professor Carol Bower	Epidemiologist (October 2001 – present)
Dr Noel French	Neonatal Paediatrician (October 2001 – present)
Dr Mary Sharp	Neonatal Paediatrician (April 2006 – present)
Dr Jennifer Sokol	Neonatal Paediatrician (October 2001 – Mar 2006)
Dr Andrew Wawryk	Paediatrician (October 2001 – present)
Dr Catherine Douglass	General Practitioner, Australian Medical Association Representative (Nov 2008 – present)

Provisional members

Professor Jan Dickinson	Maternal Fetal Medicine Specialist (October 2001 – April 2007)
Dr Helen Clark	Obstetrician (Jan 2007 – present)
Dr Annabelle Shannon	General Practitioner – obstetrician (October 2004 – December 2009)
Dr Jane Talbot	General Practitioner - obstetrician (August 2004 – April 2007)
Ms Raye McNally	Clinical Midwife (October 2004 – October 2007)

Co-opted members

Dr Lindsay Adams	Neonatal Paediatrician (May 2005 – present)
Dr Adrian Charles	Perinatal Pathologist (October 2001 – present)
Dr Donald Clarke	Obstetrician (March 2003 – present)

Medical investigators

Dr Catherine Douglass	General Practitioner – obstetrician (October 2001 – September 2008)
Dr Patrick Pemberton	Neonatal Paediatrician (October 2001 – present)
Dr Erica Shellabear	Obstetrician (August 2003 – June 2006)
Dr Christine Marsack	General Practitioner (May 2008 – present)
Dr Keren Witcombe	General Practitioner – obstetrician (April 2008 – present)

3 Methods

3.1 The Role of the Perinatal and Infant Mortality Committee (PIMC)

The PIMC exists as a statutory requirement of the *Health Act 1911*[1], under the direction of the EDPH. The membership of the Committee comprises a panel of experts, as prescribed by the *Health Act 1911*, with the Chair being the Professor of Obstetrics at The University of Western Australia. The EDPH appoints investigators to enquire into deaths and to present de-identified case summaries to the Committee at monthly meetings. Approximately twenty case summaries are presented at each meeting. The circumstances of each case are considered and constructive written feedback is provided exclusively to the medical practitioners who provided clinical care. Each case is assessed for cause of death, possible preventable factors and other issues of public health significance. The Committee examines cumulative data obtained from analyses of deaths, along with broader statewide perinatal data, to propose recommendations aimed at reducing perinatal and infant mortality rates.

The role of the Committee is educational, providing confidential written feedback to practitioners involved in individual cases, along with these triennial reports.

3.2 Reporting of Births and Deaths

It is a requirement of the *Health Act 1911*[1] that stillbirths and infant deaths are notified directly to the EDPH by attending medical practitioners. Information is also made available to the EDPH from midwifery notification forms and the Registrar General's Office (death certificates). The EPDH directs an appropriately qualified medical investigator to review the medical notes pertaining to a death. National Privacy Principles allow exemption for the disclosure of information when the disclosure is required or authorised by, or under the law.[10] Thus, medical notes pertaining to a death must be released to the appointed investigator when requested by the EDPH.

Midwives are required to report all births (including stillbirths) in Western Australia to the Department of Health via the 'Notifications by Midwives Regulations' 1994.[11] 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 (HIC). These data are referred to as the 'midwives' database'.[3]

The definition used for stillbirth is 'a fetus that does not have a heart beat or any sign of life, which is 20 weeks or more in gestation or 400g or more in birthweight.' Other definitions are described in Appendix I.

3.3 Designation of Cases for Investigation by the PIMC in 2005-07

Of the reported deaths, the EDPH designates those deaths to be further investigated.

The criteria for investigation of deaths for the years 2005-07 were unchanged from the previous triennium:

'All stillbirths and deaths of infants of 26 weeks or greater gestational age.'

Legal opinion regarding the requirement for investigation of deaths due to pregnancy termination was sought in 2004. It was deemed that it is not the role of the PIMC to investigate therapeutic post-20 weeks gestation pregnancy terminations that fall within the criterion for investigation, as there is a statutory Ministerial panel that approves such late terminations in the State of Western Australia.[2,12]

3.4 Methods of Case Investigations

For those cases that met the criteria for investigation, letters were sent to the notifying 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.

At the monthly PIMC meetings, cases were discussed and classified for:

1. aetiology of death, using PSANZ death classifications
2. preventability score
3. adverse maternal factors
4. thoroughness of investigation into the cause of death
5. early prevention issues

An electronic dataset from case investigations was created ('Perimortality dataset') and used to produce statistics for this Report. As a result of the detailed information learned during case investigations, there were some slight differences between some of the Perimortality data and the midwives' database. Therefore, minor corrections were made to the midwives' database.

3.5 Cause of Death Classification

The Committee applied 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).[13] Whilst designed for coding neonatal deaths, the Committee has found the PSANZ NDC useful to describe post-neonatal deaths as well. Investigated cases were classified at monthly PIMC meetings.

In this triennium secondary PSANZ codes were applied for perinatal and neonatal death classifications where it was considered that a single code did not adequately describe the clinical situation. Secondary classifications were coded by the medical investigator reviewing all case histories in preparation for this Report.

3.6 Preventability Scale

The Committee applied a 'Preventability Scale'[3] to classify deaths with possible preventable factors (Table 1). This scale is used to assess aspects of medical and nursing care. It does not reflect aspects of patient lifestyle that may contribute to poor outcome.

The preventability of an adverse event is defined as 'an error in management due to failure to follow accepted practice at an individual or system level' and accepted practice is taken to be 'the current level of expected performance for the average practitioner or system that manages the patient.'[3]

Preventability scores '2' and '3' reflect 'low levels' of preventable medical factors in deaths that are considered unavoidable in a medical context. Preventability scores greater than or equal to '4' code for higher levels of medical preventability and are used to code potentially avoidable deaths.

Table 1: 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

In those cases where the preventability score was greater than or equal to '2', the preventable factors were coded further (see Table 2):

Table 2: Preventable Medical Factors

Systems factors:
Significant delay in assessment, treatment or transfer
Staffing problem
Equipment problem
Problem with follow-up of abnormal test result
Co-sleeping of mother and baby in hospital
Medical Care factors:
Sub-optimal obstetric management (other than obstetric delivery skills)
Failure to identify abnormal fetal heart rate patterns on cardiotocographic (CTG) trace
Fetal heart rate monitoring not performed when indicated
Insufficient technical skills for obstetric delivery
Insufficient technical skills for resuscitation of newborn
Problems in medical care of the baby (other than resuscitation of the newborn)
Earlier referral indicated
Postnatal depression not identified

3.7 Maternal Behavioural Factors

The Committee noted documented maternal or other family behaviour that may have contributed to poor outcome. Maternal smoking status was considered. In addition, other family lifestyle factors that may have contributed to deaths were coded as 'Maternal Behavioural Factors' (Table 3).

Table 3: Maternal Behavioural Factors

■ Poor compliance with recommended medical care
■ Alcohol abuse
■ Marijuana use
■ Illicit intravenous drug use/other 'hard drugs' use
■ Domestic violence
■ Serious maternal psychiatric disorder, other than substance use
■ Non-accidental injury (NAI)
■ Other serious social problem(s)

3.8 Adequacy of Investigation into Cause of Death

An investigator reviewed the pathology tests performed for investigated cases and graded them with reference to guidelines for pathology tests to assess cause of stillbirths and infant deaths 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 =	few/no investigations to investigate the cause of death

Placental histopathology was generally considered necessary to adequately investigate the cause of stillbirths, with exceptions such as prenatally diagnosed trisomy 13. Whilst ideally a thorough post-mortem examination is performed, this is frequently not done, in accordance with parental wishes, and was not considered essential to be scored as 'adequately investigated' in this context. In the assessment of cause of stillbirth, guidelines (see Table 69, Section 5.8 of this report) also recommend amniocentesis and maternal toxicology tests, but these are still infrequently performed, and were not considered essential to code as 'adequately investigated' in this triennium.

For infant deaths, each case was considered on its own merits, according to the prior clinical history and investigations performed.

3.9 Autopsy Utility

Benefits of autopsy examination were considered in the investigated cases that underwent examination, and coded according to an 'autopsy utility'[14] (Table 5):

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.

3.10 Early Prevention Factors

The Committee considered cases where 'early prevention' or early termination of pregnancy in fetuses with severe congenital abnormalities may have prevented stillbirths and infant deaths after twenty weeks gestational age. Cases were coded for 'early prevention' factors where prenatal screening for fetal anomaly had not been performed or there had been some other problem with prenatal screening. 'Screening factors' were considered for deaths associated with major chromosomal abnormalities and major central nervous system abnormalities which are usually detected by prenatal screening.

Table 6: Early Prevention Screening Factors

■ Patient presented too late for screening (after 20 weeks gestational age)
■ Patient declined prenatal screening for congenital abnormalities
■ Patient declined termination of pregnancy for lethal congenital abnormality
■ Screening not done – unknown if offered to patient
■ False negative screening test

In addition, notes were made of cases where assisted fertility techniques may have contributed to poor outcome, such as multiple gestation pregnancies.

3.11 Statistical Methods

Categorical data were quantified using frequency distributions. Mortality rates and rate ratios, including 95% confidence intervals, were used to compare mortality rates between subgroups in the data. Pearson chi-square tests and trend analyses based on the Poisson regression method were performed to test for significant differences between subgroups.

Where confidence intervals for two compared rates do not overlap, it indicates a statistically significant difference between the two rates. Where the confidence intervals for a rate ratio do not include a value of 1, it is seen that, compared to the reference rate, the rate for the area of interest is statistically significantly different. Similarly, if the p value from a Pearson chi-square test is ≤ 0.05, it indicates a significant difference between the two rates or proportions compared.

Trend analyses were conducted to examine if there was a statistical trend over time where a p-value <0.05 indicates a significant correlation between the rates and the time (i.e. years). A negative correlation score indicates a decreasing trend over time, while a positive correlation score indicates an increase over time.

Version 9.1 of SAS (SAS Institute Inc., Cary, NC) statistical software was used for data analysis.

4 Results

4.1 Statewide Data, WA 2005-07

4.1.1 Perinatal and Infant Mortality Rates by Birth Weight, Gestational Age and Race, WA 2005-07

Statistics for live births, stillbirths and infant deaths by birth weight and gestational age are shown for the cohort 2005-07 in Tables 7 and 8.[5]

Stillbirth rates are quoted per 1000 total births and neonatal deaths are quoted per 1,000 live births. Stillbirths and neonatal deaths combined are quoted as a perinatal mortality rate, per 1,000 total births. In a similar manner, neonatal and post-neonatal death figures are combined to give the infant mortality rate, which is quoted per 1,000 live births.

Note that rates published here, from Midwifery Notification of Case Attended forms ('Midwives' forms'), Department of Health, WA, are higher than published Australian Bureau of Statistics (ABS) rates[15] from the Registrar General Offices in each state and territory. Reports of Midwives' data are produced annually and are provided to the National Perinatal Statistics Unit of the Australian Institute of Health and Welfare (AIHW).[16] These data are more comprehensive than ABS data, as in addition to notifications from the Registrar General's Office, they combine information from Midwives' forms, notifications made to the EDPH, and the Coroner's office.

In the triennium 2005-07 there were 85,723 births, 598 stillbirths, 195 neonatal deaths and 115 post-neonatal deaths.

The stillbirth rate was 7.0 per 1,000 births, decreased from 7.3 per 1,000 births in 2002-04.

The neonatal mortality rate was 2.3 per 1,000 live births, similar to 2.2 per 1000 births in 2002-04.

The perinatal mortality rate was 9.3 per 1,000 births, being similar to the 9.5 per 1,000 births in 2002-04.

The post-neonatal mortality rate was 1.4 per 1,000 live births similar to 1.3 per 1,000 live births in 2002-04.

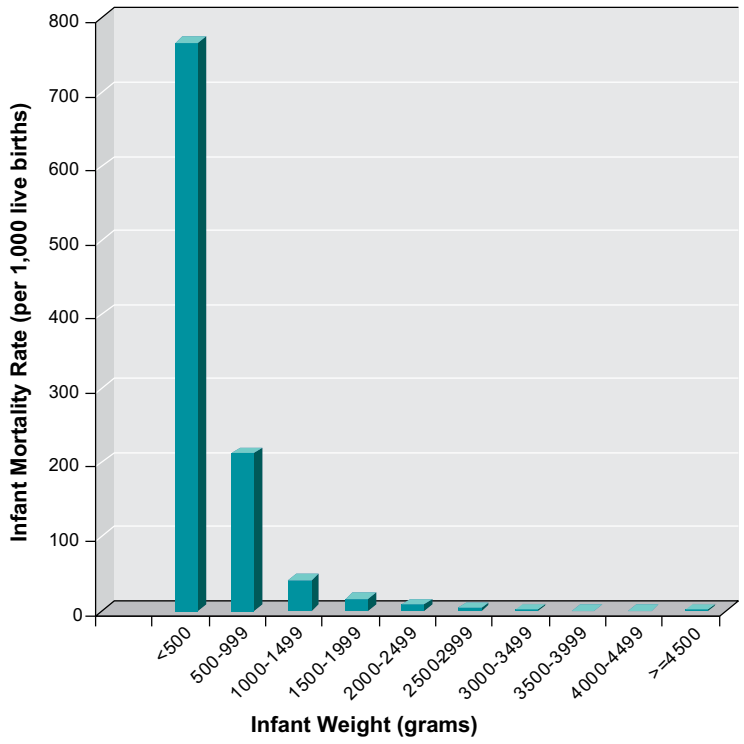
The infant mortality rate was 3.6 per 1,000 live births, being similar to the rate of 3.5 per 1,000 live births in 2002-04.

Table 7: Birth and Death Statistics by Birthweight, WA 2005-07

Infant weight (grams)	Total Births	Live births	Stillbirths		Neonatal Deaths		Perinatal Deaths		Post-neonatal Deaths		Infant Deaths	
	N	N	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
<500	331	56	275	830.8	42	750.0	317	957.7	1	17.9	43	767.9
500-999	453	347	106	234.0	63	181.6	169	373.1	11	31.7	74	213.3
1000-1499	520	477	43	82.7	15	31.4	58	111.5	5	10.5	20	41.9
1500-1999	1153	1121	32	27.8	9	8.0	41	35.6	10	8.9	19	16.9
2000-2499	3510	3477	33	9.4	12	3.5	45	12.8	17	4.9	29	8.3
2500-2999	13571	13520	51	3.8	20	1.5	71	5.2	25	1.8	45	3.3
3000-3499	31171	31137	34	1.1	22	0.7	56	1.8	31	1.0	53	1.7
3500-3999	25777	25763	14	0.5	7	0.3	21	0.8	13	0.5	20	0.8
4000-4499	7939	7932	7	0.9	3	0.4	10	1.3	2	0.3	5	0.6
>=4500	1298	1295	3	2.3	2	1.5	5	3.9	0	0.0	2	1.5
Total	**85723**	**85125**	**598**	**7.0**	**195**	**2.3**	**793**	**9.3**	**115**	**1.4**	**310**	**3.6**

Notes: – Figures in highlight reflect low case numbers which should be interpreted with caution.
– Stillbirths plus neonatal deaths = perinatal deaths
– Neonatal deaths plus post-neonatal = infant deaths.

Figure 1: Infant Mortality Rate by Birth Weight, WA 2005-07



Very low birth weight babies (<1,000g) accounted for 63.7% (n=381) of the stillbirths and 53.8% (n=105) of the neonatal deaths (Table 7).

The perinatal mortality rate for infants >=1,500g birthweight was 4.1 per 1000 births, and that for infants >=2,500g was 2.9 per 1,000 births.

The preterm (<37 weeks gestational age) birth rate was 8.7% in 2005-07, having increased from 8.4% in the years 2002-04 (Table 8).

Preterm deliveries (<37 weeks gestational age) accounted for 81.8% (n=489) of stillbirths, 71.8% (n=140) of neonatal deaths and 37.4% (n=43) of post-neonatal deaths. These data were similar to the preceding triennium.

There were 3.0% of livebirths (n=2,534) and 8.5% of stillbirths (n=51) from multiple gestation pregnancies. 20.0% (n=39) of neonatal deaths and 7.0% (n=8) of post-neonatal deaths occurred in infants from multiple pregnancies (Table 9).

There were 15.9% of Aboriginal babies of low birth weight (<2,500g), compared with 6.4% of non-Aboriginal babies.

Table 8: Birth & Death Statistics by Gestational Age, WA 2005-07

Gestational age (weeks)	Total births	Live births	Stillbirths			Neonatal Deaths			Post-neonatal deaths			Perinatal Deaths			Infant Deaths		
	N	N	N	Rate		N	Rate		N	Rate		N	Rate		N	Rate	
20-27	755	384	372	492.7		107	278.6		11	28.6		479	634.4		118	307.3	
28-32	1064	1000	66	62.0	*	15	15.0	*	8	8.0		81	76.1	*	23	23.0	*
33-36	5663	5607	51	9.0	*	18	3.2	*	24	4.3	*	69	12.2	*	42	7.5	*
37-43	78240	78133	109	1.4	*	55	0.7	*	72	0.9	*	164	2.1	*	127	1.6	*
Total	**85722**	**85124**	**598**	**7.0**	*	**195**	**2.3**	*	**115**	**1.4**	*	**793**	**9.3**	*	**310**	**3.6**	*

Note: – One case of gestational age >43 weeks.
– Figures in highlight reflect low case numbers which should be interpreted with caution.
– *indicates a significant difference when compared to the mortality rate for 20-27 weeks gestational age group.

Figure 2: Infant Mortality Rate by Gestational Age, WA 2005-07

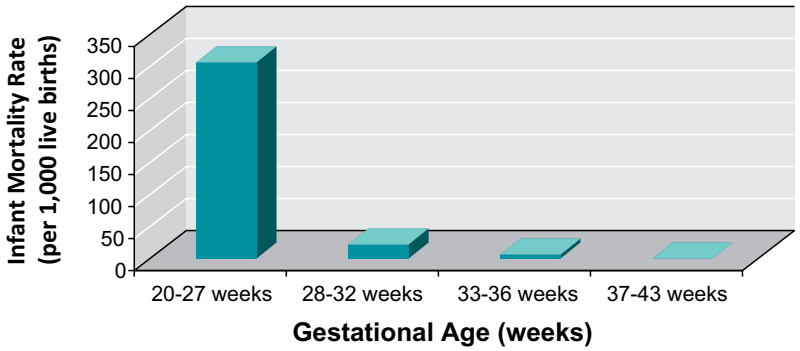


Table 9: Stillbirths and Infant Deaths in Singleton and Multiple Pregnancies, WA 2005-07

Plurality	Stillbirth		Neonatal		Post-neonatal		Total	
	N	%	N	%	N	%	N	%
Singleton	547	91.5	156	80.0	107	93.0	810	89.2
Twin	49	8.2	36	18.5	8	7.0	93	10.2
Triplet	2	0.3	3	1.5	0	0.0	5	0.6
Total	**598**	**100.0**	**195**	**100.0**	**115**	**100.0**	**908**	**100.0**

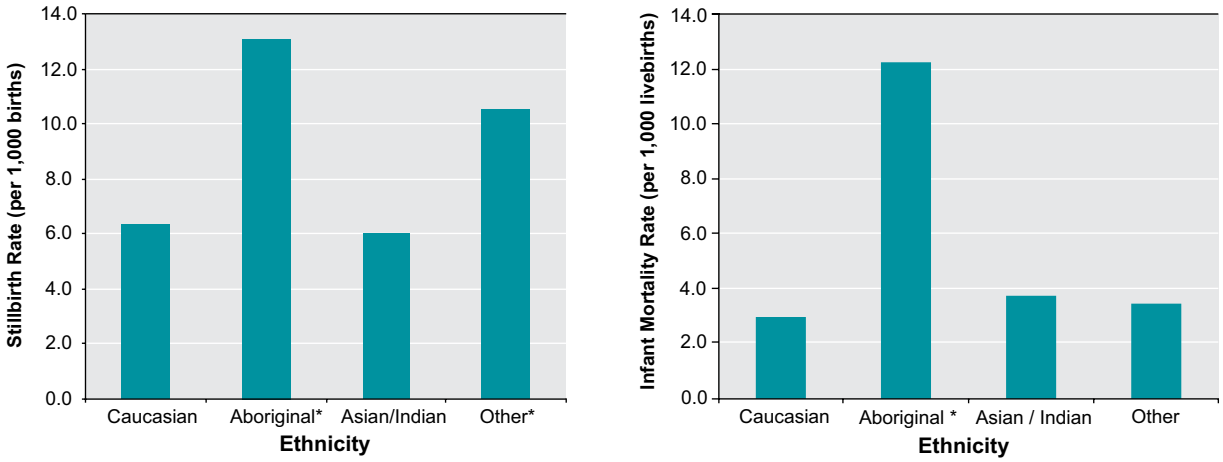
Table 10: Livebirths, Stillbirths and Infant Deaths by Ethnicity, WA 2005-07

Ethnicity	Total births	Live births	Stillbirths			Neonatal Deaths			Post-neonatal Deaths		
	N	N	N	Rate	95% CI	N	Rate	95% CI	N	Rate	95% CI
Caucasian	70667	70216	450	6.4	5.8-7.0	138	2.0	1.64-2.29	72	1.0	0.79-1.26
Aboriginal	5357	5287	70	13.1	10.0-16.1*	33	6.2	4.12-8.36*	32	6.1	3.96-8.14*
Asian/Indian	5341	5310	32	6.0	3.9-8.1	15	2.8	1.4-4.25	5	0.9	0.12-1.77
Other	4358	4312	46	10.6	7.5-13.6 *	9	2.1	0.72-3.45	6	1.4	0.28-2.50

Ethnicity	Perinatal Deaths			Infant Deaths		
	N	Rate	95% CI	N	Rate	95% CI
Caucasian	588	8.4	7.65-8.99	210	3.0	2.59-3.39
Aboriginal	103	19.3	15.55-22.90*	65	12.3	9.32-15.26*
Asian / Indian	47	8.8	6.3-11.3	20	3.8	2.12-5.41
Other	55	12.6	9.31-15.93*	15	3.5	1.72-5.24

Notes: – Figures in highlight reflect low case numbers which should be interpreted with caution.
– *indicates a significant difference between ethnic group and the Caucasian reference group.

Figure 3: Stillbirth and Infant Mortality Rates by Ethnicity, WA 2005-07

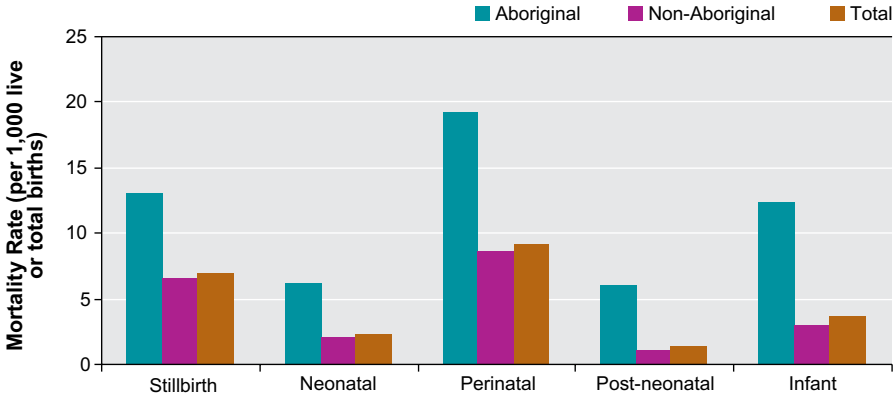


Note: – *indicates a significant difference between ethnic group and the Caucasian reference group.

82.4% of mothers giving birth were Caucasian, 6.2% were Aboriginal, 6.2% were Asian/Indian and 5.1% were of 'other' racial descent. The perinatal and infant mortality rates in Asian/Indian babies were similar to the rates for Caucasians. There were significantly higher stillbirth rates in babies born to mothers identified as Aboriginal and 'other' racial descent (Table 10, Figure 3).

Compared with non-Aboriginal mothers, the stillbirth rate was double in Aboriginal mothers (13.1 versus 6.6 per 1,000 births), the neonatal death rate three-fold higher (6.2 versus 2.0 per 1,000 livebirths), and the post-neonatal rate six-fold higher (6.0 versus 1.0 per 1,000 livebirths)(Figure 4).

Figure 4: Stillbirth and Infant Mortality Rates, by Aboriginality, WA 2005-07



Note: – all categories show a statistically significant difference between mortality rates for Aboriginals and non-Aboriginals.

4.1.2 The use of the PSANZ Classification System, WA 2005-07

There are eleven major PSANZ Perinatal Death Classification (PSANZ PDC) categories for perinatal death classification, and seven major PSANZ Neonatal Death Classification (PSANZ NDC) categories for neonatal death classification. The PSANZ classification system requires the choice of a single leading cause of death for each of the two categories (PSANZ PDC and PSANZ NDC).

Stillbirths were classified by the primary obstetric condition causing death, using the PSANZ PDC. Infant deaths were classified by the primary obstetric condition contributing to death using the PSANZ PDC (note that the PSANZ PDC includes a code for 'no obstetric antecedent'), and also by the primary pathological condition in the infant leading to death, using the PSANZ NDC.

Whilst understanding that the PSANZ PDC is designed to be hierarchial, the Committee observed some cases where it was more appropriate to designate a cause of death with a lower numerical number. For example, death due to peripartum hypoxia in a baby with a minor congenital abnormality was coded for peripartum hypoxia rather than congenital abnormality by PSANZ PDC.

In addition to the standard application of the PSANZ system, in this triennium secondary PSANZ perinatal and neonatal classifications were applied for cases where it was considered that a single code did not adequately describe the clinical situation. Additional codes for the same major PSANZ categories were excluded, such as concurrent congenital abnormalities of Down syndrome (PSANZ PDC 1.5) and congenital cardiac abnormality (PSANZ PDC 1.2). Additional codes were used where the secondary code was for a different major PSANZ category (i.e. a different first digit PSANZ code).

With this method, 66 stillbirths, 34 neonatal deaths and 24 post-neonatal deaths (n=124 of the total 908 deaths) were given a secondary PSANZ PDC code, and 12 neonatal and 9 post neonatal deaths (n=23 of the total 304 infant deaths) were allocated a secondary PSANZ NDC.

The tables and figures in section 4.1.3 describe stillbirths and neonatal deaths by the primary obstetric conditions contributing to death, using PSANZ PDC.

The tables and figures in section 4.1.4 describe neonatal and post neonatal deaths by the primary pathology occurring in the infant which led to death, using PSANZ NDC.

4.1.3 Stillbirths by Cause of Death, WA 2005-07

Table 11: Numbers and Proportions of Stillbirths by Cause of Death (PSANZ PDC), WA 2005-07

PSANZ PDC	N	%
1. Congenital Abnormality	178	29.8
2. Perinatal Infection	33	5.5
3. Hypertension	30	5.0
4. Antepartum Haemorrhage	38	6.4
5.2. Diabetes	16	2.7
5.1 5.3-5.8. Maternal Conditions	14	2.3
6.1. Twin-twin	30	5.0
6.2. Fetomaternal Haemorrhage	6	1.0
6.3. Cord Abnormality	12	2.0
6.4. Uterine Abnormality	7	1.2
6.5. Birth Trauma	0	0.0
6.6. Trauma	0	0.0
6.7. Hydrops	5	0.8
6.8. Other Specific Perinatal Conditions	1	0.2
7. Hypoxic Peripartum Death	14	2.3
8. Fetal Growth Restriction	43	7.2
9. Spontaneous Preterm	62	10.4
10. Unexplained Antepartum Death	109	18.2
11.0 No Obstetric Antecedent	0	0.0
Total	**598**	**100.0**

Leading Causes of Stillbirths

The main contributing causes of stillbirth by the PSANZ PDC in the 2005-07 triennium were congenital abnormality (29.8%), unexplained antepartum death (18.2%) and spontaneous preterm birth (10.4%). These proportions have remained similar since the years 2000-01.

The 598 stillbirths occurring in WA in 2005-07 are now described according to each of the PSANZ categories. Refer to Appendices II-III for more detailed summary tables of this information.

Stillbirths due to Congenital abnormalities (PSANZ PDC Category 1)

Of the 178 stillbirths due to congenital abnormalities, the most common types of abnormalities were: ‘multiple non chromosomal’ (n=70), central nervous system (n=55), chromosomal (n=50), and cardiovascular (n=21). There were fewer numbers of urinary tract anomalies (n=7), gastrointestinal (n=5), metabolic (n=1), musculoskeletal (n=6), respiratory (n=1) and tumours (n=2).

Using a secondary PSANZ code, there were an additional five stillbirths coded with significant congenital abnormalities. For example, a stillborn baby with Down syndrome was given a secondary code (PSANZ PDC=1.5) where the primary category for cause of death was hypoxic peripartum insult (PSANZ PDC=7). Secondary codes were found useful where the Committee had difficulty choosing a single classification for cause of death.

Stillbirths due to Perinatal Infection (PSANZ PDC Category 2)

Of the 33 stillbirths attributed to perinatal infection (5.5% stillbirths), infections were caused by: Group B Streptococcus (n=4), E coli (n=5), 'other specified bacteria' (n=6), 'unspecified bacteria' (n=3), cytomegalovirus (n=5) and other unspecified organism (n=10).

No stillbirths were attributed to Listeria or Syphilis in this triennium. Also, there were no identified viral causes of stillbirth with the exception of CMV described above. There were no stillbirths found due to Toxoplasmosis.

There were three additional stillbirths coded with perinatal infection using a secondary PSANZ PDC.

Stillbirths due to Hypertension (PSANZ PDC Category 3)

There were 30 stillbirths attributed to hypertension (5% stillbirths), comprising 26 cases of preeclampsia (including two cases of preeclampsia superimposed on chronic hypertension), three cases with chronic hypertension and one case of unspecified hypertension.

There were a further eight stillbirths associated with maternal hypertension identified using a secondary PSANZ PDC.

Stillbirths due to Antepartum Haemorrhage (PSANZ PDC Category 4)

There were 38 stillbirths attributed to antepartum haemorrhage, consisting of 36 cases of placental abruption, one case of vasa praevia and one case of undetermined antepartum haemorrhage.

There were three additional stillbirths associated with antepartum haemorrhage identified using a secondary PSANZ PDC.

Stillbirths due to Maternal Conditions (PSANZ PDC Category 5)

There were 30 stillbirths attributed to maternal medical conditions, comprising 16 cases related to maternal diabetes mellitus, six cases due to maternal injury (2 accidental, 3 non-accidental and 1 unspecified), three cases due to obstetric lupus and five cases due to other specified maternal conditions.

There were 30 additional stillbirths associated with maternal conditions identified using a secondary PSANZ PDC.

Stillbirths due to Specific Perinatal Conditions (PSANZ PDC Category 6)

PSANZ category 6 comprises a number of specific pregnancy complications including twin to twin transfusion syndrome, fetomaternal haemorrhage, cord accidents, uterine abnormalities and hydrops.

There were 30 stillbirths due to twin to twin transfusion syndrome.

There were six stillbirths due to fetomaternal haemorrhage.

There were twelve stillbirths attributed to cord complications and confirmed by placental histopathology.

There were seven stillbirths due to uterine abnormalities, such as bicornuate uterus and cervical incompetence.

There were five stillbirths due to idiopathic hydrops.

There were a further five stillbirths associated with specific perinatal conditions using a secondary PSANZ PDC.

Stillbirths due to Peripartum Hypoxia (PSANZ PDC Category 7)

There were 14 stillbirths due to hypoxic peripartum insult. Of these, three had documented intrapartum complications and another two cases had evidence of fetal compromise such as an abnormal fetal heart rate. There were a further five cases with an 'unspecified' hypoxic peripartum insult and three cases with no known intrapartum complications and no evidence of a non-reassuring fetal status.

There was one additional stillbirth with a peripartum hypoxic insult coded using a secondary PSANZ PDC.

Stillbirths due to Fetal Growth Restriction (PSANZ PDC Category 8)

There were 43 stillbirths associated with fetal growth restriction in the absence of another known condition such as preeclampsia or lupus. In 20 of these cases there was evidence of reduced vascular perfusion on Doppler studies and/or placental histopathology, and in a further 13 cases the placental histopathology was normal. There were five cases where the placenta was not examined, one case with chronic villitis, three cases with other specific placental pathology and one case was unspecified for placental condition.

There were two stillbirths with fetal growth restriction using a secondary PSANZ PDC.

Stillbirths due to Spontaneous Preterm Birth (PSANZ PDC Category 9)

There were 62 stillbirths attributed to prematurity due to spontaneous preterm birth, in the absence of another known cause for preterm birth such as perinatal infection with evidence of a fetal reaction, or preeclampsia.

In 42 cases it was unknown when membranes had ruptured, 17 cases had prolonged rupture of membranes, and three cases had rupture of membranes less than 24 hours before delivery.

There were six more stillbirths associated with spontaneous preterm birth coded using a secondary PSANZ PDC.

Unexplained Antepartum Stillbirths (PSANZ PDC Category 10)

There were 109 unexplained stillbirths. Of these, 63 had normal placental histopathology, seven cases had evidence of reduced vascular perfusion on Doppler studies or placental histopathology, five cases had chronic villitis and 13 cases had 'other specified' placental pathology. In 12 cases the placenta was not examined and in nine cases it was unspecified or unknown if the placenta was examined.

There were a further three unexplained stillbirths using a secondary PSANZ PDC.

Table 12: Numbers and Proportions of Stillbirths by Cause of Death (PSANZ PDC) and Aboriginality, WA 2005-07

PSANZ PDC	Aboriginality of Mother			
	Non-Aboriginal (N=528)		Aboriginal (N=70)	
	N	%	N	%
1. Congenital Abnormality	169	32.0	9	12.9
2. Perinatal Infection	29	5.5	4	5.7
3. Hypertension	23	4.4	7	10.0
4. Antepartum Haemorrhage	33	6.3	5	7.1
5. Maternal Conditions including diabetes mellitus	17	3.2	13	18.6
6. Specific Perinatal Conditions	59	11.2	2	2.9
7. Hypoxic Peripartum Death	14	2.7	0	0.0
8. Fetal Growth Restriction	40	7.6	3	4.3
9. Spontaneous Preterm	49	9.3	13	18.6
10. Unexplained Antepartum Death	95	18.0	14	20.0
11. No Obstetric Antecedent	0	0.0	0	0.0
Total	**528**	**100.0**	**70**	**100.0**

Table 12 shows the numbers and proportions of stillbirths by cause of death in non-Aboriginal and Aboriginal ethnic groups. The most obvious difference was the high proportion of stillbirths in Aboriginals related to maternal conditions including diabetes mellitus. The small numbers in each group mean that statistical analysis is difficult. The numbers of stillbirths and neonatal deaths are combined and analysed for statistical significance for all perinatal deaths (see Table 15 and figure 5 below).

Table 13: Numbers and Proportions of Neonatal Deaths by Cause of Death (PSANZ PDC), WA 2005-07

PSANZ PDC	N	%
1. Congenital Abnormality	52	26.7
2. Perinatal Infection	14	7.2
3. Hypertension	5	2.6
4. Antepartum Haemorrhage	6	3.1
5.2. Diabetes / Gestational Diabetes	0	0.0
5.1, 5.3-5.8. Maternal Conditions	3	1.5
6.1. Twin-twin transfusion	7	3.6
6.2. Fetomaternal Haemorrhage	2	1.0
6.3. Antepartum cord complications	0	0.0
6.4. Uterine Abnormality	0	0.0
6.5. Birth Trauma	0	0.0
6.6. Alloimmune disease	0	0.0
6.7. Idiopathic Hydrops	0	0.0
6.8. Other Specific Perinatal Conditions	0	0.0
7. Hypoxic Peripartum Death	12	6.2
8. Fetal Growth Restriction (FGR)	5	2.6
9. Spontaneous Preterm	75	38.5
10. Unexplained Antepartum Death	0	0.0
11. No Obstetric Antecedent	14	7.2
Total	**195**	**100**

The leading categories of neonatal death by PSANZ PDC were prematurity (n=75, 38.5%), and congenital abnormality (n=52; 26.7%), followed by perinatal infection and 'no obstetric antecedent' (each with n=14 cases; 7.2%). In 2002-04 the causes of neonatal death by PSANZ PDC were: prematurity 40.4% (37% in 2000-01), congenital abnormality 22.9% (28% in 2000-01) and perinatal infection 7.2% (11% in 2000-01).

Using a secondary PSANZ PDC code for neonatal deaths, additional cases were associated with the following conditions: one case with congenital abnormality, three cases with perinatal infection, three cases with maternal hypertension, two cases with antepartum haemorrhage, thirteen cases with maternal conditions, one case with peripartum hypoxia, three cases with fetal growth restriction and eight cases with spontaneous preterm birth (total n=34).

Neonatal deaths are described in more detail using PSANZ NDC classifications below (section 4.1.4).

Table 14: Numbers and Proportions of Neonatal Deaths by Cause of Death (PSANZ PDC) and Aboriginality, WA 2005-07

PSANZ PDC	Aboriginality of Mother			
	non-Aboriginal (N=162)		Aboriginal (N=33)	
	N	%	N	%
1. Congenital Abnormality	47	29.0	5	15.2
2. Perinatal Infection	13	8.0	1	3.0
3. Hypertension	4	2.5	1	3.0
4. Antepartum Haemorrhage	5	3.1	1	3.0
5. Maternal Conditions including diabetes mellitus	3	1.9	0	0.0
6. Specific Perinatal Conditions	9	5.6	0	0.0
7. Hypoxic Peripartum Death	11	6.8	1	3.0
8. Fetal Growth Restriction	4	2.5	1	3.0
9. Spontaneous Preterm	56	34.6	19	57.6
10. Unexplained Antepartum Death	0	0.0	0	0.0
11. No Obstetric Antecedent	10	6.2	4	12.1
Total	**162**	**100.0**	**33**	**100.0**

Table 14 shows the numbers and proportions of neonatal deaths by associated obstetric condition (PSANZ PDC) in non-Aboriginal and Aboriginal neonates. As seen for stillbirths, the Aboriginal group had a much higher representation of maternal medical conditions including diabetes mellitus contributing to death.

Table 15: Numbers and Mortality Rates for Perinatal deaths, by Cause of Death (PSANZ PDC) and Aboriginality, WA 2005-07

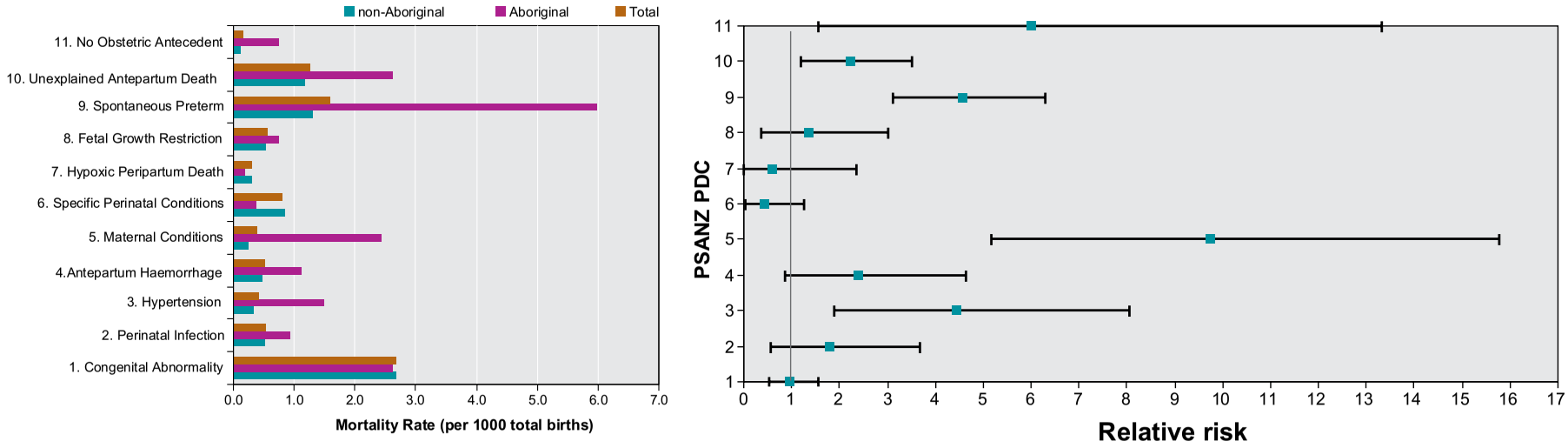
PSANZ PDC	Aboriginality of Mother							Total		
	Non-Aboriginal			Aboriginal			Rate Ratio			
	N	%	Rate	N	%	Rate		N	%	Rate
1. Congenital Abnormality	216	31.3	2.7	14	13.6	2.6	0.97	230	29.0	2.7
2. Perinatal Infection	42	6.1	0.5	5	4.9	0.9	1.79	47	5.9	0.5
3. Hypertension	27	3.9	0.3	8	7.8	1.5	4.45*	35	4.4	0.4
4. Antepartum Haemorrhage	38	5.5	0.5	6	5.8	1.1	2.37	44	5.5	0.5
5. Maternal Conditions	20	2.9	0.2	13	12.6	2.4	9.75*	33	4.2	0.4
6. Specific Perinatal Conditions	68	9.9	0.8	2	1.9	0.4	0.44	70	8.8	0.8
7. Hypoxic Peripartum Death	25	3.6	0.3	1	1.0	0.2	0.6	26	3.3	0.3
8. Fetal Growth Restriction	44	6.4	0.5	4	3.9	0.7	1.36	48	6.1	0.6
9. Spontaneous Preterm	105	15.2	1.3	32	31.1	6.0	4.57*	137	17.3	1.6
10. Unexplained Antepartum Death	95	13.8	1.2	14	13.6	2.6	2.21*	109	13.7	1.3
11. No Obstetric Antecedent	10	1.4	0.1	4	3.9	0.7	6.0*	14	1.8	0.2
Total	**690**	**100.0**	**8.6**	**103**	**100.0**	**19.2**	**2.24***	**793**	**100.0**	**9.3**

Notes: –*indicates a significant difference between rates in Aboriginals and non-Aboriginals.
– Rate here refers to the perinatal mortality rate per 1,000 total births.
– Maternal conditions includes diabetes mellitus.

In 2005-07 the leading categories of perinatal death were congenital abnormality (n=230, 29%), prematurity due to spontaneous preterm birth (n=137; 17.3%) and unexplained antepartum death (n=109, 13.7%). These were similar to 2002-04 when the contributing causes of perinatal death were congenital abnormality (n=183; 25.7%), spontaneous preterm birth (n=152; 21.3%) and unexplained antepartum death (n=100; 14.1%).

There were significantly higher perinatal mortality rates in Aboriginal births compared with non-Aboriginal births. The causes of perinatal death with the highest increased risks for Aboriginals were: maternal conditions including diabetes mellitus (nine-fold), perinatal death without an obstetric antecedent (six-fold) and hypertension and spontaneous preterm birth (four-fold).

Figure 5: Perinatal Mortality Rates by Cause of Death (PSANZ PDC) and Aboriginality, WA 2005-07



4.1.4 Infant Deaths by Cause of Death, WA 2005-07

This section describes neonatal deaths and post-neonatal deaths according to the PSANZ NDC. As previously described, the PSANZ PDC classification system focuses on pregnancy-related precedents to neonatal death, and differs to the PSANZ NDC that describes neonatal deaths according to the pathology in the neonate that led to death.

The PSANZ NDC was originally designed to describe neonatal deaths, but has been adopted by the Committee to describe post-neonatal deaths as well, also using the dual classification systems (PSANZ PDC and PSANZ NDC) for comparative purposes.

The following tables show infant deaths separated into neonatal and post-neonatal deaths by cause of death, using PSANZ NDC, and comparisons by Aboriginality. See Appendix IV for details of the numbers in each of the sub-categories of PSANZ NDC.

Table 16: Numbers and Proportions of Neonatal Deaths, by Cause of Death (PSANZ NDC), WA 2005-07

PSANZ NDC	N	%
1. Congenital Abnormality	54	27.7
2. Extreme Prematurity	59	30.3
3. Cardio-Respiratory Disorder	12	6.2
4. Infection	13	6.7
5. Neurological	34	17.4
6. Gastrointestinal Tract	5	2.6
7.1 SIDS	9	4.6
7.2-7.9 Other	9	4.6
Total	**195**	**100.0**

The leading causes of neonatal deaths by the neonatal classification system (PSANZ NDC) in 2005-07 were prematurity (n=59, 30.3%), congenital abnormalities (n=54; 27.7%) and neurological disorders (n=34, 17.4%)(See Table 16).

For comparison, in 2002-04 the leading causes of neonatal death by PSANZ NDC were prematurity (n=42; 25.3% compared with 30% in 2000-01), congenital abnormalities (n=37; 22.3%, and 26% in 2000-01), cardiorespiratory disorders (n=26; 15.7% and 13% in 2000-01) and neurological disorders (n=24; 14.5%, and 13% in 2000-01).

Table 17: Numbers and Proportions of Neonatal Deaths, by Neonatal Cause of Death and Aboriginality (PSANZ NDC), WA 2005-07

PSANZ NDC	Aboriginality of Mother			
	non-Aboriginal (N=162)		Aboriginal (N=33)	
	N	%	N	%
1. Congenital Abnormality	49	30.2	5	15.2
2. Extreme Prematurity	44	27.2	15	45.5
3. Cardio-Respiratory Disorder	9	5.6	3	9.1
4. Infection	12	7.4	1	3.0
5. Neurological	31	19.1	3	9.1
6. Gastrointestinal Tract	4	2.5	1	3.0
7. SIDS & Other	13	8.0	5	15.2
Total	162	100.0	33	100.0

Table 17 shows neonatal deaths according to neonatal pathology (PSANZ NDC) and by Aboriginality. The main differences were a lower proportion of deaths due to congenital abnormality, and a higher proportion of deaths due to extreme prematurity, in Aboriginal compared with non-Aboriginal neonates.

Causes of Neonatal Deaths by PSANZ NDC, 2005-07

Neonatal Deaths due to Congenital Abnormality (PSANZ NDC Category 1)

There were 54 neonatal deaths due to congenital abnormality, with the most common abnormalities being cardiovascular (n=13), central nervous system (n=12) and chromosomal (n=7).

There were no additional neonatal deaths identified using a secondary PSANZ NDC code.

Neonatal Deaths due to Extreme Prematurity (PSANZ NDC Category 2)

There were 59 neonatal deaths due to extreme prematurity. This category is reserved for neonates at the borders of viability. In most cases it was not specified whether resuscitation was attempted.

There were two additional neonatal deaths identified in this category using a secondary PSANZ NDC code.

Neonatal Deaths due to Cardio-Respiratory Disorder (PSANZ NDC Category 3)

There was a reduction in deaths related to cardiorespiratory disorders from 15.7% (n=26) in 2002-04 to 6.7% (n=12) in 2005-07.

The 12 deaths from cardio-respiratory disorders, comprising 2 cases of hyaline membrane disease, two cases of meconium aspiration syndrome, one case of primary persistent pulmonary hypertension, three cases of pulmonary hypoplasia, two cases of chronic neonatal lung disease and two cases with other specified cardiorespiratory disorders.

There were three additional neonatal deaths identified in this category using a secondary PSANZ NDC code.

Neonatal Deaths due to Infection (PSANZ NDC Category 4)

Of the 13 deaths due to infection, nine were attributed to a congenital bacterial cause, three to an unspecified organism and one death was due to a fungal infection.

There were two additional neonatal deaths identified in this category using a secondary PSANZ NDC code.

Neonatal Deaths due to Neurological Disorder (PSANZ NDC Category 5)

There were 34 neonatal deaths due to neurological disorders, with 20 due to hypoxic ischaemic encephalopathy, 12 due to intracranial haemorrhage and two cases due to unspecified neurological disorders.

There were four additional neonatal deaths identified in this category using a secondary PSANZ NDC code.

Neonatal Deaths due to Gastrointestinal Tract (PSANZ NDC Category 6)

There were five deaths due to necrotising enterocolitis. There were no deaths identified in this category using a secondary PSANZ NDC code.

Neonatal Deaths due to SIDS and 'Other' (PSANZ NDC Category 7)

There were nine neonatal cases of SIDS (all SIDS type II). There were three neonatal deaths due to trauma, five cases classified as 'other/unspecified' and one case of multisystem failure.

There was one neonatal death in this category using a secondary PSANZ NDC code.

Table 18: Numbers and Proportions of Post-neonatal deaths by Cause of Death (PSANZ NDC), WA 2005-07

PSANZ NDC	N	%
1. Congenital Abnormality	39	33.9
2. Extreme Prematurity	2	1.7
3. Cardio-Respiratory Disorder	7	6.1
4. Infection	15	13.0
5. Neurological	4	3.5
6. Gastrointestinal Tract	4	3.5
7.1 SIDS	35	30.4
7.2-7.9 Other	9	7.8
Total	**115**	**100.0**

The leading categories of post-neonatal deaths by PSANZ Neonatal Death Classification (PSANZ NDC) were congenital abnormality (33.9%), SIDS (30.4%), infection (13.0%) and 'other' which includes injuries and indeterminate causes of death (7.8%). These proportions differed to the previous triennium (2002-04) when SIDS was the equal leading cause of death (23.4%, and which had reduced from a proportion of 31% in the years 2000-01), congenital abnormality (23.4%,

which had increased from the 19% in 2000-01) and 'other' which represented a significantly greater proportion (27.7%) in 2002-04 and 21% in 2000-01.

Causes of Post-neonatal Deaths by PSANZ NDC, 2005-07

Post-neonatal Deaths due to Congenital Abnormality (PSANZ NDC Category 1)

There were 39 post-neonatal deaths due to congenital abnormality, comprising cardiovascular anomalies (n=11), central nervous system (n=7), chromosomal (n=6), multiple non-chromosomal (n=4), gastro-intestinal (n=4), musculoskeletal (n=4), metabolic (n=2) and urinary tract (n=1).

There were four additional post-neonatal deaths with congenital abnormalities using a secondary PSANZ NDC code.

Post-neonatal Deaths due to Extreme Prematurity (PSANZ NDC Category 2)

There were two post-neonatal deaths due to extreme prematurity.

There was one additional post-neonatal death using a secondary PSANZ NDC code for extreme prematurity.

Post-neonatal Deaths due to Cardio-Respiratory Disorder (PSANZ NDC Category 3)

The seven cardio-respiratory deaths comprised one case of primary persistent pulmonary hypertension, five cases of chronic neonatal lung disease and one other case with a specific cardio-respiratory disorder.

There was one post-neonatal death in this category using a secondary PSANZ NDC code.

Post-neonatal Deaths due to Infection (PSANZ NDC Category 4)

Of the 15 deaths due to infection, ten were attributed to a bacterial cause and five to an unspecified acquired viral illness.

There were two additional post-neonatal deaths coded with infection using a secondary PSANZ NDC code.

Post-neonatal Deaths due to Neurological Disorder (PSANZ NDC Category 5)

There were four post-neonatal deaths due hypoxic ischaemic encephalopathy.

There was one additional post-neonatal death identified with a neurological disorder using a secondary PSANZ NDC code.

Post-neonatal Deaths due to Gastrointestinal Tract Disorders (PSANZ NDC Category 6)

There were four post neonatal deaths due to necrotising enterocolitis. There were no additional deaths using a secondary PSANZ NDC code for this category.

Post-neonatal Deaths due to SIDS and 'Other' (PSANZ NDC Category 7)

There were 35 post-neonatal cases of SIDS (Eight cases of SIDS type 1 and 27 cases of SIDS type II). There were three post-neonatal deaths due to trauma and four cases classified as 'other/ unspecified'.

There were no additional deaths using a secondary PSANZ NDC code.

Table 19: Numbers and Proportions of Post-neonatal deaths by Cause of Death (PSANZ NDC),and Aboriginality, WA 2005-07

PSANZ NDC	Aboriginality of Mother			
	non-Aboriginal (N=83)		Aboriginal (N=32)	
	N	%	N	%
1. Congenital Abnormality	31	37.3	8	25.0
2. Extreme Prematurity	2	2.4	0	0.0
3. Cardio-Respiratory Disorder	5	6.0	2	6.3
4. Infection	6	7.2	9	28.1
5. Neurological	4	4.8	0	0.0
6. Gastrointestinal Tract	4	4.8	0	0.0
7. SIDS & Other	31	37.3	13	40.6
Total	**83**	**100.0**	**32**	**100.0**

Table 19 shows post-neonatal deaths by Aboriginality and by the pathological cause in the infant (PSANZ NDC). The most obvious difference was a higher proportion of deaths in Aboriginal compared with non-Aboriginal infants due to infection (28.1% compared with 7.2% respectively).

Table 20: Numbers of Infant Deaths, and Infant Mortality Rates, by Cause of Death (PSANZ NDC) and Aboriginality, WA 2005-07

PSANZ NDC	Aboriginality of Mother							Total		
	non-Aboriginal			Aboriginal			RR			
	N	%	Rate	N	%	Rate		N	%	Rate
1. Congenital Abnormality	80	32.7	1.0	13	20.0	2.5	2.5 *	93	30.0	1.1
2. Extreme Prematurity	46	18.8	0.6	15	23.1	2.8	4.9 *	61	19.7	0.7
3. Cardio-Respiratory Disorder	14	5.7	0.2	5	7.7	0.9	5.4 *	19	6.1	0.2
4. Infection	18	7.3	0.2	10	15.4	1.9	8.4 *	28	9.0	0.3
5. Neurological	35	14.3	0.4	3	4.6	0.6	1.3	38	12.3	0.4
6. Gastrointestinal Tract	8	3.3	0.1	1	1.5	0.2	1.9	9	2.9	0.1
7.1 SIDS	32	13.1	0.4	12	18.5	2.3	5.5 *	44	14.2	0.5
7.2-7.9 Other	12	4.9	0.1	6	9.2	1.1	8.2 *	18	5.8	0.2
Total	**245**	**100.0**	**3.1**	**65**	**100.0**	**12.3**	**4.0 ***	**310**	**100.0**	**3.6**

Note: – *indicates a significant difference between non-Aboriginal and Aboriginal mortality rates.

Figure 6: Infant Mortality Rates by Cause of Death (PSANZ NDC) and Aboriginality, WA 2005-07

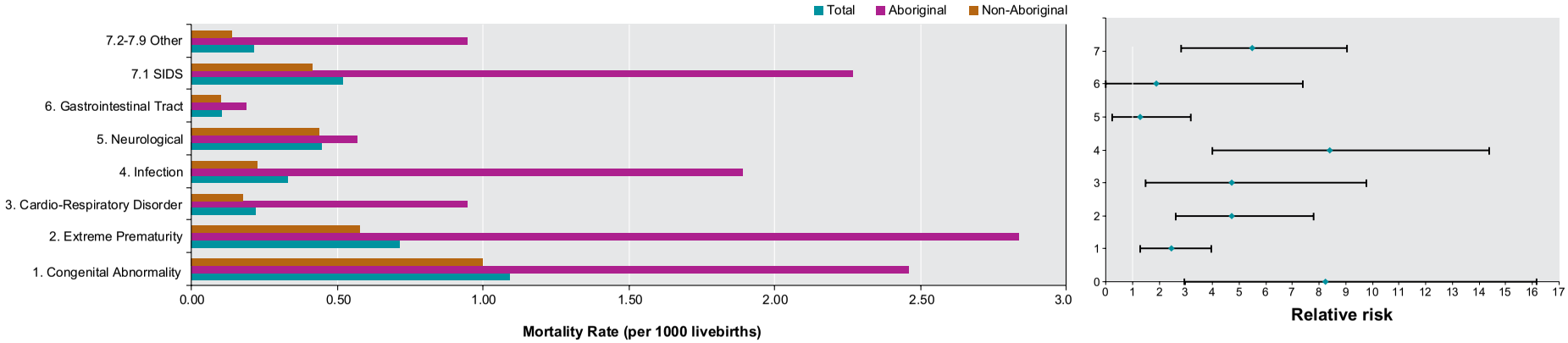


Table 20 and Figure 6 show the causes of infant deaths by Aboriginality in 2005-07, combining neonatal and post-neonatal data. The proportions of infant mortality by each of the PSANZ NDC categories reflect the pathological causes in the infant.

The main contributing causes of infant death by PSANZ NDC in 2005-07 were congenital abnormality (30.0%), extreme prematurity (19.7%) and SIDS (14.2%).

Aboriginal infants had increased risks of death in all PSANZ categories except neurological and gastrointestinal conditions, but the disparities were greatest for infection (8-fold), 'other' which includes trauma (8-fold), SIDS (5-fold) and cardio-respiratory disorders (5-fold).

4.1.5 Term Gestation Stillbirths and Infant Deaths, 2005-07

Table 21: Numbers and Proportions of Stillbirths and Infant Deaths in pregnancies of 37 weeks or greater Gestational age, by Cause of Death (PSANZ PDC), 2005-07

PSANZ PDC	Stillbirth		Neonatal		Post-neonatal		Infant		Total	
	N	%	N	%	N	%	N	%	N	%
1. Congenital Abnormality	8	7.3	23	41.8	21	29.2	44	34.6	52	22.0
2. Perinatal Infection	2	1.8	4	7.3	0	0.0	4	3.1	6	2.5
3. Hypertension	5	4.6	0	0.0	0	0.0	0	0.0	5	2.1
4. Antepartum Haemorrhage	6	5.5	0	0.0	0	0.0	0	0.0	6	2.5
5. Maternal Conditions	9	8.3	0	0.0	0	0.0	0	0.0	9	3.8
6. Specific Perinatal Conditions	14	12.8	1	1.8	0	0.0	1	0.8	15	6.4
7. Hypoxic Peripartum Death	14	12.8	11	20.0	4	5.6	15	11.8	29	12.3
8. Fetal Growth Restriction	13	11.9	2	3.6	1	1.4	3	2.4	16	6.8
10. Unexplained Antepartum Death	38	34.9	0	0.0	0	0.0	0	0.0	38	16.1
11. No Obstetric Antecedent	0	0.0	14	25.5	46	63.9	60	47.2	60	25.4
Total	**109**	**100.0**	**55**	**100.0**	**72**	**100.0**	**127**	**100.0**	**236**	**100.0**

Of the 598 stillbirths in 2005-07, 109 occurred in term gestation pregnancies. The leading categories of these term or post-term gestation stillbirths were 'unexplained' (n=38, 34.9%), hypoxic peripartum death, specific perinatal conditions (n=14, 12.8% for each category) and fetal growth restriction (n=13, 11.9%).

Thirty of the total number of 109 unexplained antepartum deaths in 2005-07 (27.5%) occurred in stillbirths of 37 weeks or greater gestational age (Tables 11 and 21). Coincidentally, 109 stillbirths occurred in pregnancies of at least 37 weeks gestational age, and 109 unexplained antepartum deaths occurred in pregnancies of at least 20 weeks gestational age.

Of the 195 neonatal deaths in 2005-07, 55 were in term or post term neonates, and the leading PSANZ PDC classifications for these were congenital abnormality (n=23; 41.8%), 'no obstetric antecedent' (n=14; 25.5%) and hypoxic peripartum death (n=11, 20.0%).

Table 22: Numbers and Proportions of Deaths in Infants of 37 weeks or greater Gestational Age, by Cause of Death (PSANZ NDC), 2005-07

PSANZ NDC	neonatal		post-neonatal		Infant	
	N	%	N	%	N	%
1. Congenital Abnormalities	22	40.0	21	29.2	43	33.9
3. Cardio-respiratory disorders	3	5.5	0	0.0	3	2.4
4. Infection	4	7.3	15	20.8	19	15.0
5. Neurological	12	21.8	4	5.6	16	12.6
7. Other	14	25.5	32	44.4	46	36.2
Total	**55**	**100.0**	**72**	**100.0**	**127**	**100.0**

Of the 303 infant deaths in the triennium, 127 occurred in infants of 37 weeks or greater gestational age. The leading causes of infant deaths in these term babies were SIDS and other (36.2%), congenital abnormalities (33.9%) and infection (15.0%).

4.1.6 Stillbirths and Infant Deaths by Maternal Smoking Status, WA 2005-07

The prevalence of smoking in pregnancy has reduced over time. In 2005-07 the prevalence of smoking in mothers was 17.0%. In 2002-04, 18.7% of mothers were smokers, and in 2000-01 the proportion was 21.3%.[5]

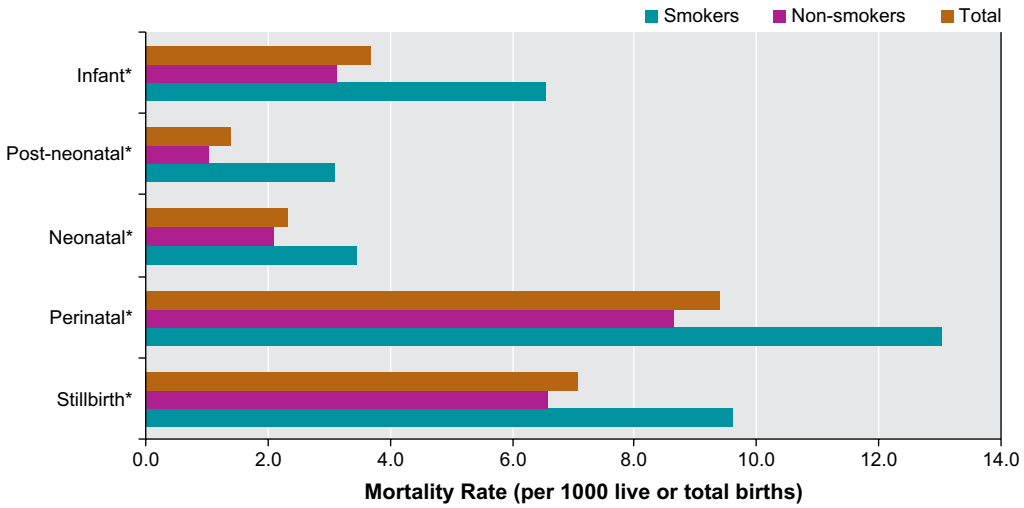
25.4% (n=231) of stillbirths and infant deaths in 2005-07 occurred in smoking mothers (total deaths = 908).

23.6% (n=187) of perinatal deaths occurred in smoking mothers (total number perinatal deaths = 793).

30.0% (n=93) of infant deaths occurred to smoking mothers (total number infant deaths = 310).

Figure 7 illustrates the significantly increased risks of stillbirth and infant death related to maternal smoking in WA in 2005-07. The perinatal mortality rate was 13.0 in smoking mothers and 8.7 in non-smokers. The infant mortality rate was 6.5 in mothers who smoked compared with 3.1 in non-smoking mothers.

Figure 7: Stillbirth and Infant Mortality Rates, by Maternal Smoking Status, WA 2005-07



Note: –*indicates a significant difference between mortality rates for smokers and non-smokers.

Table 23: Numbers and Rates of Perinatal Deaths by Cause of Death (PSANZ PDC) and Maternal Smoking Status, WA 2005-07

PSANZ PDC	Smoking During Pregnancy				Rate Ratio
	Yes		No		
	N	Rate	N	Rate	
1. Congenital Abnormality	53	3.7	177	2.5	1.5*
2. Perinatal Infection	9	0.6	38	0.5	1.2
3. Hypertension	11	0.8	24	0.3	2.2*
4. Antepartum Haemorrhage	14	1.0	30	0.4	2.3*
5. Maternal Conditions	9	0.6	24	0.3	1.8
6. Specific Perinatal Conditions*	2	0.1	68	1.0	0.1*
7. Hypoxic Peripartum Death	10	0.7	16	0.2	3.1*
8. Fetal Growth Restriction	14	1.0	34	0.5	2.0*
9. Spontaneous Preterm*	41	2.9	96	1.4	2.1*
10. Unexplained Antepartum Death	19	1.3	90	1.3	1.0
11. No Obstetric Antecedent	5	0.3	9	0.1	2.7
Total*	**187**	**13.0**	**606**	**8.6**	**1.5***

Note: –*indicates a significant difference in rates between smokers and non-smokers.

There were significantly more perinatal deaths in smoking mothers compared with non-smoking mothers (Table 23). The greatest increased risk ratios were seen for hypoxic peripartum death (Rate ratio (RR)=3.1), antepartum haemorrhage (RR=2.3), hypertension (RR=2.2), spontaneous preterm birth (RR=2.1) and fetal growth restriction (RR=2.0) amongst smoking mothers.

Table 24: Numbers and Rates of Infant Deaths by Cause of Death (PSANZ-NDC) and Maternal Smoking Status, WA 2005-07

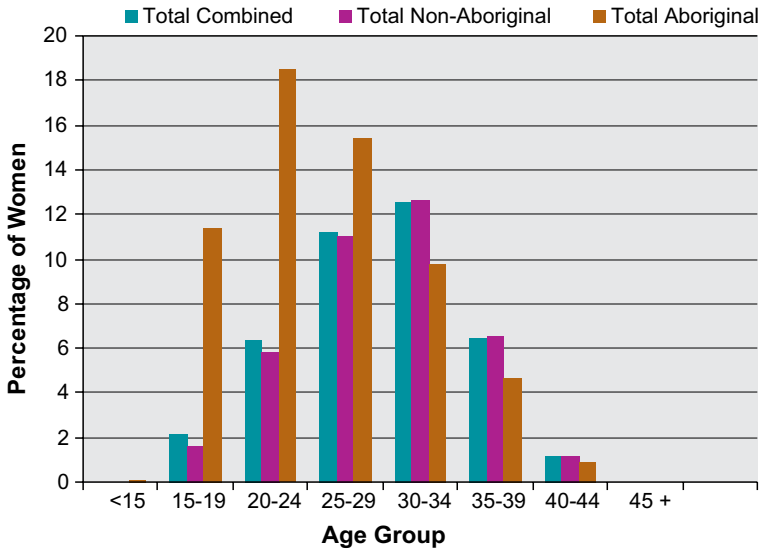
PSANZ NDC	Smoking During Pregnancy				Rate Ratio
	Yes		No		
	N	Rate	N	Rate	
1. Congenital Abnormality	21	1.5	72	1.0	1.4
2. Extreme Prematurity	17	1.2	44	0.6	1.9*
3. Cardio-Respiratory Disorder	3	0.2	16	0.2	0.9
4. Infection	13	0.9	15	0.2	4.2*
5. Neurological	13	0.9	25	0.4	2.5*
6. Gastrointestinal Tract	2	0.1	7	0.1	1.4
7.1 SIDS	21	1.5	23	0.3	4.5*
7.2-7.9 Other	3	0.2	15	0.2	1.0
Total	**93**	**6.5**	**217**	**3.1**	**2.1***

Note: –*indicates a significant difference in rates between smokers and non-smokers.

There were significantly higher infant mortality rates in infants of smoking mothers compared with non smoking mothers. The greatest increased risk ratios were seen with deaths attributed to SIDS (RR=4.5) and to infection (RR=4.2)(Table 24).

4.1.7 Mortality Rates by Maternal Age and Aboriginality, WA 2005-07

Figure 8: Percentage of Women Giving Birth, by Maternal Age and Aboriginality, WA 2005-07



The mean maternal age in WA in 2007 was 29.5 years.[5] Figure 8 shows the maternal age distribution for women giving birth by Aboriginality, for 2005-07, illustrating the younger age of reproduction for Aboriginal women.

Table 25: Numbers and Rates of Stillbirths, Neonatal and Post-neonatal Deaths, by Maternal Age and Aboriginality, WA 2005-07

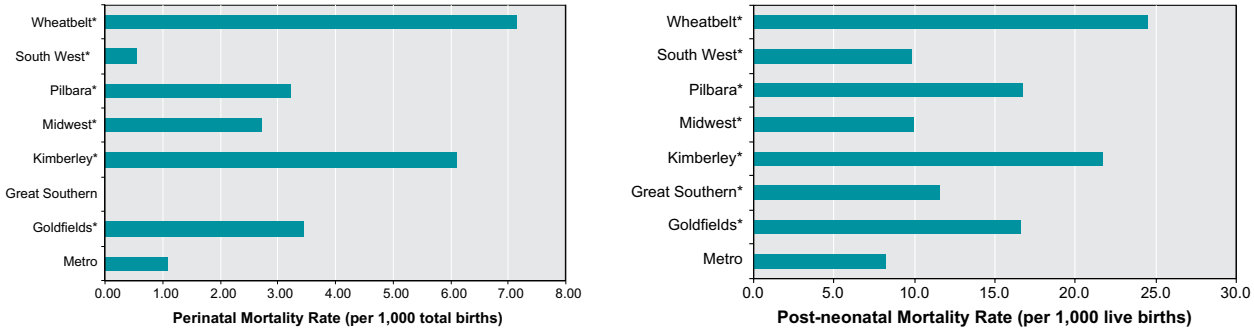
Maternal Age	Stillbirths					Neonatal Deaths					Post-Neonatal Deaths				
	Aboriginal		non-Aboriginal		RR	Aboriginal		non-Aboriginal		RR	Aboriginal		non-Aboriginal		RR
	N	Rate	N	Rate		N	Rate	N	Rate		N	Rate	N	Rate	
<=19	14	11.0	29	8.8	1.3*	8	6.4	21	6.4	1.0	9	7.2	8	2.5	2.9 *
20-34	47	12.8	367	6.1	2.3*	21	5.8	105	1.8	3.3*	19	5.2	61	1.0	5.1 *
>=35	9	22.0	132	7.7	2.9*	4	10.0	36	2.1	4.7*	4	10.0	14	0.8	12.0 *
Total	**70**	**13.1**	**528**	**6.6**	**2.0***	**33**	**6.2**	**162**	**2.0**	**3.1***	**32**	**6.1**	**83**	**1.0**	**5.8 ***

Notes: –*indicates a significant difference when comparing the rate in Aboriginal women in the corresponding age group to non-Aboriginal women.
– Statistics using cells with low numbers should be interpreted with caution.

In Table 25 the disparities in stillbirth, neonatal and post-neonatal mortality rates between non-Aboriginal and Aboriginal mothers by different age groupings is shown. The greatest discrepancies were in older Aboriginal mothers (>=35 years) compared with non-Aboriginal mothers, with relative risks of 2.9 for stillbirths, 4.7 for neonatal deaths and 12.0 for post-neonatal deaths.

4.1.8 Mortality Rates by Maternal Residence, WA 2005-07

Figure 9: Perinatal and Post-neonatal Mortality Rates by Maternal Residence, WA 2005-07



Note: – *indicates a statistically significant difference to the metropolitan rate.

Figure 9 shows mortality rates for different geographical locations within Western Australia, with statistical comparisons with the metropolitan area. These figures are derived using maternal postcodes for residence, and do not always reflect where births occurred. Of the group of all mothers who gave birth in 2005-07, 80% lived in the metropolitan area.[5]

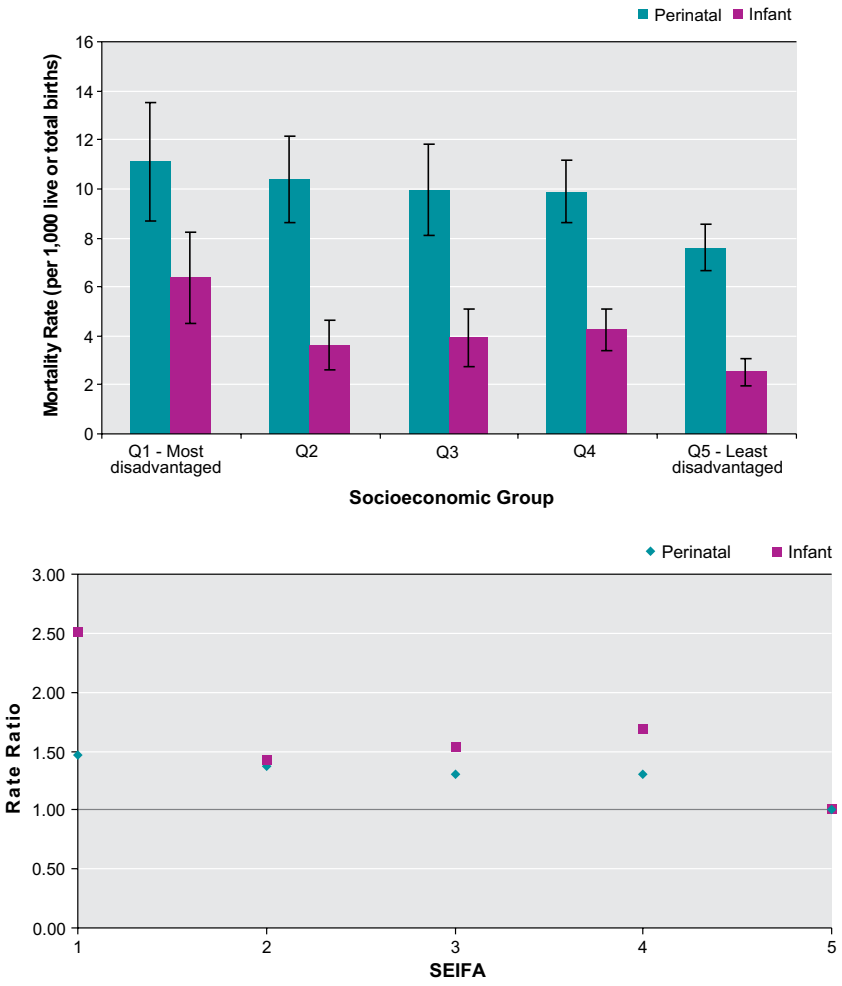
The perinatal mortality rates in all rural areas were significantly higher than the metropolitan rate. In particular, the rate ratio was almost three fold higher for the Wheatbelt (24.5 deaths per 1,000 total births) and more than double for women residing in the Kimberley (21.6 per 1,000 total births), Pilbara (16.7 deaths per 1,000 total births) and Goldfields (16.6 deaths per 1,000 total births) compared to the metropolitan area (8.2 deaths per 1,000 total births)(Figure 9).

The post-neonatal mortality rates were significantly higher in most rural areas, except for the Southwest region in which they were significantly lower than metropolitan rates. The Great Southern figures were too small to make valid comparisons. Again the highest risk ratios were seen for the Wheatbelt (7.2 deaths per 1,000 live births) and Kimberley (6.1 deaths per 1,000 live births), followed by the Goldfields (3.5 deaths per 1,000 live births) and Pilbara (3.2 deaths per 1,000 live births), compared with the metropolitan area (1.1 deaths per 1,000 live births)(Figure 9).

4.1.9 Mortality Rates and Socioeconomic Factors, WA 2005-07

Figure 10 shows further assessment of socioeconomic distributions of births and deaths, using maternal postcode as a marker for socioeconomic status. The Socio-economic Indexes for Areas (SEIFA) published by the ABS[17] for each Census Collection District in WA were used to allocate each postcode to a socioeconomic level. The postcodes are grouped so that Quintile 1 (Q1) represents 'most disadvantaged' and Quintile V (Q5) represents 'least disadvantaged'.

Figure 10: Perinatal and Infant Mortality Rates by Socioeconomic Status, WA 2005-07



In general, both the perinatal and the infant mortality rates increased as the socioeconomic disadvantage increased. The greatest differences in relative risks were seen in infant mortality rates in the most disadvantaged group compared to the least disadvantaged group.

4.1.10 Preterm Births by Hospital Location, WA 2005-07

Most preterm deliveries in WA occurred at KEMH in 2005-07, with 84.5% of babies of less than 28 weeks gestational age and 84.7% of babies less than 1,000g birthweight being delivered at this hospital. These proportions have remained similar since 2000-01.[5]

Table 26: Preterm Births by Hospital Establishment, WA 2005-07

Gestational age	KEMH		Other Metro hospitals	Rural hospitals	Total
	No. of preterm births	% of total	No. of preterm births	No. of preterm births	No. of preterm births
<28 weeks	638	84.5	55	49	742
<30 weeks	865	85.0	73	63	1,001
<32 weeks	1,267	86.3	101	80	1,448
<34 weeks	1,934	83.0	249	119	2,302

Note: – 83,394 cases having gestational age >34 weeks
– 77 cases having place of birth outside hospital

Table 27: Low Birthweight Births, by Hospital Establishment, WA 2005-07

Birth weight	KEMH		Other Metro hospitals	Rural hospitals	Total
	No. of preterm births	% of total	No. of preterm births	No. of preterm births	No. of preterm births
<1000g	664	84.7	58	49	771
<1500g	1,123	86.1	86	76	1,285

Note: – 84,419 cases having birthwieght >= 1500g
– 32 cases having place of birth outside hospital

4.1.11 Trends in Birth Rates and Mortality Rates, WA 1990-2007

Figures 11-15 show trends in births, stillbirths, and infant deaths from 1990-2007.[5]

Whilst there has been a statistically significant reduction in birth rates in both Aboriginal and non-Aboriginal mothers over the entire 17-year period, one can see a slight upward trend in recent years, (Figure 11). Correlation coefficients (r) for rates over time for non-Aboriginal, Aboriginal and total population births were r = -0.919 (p=0.005), r = -0.760 (p = 0.034) and r = -0.918 (p = 0.005), respectively.

Figure 11: Trends in Birth Rates by Aboriginality, WA 1990-2007

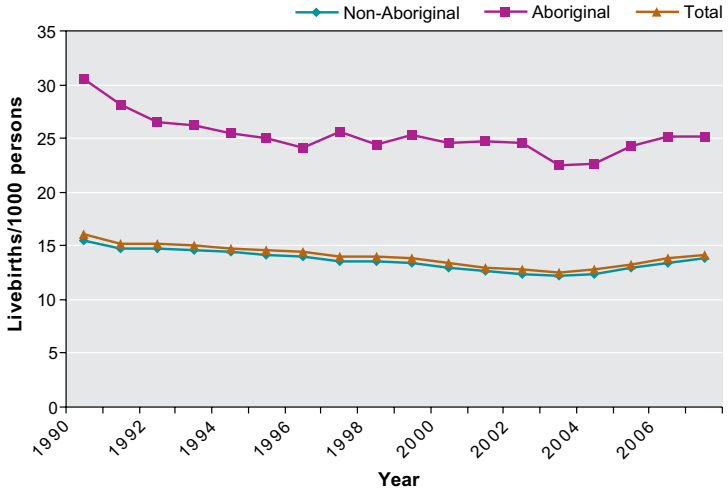
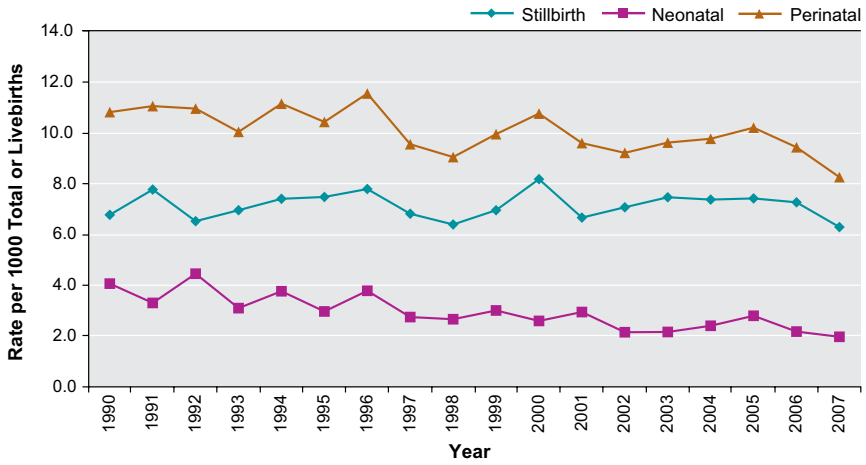


Figure 12: Trends in Perinatal Mortality Rates, WA 1990-2007



There has not been a significant change in stillbirth rates over the 17 year period shown ($r = -0.060$, $p = 0.863$). There appears to have been a slight reduction in the perinatal mortality rate during the time frame but this did not reach statistical significance ($r = -0.607$, $p = 0.095$). There has, however, been a significant reduction in the neonatal mortality rate over this time period ($r = -0.786$, $p = 0.028$).

Figure 13: Trends in Perinatal Mortality Rates by Aboriginality, WA 1990-2007

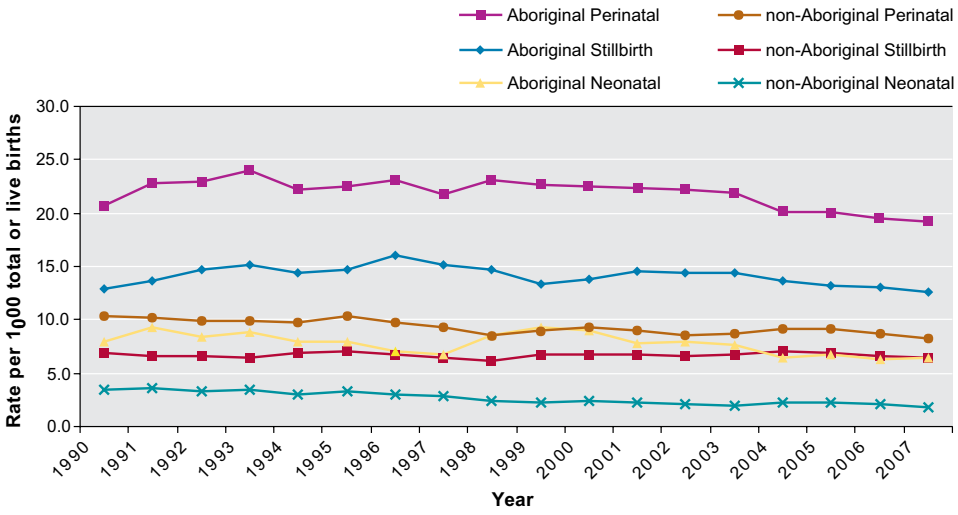


Figure 13 illustrates time trends in stillbirth, neonatal and perinatal mortality rates in non-Aboriginal and Aboriginal people, for 1990-2007, depicted by six separately plotted lines. There was a statistically significant reduction in neonatal deaths in non-Aboriginal infants over this time ($r = -0.820$, $p = 0.02$) but analyses of the other five groups did not show any statistically significant changes.

There have been significant reductions in neonatal ($r = -0.786$, $p = 0.028$), post-neonatal ($r = -0.874$, $p = 0.011$) and total infant mortality rates ($r = -0.915$; $p = 0.006$) over the period 1990-2007 (Figure 14).

Figure 14: Trends in Infant Mortality Rates, WA 1990-2007

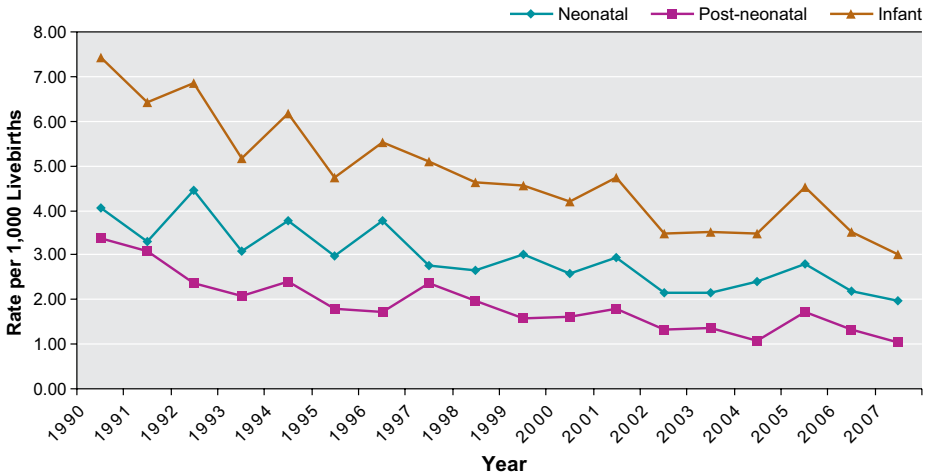
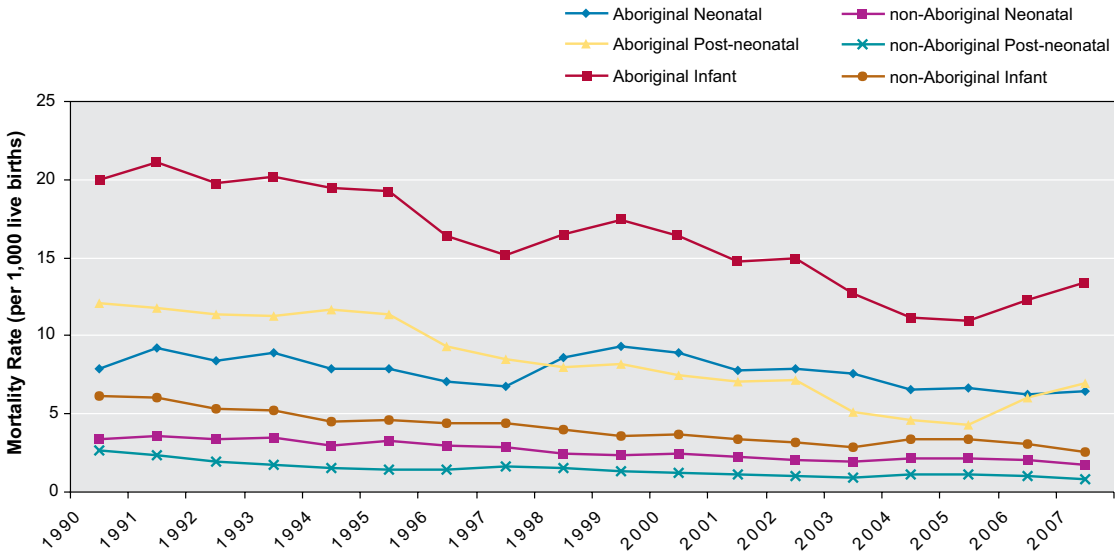


Figure 15: Trends in Infant Mortality Rates, by Aboriginality, WA 1990-2007



The neonatal, post-neonatal and overall infant mortality rates in non-Aboriginal people have significantly declined over this time (neonatal r = -0.815, p = 0.021; post-neonatal r = -0.821, p = 0.020; infant r = -0.903, p = 0.007). The post-neonatal mortality rate in Aboriginal infants declined significantly over this time period (r = -710; p = 0.050), but the neonatal mortality rate in Aboriginal infants did not. The overall infant mortality rate in Aboriginals has shown a downward trend which did not quite reach statistical significance (p = .08)(Figure 15).

Figure 16: Trends in Preterm Birth Rates, by Aboriginality, WA 1990-2007

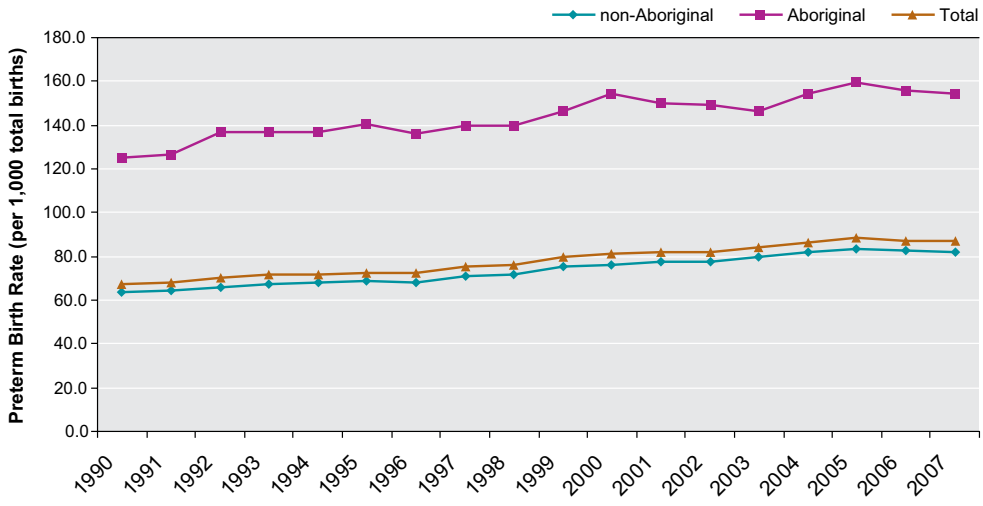


Figure 16 illustrates how the problem of preterm birth has increased over the period 1990-2007. The trend analyses showed increased rates for both non-Aboriginal mothers (r = 0.916, p = 0.006) and Aboriginal mothers (r = 0.927, p = 0.004), and that Aboriginal mothers had considerably higher rates of preterm birth than non-Aboriginal mothers (p<0.001).

4.1.12 Maternal Medical Conditions, WA 2005-07

Table 28: Maternal Medical Conditions, Births and Stillbirths, WA 2005-07

Medical Conditions	Number of Births	% of Births	Number of Stillbirths	% of Stillbirths
Essential hypertension	924	1.1	10	1.7
Pre-existing diabetes mellitus	606	0.7	11	1.8
Asthma	9,103	10.6	64	10.7
Genital herpes	1,552	1.8	9	1.5
Other	17,140	20.0	163	27.3
Total	**29,325**	**34.2**	**257**	**43.0**

Table 28 shows reported maternal medical conditions, as listed on midwives' forms for births in 2005-07.[5] Medical conditions were listed for 34.2% of mothers giving birth in the triennium (n=29,325 of 85,723 total births) and for 43.0% of mothers experiencing a stillbirth (n=257 of 598 total stillbirths).

The prevalence of essential hypertension was reported in 1.1% of mothers giving birth (n= 924 of 85,723 total births) and 1.7% of mothers who had stillbirths (n=10 of 598 total stillbirths). The prevalence of pre-existing maternal diabetes mellitus was reported in 0.7% (n=606) of mothers giving birth and 1.8% of mothers with stillbirths (n=11). Asthma was reported in 10.6% (n=9,103) of all mothers and 10.7% (n=64) of mothers with stillbirths. Genital herpes was reported in 1.8% (n=1,552) of mothers in the triennium and in 1.5% (n=9) of mothers who had stillbirths. Another medical condition was reported for 20.0% of mothers giving birth (n=17,140)and for 27.3% (n=163) of mothers who experienced a stillbirth in the triennium. There are some limitations in the reporting of medical conditions via the midwives' forms.

This completes Section 4.1 describing all births, stillbirths and infant deaths in 2005-07 in WA. The following Section 4.2 pertains to those deaths investigated in detail by the PIMC.

4.2 Cases Investigated by the PIMC, WA 2005-07

4.2.1 Investigated Deaths with Preventable Medical Factors – Overview, WA 2005-07

The EDPH directed the Committee to investigate stillbirths and infant deaths of at least 26 weeks gestational age, excluding known terminations. This led to detailed investigations into 458 of the 908 (50.4%) deaths in the triennium, which comprised 251 of the 598 stillbirths, 96 of the 195 neonatal deaths and 111 of the 115 post-neonatal deaths (Table 29).

Table 29: Numbers and Proportions of Investigated Deaths, WA 2005-07

	Stillbirths	Neonatal Deaths	Post-neonatal Deaths	Total
Total number deaths in 2005–07	598	195	115	908
Number deaths >=26 weeks not investigated	13	2	0	15
Number deaths investigated >=26 weeks gestational age	251	96	109	456
Number deaths investigated <26 weeks gestational age	0	0	2	2
Total number of investigated deaths	251	96	111	458
Proportion of deaths investigated	**42.0%**	**49.2%**	**96.5%**	**50.4%**

At the time of this report, one neonatal death was still being investigated; the Committee was awaiting the findings of a Coronial inquiry into this case.

The EDPH did not request investigations into 15 deaths (13 stillbirths and two neonatal deaths) in babies of at least 26 weeks gestational age. Investigations were directed into two cases which were subsequently found to be in babies born prior to 26 weeks gestational age. These were both post-neonatal deaths in infants born at 25 weeks gestational age.

The Committee scored the cases by a 6 point 'preventability score,'[3] where 1 = virtually no evidence for preventability and 6 = virtually certain evidence for preventability (Table 30). Cases with scores >=4 were considered potentially avoidable deaths. Cases with scores of 2 or 3 had one or more preventable medical factors but were thought unlikely to have been avoidable deaths.

Of the 458 cases investigated, the Committee coded 47 cases (10.3%) with some evidence of preventability (preventability score >=2), and 11 of these cases (2.4%) as likely to have been avoidable (high preventability score >=4). The 47 cases with preventability comprised 24 stillbirths, 19 neonatal deaths and 4 post-neonatal deaths. The subset of eleven of these 47 cases with high preventability scores consisted of 4 stillbirths, 5 neonatal deaths and 2 post-neonatal deaths (Table 30).

This showed a slight improvement compared with 2002-04 in which there were 445 cases investigated, with 59 cases (13.3%) having preventability (preventability score >=2) and 18 cases (4.0%) considered potentially avoidable (high preventability score >=4).

Table 30: Numbers and Proportions of Investigated Deaths by Preventability Score, WA 2005-07

Preventability Score:
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 ('avoidable') 4 = Preventability more likely than not, more than 50-50 but close call 5 = Strong evidence for preventability 6 = Virtually certain evidence for preventability

Preventability	Stillbirths	Neonatal Deaths	Post-neonatal Deaths	Total	Proportion
No preventability (Score 1)	227	77	107	411	89.74%
Low preventability (Score 2-3)	20	14	2	36	7.86%
High preventability (Score 4-6)	4	5	2	11	2.40%
Any preventability (Score >1)	24	19	4	47	10.26%

In 2005-07, 90.7% of deaths met the Committee's expectations of appropriate medical care, and 97.6% of deaths were considered unavoidable in a medical context.

Table 31 describes the types of preventable medical factors that were identified in the 47 cases with preventability, categorised broadly as 'systems' or 'medical care' factors. Cases may have been coded with more than one type of preventable factor. There were 18 'systems factors' identified and 50 'medical care' factors identified across the 47 cases. The distribution of these factors was: 16 cases had systems factors, 36 cases had medical care factors and five cases had both systems factors and medical care factors (total n=47 cases).

Table 31: 'Systems' and 'Medical Care' Factors in Investigated Deaths with Preventability Score >=2, WA 2005-07

Systems factors: Present in =16 cases*	Number of Incidents
a) Significant delay in assessment, treatment or transfer	8
b) Staffing problem	3
c) Equipment problem	0
d) Problem with follow-up of abnormal test result	5
e) Co-sleeping of mother and baby in hospital	1
Total	**18**
Medical Care factors: Present in n=36 cases*	
a) Sub-optimal obstetric management (other than obstetric delivery skills)	21
b) Failure to identify abnormal fetal heart rate patterns on cardiotocographic (CTG) trace	9
c) Fetal heart rate monitoring not performed when indicated	5
d) Insufficient technical skills for obstetric delivery	2
e) Insufficient technical skills for resuscitation of newborn	2
f) Problems in medical care of baby (other than resuscitation of the newborn)	5
g) Earlier referral indicated	6
h) Postnatal depression not identified	0
Total	**50**

Note: – *Five cases had both System and Medical Care Factors.

4.2.2 Investigated Deaths with Preventable Medical Factors – Systems factors, WA 2005-07

Systems factors contributing to sub-optimal medical outcomes can be difficult to identify from the medical notes. Commonly systems factors such as staffing problems may not be documented in patient notes, although these matters may be reported through other quality assurance protocols such as the Advanced Incident Management System (AIMS) used in WA. It is recognised that the detection of systems factors may be underestimated by the methodology used in this work.

There were sixteen cases coded with preventability related to systems factors. The problems were delays in assessment or treatment, staff problems and management of abnormal test results.

Significant delay in assessment, treatment or transfer

The Committee coded eight deaths with preventability secondary to significant delays in assessment or treatment. These comprised:

- **Delays in 'decision to delivery time' by caesarean section:**
  - 90 minutes delay until caesarean section in a secondary metropolitan hospital following an 'alarm' of marked fetal distress
  - 2.5 hours until caesarean section in a secondary hospital in the presence of significant fetal distress, with delay mainly related to insertion of an epidural.
- **Delay in transfer by Royal Flying Doctor Service (RFDS):** One case was considered potentially preventable due to an excessive delay in the patient transfer time due to very high demands on the RFDS services at the time.
- **Delays in treating neonates at risk of sepsis:**
  - delays (>3 hours) in screening and treating neonates at risk of sepsis
  - administration of oxygen to a neonate with mild respiratory distress for several hours without medical review until deterioration occurred
  - delays in calling for help in neonatal resuscitation
  - delay in staff arriving for resuscitation of a flat baby in tertiary centre
- **Delay in treatment:**
  - A mishap occurred when a GP faxed a referral to hospital requesting urgent assessment of a pregnant woman with an abnormal ultrasound finding but a routine appointment was issued.

Staffing problems

Staff problems (three identified cases) included staff being unfamiliar with the management of seriously ill neonates, and difficulty locating an appropriate specialist.

Equipment problems

There were no deaths identified with preventability related to equipment problems in this triennium. However, this may represent under-recognition due to the case review methods used by the PIMC.

Problem with follow-up of abnormal test results

There were five cases where earlier follow up of abnormal test results may have improved outcomes. Examples included:

- A medical attendant was not advised of poor blood gas results, leading to a delay in assessment and treatment of a sick neonate.
- In two cases formal ultrasound examinations were arranged to assess women with risk factors for growth restriction, with no ensuing action taken for up to three days following abnormal ultrasound findings of growth restriction and abnormal umbilical artery Doppler ratios, with resultant fetal deaths.

- A fetal death occurred a few days after two non-reactive CTG traces were recorded but not acted upon, when normal procedures would be to assess fetal wellbeing within 24 hours of two non-reactive traces.

One hospital documented a formal change in systems processes following one of these cases, to ensure that direct liaison should occur between the radiology department and the on-call obstetric registrar in the presence of abnormal ultrasound findings.

Co-sleeping of mother and baby in hospital

A sudden unexpected death in infancy (SUDI) which occurred whilst mother and baby were co-sleeping in hospital was coded with low-level medical preventability.

Key Points: SYSTEMS FACTORS

- Good communication reduces medical errors.
- Where problems are anticipated, early transfer of high-risk patients is recommended.
- Consideration should be given to appropriate 'Decision to Delivery Times' for caesarean section. Improved resources may be required to support this recommendation.
- Radiology staff should speak directly to the obstetric team when adverse fetal signs are detected by ultrasound.
- Neonates with respiratory distress or other risk factors for sepsis should be administered antibiotics as a matter of priority.
- Staff should advise parents of the risks of co-sleeping, and this should be discouraged particularly in hospital. Growth restricted and preterm infants are particularly vulnerable to the risks of co-sleeping.

4.2.3 Investigated Deaths with Preventable Medical Factors - Medical Care Factors, WA 2005-07

Table 31 lists the numbers of cases with potentially preventable medical care factors. These factors included sub-optimal antenatal and intrapartum obstetric management decisions, failure to identify abnormal fetal heart rate patterns on CTG traces, fetal heart rate monitoring not performed when clinically indicated, problems in technical skills for obstetric delivery and resuscitation of the newborn, problems with medical care of the baby, and earlier referral being indicated.

Sub-optimal antenatal and intrapartum obstetric management decisions (other than obstetric delivery skills)

There were 21 cases (18 planned hospital births; three planned home births) in which alternative antenatal care or intrapartum medical management decisions may have led to improved outcomes.

These included:

- Diagnosis and management of diabetes mellitus (6 cases)
- Management of hypertension (4 cases)
- Identification and management of fetal growth restriction (4 cases)
- Management of twin-twin transfusion syndrome

- Identification of chronic fetomaternal haemorrhage
- Management of a high risk grandmultiparous patient, who developed uterine rupture in labour
- Management of reduced fetal movements
- Undiagnosed breech presentation
- Post dates management

Examples of specific problems included:

- Poor glucose control in pregnant mothers with diabetes mellitus
- No action was taken in third trimester to assess fetal status in a mother with diabetes mellitus
- Lack of appreciation of the importance of an estimated fetal weight above the 97th centile at 34 weeks gestational age in a mother with borderline gestational diabetes mellitus (GDM); no routine CTG monitoring
- 'False reassurance' in a mother with risk factors for diabetes mellitus having a normal glucose challenge at 25 weeks gestational age, with no repeat glucose tolerance test (GTT) being performed. There was glycosuria and considerable maternal weight gain. A term macrosomic stillbirth resulted, and a high maternal glycated haemoglobin confirmed GDM.
- Fetal growth restriction was missed in a mother with significant risk factors of hypertensive disease of pregnancy and amphetamines abuse
- No action was taken to assess fetal wellbeing in the presence of 'small for dates' measurements of fundal height
- No recorded measurements of fundal height in routine antenatal checks; fetal growth restriction not identified in an obese smoker
- No assessment of fetal wellbeing in a post dates pregnancy
- Poor anticipation of shoulder dystocia in the presence of risk factors
- Insufficient monitoring of fetal wellbeing in the presence of hypertension from 39 weeks gestational age; fetal death occurred after 41 weeks gestational age.

The Committee noted difficulties in managing patients living in remote areas with significant medical problem such as diabetes mellitus. It was observed that compromises in ideal clinical practice are sometimes accepted, such as poor glucose control in diabetic patients, because of an anticipated greater danger of hypoglycaemia in itinerant patients living in remote communities. However, the Committee advocates close attention to normalising blood glucose levels in pregnant women with diabetes mellitus, where possible.

Lessons from these cases:

Optimise glucose control in gestational diabetes mellitus.

Give consideration to the fetus of a mother with gestational diabetes: apparently 'normal' growth may represent relative growth restriction.

Screen for fetal growth restriction in the presence of hypertension in pregnancy and in mothers using illicit drugs.

Consider fetomaternal haemorrhage in the patient with reduced fetal movements.

Failure to identify abnormal fetal heart rate patterns on CTG trace

There were nine cases in which attendant staff did not recognise adverse cardiotocographic traces. Examples included:

- Failure to identify late decelerations
- No action taken in the presence of recurrent fetal bradycardia
- Missed late decelerations on admission CTG, so no continuous monitoring performed.

The PIMC recognises that with the benefit of hindsight it is often possible to be critical of misinterpreting 'difficult' abnormal CTG traces, but it is important for staff to be well trained in the use and interpretation of CTG traces.

Fetal heart rate monitoring not performed when indicated

There were a further five cases where the addition of CTG monitoring in keeping with RANZCOG guidelines may have improved the outcome. Staff are reminded of the indications for monitoring. In particular, monitoring may help detect hypoxaemia in vulnerable post dates or growth restricted fetuses.

Problems in technical skills for obstetric delivery

There were two cases identified where there were problems in technical skills for obstetric delivery. One involved a shoulder dystocia with no documentation of any special manoeuvres to expedite delivery. The other was a 'missed' breech presentation in which staff had difficulty with the delivery, especially applying forceps to the aftercoming head.

Problems in technical skills for resuscitation of the newborn

One case had low level preventability related to technical skills for resuscitation of a neonate. The Committee notes the requirement for all Department of Health, WA maternity staff to attend Neonatal Resuscitation Program (NRP) training.

Educational resources are available for staff to maintain skills in fetal assessment, CTG interpretation and resuscitation of the newborn (NRP training).

Contact the Statewide Obstetric Support Unit (SOSU) on (08) 9340 1605, or KEMH Post graduate education on (08) 9340 2222 for further details.

RANZCOG Guidelines: http://www.ranzcog.edu.au/publications/collegestatements.shtml

Problems in medical care of the baby (other than resuscitation of the newborn)

- There were five cases considered potentially preventable directly related to the medical management of the neonate (preventability scores 6, 4, 2, 2, 2). One of these with 'low level preventability' related to the difficult decision about when to surgically operate in the presence of suspected necrotising enterocolitis.
- In two cases of diaphragmatic hernia closer adherence to recommended guidelines for management may have improved outcomes. These guidelines include optimising ventilation in the first 24 hours, avoiding early surgery and performing a cardiac echo prior to surgery.
- Two cases related to problems in the recognition and management of seriously ill neonates.

Earlier referral indicated

Earlier referral may have improved outcome in at least six cases (four planned hospital births, two planned home births). These cases had generally high preventability scores (6, 5, 5, 4, 4, 3).

The Committee observed cases in which earlier referral to specialist care, or earlier transfer to a regional or tertiary hospital may have improved the outcomes. Staff are reminded of the importance of good communication, and close telephone liaison with transport staff is encouraged.

4.2.4 Investigated Stillbirths by Cause of Death (PSANZ PDC) and Preventability Score, WA 2005-07

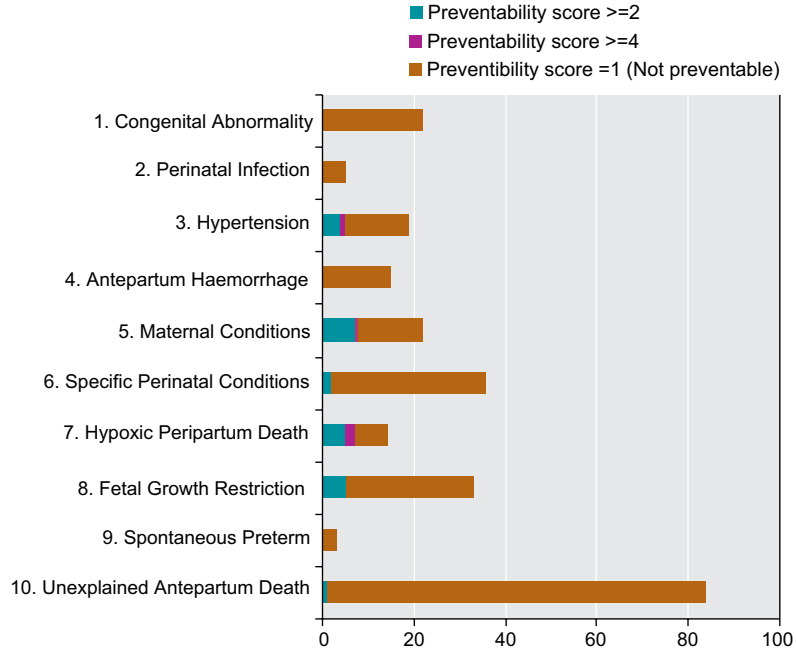
Sections 4.2.1 - 4.2.3 considered types of preventable medical factors according to systems factors and medical care factors. Section 4.2.4 presents preventable medical factors in another manner, according to the cause of death.

Table 32 and Figure 17 show the investigated stillbirths (n=251) by cause of death, and the proportion of cases with potentially preventable medical factors (n=24; 9.6%).

Table 32: Number of Stillbirths by Cause of Death (PSANZ PDC), and Preventability Scores, Investigated Cases, WA 2005-07

PSANZ-PDC	Stillbirths				
	Total		Preventability Score		
			>=4	>=2	
	N	%	N	N	%
1. Congenital Abnormality	22	8.8	0	0	0.0
2. Perinatal Infection	5	2.0	0	0	0.0
3. Hypertension	19	7.6	1	4	21.1
4. Antepartum Haemorrhage	15	6.0	0	0	0.0
5. Maternal Conditions	22	8.8	1	7	31.8
6. Specific Perinatal Conditions	34	13.5	0	2	5.9
7. Hypoxic Peripartum Death	14	5.6	2	5	35.7
8. Fetal Growth Restriction	33	13.1	0	5	15.2
9. Spontaneous Preterm	3	1.2	0	0	0.0
10. Unexplained Antepartum Death	84	33.5	0	1	1.2
11. No Obstetric Antecedent	0	0.0	0	0	0.0
Total	**251**	**100.0**	**4**	**24**	**9.6**

Figure 17: Number of Stillbirths by Cause of Death (PSANZ PDC) and Preventability Score, Investigated Cases, WA 2005-07



The categories with the highest proportion of preventable factors were maternal conditions, peripartum hypoxia, fetal growth restriction and hypertension. These findings were very similar to the 2002-04 triennium.

There were seven stillbirths attributed to maternal medical conditions (including diabetes) with preventable medical factors.

There were five stillbirths due to hypoxic peripartum insult with preventable medical factors.

There were five stillbirths with fetal growth restriction and four stillbirths related to maternal hypertension with preventable medical factors.

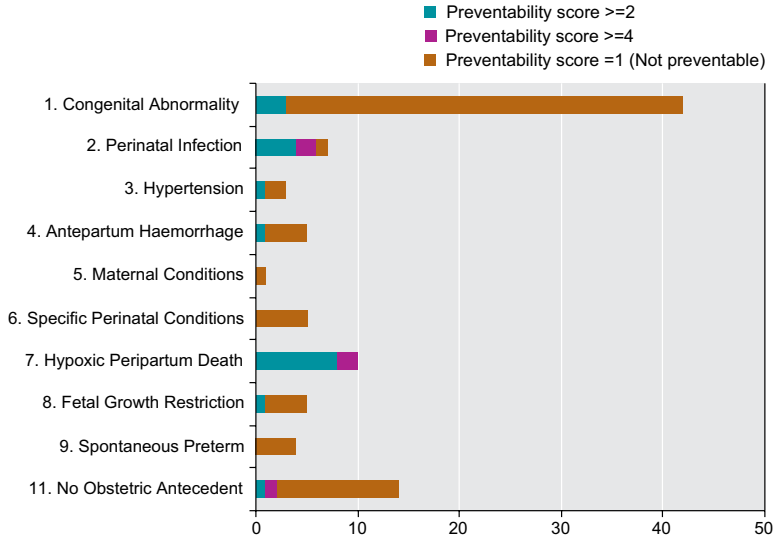
4.2.5 Investigated Neonatal Deaths by Obstetric Precursor (PSANZ PDC) and Preventability Score, WA 2005-07

Table 33 and Figure 18 show investigated neonatal deaths (n = 96) by cause of death, and the proportion of cases with any preventable medical factors (n = 19; 19.8%).

Table 33: Investigated Neonatal deaths by Cause of Death (PSANZ PDC), and Preventability Score, WA 2005-07

PSANZ-PDC	Total		Preventability Score		
			>=4	>=2	
	N	%	N	N	%
1. Congenital Abnormality	42	43.8	0	3	7.1
2. Perinatal Infection	7	7.3	2	4	57.1
3. Hypertension	3	3.1	0	1	33.3
4.Antepartum Haemorrhage	5	5.2	0	1	20.0
5. Maternal Conditions	1	1.0	0	0	0.0
6. Specific Perinatal Conditions	5	5.2	0	0	0.0
7. Hypoxic Peripartum Death	10	10.4	2	8	80.0
8. Fetal Growth Restriction	5	5.2	0	1	20.0
9. Spontaneous Preterm	4	4.2	0	0	0.0
10. Unexplained Antepartum Death	0	0.0	0	0	0.0
11. No Obstetric Antecedent	14	14.6	1	1	7.1
Total	**96**	**100.0**	**5**	**19**	**19.8**

Figure 18: Neonatal Deaths by Cause of Death (PSANZ PDC) and Preventability Score, Investigated Cases, WA 2005-07



The cause of death categories with the highest proportion of deaths with preventable medical factors (preventability score >=2) were hypoxic peripartum deaths (eight of the ten deaths) and perinatal infection (four of the seven deaths). The proportion of preventable deaths for other categories are of interest, but the numbers were low (Table 32 and Figure 18).

4.2.6 Investigated Neonatal and Post-neonatal Deaths by Cause of Death (PSANZ NDC) and Preventability Score, WA 2005-07

This section again examines neonatal deaths, but using the classification system for the primary condition in the infant that led to death (PSANZ NDC). This classification system was also used for post-neonatal deaths.

The numbers of neonatal deaths with preventable factors were low (n=19), but significant findings were that seven of the 20 deaths (35%) due to neurological disorders including hypoxic ischaemic encephalopathy had preventability; four of the ten deaths (40%) due to infection, and two of the five deaths (40%) due to cardiorespiratory disorders had some preventability.

Four of the 111 investigated post-neonatal deaths had preventable factors. Two deaths of the four deaths (50%) due to neurological conditions and two of the 39 deaths (5%) due to congenital abnormalities had potentially preventable factors (Table 34).

Table 34: Neonatal and Post Neonatal Deaths by Cause of Death (PSANZ NDC), Preventability Score, Investigated Cases, WA 2002-04

PSANZ NDC	Neonatal					Post-neonatal				
	Total		Preventability Score			Total		Preventability Score		
			>=4	>=2				>=4	>=2	
	N	%	N	N	%	N	%	N	N	%
1. Congenital Abnormality	40	41.7	0	3	7.5	39	35.1	0	2	5.1
2. Extreme Prematurity	1	1.0	0	0	0.0	0	0.0	0	0	0
3. Cardio-Respiratory Disorder	5	5.2	0	2	40.0	7	6.3	0	0	0
4. Infection	10	10.4	2	4	40.0	15	13.5	0	0	0
5. Neurological	20	20.8	2	7	35.0	4	3.6	2	2	50
6. Gastrointestinal Tract	2	2.1	0	1	50.0	3	2.7	0	0	0
7. SIDS & Other	18	18.8	1	2	11.1	43	38.7	0	0	0
Total	**96**	**100.0**	**5**	**19**	**19.8**	**111**	**100.0**	**2.0**	**4.0**	3.6

4.2.7 Maternal Behaviour and Lifestyle Factors, WA 2005-07

Statewide data for 2005-07 (section 4.1.4) indicated that 25.4% of stillbirths and infant deaths (n=231) occurred to smoking mothers (total number deaths, n=908). The proportions were 23% (n=138) of stillbirths and 30% (n=93) of infant deaths. Similar proportions were seen in 2002-04.

In addition to smoking, other adverse maternal or other family lifestyle factors that may have contributed to the poor outcome were noted in the investigated cases. These maternal behavioural factors ('maternal factors') included poor compliance with recommended medical care, and alcohol and other substance use. They were identified in 24.5% (n=112) of the investigated deaths, which was slightly higher than that seen in 2002-04 (22%). The proportions of cases with maternal behaviour factors, by type of death are shown in Figure 19 and Table 35, being most significant for post-neonatal deaths (18.7% of stillbirths, 22.9% of neonatal deaths and 38.7% of post-neonatal deaths).

Figure 19: Proportion of Cases with Maternal Behavioural Factors, by Type of death, Investigated Cases, WA 2005-07

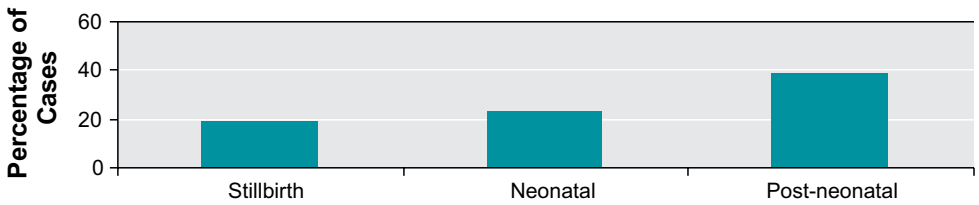


Table 35: Number and proportion of deaths with Maternal Behavioural Factors, by type of death, Investigated Cases, WA 2005-07

Maternal Factors	Stillbirth		Neonatal		Post-neonatal		Total
	N	%	N	%	N	%	N
Yes	47	18.7	22	22.9	43	38.7	112
No	202	80.5	67	69.8	58	52.3	327
Total	**251**	**100.0**	**96**	**100.0**	**111**	**100.0**	**458**

Key Points

Maternal smoking was a significant risk factor for stillbirth and infant death.

Other aspects of maternal or family behaviour that may have contributed to the outcome of stillbirth or infant death - such as substance use and poor compliance with medical care - were associated with 24.5% of the investigated deaths.

Tables 36 and 37 provide details of the cases with 'maternal behavioural factors' (n=112).

Table 36: Types of Maternal Behavioural Factors: Investigated Cases, WA 2005-07

Maternal Factor	All Deaths		Stillbirths				Neonatal Deaths				Post-neonatal Deaths			
	N=458		Non-Aboriginal N=216		Aboriginal N=35		Non-Aboriginal N=84		Aboriginal N=12		Non-Aboriginal N=80		Aboriginal N=31	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Poor compliance	74	16.2	13	6.0	22	62.9	5	6.0	7	58.3	6	7.5	21	67.7
Alcohol abuse	28	6.1	4	1.9	10	28.6	0	0.0	3	25.0	2	2.5	9	29.0
Marijuana use	33	7.2	9	4.2	6	17.1	5	6.0	2	16.7	6	7.5	5	16.1
IV drugs / other hard drugs	19	4.1	5	2.3	3	8.6	4	4.8	1	8.3	5	6.3	1	3.2
Domestic violence	22	4.8	7	3.2	7	20.0	0	0.0	0	0.0	4	5.0	4	12.9
Other serious social problems	10	2.2	1	0.5	0	0.0	1	1.2	1	8.3	1	1.3	6	19.4
Maternal psychiatric disorder	8	1.7	1	0.5	0	0.0	2	2.4	0	0.0	4	5.0	1	3.2
Non accidental injury	6	1.3	0	0.0	0	0.0	2	2.4	0	0.0	1	1.3	3	9.7

Note: Cases may be coded more than once.

Table 36 gives details of the types of behaviour that may have contributed to adverse outcomes. Alcohol abuse was listed only where the notes recorded excessive alcohol consumption.

Table 37 shows that there were significant correlations between those with 'maternal behavioural factors' and with smoking and living in a rural area. In the group of mothers with 'maternal behavioural factors', 65 (58%) were also smokers and 52 (46.4%) lived in the metropolitan area, compared with the group of all mothers who gave birth in 2005-07, which comprised 17% smokers and 80% who lived in the metropolitan area. Sixtyfour (57.1%) of mothers with 'maternal behavioural factors' were Aboriginal.

Maternal Factors – all deaths

Of the 458 investigated deaths, 74 mothers (16.2%) were poorly compliant with medical care. There was documentation that 28 mothers (6.1%) drank alcohol excessively, 33 (7.2%) used marijuana and 19 (4.1%) used illicit intravenous or other 'hard' drugs.

Of the 28 mothers known to have used an excessive amount of alcohol, six were non-Aboriginal and 22 were Aboriginal. Of the 33 mothers documented to use marijuana, 20 were non-Aboriginal and 13 were Aboriginal. Of the 19 mothers known to have used IV or other 'hard drugs', 14 were non-Aboriginal and five were Aboriginal.

Documented domestic violence was associated with 22 of the investigated deaths (4.8%). Eleven were non-Aboriginal and eleven were Aboriginal families. A further ten cases (three non-Aboriginal and seven Aboriginal) were associated with 'other serious social problems'.

A maternal psychiatric disorder which may have potentially contributed to the poor outcome was documented in eight cases (1.7%).

Six investigated deaths were due to 'non accidental injury' (three Aboriginal and three non-Aboriginal). These were all infant deaths, comprising six of the 207 (2.9%) infant deaths.

Maternal Factors – stillbirths

Of the 216 stillbirths to non-Aboriginal mothers, the proportions with maternal factors were:

- 6.0% (n=13) had poor compliance with medical care
- 1.9% (n=4) used alcohol excessively
- 4.2% (n=9) used marijuana in pregnancy
- 2.3% (n=5) used 'hard drugs' in pregnancy
- 3.2% (n=7) had documented experience of domestic violence.

Of the 35 stillbirths to Aboriginal mothers in 2005-07 there were significant proportions with maternal factors, reflected by:

- 62.9% (n=22) with poor compliance with medical care
- 28.6% (n=10) used alcohol excessively
- 17% (n=6) used marijuana in pregnancy
- 8.6% (n=3) used 'hard drugs' in pregnancy
- 20% cases (n=7) had documented experience of domestic violence.

Maternal Factors – infant deaths

Similar associations were found for mothers with infant deaths as shown above for stillbirths (Table 36). In particular, of the 31 post neonatal deaths to Aboriginal mothers,

- 67% (n=21) had poor compliance with medical care
- 29% (n=9) used alcohol excessively
- 16% (n=5) used marijuana
- 12.9% (n=4) experienced domestic violence
- 19% (n=6) experienced 'other serious social problems'
- 9.7% (n=3) infants had a non accidental injury.

Table 37: Deaths with Maternal Behavioural Factors: Associated Factors, Investigated Cases, WA 2005-07

Maternal Characteristics	Type of Death								Aboriginality			
	All deaths (N=112)		Stillbirths (n=47)		Neonatal (N=22)		Post-neonatal (N=43)		Aboriginal (N=64)		Non-Aboriginal (N=48)	
	N	%	N	%	N	%	N	%	N	%	N	%
Smoker	65	58.0	30	63.8	11	50.0	24	55.8	40	62.5	25	52.1
Maternal Age (years)												
<=19	27	24.1	11	23.4	6	27.3	10	23.3	17	26.6	10	20.8
20-34	71	63.4	29	61.7	15	68.2	27	62.8	37	57.8	34	70.8
>=35	14	12.5	7	14.9	1	4.5	6	14.0	10	15.6	4	8.3
Metropolitan Postcode	52	46.4	20	42.6	11	50.0	21	48.8	13	20.3	39	81.3
Assessment												
Preventability score >=2	9	8.0	6	12.8	3	13.6	0	0.0	5	7.8	4	8.3
Preventability score >=4	2	1.8	0	0.0	2	9.1	0	0.0	0	0.0	2	4.2
Autopsy performed	80	71.4	30	63.8	12	54.5	38	88.4	47	73.4	33	68.8

4.2.8 Sudden Unexpected Deaths in Infancy (SUDI), Investigated Cases, WA 2005-07

There were 62 sudden unexpected deaths in infancy (SUDI) cases in the triennium 2005-07 that were investigated by the PIMC. The causes of death, according to PSANZ PDC and PSANZ NDC are shown in Tables 38 and 39. Of the 62 SUDI cases, there were 44 cases classified as SIDS, with the second most common cause of death being postnatal infection (n=13 as per PSANZ NDC).

Of the 44 SIDS deaths, half occurred in smoking mothers (n=31) and 12 infants (27.3% of SIDS cases) were Aboriginal.

Table 38: SUDI Cases by Obstetric Cause of Death (PSANZ PDC), Investigated Cases, WA 2005-07

	N	%
11.11 SIDS type I	9	14.5
11.12 SIDS type IIa	1	1.6
11.13 SIDS type IIb	34	54.8
11.2 Postnatal infection	11	17.7
1.3 Accidental asphyxiation	3	4.8
11.4 Other accident or violence	1	1.6
11.9 Unknown	1	1.6
7.1 Hypoxic peripartum insult	1	1.6
8.4 Fetal growth restriction	1	1.6
TOTAL	**62**	**100%**

Table 39: SUDI Cases by Neonatal Death Classification, (PSANZ NDC), Investigated Cases, WA 2005-07

PSANZ NDC	non-Aboriginal		Aboriginal		Total	
	N	%	N	%	N	%
4.1 - Bacterial	0	0	1	4.3	1	1.6
4.12 - Acquired bacterial	1	2.6	7	30.4	8	12.9
4.22 - Viral	3	7.7	1	4.3	4	6.5
5.1 - Hypoxic ischaemic encephalopathy/perinatal asphyxia	0	0	1	4.3	1	1.6
7.1 - SIDS	32	82.1	12	52.2	44	71.0
7.8 - Other	1	2.6	1	4.3	2	3.2
7.91 - Unknown	1	2.6	0	0.0	1	1.6
7.92 - Unknown	1	2.6	0	0.0	1	1.6
Total	**39**	**100.0**	**23**	**100.0**	**62**	**100.0**

Table 40: SUDI Cases by Birth weight and Aboriginality, Investigated Cases, WA 2005-07

Weight Group (grams) at birth	Aboriginality				Total	
	non-Aboriginal		Aboriginal			
	N	%	N	%	N	%
<1,500	1	2.6	2	8.7	3	4.8
1,500 - <2,500	8	20.5	4	17.4	12	19.4
>=2,500	30	76.9	17	73.9	47	75.8
Total	**39**	**100.0**	**23**	**100.0**	**62**	**100.0**

A significant proportion of SUDI cases occurred in low birth weight infants, with three infants less

than 1,500g birthweight and twelve infants between 1,500g and 2,499g birthweight. Overall, 24.8% of SUDI cases occurred in low birth weight infants (Table 40). By comparison, 6.8% of all births in 2007 were of low birth weight.[5]

A majority of SUDI cases (85.5%) occurred in infants of 37 weeks or greater gestational age (Table 41; Figure 20), and 27.4% (n=17) of the SUDI cases occurred in growth restricted infants (Table 42). The proportions of SUDI cases by birth weight, presence of growth restriction and gestational ages were generally similar in both non-Aboriginal and Aboriginal groups.

Table 41: SUDI Cases by Gestational Age and Aboriginality, Investigated Cases, WA 2005-07

Gestational Group (weeks)	Aboriginality				Total	
	non-Aboriginal		Aboriginal			
	N	%	N	%	N	%
<32	2	5.1	1	4.3	3	4.8
32-<37	3	7.7	3	13.0	6	9.7
Term	34	87.2	19	82.6	53	85.5
Total	**39**	**100.0**	**23**	**100.0**	**62**	**100.0**

Figure 20: Numbers of SUDI Cases, by Gestational Age, Investigated Cases, WA 2005-07

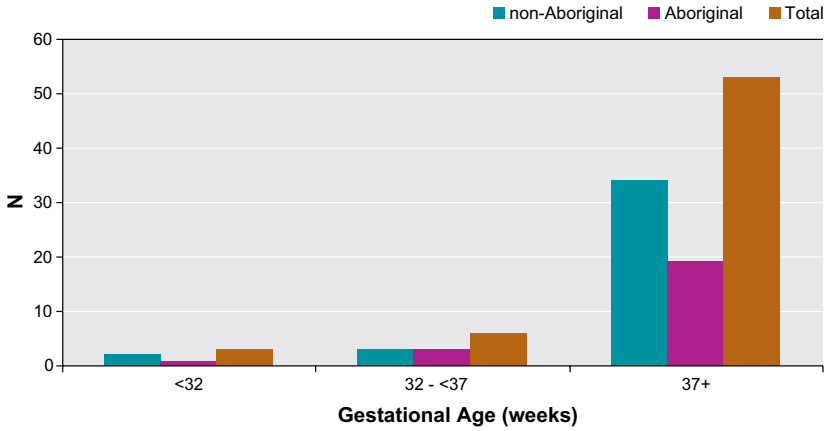


Table 42: SUDI Cases by Fetal Growth Restriction and Aboriginality, Investigated Cases, WA 2005-07

Fetal Growth Restriction	Aboriginality				Total	
	non-Aboriginal		Aboriginal			
	N	%	N	%	N	%
Yes	11	28.2	6	26.1	17	27.4
No	28	71.8	17	73.9	45	72.6
Total	**39**	**100.0**	**23**	**100.0**	**62**	**100.0**

The distribution of SUDI cases by age at death, sleeping position identified, sleeping surface, and maternal smoking status are shown in Table 43 and Figures 21-25.

Table 43: SUDI Cases by Age of Death, Investigated Cases, WA 2005-07

Age at Death	Aboriginality				Total	
	non-Aboriginal		Aboriginal			
	N	%	N	%	N	%
Neonate	8	20.5	5	21.7	13	21.0
>28 days - 12 weeks	8	20.5	3	13.0	11	17.7
>12 weeks - 4 months	16	41.0	8	34.8	24	38.7
>4 months - 8 months	7	17.9	7	30.4	14	22.6
Total	**39**	**100.0**	**23**	**100.0**	**62**	**100.0**

Figure 21: Age at Death, SUDI Cases, Investigated Cases, WA 2005-07

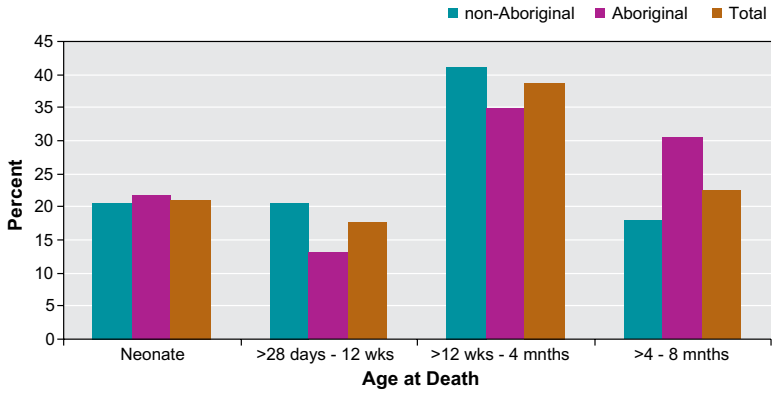


Figure 22: Age at Death, SIDS Cases, Investigated Cases, WA 2005-07

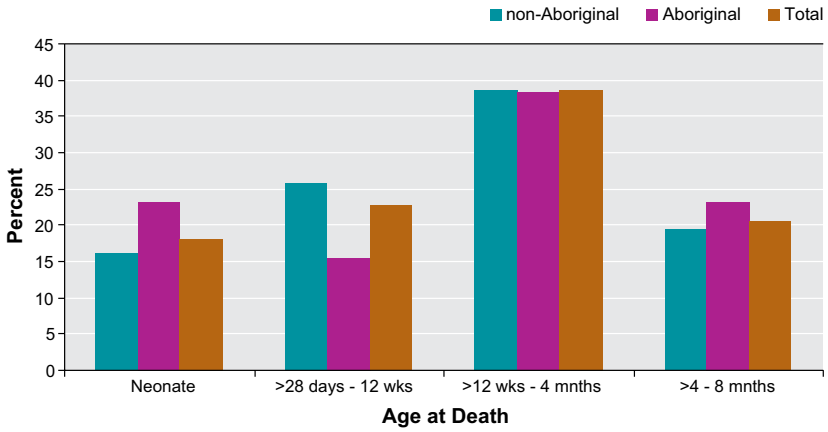


Figure 23: Sleeping Position Identified and Recorded, SUDI Cases, Investigated Cases, WA 2005-07

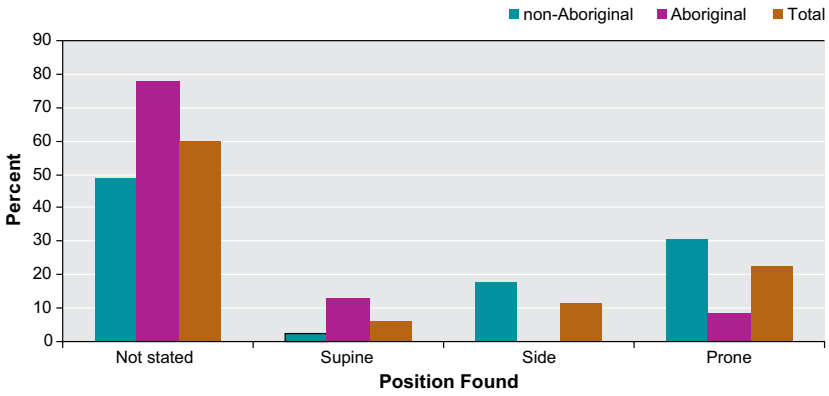


Figure 24: SUDI Cases by Sleeping Surface, Investigated Cases, WA 2005-07

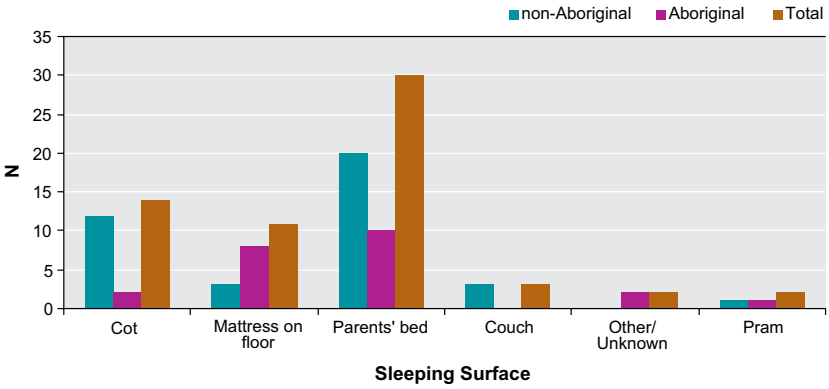
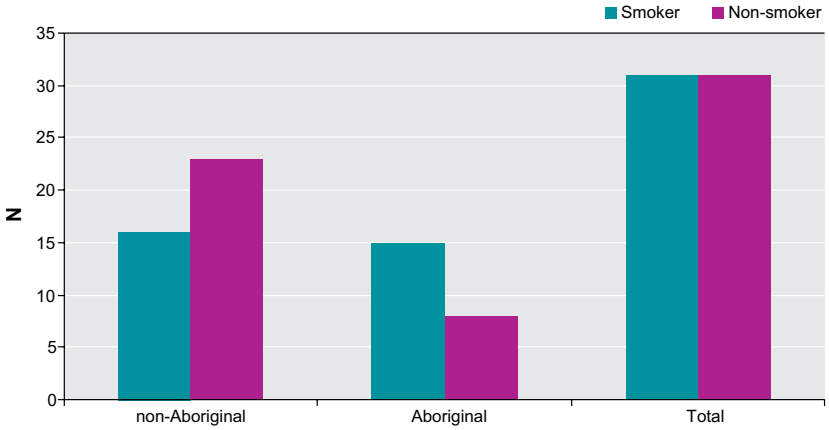


Figure 25: SUDI Cases by Maternal Smoking status, Investigated Cases, WA 2005-07

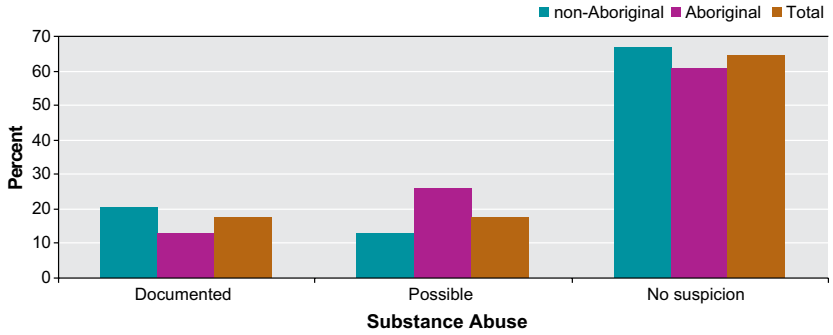


Of the 62 SUDI cases, there was documentation that the parent or care giver was using illicit substances or drinking alcohol around the time that the baby died in eleven cases. In a further eleven cases the parent(s) were known to use illicit substances or drink excessively in the pregnancy, although there was no documentation at the time of infant death. In the other 40 cases there was no suspicion of parental intoxication in pregnancy or at the time of infant death (Table 44 and figure 26).

Table 44: SUDI Cases associated with Substance use or Intoxication, Investigated Cases, WA 2005-07

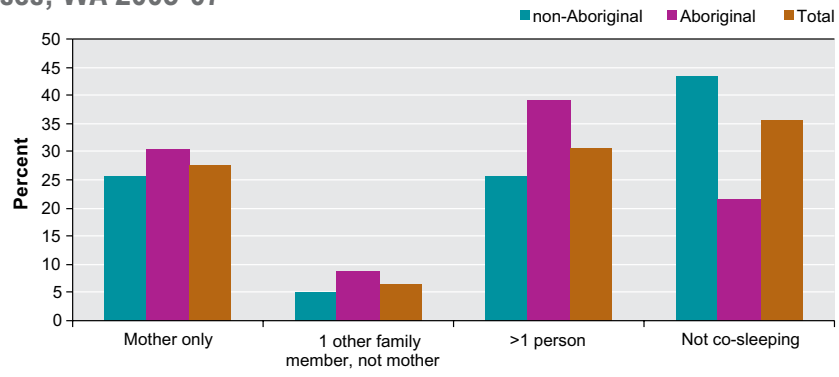
Substance Abuse	Aboriginality					
	non-Aboriginal		Aboriginal		Total	
	N	%	N	%	N	%
Documented	8	20.5	3	13.0	11	17.7
Possible use, on past history	5	12.8	6	26.1	11	17.7
No suspicion	26	66.7	14	60.9	40	64.5
Total	**39**	**100.0**	**23**	**100.0**	**62**	**100.0**

Figure 26: SUDI Cases associated with Substance use or Intoxication, Investigated Cases, WA 2005-07



There were 40 SUDI cases which occurred whilst co-sleeping in 2005-07, compared with 33 cases in 2002-04. In 2002-04 SIDS deaths and all infant deaths associated with co-sleeping were analysed, but not all 'SUDI cases' were specifically analysed as a group.

Figure 27: Proportion of SUDI Cases associated with Co-sleeping, by Aboriginality, Investigated Cases, WA 2005-07



Of the 40 infant deaths which occurred whilst co-sleeping:

- Nine (22.5%) were in infants born preterm.
- 13 (32.5%) were of low birth weight infants and 13 were growth restricted infants. These groupings are overlapping but slightly different.
- All occurred prior to 8 months of age, with the majority prior to 4 months of age (n=29, 72.5%).
- 21 (52.5%) were infants of smoking mothers.
- 22 were non-Aboriginal and 18 were Aboriginal.
- The majority of deaths occurred in the parents' bed (n=26, 65%)
- Substance use or intoxication was documented in ten cases (25%), and possible in a further eleven cases (27.5%) where the parent(s) were previously documented to use excessive alcohol or illicit substances.
- One case occurred whilst co-sleeping in hospital (compared with four cases in the triennium 2002-04).

Table 45: Demographic descriptors of Infant Deaths which occurred whilst Co-sleeping, Investigated Cases, WA 2005-07

Gestational Age Group	non-Aboriginal		Aboriginal		Total	
	N	%	N	%	N	%
<32 weeks	2	9.1	1	5.6	3	7.5
32-<37 weeks	3	13.6	3	16.7	6	15
Term	17	77.3	14	77.8	31	77.5
Total	**22**	**100.0**	**18**	**100.0**	**40**	**100**

Weight Group	non-Aboriginal		Aboriginal		Total	
	N	%	N	%	N	%
<1.5kg	1	4.5	2	11.1	3	7.5
1.5kg - <2.5kg	7	31.8	3	16.7	10	25
>=2.5kg	14	63.6	13	72.2	27	67.5
Total	**22**	**100.0**	**18**	**100.0**	**40**	**100**

FGR	non-Aboriginal		Aboriginal		Total	
	N	%	N	%	N	%
Yes	10	45.5	3	16.7	13	32.5
No	12	54.5	15	83.3	27	67.5
Total	**22**	**100.0**	**18**	**100.0**	**40**	**100**

Age at Death	non-Aboriginal		Aboriginal		Total	
	N	%	N	%	N	%
Neonate	6	27.3	4	22.2	10	25
>28days - 12wks	6	27.3	2	11.1	8	20
>12wks - 4mnths	5	22.7	6	33.3	11	27.5
>4 - 8mths	5	22.7	6	33.3	11	27.5
Total	**22**	**100.0**	**18**	**100.0**	**40**	**100**

Sleeping position identified	non-Aboriginal		Aboriginal		Total	
	N	%	N	%	N	%
Not stated	16	72.7	15	83.3	31	77.5
Supine	0	0.0	3	16.7	3	7.5
Side	3	13.6	0	0.0	3	7.5
Prone	3	13.6	0	0.0	3	7.5
Total	**22**	**100.0**	**18**	**100.0**	**40**	**100**

Bed Type	non-Aboriginal		Aboriginal		Total	
	N	%	N	%	N	%
Mattress on floor	3	13.6	8	44.4	11	27.5
Parents bed	16	72.7	10	55.6	26	65
Couch	3	13.6	0	0.0	3	7.5
Total	**22**	**100.0**	**18**	**100.0**	**40**	**100**

Smoking	non-Aboriginal		Aboriginal		Total	
	N	%	N	%	N	%
Yes	11	50	10	55.6	21	52.5
No	11	50	8	44.4	19	47.5
Total	**22**	**100**	**18**	**100.0**	**40**	**100**

Substance Abuse	non-Aboriginal		Aboriginal		Total	
	N	%	N	%	N	%
Documented	7	31.8	3	16.7	10	25
Possible	5	22.7	6	33.3	11	27.5
No suspicion	10	45.5	9	50.0	19	47.5
Total	**22**	**100.0**	**18**	**100.0**	**40**	**100**

The infant deaths which occured whilst co-sleeping were classified for cause of death (Table 46). The leading categories by PSANZ NDC were: SIDS (n=29) and infection (n=8). It may be noted that 29 of the total 44 SIDS cases (66%) occurred in association with co-sleeping. This was an increase from 2002-04 when there were 13 SIDS deaths that occurred whilst co-sleeping, which represented over half of the total SIDS deaths in that period (n=23; 57%).

Table 46: Infant Deaths which occurred whilst Co-sleeping, by PSANZ classifications, Investigated Cases, WA 2005-07

PSANZ PDC	non-Aboriginal	Aboriginal	Total
7.1 Hypoxic peripartum death, with intrapartum complications	0	1	1
11.12 SIDS Category IB: classic features of SIDS present but incompletely documented	0	1	1
11.13 SIDS Category II: Infant deaths that meet Category I except for one or more features	19	10	29
11.2 Postnatally acquired infection	2	5	7
11.3 Accidental asphyxiation	1	1	2
Total	**22**	**18**	**40**

PSANZ NDC	non-Aboriginal	Aboriginal	Total
4.1 Bacterial infection	0	1	1
4.12 Acquired bacterial infection	0	4	4
4.22 Infection	2	1	3
5.1 Hypoxic ischaemic encephalopathy/ perinatal asphyxia	0	1	1
7.13 SIDS Category II: Infant deaths that meet Category I except for one or more features	19	10	29
7.8 Other	0	1	1
7.92 Undertermined/unknown	1	0	1
Total	**22**	**18**	**40**

4.2.9 Maternal Body Mass Index and Stillbirth and Infant Deaths, Investigated Cases, WA 2005-07

It was not possible to make meaningful analyses of relationships between body mass index and pregnancy outcomes due to missing height and weight data in a high proportion of mothers. Table 47 shows that of the 251 investigated stillbirths, clinical notes recorded maternal height in 156 cases (62.2%) of women, maternal weight in 180 (71.7%) and both height and weight in 114 (45.4%) women. Maternal height is requested on midwifery notification forms, but maternal weight is not collected.

Table 47: Maternal Height and Weight Records, Investigated Cases, WA 2005-07

	Total		Stillbirths (N=251)		Neonatal Deaths (N=96)		Post-neonatal Deaths (N=111)	
	N	%	N	%	N	%	N	%
Height recorded	283	31.2	156	62.2	59	61.5	68	61.3
Weight recorded	252	27.8	180	71.7	37	38.5	35	31.5
Both height and weight recorded	154	17.0	114	45.4	21	21.9	19	17.1

4.2.10 Causes of Death for Pregnancies >=37 weeks Gestational Age, Investigated Cases, WA 2005-07

There were 106 investigated stillbirths in pregnancies of 37 weeks and greater gestational age. The majority of these were unexplained (35.8%), followed by hypoxic peripartum insult (13.2%), specific perinatal conditions (12.3%) and fetal growth restriction (11.3%) (Table 48).

Table 48: Causes of Death by PSANZ PDC in Pregnancies >= 37 weeks Gestational Age, Investigated Cases, WA 2005-07

PSANZ PDC	Stillbirth		Neonatal		Post-neonatal		Infant		Total	
	N	%	N	%	N	%	N	%	N	%
1. Congenital Abnormality	8	7.5	23	43.4	21	29.2	44	35.2	52	22.5
2. Perinatal Infection	2	1.9	4	7.5	0	0.0	4	3.2	6	2.6
3. Hypertension	5	4.7	0	0.0	0	0.0	0	0.0	5	2.2
4.Antepartum Haemorrhage	6	5.7	0	0.0	0	0.0	0	0.0	6	2.6
5. Maternal Conditions	8	7.5	0	0.0	0	0.0	0	0.0	8	3.5
6. Specific Perinatal Conditions	13	12.3	1	1.9	0	0.0	1	0.8	14	6.1
7. Hypoxic Peripartum Death	14	13.2	9	17.0	4	5.6	13	10.4	27	11.7
8. Fetal Growth Restriction	12	11.3	2	3.8	1	1.4	3	2.4	15	6.5
9. Spontaneous Preterm	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
10. Unexplained Antepartum Death	38	35.8	0	0.0	0	0.0	0	0.0	38	16.5
11. No Obstetric Antecedent	0	0.0	14	26.4	46	63.9	60	48.0	60	26.0
Total	**106**	**100.0**	**53**	**100.0**	**72**	**100.0**	**125**	**100.0**	**231**	**100.0**

There were 53 investigated neonatal deaths in infants of 37 weeks or greater gestational age. The leading causes/categories of death by PSANZ PDC were congenital abnormalities (43.4%), no obstetric antecedent (26.4%) and hypoxic peripartum death (17.0%; Table 48).

There were 72 investigated post-neonatal deaths in infants of 37 weeks or greater gestational age. The leading categories of death by PSANZ NDC were 'SIDS and other' (44.4%), congenital abnormalities (29.2%) and infection (20.8%; Table 49).

Table 49: Causes of Infant Deaths by PSANZ NDC in Infants of >= 37 weeks Gestational Age, Investigated Cases, WA 2005-07

PSANZ NDC	Neonatal		Post-neonatal		Infant	
	N	%	N	%	N	%
1. Congenital Abnormalities	22	41.5	21	29.2	43	34.4
3. Cardio-respiratory disorders	3	5.7	0	0.0	3	2.4
4. Infection	4	7.5	15	20.8	19	15.2
5. Neurological	10	18.9	4	5.6	14	11.2
7. Other	14	26.4	32	44.4	46	36.8
Total	**53**	**100.0**	**72**	**100.0**	**125**	**100**

4.2.11 Home Births, Investigated Cases, WA 2005-07

In WA in 2005-07, there were at least 658 planned home births, 559 actual home births, 84,365 planned hospital births (including birth centre births) and 137 births in which the intended place of birth was unspecified (Table 50). Planned home births may be under-reported, particularly those planned home births which subsequently become hospital births, because of problems in interpretation of the question on the Midwives' form pertaining to 'intended place of birth' at the beginning of labour.

Six hundred and forty (640) of the 658 planned home births, and 75,650 of the 84,365 planned hospital births (including birth centre births)were at term or post term (>= 37 weeks gestational age).

Table 50: Numbers of Planned Home Births, Actual Home Births, and Planned Hospital Births, WA 2005-07

YEAR	Planned Home births	Actual Home births	Planned Hospital births (including birth centre births)	Undecided
2005	177	155	26619	28
2006	234	195	28185	51
2007	247	209	29561	58
Total	**658**	**559**	**84365**	**137**

Of the 458 stillbirths and infant deaths investigated by the Committee for the years 2005-07, seven deaths were identified in the group of women who planned to give birth at home with midwifery assistance. Six of these deaths occurred in pregnancies of at least 38 weeks gestational age, and one occurred at 30 weeks gestation.

Four of these cases were coded as 'hypoxic peripartum deaths' by PSANZ PDC classification. They occurred in term or post term pregnancies. These four cases had preventable medical factors (preventability scores >=2) and three were considered potentially avoidable deaths (preventability scores >=4). The proportion of deaths in planned home births with preventability scores >=2 was

57.1% (n=4, of total N=7), which was higher than the proportion of 10.3% of all investigated deaths with preventability scores >=2, (n=47, of total N=458). The proportion of potentially avoidable deaths with preventability scores >=4 was 42.9% (n=3, of total N=7) in planned home births and 2.4% of all investigated deaths (n=11 of total N=458).

The other three deaths that occurred in planned home births were due to congenital abnormalities and had no preventable medical factors.

The Committee commented on problems observed in one or more of the deaths that occurred in the planned home birth cases, including:

- Absence of some routine screening tests in pregnancy (problems with adherence to routine policies)
- Delays in transfer from home to hospital
- Poor communication with medical staff
- The use of alternative or homeopathic medication
- Lack of investigations into the cause of death.

In one case the mother declined to follow medical advice which may have contributed to the outcome.

Table 51: Causes of Stillbirths and Infant Deaths in Planned Home Births by PSANZ PDC, Investigated Cases, WA 2005-07

Type of Death	Place of Birth	PSANZ PDC
stillbirth	hospital	7.2
stillbirth	home	7.9
infant	home	7.1
infant	home	7.3
infant	hospital	1.3
infant	hospital	1.1
stillbirth	hospital	1.5

Table 52: Numbers and Percentages of Stillbirths and Infant Deaths in Planned Home Births, by Preventability Score, Investigated Cases, WA 2005-07

Preventability Score =1		Preventability Score >=2		Preventability Score >=4	
Number	Percentage	Number	Percentage	Number	Percentage
3	42.86	4	57.14	3	42.86

(Total n=7, being the sum of cases with preventability score =1 plus cases with preventability score >=2)

Table 53 compares the mortality rates in planned home births (total n=640) and planned hospital births (including birth centre births, n=75,640) at term or post term (>=37 weeks gestational age).

The greatest discrepancy in mortality risks for planned home births compared to planned hospital births was in deaths due to peripartum hypoxia (Table 54). There were 28 perinatal deaths attributed to hypoxic peripartum insult in the 2005-07 triennium (24 in planned hospital births and 4 in planned homebirths). The risk ratio for stillbirth attributed to peripartum asphyxia was 21.5 times higher for the planned home birth group compared to the planned hospital group. The risk ratio for infant death due to peripartum asphyxia was 18.2 times higher for the planned home births compared with planned hospital births. These figures all reached statistical significance, but some caution must be exercised in their interpretation due to small numbers overall.

Table 53: Stillbirth and Infant Mortality Rates in Planned Home Births and Planned Hospital Births, for Pregnancies >=37 weeks gestational age, Investigated Cases, WA 2005-07

Type of Death	Planned Homebirths (n=640)		Deaths in Planned Hospital births		Rate Ratio	Significance
	N	Rate	N	Rate		
Stillbirth:	3	4.69	104	1.36	3.4	
Neonatal	2	3.13	51	0.67	4.7	
Perinatal	5	7.81	155	2.03	3.9	*
Post-neonatal	1	1.56	69	0.90	1.7	
Infant	3	4.69	120	1.57	3.0	
Total	**6**	**9.38**	**224**	**2.93**	**3.2**	*

Table 54: Hypoxic Peripartum Deaths in Planned Homebirths and Planned Hospital births, for Pregnancies >=37 weeks gestational age, Investigated Cases, WA 2005-07

Type of Death	Planned Homebirths (n=640)		Planned Hospital births (n=75,650)		Rate Ratio	Significance
	N	Rate	N	Rate		
Stillbirth:	2	3.13	11	0.15	21.5	*
Neonatal	1	1.56	10	0.13	11.8	
Perinatal	3	4.69	21	0.28	16.9	*
Post-neonatal	1	1.56	3	0.04	39.4	
Infant	2	3.13	13	0.17	18.2	*
Total	4	6.25	24	0.32	19.7	*

Notes for Tables 53 and 54:

- Due to very small total numbers of deaths in the planned homebirth group, the mortality rate from the hospital births group was applied to the homebirths population in order to derive an indirectly standardised rate ratio. As the number of deaths from planned homebirths is very small, the reliability of the mortality rates produced is decreased, and caution should be used in interpreting these rates.
- Total deaths = n stillbirths plus n infant deaths
- * indicates that the mortality rate in planned homebirths is significantly different to the mortality rate in term planned hospital births, and higher than expected.

4.2.12 Pathology Investigations into Cause of Death, Investigated Cases, WA 2005-07

The results of postmortem examinations were available for investigated cases. Table 55 shows the numbers and proportions by type of death. 65.3% of investigated deaths underwent postmortem, reduced slightly from 2002-04, when 68% of investigated deaths had postmortem examinations.

Table 56 and figure 28 show the benefits conferred by post-mortem examination, using an 'autopsy utility scale'[13]; these findings were similar to review of deaths in 2002-04.[4] Of the investigated deaths that had post-mortem examination performed, in 21.4% the post-mortem confirmed the clinical diagnosis, in 20.4% it gave the diagnosis, in 22.4% additional information was gleaned from the post-mortem and in 35.5% of cases the post-mortem results were inconclusive.

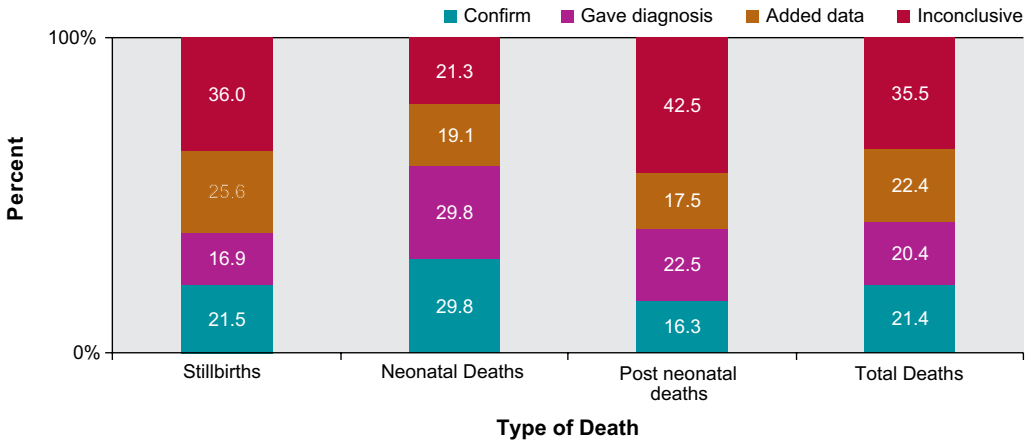
Table 55: Postmortem Examinations Performed, Investigated Cases, WA 2005-07

YEARS	Stillbirths		Neonatal Deaths		Post neonatal deaths		Total Deaths	
	N	%	N	N	%	N	N	%
2005-07	172	68.5	47	49.0	77	69.4	299	65.3

Table 56: Autopsy Utility for Perinatal and Infant Deaths, Investigated Cases, WA 2005-07

Autopsy Utility	Stillbirths (SBs)		Neonatal Deaths (NNDs)		Post neonatal deaths (PNND)		Total Deaths	
	N	%	N	%	N	%	N	%
Confirm diagnosis	37	21.5	14	29.8	13	16.25	64	21.4
Gave diagnosis	29	16.9	14	29.8	18	22.5	61	20.4
Added data	44	25.6	9	19.1	14	17.5	67	22.4
Inconclusive	62	36.0	10	21.3	34	42.5	106	35.5
Total	**172**	**100%**	**47**	**100%**	**80**	**100%**	**299**	**100%**

Figure 28: Autopsy Utility for Perinatal and Infant Deaths, Investigated Cases, WA 2005-07



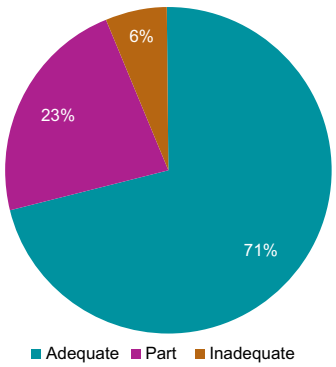
Of the investigated cases, 71% of stillbirths, 87% of neonatal deaths and all post neonatal deaths were considered appropriately investigated. The level of investigative work-up of deaths has improved progressively since 2000-01.[4]

In 2005-07, 23% of stillbirths were only partially investigated and 6% were inadequately assessed for cause of death.

Table 57: Investigations to Assess Cause of Stillbirths and Infant Deaths, Investigated Cases, WA 2005-07

Investigative Work Up	Stillbirths N=251		Unexplained SBs N=83		Infant deaths N=207		Total Deaths N=458	
	N	%	N	%	N	%	N	%
Adequate	178	70.9	55	66.3	198	95.7	376	82.1
Partial	58	23.1	22	26.5	8	3.9	66	14.4
Inadequate	15	6.0	6	7.2	1	0.5	16	3.5

Figure 29: Pathology Investigations to Assess Cause of Stillbirths, Investigated Cases, WA 2005-07



4.2.13 Early Prevention Factors, Investigated Cases, WA 2005-07

Table 58 shows that 39 of the investigated cases (8.5% of total 458 investigated stillbirths and infant deaths) were identified in which 'early prevention factors' were identified. 'Early prevention factors' related to failure to detect congenital abnormalities early in pregnancy when termination of pregnancy may have been an option.

There were seven patients who presented 'too late' for routine screening for fetal anomalies. Ten patients had serious fetal abnormalities detected but declined termination of pregnancy. There were five cases where prenatal diagnosis was not done, and it was unclear from the notes whether or not testing had been offered. There were nine cases where the screening test result was falsely negative. There were three cases of abnormal first trimester screening (increased risk of chromosomal abnormality) and two cases with sub-optimal views on anatomy scan which were not followed up by medical staff.

Table 58: Stillbirths and Infant Deaths with 'Early Prevention' Factors, Investigated Cases, WA 2005-07

Presented too late for screening (after 20 weeks gestational age)	7 cases
Declined prenatal screening for congenital abnormalities	3 cases
Declined termination of pregnancy for lethal congenital abnormality	10 cases
Screening not done – unknown if offered to patient	5 cases
False negative screening test	9 cases
Abnormal first trimester screening result not followed up by medical staff	3 cases
Poor view cardiac anatomy on 18 weeks ultrasound scan not followed up	2 cases
Total	**39 cases**

4.2.14 Deaths occurring in Pregnancies achieved through Assisted Fertility Techniques, Investigated Cases 2005-07

Stillbirths and infant deaths occurring in pregnancies achieved through assisted fertility interventions were noted. There was one case of twin to twin transfusion syndrome in IVF twins. There were nine stillbirths and infant deaths in pregnancies associated with assisted fertility treatments related to chromosomal abnormalities (n=3), hypertension (n=2), maternal diabetes (n=1), fetal growth restriction (n=1) and unexplained stillbirth (n=2). In these cases, it was unknown whether the fertility interventions contributed to the poor outcome.

4.2.15 Vaccine Preventable Deaths, Investigated Cases, 2005-07

In the triennium there was one death observed due to a vaccine preventable death where an infant had not received the recommended vaccination schedule. The organism was Haemophilus influenza type B.

5 Discussion

5.1 Reporting and Audit Requirements for Perinatal and Infant Deaths in WA

There are a number of clinical governance activities operating in WA to promote high standards of clinical care, continuous improvements in service and an environment that supports clinical excellence.[18]

There are statutory requirements for reporting stillbirths and neonatal deaths to the Executive Director of Public Health (EDPH) who directs investigations into certain deaths which are reviewed by the PIMC as described in this Report.

In addition to these statutory requirements, infant deaths are reportable to the Coroner if the cause of death is unexpected or unknown, is suspicious, occurs due to violence, under anaesthetic or whilst the baby is in care. Stillbirths do not need to be reported to the Coroner. This includes fetal deaths resulting from trauma, such as motor vehicle accidents, although it would be appropriate to report such incidents to the police. The Coronial remit covers deaths, so if a baby has no signs of life after birth the Coroner is generally not involved. However, in cases of concealed pregnancy where the baby's status at birth is not independently verified, the Coroner's office should be consulted.

In addition to statutory and Coronial requirements, public hospitals in WA have a policy of reporting and investigating clinical incidents using the **Advanced Incident Management System (AIMS)**, a voluntary reporting scheme in use in WA since 2001.[19]

Clinical incidents are defined as:

> *'an event or circumstance resulting from health care which could have, or did lead to unintended harm to a person, loss or damage, and/or a complaint. Clinical incidents include:*
>
> - *near misses – incidents that may have, but did not cause harm; and*
> - *adverse events - an incident in which harm resulted to a person. Harm includes death, disease, injury, suffering and/or disability.'*

Clinical incidents are 'events or circumstances **resulting from healthcare**' which may have caused or did cause harm. Therefore, deaths that do not result from healthcare do not require reporting to AIMS. The incidents reported to AIMS are classified and reviewed both at unit level and statewide level, to improve systems. Root cause analysis is a method often used to review serious incidents.

In addition to AIMS reporting, some serious incidents are classified as **sentinel events** and are reportable as a **mandatory** requirement in WA.

Sentinel events are defined as rare, preventable clinical incidents that lead to, or can lead to serious patient outcomes including death. In October 2003, Department of Health, WA introduced the Sentinel Event Program.[20]

The obstetric incidents that are reportable in this program include:

'Maternal death or serious morbidity associated with labour or delivery.

… This category captures those events in which there was death or serious disability associated with labour or delivery, in a low-risk pregnancy, while the woman was being cared for in a health service. It includes events that occur within 42 days post-delivery, and excludes deaths from pulmonary or amniotic fluid embolism, acute fatty liver of pregnancy or cardiomyopathy.

Neonatal sentinel events include:

- *an infant discharged to wrong family or infant abduction*
- *an unexpected death or serious disability reasonably believed to be preventable.'*

In the *WA Sentinel Event Report 2006-2007* one death and one case of serious morbidity in the category of 'incidents causing maternal death or serious morbidity associated with labour or delivery' were reported in 2006/2007.[20] The National Sentinel Events Report detailed 16 events of this type in 2004/2005 for Australia.[21] Note that there are significant restrictions in the definition of an obstetric sentinel event. The most common contributing factors were human resources and physical environment. Examples of these included:

- *Some items required to treat the patient were not available*
- *Failure to consistently apply guidelines*
- *Lack of a comprehensive orientation of staff to procedures*
- *Lack of guidelines related to obtaining specialist advice*
- *Uncoordinated approach to delivery of care.*

A further level of reporting is required under the **Western Australian Review of Mortality (WARM) Policy**. This policy arose from a commitment in 2005, by Department of Health, WA to review all inpatient deaths. It was introduced in 2006, with mandatory reporting by public hospitals required from January 2007, and for private hospitals from January 2009.[22] This policy aims to reduce preventable deaths by ensuring that all inpatient deaths are systematically reviewed and appropriate recommendations are made and put into effect. WARM policy requires that inpatient deaths be assessed within three months of the death.

In addition to statewide reporting requirements, health services are encouraged to have regular local obstetric case reviews.

In summary, a number of reporting and audit processes are in place in WA, at local and at statewide levels, aimed to improve systems and health outcomes. Table 59 summarises the reporting systems for perinatal and infant deaths according to statutory requirements, Department of Health, WA mandatory requirements, and other recommended reporting activities. Table 60 summarises perinatal audit activities by local hospital and state levels.

Table 59: Reporting Systems for Stillbirths and Infant Deaths in WA

(i) Statutory requirements
■ Perinatal and infant deaths must be reported to the Executive Director, Public Health (Section 336 A of *Health Act 1911*).
■ Deaths of persons under anaesthesia must be reported to the Executive Director, Public Health (Section 336 B of *Health Act 1911*).
■ Reportable deaths require notification to the Coroner as specified by the *Coroner's Act 1996*
■ Certification of death (*Births, Deaths and Marriages Registration Act 1998*)
(ii) Mandated requirements as per WA Office Safety and Quality in Healthcare (OSQH):
■ Inpatients deaths must be reported to Western Australian Review of Mortality (WARM)
■ Deaths that occur whilst under the care of a surgeon are reportable to the WA Audit of Surgical Mortality (WAASM)
■ Sentinel events must be notified to the Director Office of Safety and Quality in Healthcare
(iii) Professional obligations
■ Deaths should be reported to local hospital / health service mortality committee(s), and to other clinical incident monitoring systems where relevant, such as the Advanced Incident Monitoring System in public hospitals.
■ Serious adverse events that have the potential to result in a medico-legal claim should be reported to the appropriate bodies.

Sources: Modified from 'Sentinel Event Policy, WA Health 2007', with addition of WARM policy, see: Office of Safety and Quality in Health Care: http://www.safetyandquality.health.wa.gov.au

Table 60: Summary of Audit Activities for Perinatal Death in WA

Local hospital or area level
■ Clinical incident reviews through Advanced Incident Monitoring System (AIMS), with root cause analyses for sentinel events (also at State level)
■ obstetric case reviews /neonatal case reviews
■ perinatal death committee / infant death committee
State level
■ Perinatal and Infant Mortality Committee (PIMC)
■ WA Review Mortality (WARM)
■ Coronial Investigations (some infant deaths only)

5.2 Staff Support

The Statewide Obstetric Support Unit of WA (SOSU) reviewed the management of perinatal loss in metropolitan public hospitals in WA in 2009 (Metropolitan Perinatal Loss Needs' Analysis Project; MPLNAP).[23] A variety of audit activities were observed in the hospitals reviewed. There was acknowledgement of the high levels of stress on staff caring for families experiencing stillbirth or infant death, particularly in the presence of preventable medical factors and fear of litigation.

The importance of peer debriefing was widely acknowledged in MPLNAP site visits. Review and debriefing activities were described as usually beneficial but sometimes confronting.

Case reviews should seek to identify remediable health care issues, and avoid individual blame or criticism. There is the potential for reviews to be interpreted as being critical of particular staff members. This highlights the importance of undertaking case reviews in a manner that is constructive and focused on identifying systems factors. Regular general obstetric case reviews are recommended, and may help to dispel some of the sensitivity around discussing cases with poor outcomes.

Some local research about perinatal loss care showed that midwives gained most satisfaction from providing skilled midwifery care that they considered made a difference to women.[24] This was enabled when midwives were able to provide continuity of midwifery carer to women. The least satisfying aspects of care related to the difficulties in dealing with emotional and grief responses, and communication difficulties.

Managing stress associated with traumatic incidents is relevant to many professions including police, ambulance, fire and rescue and health personnel. Some cognitive behavioural techniques can be taught to assist staff to cope with such stress.[25]

There is conflicting information in the published literature about the effects of debriefing.[26,27,28] It is recommended that staff experiencing significant distress be counselled by a trained counsellor. Department of Health, WA employees have access to the independent counselling firm Converge.[29] Other options are listed in Table 61.

Table 61: Staff Support Options

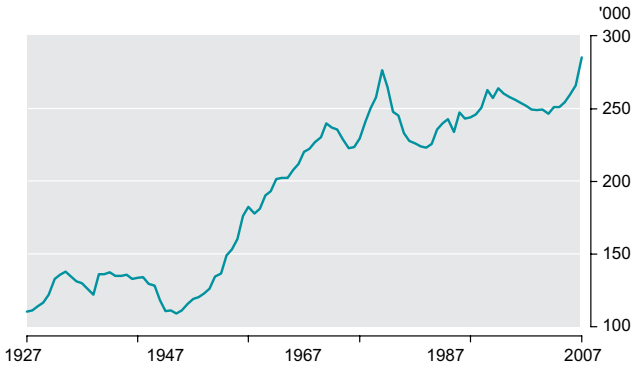
■ Informal debriefing
■ Formal debriefing
■ Professional counselling for Department of Health, WA employees through 'Converge' private employee assistance program
■ Other private professional counselling services
■ AMA 'Colleague of First Contact'
■ SOSU

5.3 Births and Deaths: How does WA Compare?

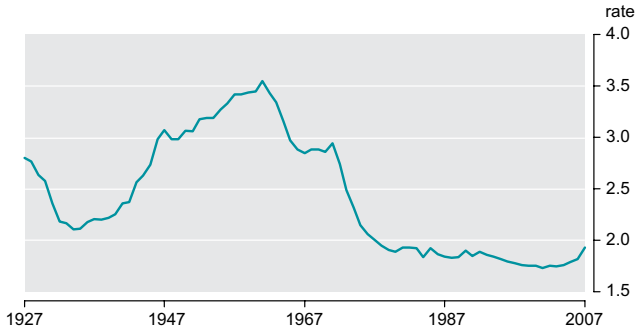
Australia is experiencing a relative baby boom at present. In 2008 the highest ever annual number of births were registered (n= 296,600), being 4% more than in 2007. Australia's total fertility rate (TFR) in 2008 was 1.97 babies per woman, the highest since 1977 (2.01).[30]

Figure 30: Trends in Numbers of Registered Births, Fertility Rates and Median Maternal Ages in Australia

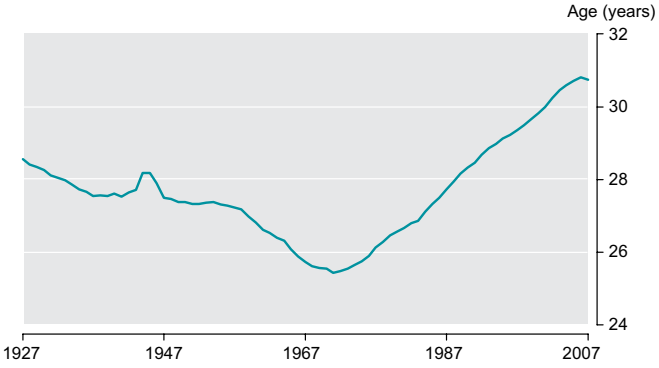
Registered births



Total fertility rate (births per woman)



Median age of mother



Ref: ABS[30]

The trend of increasing maternal age has continued in recent years. The average age of mothers giving birth in Australia in 2007 was 29.9 years.[6]

Table 62: Approximate Maternal and Infant Mortality Rates in Australia

Approximate Mortality Rates in Australia	
Maternal death	**1 in 10,000**
Perinatal death	**1 in 100**
Miscarriage	**1 in 6**
Stillbirth	8 in 1,000
Neonatal death	2 in 1,000
Infant death	4 in 1,000
Child death	1 in 10,000

The proportion of preterm births has also continued to rise, with 7.4% of babies being born preterm in Australia in 2007[6], and the rate in WA is higher than nationally, at 8.7% in 2005-07.[5]

There have been significant obstetric and gynaecological changes in recent decades including increasing instrumentation rates, increasing infertility rates, and the associated increased use and success of assisted fertility treatments. Important modern problems of affluence are obesity, diabetes mellitus and physical inactivity. In particular, morbid obesity is increasing. All of these factors influence health outcomes.

There are approximately 30,000 births, 200 stillbirths and 100 infant deaths each year in WA. Whilst infant mortality rates continue to decline over time, there has not been a significant reduction in the stillbirth rate in the last two decades.

WA reported the lowest perinatal mortality rate of all the states and territories in 2007, as shown in Table 63 (AIHW data).[6] WA also had the lowest infant mortality rate (IMR) in 2007 of 2.4 infant deaths per 1000 live births, and the second lowest IMR in 2008 (IMR=3.4) compared with the national averages (National IMR =4.2 in 2007; IMR = 4.1 in 2008)(ABS data).[7]

Table 63: Stillbirths, Neonatal and Perinatal Deaths by State and Territory, 2007

	State/territory of usual residence								
	NSW	VIC	QLD	WA	SA*	TAS	ACT	NT*	TOTAL
Number									
Live births*	96,998	70,531	60,053	29,913	19,581	6,285	4,648	3,642	**291,651**
Fetal deaths	673	573	446	212	136	45	33	33	**2,151**
Neonatal deaths*	255	239	195	59	48	18	14	15	**844**
Perinatal deaths	*928*	*812*	*641*	*271*	*185*	*63*	*47*	*49*	***2,995***
Total births	**97,671**	**72,473**	**60,499**	**30,125**	**19,718**	**6,330**	**4,681**	**3,675**	293,802
Rate per 1,000 births*									
Fetal deaths	6.9	7.9	7.4	7.0	6.9	7.1	7.0	9.0	**7.3**
Neonatal deaths*	2.6	3.4	3.2	2.0	2.5	2.9	3.0	4.4	**2.9**
Perinatal deaths	*9.5*	*11.2*	*10.6*	*9.0*	*9.4*	*10.0*	*10.0*	*13.3*	***10.2***

Note: – Consult reference source for explanatory notes.[6]

The history of decline in infant mortality is described in ABS literature.[31] In the early 1900's the IMR was around 100 infant deaths per 1,000 live births. By the mid 1920s the IMR was less than 50 and since 1983 it has been below 10. Until the 1930's, the decline in IMR was mostly due to the rapid decline in post-neonatal deaths. The decline in post-neonatal deaths was mainly due to reduction in infectious diseases, related to improved nutrition, better living conditions, enhanced public health awareness, antibiotics and vaccination.

In the post World War II era the decline in neonatal mortality rate was faster than the decline in post-neonatal death rate, and mainly due to improved medical and obstetric care. Neonatal intensive care developments since the 1970's dramatically reduced neonatal death rates. In the last two decades there have also been impressive reductions in deaths due to SIDS and accidents.

According to United Nations data, in 2006 Australia was ranked 17th for IMR compared with all countries.[32]

Table 64 shows comparative data for infant deaths in non–Aboriginal and Aboriginal infants in Australia 2003-08. The IMR is around double in Aboriginal people.

Table 64: Infant Mortality Rate, by Aboriginality and State or Territory, Australia 2003-2008

	NSW	QLD	SA	WA	NT
INDIGENOUS					
Male					
2003–2005	8.8	14.6	7.1	13.9	21.2
2004–2006	7.9	14.5	8.2	13.0	21.0
2005–2007	10.0	11.0	10.2	10.6	19.1
2006–2008	8.3	8.4	6.8	11.5	15.1
Female					
2003–2005	7.9	6.9	8.3	11.6	9.5
2004–2006	7.0	7.6	4.9	10.7	12.1
2005–2007	7.7	7.2	7.4.	9.8	12.1
2006–2008	7.1	7.4	5.9	8.8	11.9
Persons					
2003–2005	8.4	10.9	7.7	12.8	15.6
2004–2006	7.5	11.1	6.7	11.9	16.7
2005–2007	8.9	9.1	8.9	10.2	15.7
2006–2008	7.7	7.9	6.4	10.1	13.6
ALL PERSONS					
Persons					
2003–2005	4.7	5.0	4.0	4.2	9.5
2004–2006	4.8	5.2	3.8	4.5	9.7
2005–2007	4.7	5.1	4.3	3.9	9.0

Ref: ABS[7]

Significant challenges in provision of perinatal healthcare in WA are:

- higher birth rates
- workforce shortages, particularly midwives, nurses and medical staff with obstetric and neonatal skills for rural areas
- expansive distances – difficulties in retrieving patients
- high caesarean section rate
- high proportion of Aboriginal people living in deprived social conditions

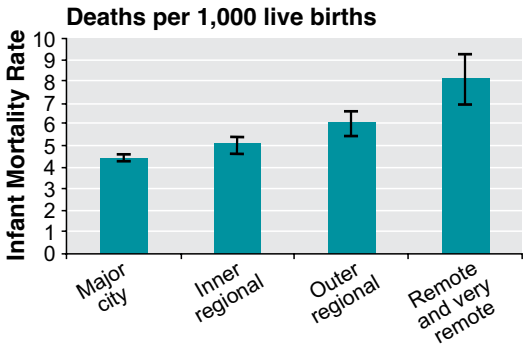
5.4 Challenges in Obstetric and Infant Health in WA

5.4.1 Overview: the big State of WA

Whilst WA compares well with national data for overall perinatal and infant mortality rates, there remain particular challenges in addressing the poorer health outcomes in certain groups – those living in rural and remote areas, Aboriginal people, and others living in socially disadvantaged circumstances, as shown in the results (Section 4) of this report. Figure 31 illustrates that higher infant mortality rates are associated with increasing remoteness in Australia.

Other significant problems in WA are health workforce shortages, especially in rural areas, and other problems related to the huge land area of Australia's largest state.

Figure 31: Infant Mortality Rates, by Remoteness, Australia 2004-06



Ref: AIHW[33]

5.4.2 More Births in WA

There has been a significant increase in the number of births in recent years in WA, in keeping with national trends. This has increased pressure on many units, particularly in the presence of widespread workforce shortages.[34] Most of the increased activity has been experienced by metropolitan hospitals.[5]

Of the 28,254 births in WA in 2006, there were 5,792 (20.5%) in KEMH, 11,164 (39.5%) in other public hospitals, 10,007 (38.0%) in private hospitals, 194 (0.7%) planned home births and 107 (0.3%) babies were born before arrival at hospital.[5]

There have also been significant demographic changes in recent years, which add to complexity and workload, particularly an increase in older mothers and an increase in caesarean section rates.[5] The proportion of women giving birth who were over the age of 35 yrs has doubled in the last fifteen years (9.9% in 1991 and 20.5% in 2006). In 2006, 9,235 (32.7%) women giving birth had a caesarean section, with a higher prevalence in older women and those with private health insurance. This compares with 33.9% in 2005 and 18.4% in 1991. The proportion of elective and emergency caesarean sections in 2006 were: 5,280 (18.7%) elective and 3,955 (14.0%) emergency.[5] High caesarean section rates have significant implications for health service funding, staffing needs, and longer confinement periods in hospital.

5.4.3 Workforce and Health Planning

There is a shortage of health care professionals in WA across the spectrum of medical, midwifery, nursing and allied health, particularly in rural areas.[34-36]

A study of rural WA in 2006 identified procedural workforce gaps to be 14.5 full time equivalent GP proceduralists and 12 procedural specialists.[37]

In the consultation stage for the policy framework document, 'Improving Maternity Services: Working Together Across Western Australia: A Policy Framework'[38], the Women's and Newborn's Health Network (W&NHN) became aware of a need to improve knowledge of the existing maternity services in WA. One of the first priorities identified by the W&NHN was to perform a statewide mapping of the maternity workforce and a service delivery inventory. This led to a collaborative project of the Statewide Obstetric Support Unit (SOSU) and W&NHN to build a Maternity and Neonatal Services map 'MANSmap' of WA in 2008. The project methods comprised detailed electronic surveys and telephone interviews of leading obstetric and midwifery staff working in the 30 public obstetric units across WA.[34]

Key workforce findings of the MANSmap project showed that, of the 30 units surveyed:

- 29 units had a shortage of midwives
- 19 units identified shortages of obstetric medical staff
- Consultant obstetricians were working in 55 obstetric positions across the 30 units. Of these 55 consultants, 47 worked in metropolitan hospitals (32 in the north metropolitan area and 15 in the south metropolitan area) and eight worked in rural units, across five of the State's regional hospitals.
- Non-specialist medical practitioners provided obstetric services for most of the rural units. In addition, many rural units were dependent on the services of overseas trained medical practitioners to provide obstetric services, due to a deficit of local graduates to fill the positions.
- There were units with very high ratios of births per doctor providing obstetric services in some metropolitan and some country health services.
- There was a reliance on GP anaesthetists in rural hospitals.
- 16 units may have benefitted from more neonatal unit staff (predominantly neonatal nursing/ midwifery staff)
- At least 6 units may have benefitted from additional paediatric medical staff.

Workforce issues include the age of practitioners, housing, professional and social isolation, job satisfaction, high staff turnover, skills maintenance and skills mix.[37,39,40]

Incentives for consultant obstetricians, GP-obstetricians, anaesthetists and GP-anaesthetists, paediatricians, midwives and nurses to work in rural areas are of high priority. These include financial incentives, accommodation provision/support, locum support and shared on call arrangements. In particular, housing is identified as a priority issue for recruitment and retention of staff in rural areas.[34]

Existing supports are acknowledged, but additional financial and peer supports are required to address ongoing workforce gaps.

The provision of perinatal services is ideally coordinated by a statewide approach, with consideration of many factors including workforce issues and demographic trends.

The significant proportion of maternity services provided by the private sector in WA should be considered (38% of births in 20065), along with factors that may influence this.

The W&NHN and SOSU are working to provide leadership and guidance for best obstetric practice, whilst the W&NHN, WA Neonatal Network, Neonatal Emergency Transport Service (NETS) WA and Neonatal Outreach Education are all working to provide leadership and guidance for optimal neonatal practice.

Utilising MANSmap data, health service reviews, and consultation throughout the State, these bodies are working towards policies to improve the delivery of obstetric and neonatal care.

Identified priorities for maternity care in WA are safety, continuity of care, improving access to services, and minimizing disparities in health outcomes for at-risk groups.[36]

The 'WA Neonatal Framework and Model of Care 2009' aims to improve neonatal outcomes and support the development of a sustainable workforce through a coordinated centralised service and coordinated cot management systems.[41] The Network has developed a statewide plan for all aspects of neonatal care in WA, which has included advice of the need to expand the capacity and workloads of secondary level nurseries in WA.[42]

Recommendation 1:

Support Statewide Planning:

The statewide initiatives of the Women's and Newborns' Health Network, the Statewide Obstetric Support Unit and the WA Neonatal Network should be adequately resourced, to optimise coordination of obstetric and neonatal care in WA.

5.4.4 Patient Trasfers

The tertiary level obstetric and paediatric hospitals of WA are in metropolitan Perth. Transferring high risk obstetric patients and infants to these centres is an important service provided conjointly by RFDS, NETS and St John Ambulance Services (SJA). These services have experienced increasing demand in recent years, and it is important that they are resourced and utilised appropriately.

MANSmap data showed high numbers of emergency transfers of mothers and neonates to Perth.[34] Commonly mothers and neonates are transferred to obtain consultant medical care and specialised neonatal nursery care. Some transfers occur due to a lack of suitably trained nurses for neonatal nursery care, and back transfer of neonates (from specialised neonatal units) are frequently hindered by staff limitations in smaller units. Additional consultant obstetricians, paediatricians, and neonatally-skilled nurses in rural centres may reduce the number of patients requiring transfer.

Recommendation 2:

Deliver very preterm babies (<32 weeks gestational age) in a tertiary centre

Priority in utero transfer to a tertiary centre is recommended in the presence of threatened preterm labour.

Transport services should be adequately resourced.

Table 65: Advice for RFDS Transfers

- When an obstetric transfer may be required, refer to RFDS early.
- In utero transfer to tertiary centre is far preferable to delivery of preterm neonate in a peripheral hospital.
- A reliable history and examination findings are crucial to decision making.
- Arrange ambulance transfer to ensure the patient is ready at the airport when the aircraft is scheduled to land, to avoid delays.
- Consult medical guidelines prepared by RFDS and NETS:
  - RFDS clinical guidelines:
    ROYAL FLYING DOCTOR SERVICE OF AUSTRALIA RFDS Western Operations
    CLINICAL MANUAL VERSION 4.0 - DATED: 1 JANUARY 2006; http://www.rfds.info/
  - Newborn Emergency Transport Service (NETS) Medical Guidelines:
    http://www.kemh.health.wa.gov.au/development/manuals/NETS_manual/index.htm

Ref: RFDS[115] and NETS[43]

Table 65 lists some important notes from the RFDS regarding medical evacuations. The RFDS team has considerable experience in the safe and successful transfer of pregnant women. When considering transferring a woman with threatened preterm labour, it is important to liaise with RFDS staff to determine if transfer is preferable to keeping the patient in an outlying hospital. In most instances, 'in utero' transfer is the best option.

When a preterm baby does deliver in a regional or district hospital, NETS, RFDS and SJA may all be required to arrange transfer of the neonate. Local staff may be required to provide the acute neonatal resuscitation service, which may necessitate ventilation by hand for many hours before a team can arrive to help stabilise and transfer the baby.

NETS provides a valuable service in providing consultant advice, and in transporting sick infants to appropriate special nurseries.[43] NETS is discussed further in the 'Articles Section' of this report.

5.4.5 Aboriginal Health

An estimated 3.4% of the total population in WA identifies as Aboriginal/Indigenous.[44] In WA in 2007, 5.9% of mothers were of Aboriginal or Torres Strait Islander descent compared with the national average of 3.8%.[6]

This minority group experiences very significantly higher birth and death rates compared to non-Aboriginals. Many Aboriginal families live in disadvantaged circumstances, and have difficulty accessing health services.

Recommendation 3:

Improve Aboriginal care:

Culturally appropriate initiatives to reduce the high mortality rates in Aboriginal people are sought. Specific programs working to 'close the gap' between Aboriginal and non-Aboriginal people should be adequately resourced.

'There is an irrefutable relationship between the social inequalities experienced by Indigenous people and their current health status.'[45] This social disadvantage, directly related to dispossession and characterised by poverty and powerlessness, is reflected in measures of their education, employment, and income.[44]

Aboriginal women have generally higher fertility rates, with the greatest differences seen in teenage birth rates, as shown in national ABS data (2008) where Aboriginal teenagers had a four-fold fertility rate compared with all teenage women.[30]

Low birth weight is a recognised risk factor for infant morbidity and mortality. Risk factors for low birth weight include socioeconomic disadvantage, the size and age of the mother, the number of babies previously born, the mother's nutritional status, illness during pregnancy, the duration of pregnancy, alcohol, smoking and other drugs.[44,46,47] Average Aboriginal birthweights were 200g less than non-Aboriginal babies in 2007 and Aboriginal babies were more than twice as likely to be of low birthweight compared with non-Aboriginal babies.[6]

Aboriginal people experience a considerably greater burden of disease compared with non-Aboriginals, associated with high social stressors, higher prevalences of infectious diseases, mental health problems and considerably higher rates of tobacco and alcohol misuse.[44,48] They have significantly higher rates of domestic violence, injury due to motor vehicle accidents and other causes, self harm and suicide.[44]

Understanding of the factors contributing to most types of injury among Indigenous people … need to be seen within a broad context including: disruption to cultural, environmental, and lifestyle variables; socioeconomic disadvantage; geographical isolation; increased road usage; exposure to hazardous environment(s); substance abuse; violence; social and familial dysfunction; risky behaviour; risky home environments; and limited access to health and social support services.[44,49]

Aboriginal people have poorer nutritional status.[44] They frequently have poor access to fresh food. There are financial and physical obstacles to consumption of a healthy diet for many Aboriginal people.

Breastfeeding is an important health issue. Breastfeeding rates in Aboriginal people have generally been similar to, or higher than, non-Aboriginal people, although available data are limited. Higher breastfeeding rates have been associated with increasing remoteness of location.[46,50] Ongoing programs to encourage breastfeeding are recommended.

An analysis of national health data for Indigenous populations in Australia, New Zealand, Canada and the United States of America found that 'Australia ranks bottom in the league table of first-world nations working to improve the health and life expectancy of Indigenous people'. The report noted that the poor health status of Indigenous Australians is related to 'social and economic factors: diseases triggered by poverty; overcrowded housing; poor sanitation; lack of access to education; poor access to medical care for accurate diagnosis and treatment; and poor nutrition' and called for 'Federal, State and Territory leaders from all sides of politics to commit to an agreed time frame for achieving health equality'.[51,52]

Federal and State government policies and planners are seeking to 'close the gap' between Aboriginal and non-Aboriginal peoples.

5.4.6 Maternal Behavioural Factors

Burden of Disease and Preventable health risk factors

A study of the burden of disease and injury in 2006 in WA considered nine preventable health risk factors.[53] The risk factors chosen were tobacco, alcohol, physical inactivity, illicit drugs, inadequate fruit and vegetable consumption, unsafe sex, high body mass, high blood pressure and high blood cholesterol. The Report, *'The burden of disease and injury attributed to preventable risks to health in Western Australia'*,[53] highlights the significant health gains that could be achieved in WA through the reduction of selected risk factors and provides insight to the changing risk factor impact on population health. The key findings were that high body mass ranked as the highest contributor to disease burden, accounting for 8.7% of the total burden of disease and injury in WA in 2006. The next leading risk factor was tobacco (6.5%). The body mass burden impacted at a significantly younger age than the tobacco burden. The burdens attributed to high body mass and tobacco were followed by physical inactivity (6.1%), high blood pressure (6.0%), high blood cholesterol (5.0%), alcohol harm (3.8%), inadequate fruit and vegetable intake (2.3%), illicit drug use (1.6%) and unsafe sex (0.5%). An estimated 29.5% of the total burden of disease and injury in WA in 2006 was attributed to the joint effect of the nine risk actors.

Recommendation 4:

Improve Social care:

Additional support is required to assist families in difficult social circumstances.

a) Equitable access to antenatal and infant health care is recommended.

b) Additional social work staff for antenatal clinics may be beneficial.

c) Additional resources for the Department of Child Protection to protect babies and assist families with serious social problems should be considered.

Maternal Behavioural Factors contributing to Stillbirths and Infant deaths in WA

The PIMC observed that significantly more stillbirths and infant deaths in WA in the years 2000-07 had maternal/parental behavioural risk factors compared with preventable medical factors. In 2005-07, 18.7 % of investigated stillbirths, 22.9% of investigated neonatal deaths and 38.7% of post-neonatal deaths had maternal behavioural factors compared with 10% of cases with preventable medical factors.

Most of the behavioural factors coded by the PIMC were modifiable risk factors. These included poor compliance with recommended medical care, alcohol abuse, marijuana and other illicit substance use, domestic violence and non-accidental injury. Serious maternal psychiatric conditions that may have contributed to stillbirth or infant death were also coded as 'maternal behavioural factors'. In addition, the contribution of smoking to stillbirths and infant deaths was considered, with smoking data obtained from midwifery notification forms.

Poor Compliance

Infrequent antenatal attendance is associated with an increased risk of perinatal death.[54,55] Poor maternal compliance was observed in 16% of investigated deaths in WA in 2005-07. In particular, poor compliance was observed in a high proportion of Aboriginal families. There is evidence that attendance is more likely at culturally acceptable and easily accessed clinics, and some evidence that this improves health outcomes.[56]

Antenatal care provides essential information and support to expectant mothers throughout pregnancy, and can greatly reduce the risk of mortality during childbirth. A number of factors which have been found to contribute to successful antenatal services in Indigenous communities include community-based or community-controlled services; integrated services; respect for Indigenous people and culture; and a focus on communication, relationship building and trust.[57]

Improved data collection regarding antenatal attendance may allow for a more accurate assessment of the relationship between antenatal attendances, compliance with medical advice and pregnancy outcomes. These data are collected routinely in Queensland, South Australia and the Northern Territory.[6] It may assist in health planning to add questions about antenatal attendances to the Midwives' notification forms in WA.

Smoking

Smoking remains a significant modifiable risk factor for stillbirth and infant death, along with being a major cause of morbidity. There has been a gradual downward trend in the prevalence of smoking in pregnant women in WA in recent years.[5] National data showed prevalence of smoking in pregnancy ranged from 12.8% in NSW to 28% in Tasmania in 2007, with a national average of 16.6% which was similar to WA (17%), although the national data showed little change in the previous five years.[6]

There are also variations in the prevalence of smoking during pregnancy in certain sub-populations, with national AIHW data collected in 2005 showing that women who were socially most disadvantaged were more than four times more likely to smoke than women who were least disadvantaged (28% compared to 6%). Women with Aboriginal or Torres Strait Islander backgrounds were more than three times more likely to smoke during pregnancy than non-Indigenous women (53% compared with 16%). The likelihood of smoking during pregnancy decreased with maternal age. Forty-two percent of teenagers smoked during pregnancy.[58] Other research has shown that women without a partner, the less educated, those with lower socioeconomic status and women with a psychiatric disorder are more likely to smoke during pregnancy.[59, 60]

The Australian National Tobacco Strategy 2004–2009 has identified expectant and new parents as a priority target group for future education and cessation support interventions.[61] There is evidence that known adverse effects of smoking, preterm birth and fetal growth restriction, may be reversible if smoking is stopped prior to 15 weeks gestation.[62]

There are a number of consumer 'quit' support programs, including the RANZCOG 'Assistance with Smoking Cessation During Pregnancy'[63] along with several useful weblinks about tobacco available: http://www.tobaccoinaustralia.org.au/appendix-1.[64]

Alcohol Abuse and Illicit Substance Use

Alcohol and other harmful substance use were associated with a number of investigated deaths in WA in 2005-07. Illicit substance use is more likely amongst mothers who are younger and Aboriginal.[65]

It is recommended that medical staff and midwives enquire about the use of alcohol and other substances in all pregnant women. Routine collection of information on the Midwives' forms about alcohol use in pregnancy is also recommended.

Current Australian guidelines advise that no alcohol in pregnancy is the safest option.[66,67] The WA Institute of Child Health Research has developed resources to assist health professionals counsel patients in this regard.[68]

Clinical guidelines have been developed for the management of women with chemical dependency problems.[69] The guidelines recommend that *'pregnant women with significant problematic drug or alcohol use will benefit from appropriate referral for specialist drug and alcohol assessment, appointment of a consistent and continuous case manager and care team who use effective communication systems; and specific treatments for their drug use, which may include counselling, pharmacotherapies and relapse prevention strategies.'*

Internet Links for Information & Services to assist families with mental health problems include:

WA Government mental health information and resources web link:
http://www.health.wa.gov.au/mentalhealth/home/

WA Perinatal Mental Health Unit (WAPMHU):
http://www.kemh.health.wa.gov.au/health_professionals/WA_perinatal_mental_health_unit/

Beyond blue resources for depression:
http://www.beyondblue.org.au/index.aspx?link_id=105.898&oid=681

Ngala Family Resource Centre provides early parenting assistance:
http://www.ngala.com.au/

North Metropolitan Area Health Service Project: Healthy babies for mothers with serious mental illness: http://www.nmahsmh.health.wa.gov.au/projects/healthybabies.cfm

Best Beginnings early intervention home visiting program for mothers with high risk social factors. http://www.community.wa.gov.au/DCP/Resources/Best_Beginnings.htm

A specialised chemical dependency clinic operates at KEMH and can provide this type of multidisciplinary comprehensive care, along with offering advice and support to practitioners thoughout WA.

Additional advice and information to assist practitioners in managing pregnant women with addiction and other mental health problems can be accessed via the departments of psychological medicine and social work at KEMH (Phone 08 9340 2222 switch at KEMH).

Postnatal follow-up of mothers using illicit substances, and their babies, is recommended, with involvement of social workers and welfare agencies strongly recommended.

Mothers with mental health problems

In WA in 2005-07, eight mothers were identified with a serious mental health disorder that may have contributed to the poor outcome of stillbirth or infant death. This may be viewed as the 'tip of the iceberg' of families adversely affected by mental health problems. The prevalence of mental health disorders in the community is known to be very high. There are several support agencies for patients and health professionals dealing with patients with postnatal depression and other mental health disorders.[70-72]

Domestic Violence

Domestic violence was documented in 4.8% of women who experienced a stillbirth or infant death in WA in 2005-07. The prevalence of domestic violence is particularly high in Aboriginal families. There is evidence that intimate partner violence is linked to poor obstetric outcomes including an increased risk of death and preterm birth.[73]

Domestic violence frequently commences during pregnancy (30% of cases in a UK study, 2006) and commonly children are in the same or next room.[74]

In WA new 'Guidelines for Protecting Children' were released in 2009 (replacing Guidelines for Responding to Child Abuse and Neglect and the impact of Family and Domestic Violence 2004) to strengthen systems to protect children.[75]

Counselling and safety planning are beneficial in assisting people affected by violence.[76] There is support for routine systematic screening for the presence of abuse in pregnancy.[73] Routine screening is in place at KEMH. The PIMC recommends that all women are screened for domestic violence in pregnancy. Information and resources are available through Domestic Violence Advocacy Support Central and local guidelines are available.[77,78]

Emergency phone numbers	
Healthdirect Australia	1800 022 222
Mental Health Emergency Response Line	Metro 1300 555 788 or Peel 1800 676 822
Rurallink	1800 552 002

Recommendation 5:

Improve access to mental health care:

Additional support is required to assist families affected by addiction and other mental health disorders.

a) Routine screening for depression, substance abuse, and domestic violence is recommended in the antenatal and postnatal periods.

b) Equitable access to outpatient/inpatient mental health services is recommended.

Summary: Social Issues

Increased support should be given to agencies working to assist families with social risk factors such as poor housing, domestic violence and alcohol and other substance use.

Additional outreach services are recommended to improve compliance with antenatal and infant health care for those who have difficulty accessing medical services. This includes women in socially disadvantaged circumstances, particularly Aboriginal women and those living in remote areas, adolescent mothers, families affected by addiction, domestic violence and mental health disorders.

Screening for depression and domestic violence is recommended as a routine in antenatal and postnatal assessments.

5.5 'Lessons to learn', Preventable Deaths, WA 2005-07

The PIMC considered that the majority of investigated stillbirths and infant deaths in 2005-07 met expectations of appropriate medical care. However, 10% of deaths had preventable medical factors. The areas where improved outcomes may have been achieved related to the management of labour, identification and management of fetal growth restriction, the management of maternal diabetes, hypertension, peripartum sepsis and the sick neonate.

The WA findings were similar to recent South Australian research where 11.2% (n=68 cases) of perinatal deaths in 2001-05 were associated with deficiencies in professional care.[55]

5.5.1 Systems Factors

Systems factors may not be documented in case notes, thus not identified in PIMC case reviews. It is helpful to review other data regarding systems factors. Several systems problems were identified in the MANSmap survey of public maternity units in WA in 2008.[34] Some problems related to staff availability, especially for emergency care, delays in caesarean section services, and equipment issues.

Most preventable factors related to the:

- management of labour
- management of diabetes
- management of peripartum sepsis
- identification and management of the sick neonate

The MANSmap survey showed that many obstetric units relied on an 'availability list' for some medical services, such as anaesthetic and paediatric services, which differed to units that paid staff to be on call. In addition, some doctors provided services on an 'availability' basis to more than one hospital at the same time, commonly in the metropolitan area. In some units with an 'availability only' service, sometimes there were delays in locating staff to provide services, especially epidurals, and occasionally patient transfers were required because of this. The benefits of paid on-call systems were highlighted, saving time, and identifying a 'duty of care' with the practitioner on-call.

Mobile phone coverage was identified as an important issue in rural areas.

Time to arrange an emergency caesarean section is an important determinant for neonatal outcomes. In the 2008 MANSmap survey of the 30 public obstetric units in WA, there were five units without emergency caesarean sections facilities on site. Usual caesarean section 'decision to delivery' time estimates were self-reported by the units as:

- Within one hour: 22 units (five of these usually within half an hour)
- Within two hours: seven units
- Within three hours: one unit.

Several public obstetric units had limited ultrasound services and some units lacked emergency ultrasound diagnostic facilities. Ensuring the availability of basic ultrasound equipment for emergency use was identified as a priority to assist in safe practice.

All WA public maternity units had basic equipment for neonatal resuscitation and stabilisation, but the MANSmap questionnaire documented differences in equipment and services in nurseries. Unfamiliarity with equipment may lead to problems in providing services, and it is recommended that there be consistency in equipment around the State.

5.5.2 Medical Care Factors: Skills, Knowledge and Training

Access to on-line guidelines at the point of patient contact is recommended to assist in management decisions. KEMH guidelines for obstetrics and neonatology are readily available.[79,80] Staff should be aware of these, in conjunction with RANZCOG guidelines.[81] KEMH antenatal shared care guidelines for general practitioners have recently been updated.[82]

Medical practitioners and midwives should have training and practice drills, particularly in the following areas:

- The use and interpretation of electronic fetal heart rate monitoring in labour
- The management of obstetric and neonatal emergencies

On-line education about fetal physiology and electronic fetal heart rate monitoring is available to all *Department of Health, WA* labour and birth suite staff (K2 program).[83]

Recommendation 6:

Maintain Professional Training and Standards:

a) Medical practitioners and midwives should maintain knowledge and skills through continuing professional education activities, including mock procedural and resuscitation training to maintain clinical skills, build teamwork and improve communication skills.

b) Suitable obstetric and neonatal training programs should be adequately resourced and delivered throughout the State.

'Obstetrics is a high risk speciality, in which emergencies are to some extent, inevitable. Training staff to manage these emergencies is a fundamental principle of risk management. Traditional risk management strategies based on incident reporting and event analysis are reactive and not always effective. Simulation based training is an appropriate proactive approach to reducing errors and risk in obstetrics, improving teamwork and communication, whilst giving the student a multiplicity of transferable skills to improve their performance'.[88]

Some preventable deaths in WA highlighted the need for adequate training and retention of technical skills for doctors and midwives. Clear communication skills and good teamwork improve outcomes, particularly in emergency situations. Role playing and simulation training for obstetric emergency drills improve teamwork and can improve neonatal outcomes.[8,84,85] Some of

this evidence is from local experience where significantly improved Apgar scores and reduced caesarean section rates were observed following the introduction of an Outreach Obstetrics education training in rural and remote areas.[8] This retrospective audit compared obstetric and neonatal outcomes prior to the training in 1999-2001 and following training in 2004-05. A small team of obstetricians and midwife educators from KEMH travelled to each of 14 rural and remote hospitals throughout the State once every 12–18 months to deliver the 1-day training programme, which continued to evolve in response to course evaluations. By the end of the study period, each site had received at least two training visits. The evidence-based education program was provided to all rural GP obstetricians and midwives, and consisted of all aspects of obstetric care with particular emphasis on obstetric emergencies. The Outreach Obstetrics training programme included sessions in teamwork, antenatal care, intrapartum fetal heart rate monitoring, obstetric emergencies, postpartum care, neonatal resuscitation, local birth statistics review and case presentations. The training included interactive hands-on participation via workshops and practice drills. Following the introduction of training to rural and remote areas, there was a highly significant 25% reduction in the rate of infants born with low 5-min Apgar scores. At the same time, there was a non-significant 21% decrease in the stillbirth rate and a non-significant 22% improvement in the perinatal death rate. The moderate/severe hypoxic ischaemic encephalopathy rates showed a similar trend of a non-significant 10% improvement. Over the same period, there were no significant changes in any of the outcome criteria in the metropolitan area, and the caesarean section rate in the metropolitan area increased in the same time frame.

This study demonstrates the value of an 'efficient' outreach hands-on training program. The PIMC recommends that this style of training program be resourced, expanded and empowered to offer training to all obstetric, midwifery and neonatal staff in WA.

As discussed by Maouris et al., it is difficult to know which particular aspect of the Outreach Obstetrics training program was most important in its success.[8] Other research has failed to demonstrate that 'teamwork training' alone can improve maternal and neonatal outcomes,86,87 however the authors believed that 'the quality of obstetric care depends primarily on how well midwives and doctors function together as a team and involving them in drills is the best way to improve teamwork.[8]

Completion of the Neonatal Resuscitation Program (NRP) is required by the W&NHN to provide credentialing of these resuscitation skills. In the 2008 MANSmap survey of the 30 public obstetric units in WA, 15 hospitals required that staff attend NRP training, and 15 did not have this requirement. Some units commented that midwives were required to demonstrate competency, but there was no similar requirement of medical staff.[34]

Consideration should be given to the development of formal guidelines on recommended minimum requirements for maintenance of necessary obstetric and neonatal care skills.

Recommendation 7:

Improve monitoring for fetal wellbeing in labour.

It is recommended that all staff providing intrapartum care avail themselves of educational resources for the use and interpretation of CTG traces.

In addition to the need for technical training for competent practical skills, the PIMC observed that some staff would benefit from additional knowledge in the:

- management of diabetes mellitus in pregnancy
- recognition and treatment of the sick neonate

An educational paper, 'Optimising Outcomes for Women with Diabetes in Pregnancy', was printed in the 12th PIMC Report. A summary of pertinent points is reprinted in Table 66.[4]

Table 66: Optimising Outcomes for Women with Diabetes in Pregnancy

Summary Points:
■ The prevalence of diabetes is increasing in pregnancy. ■ Tight control of diabetes mellius (DM) before and during pregnancy significantly improves outcomes. ■ Team management is recommended. ■ Optimal intrapartum glycaemic control reduces the frequency of abnormal fetal heart rate patterns and improves neonatal outcome.
Pre-existing DM in pregnancy:
■ Refer pre-pregnancy for specialist review and optimise control ■ High dose folic acid - 5mg daily ■ Four times per day insulin regimen with frequent monitoring ■ Target glucose levels fasting <5.5mM and 2 hr post-prandial 4-7mM ■ Team management (including exercise and dietary advice)
GDM:
■ Screening for all women ■ Team management and tight control, as for those with pre-existing DM
Fetal Surveillance:
■ for those on treatment for DM, serial ultrasound assessment from 28 weeks ■ for those with diet-controlled GDM, ultrasound at 34 weeks or earlier and repeat ultrasound at 38 weeks for infants with AC>90th centile ■ CTG twice weekly from 34 weeks
Peripartum management:
■ for those on treatment for DM, deliver 38-39 weeks ■ for those on diet-controlled GDM, deliver by 40 weeks ■ be watchful for increased risk of operative delivery and shoulder dystocia ■ consider elective caesarean section for macrosomia ■ glucose/insulin infusion in labour for all those with type 1 DM ■ monitor BGL in labour and glucose/insulin infusion if hyperglycaemic ■ continuous electronic fetal monitoring ■ watch for hypoglycaemia postpartum (see KEMH guidelines for management of the newborn)
Postpartum follow-up:
■ screen for type 2 DM in those with GDM

Staff working in perinatal care are reminded of subtle signs of a sick neonate and the importance of keeping babies 'warm, pink and sweet'. Staff are referred to the KEMH neonatal care guidelines, and NETS guidelines for further information.[43,80,89]

Resources for neonatal management:

- KEMH neonatal care unit clinical guidelines: http://www.kemh.health.wa.gov.au/services/nccu/guidelines
- Newborn Emergency Transport Service (NETS) Medical Guidelines; http://www.kemh.health.wa.gov.au/development/manuals/NETS_manual/index.htm
- Neonatology: Management, Procedures, On-Call Problems, Diseases, and Drugs - 6th Ed. (2009)

5.6 Causes of Perinatal and Infant Deaths in WA

The leading categories of perinatal death in WA in 2005-07 were congenital abnormality, prematurity due to spontaneous preterm birth and unexplained antepartum death.

The leading causes of infant death in WA in 2005-07 were congenital abnormality, extreme prematurity and SIDS.

The causes of death by each major PSANZ category will be considered consecutively.

5.6.1 Stillbirths and infant deaths due to Congenital abnormalities

Congenital abnormalities (PSANZ PDC category 1) are an important public health issue, being associated with pregnancy terminations, stillbirths and infant deaths, and survivors with severe disabilities. Despite widely accepted screening programs, there were still significantly high numbers of stillbirths and infant deaths due to congenital abnormality in WA this triennium. This is consistent with an increasing proportion of older mothers.

Of the 178 stillbirths due to congenital abnormalities in WA 2005-07, there were 55 cases with lethal central nervous system abnormalities and 50 lethal chromosomal abnormalities (n=50). Some of these would have been detected by a routine anatomical scan performed around 18-20 weeks gestational age, and some of these pregnancies would have been interrupted. Where pregnancies are terminated after 20 weeks gestational age, these cases are included in the figures for stillbirths. Death certificates do not always indicate when pregnancies are terminated. Of the deaths investigated by the PIMC (>= 26 weeks gestational age), there were 21 cases of lethal abnormalities identified where there may have been an opportunity for earlier detection and optional termination of pregnancy at an earlier gestational age. There were also nine women who were found to have fetuses with lethal congenital abnormalities who chose to continue their pregnancies.

Mid-trimester terminations cause considerable emotional and physical hardship, but where abnormalities are detected early, women are provided with the opportunity to choose this in preference to a late stillbirth or infant death. For those women who choose to continue a pregnancy with a known fetal anomaly, they have more time to adjust to the diagnosis. Late abortions (>=20 weeks gestational age) must be approved by a medical panel appointed by the Minister for Health.*

The MANSmap survey in 2008 identified that several public obstetric units had limited ultrasound services and there were no local facilities for first trimester screening (FTS) at six sites. Improved access to screening services in rural areas would be beneficial.[34]

Preventative initiatives are encouraged to reduce the incidence of congenital abnormalities. Good maternal nutrition, periconceptional folic acid supplementation and avoidance of harmful substances in early pregnancy are encouraged. It is recommended that educational efforts inform the public of important pre-conception information, including information about the increased risk of congenital abnormalities with increasing maternal age, and the decreased risk of central nervous system congenital abnormalities with periconceptional folic acid supplementation. The Birth Defects Registry of WA has observed a 30% reduction in the occurrence of neural tube defects since the introduction of a public health campaign to voluntarily increase periconceptional folic acid consumption.[90] These data have been used to inform the decision to implement mandatory fortification of bread-making flour with folic acid in Australia, which occurred in 2009. It is hoped that this will provide additional benefits by assisting women with unplanned pregnancies and women in Aboriginal communities where other interventions have been less successful.

Guidelines for prenatal screening tests: http://kemh.health.wa.gov.au/health/fetal_monitoring/

Information from Genetic Services of WA:
http://kemh.health.wa.gov.au/services/genetics/healthprof.htm

Additional pre-conception counselling should be provided for those with risk factors including diabetes, family history of congenital abnormalities, and women taking potentially teratogenic medication such as anti-convulsants.[91] Higher intakes of folic acid and optimal glucose control for women with pre-existing diabetes mellitus are recommended.[92] Avoidance of alcohol throughout pregnancy is recommended, as per National Health and Medical Research Council (NHMRC) guidelines.[66]

There has recently been attention to the importance of adequate maternal iodine consumption. The NHMRC recommends that all women who are pregnant, breastfeeding or considering pregnancy, take an iodine supplement of 150 micrograms (µg) each day.[93] There is, however, a need to be aware of the risk of inducing neonatal hypothyroidism through excessive maternal iodine consumptio.

Guidelines about prenatal screening tests and interpretation of results from KEMH, and information for health professionals about hereditary diseases from Genetic Services of WA are available, with both offering on-line services.[94,95]

Recommendation 8:

Reduce congenital abnormalities

a) Minimise congenital abnormalities and improve maternal health:
b) Optimise conditions for conception with good nutrition and periconceptional folic acid and iodine supplementation
c) Avoid excessive alcohol and other harmful substances
d) Optimise periconceptional glucose control in those with impaired glucose tolerance
e) Avoid obesity
f) Improve access to first trimester genetic screening

5.6.2 Stillbirths and Infant deaths due to Infection

General Comments

Perinatal infection (PSANZ PDC category 2) was the principal cause of death in 5.5% (n=33) of stillbirths, and 9.4% (n=13) of infant deaths were attributed to infection in WA in 2005-07.

Lower rates of infection causing stillbirth and infant death in non-Aboriginal people in WA are reflective of generally higher standards of living.

The National Immunisation Program Schedule advises additional vaccines for Aboriginal infants who are at increased risk of infection.[96]

Further reductions in infant deaths may be seen with more rapid identification and treatment of early sepsis, especially in neonates.

Bacterial infections

There is an active antenatal screening and treatment program for Group B Streptococcus (GBS) in place in WA. Health professionals are reminded that overwhelming neonatal GBS sepsis can occur very quickly.

There were no stillbirths due to Listeria in this triennium and there was a single stillbirth attributed to Listeria in 2002-04. A considerable amount of maternal anxiety is related to a public health campaign regarding 'safer eating' practices to avoid Listeria infection.[97,98] This advice includes good food hygiene, including washing raw vegetables and cooking raw food thoroughly, avoidance of cold meats and soft cheeses, as well as thoroughly reheating leftovers.[99,100]

Viral Infections

There were five cases of CMV infection causing stillbirth in WA in 2005-07. No other viral agents, including hepatitis and HIV, were identified as causes of stillbirth or infant deaths in the triennium.

An epidemic of influenza A 'swine influenza' occurred in Australia in 2009. Some serious clinical cases occurred in pregnant women. A vaccine was for this influenza strain was developed, and a public health campaign recommends vaccination for pregnant women. Seasonal influenza vaccine is also recommended for infants from the age of six months, with the exclusion of CSL brand 2010 Fluvax which has been advised against following reports of serious side effects in infants receiving this vaccine.[101] The Department of Health WA continues to recommend and provide free influenza vaccination for all pregnant women. Recent discussions with Dr Tony Keil, consultant microbiologist at KEMH, confirm that influenza vaccination (including the swine flu strain) is recommended for all pregnant women because the benefits are considered to outweigh any risks.[102]

5.6.3 Stillbirths and Infant deaths due to Maternal Conditions

Hypertension (PSANZ PDC category 3) is now an uncommon cause of stillbirth and neonatal death in Australia with national data showing 2-3% perinatal deaths attributed to hypertension in 2007.[103] There were 5% (n = 30) of stillbirths attributed to hypertension in WA in 2005-07. The Midwives' notification forms identified that 1.1% of women giving birth in the triennium had essential hypertension, and 1.7% of stillbirths occurred to women with essential hypertension in this time period (Table 28).[5] Careful antenatal screening and appropriate management of preeclampsia have led to significant reductions in deaths due to hypertension over recent decades.

Similarly small proportions of stillbirths and neonatal deaths are now due to antepartum haemorrhage (PSANZ PDC category 4) with national data showing about 6% attributed to this diagnosis in 2007.[103] In WA 2005-07, 6.4% (n=38) stillbirths and n=6 neonatal deaths were due to this condition. Improved outcomes are associated with good control of hypertensive disorders of pregnancy, and avoidance of smoking.

A relatively small proportion of 6% of stillbirths (n=30) were due to maternal conditions (PSANZ PDC category 5), including diabetes (n=16) as a primary code in WA 2005-07, but an equal number of additional cases with maternal disorders were identified using a secondary PSANZ PDC code. Use of this secondary code improves awareness of the burden of disease represented by these conditions.

There is a need for greater understanding of perinatal mortality and also maternal and infant morbidity associated with maternal medical conditions. For example, national data showed that hypertension/preeclampsia and diabetes were leading nominated reasons for induction of labour in 2007.[6] State and territory data on selected pre-existing conditions and complications arising in pregnancy for 2007 are shown in Table 67. The collection of comprehensive and reliable information on risk factors and complications arising in pregnancy continues to be a challenging area. The development of nationally consistent collection methods and classifications of these conditions is an identified priority in national perinatal data development.[6]

Table 67: Pre-existing Conditions and Complications in Pregnancy, by State and Territory, Australia 2007

Medical condition or complication	NSW	VIC	QLD	WA	SA	TAS	ACT	NT
Number								
Essential hypertension	721	762	433	395	225	99	79	28
Diabetes mellitus	546	399	320	254	119	20	92	44
Epilepsy	n.a.	415	288	138	112	70	26	22
Antepartum haemorrhage	n.a.	2,203	1,467	1,041	699	145	266	52
Placenta praevia	n.a.	564	406	189	110	24	59	n.a.
Abruptio placenta	n.a.	277	295	108	94	15	27	n.a.
Other	n.a.	1,362	766	744	495	106	180	n.a.
Pregnancy-induced hypertension	5,515	3,462	3,231	149	1,361	336	209	136
Gestational diabetes	4,091	3,626	3,072	1,369	947	173	305	268
Fetal distress	n.a.	13,146	11,216	3,721	2,339	66	353	387
Cord prolapse	n.a.	116	100	40	28	<5	6	8
Postpartum haemorrhage	1,120	7,843	2,729	3,528	1,836	218	430	473
Retained placenta	n.a.	1,026	764	375	291	n.a.	116	19
Rate per 1,000 women who gave birth								
Essential hypertension	7.6	10.7	7.3	13.3	11.6	15.9	14.6	7.4
Diabetes mellitus	5.8	5.6	5.4	8.6	6.1	3.2	17.0	11.7
Epilepsy	n.a.	5.8	4.9	4.7	5.8	11.3	4.8	5.9
Antepartum haemorrhage	n.a.	30.9	24.8	35.1	35.9	23.3	49.1	13.8
Placenta praevia	n.a.	7.9	6.9	6.4	5.7	3.9	10.9	n.a.
Abruptio placenta	n.a.	3.9	5.0	3.6	4.8	2.4	5.0	n.a.
Other	n.a.	19.1	12.9	25.1	25.4	17.1	33.2	n.a.
Pregnancy-induced hypertension	58.3	48.6	54.6	5.0	69.9	54.1	38.6	35.2
Gestational diabetes	43.3	50.9	51.9	46.2	48.6	27.8	56.3	71.3
Fetal distress	n.a.	184.7	189.4	125.6	120.2	10.6	65.1	103.0
Cord prolapse	n.a.	1.6	1.7	1.3	1.4	n.p.	1.1	2.1
Postpartum haemorrhage	11.8	110.2	46.1	119.1	94.3	35.1	79.4	125.8
Retained placenta	n.a.	14.4	12.9	12.7	14.9	n.a.	21.4	5.1

Ref: AIHW[6]

There is no specific classification for maternal obesity. In addition, there is poor data collection of height and weight in pregnancy in WA as shown in section 4.2.9. The importance, and increasing prevalence, of maternal obesity is of great concern. Obesity, with or without associated diabetes, increases morbidity and mortality risks in pregnancy. Obesity is associated with higher rates of complications including pre-eclampsia, chronic and pregnancy-induced hypertension, chronic and gestational diabetes mellitus, fetal macrosomia, caesarean section, preterm birth, birth defects, stillbirth and neonatal death.[104-107]

Recommendation 9:

Reduce and manage obesity:

a) Obesity should be considered a high risk factor in pregnancy

b) The development of guidelines for the management of obesity in pregnancy is recommended.

c) Additional resources for diet and exercise programs for obese women are recommended.

> *'Obesity is a pandemic in Western society and will only get worse unless the cultural and social habits relating to food and exercise are addressed. Unfortunately, intervention programs are unlikely to be successful. Education about diet and exercise needs to start early in life…'*[108]

Recommendation 10:

Improve Data collection:

Routine collection of data about number of antenatal attendances, maternal weight and alcohol and substance use via Midwifery notification forms is recommended.

The PIMC recommends that obesity should be considered a high risk factor in pregnancy and specific guidelines should be developed to assist in the management of this condition. Additional education about healthy diet, pre-conceptional weight loss for obese mothers, and exercise programs are recommended. Further, the Committee advocates routine collection of height and weight data via additional fields on Midwives' forms.

5.6.4 Perinatal deaths due to Specific Perinatal Conditions

In WA 2005-07, the majority of investigated perinatal deaths due to specific perinatal conditions (PSANZ Category 6) had no preventable medical factors (n=34 cases; two cases with preventable medical factors). The majority of deaths due to specific perinatal conditions were twin to twin transfusion syndrome with 5% (n=30) of stillbirths in WA 2005-07 due to this condition including one pregnancy conceived through IVF. It is recognized that assisted fertility treatments are associated with an increased risk of multiple pregnancy. AIHW data from four states/territories on the use of assisted reproduction technology (ART) in 2007 showed that 3.1% of women who gave birth received ART treatment.[6] Prudent use of ART is recommended, with attempts to reduce multiple gestation pregnancies.

Best management of multiple pregnancy requires ascertainment of chorionicity at 12 weeks gestation and frequent ultrasound assessments of fetal growth, as per guidelines.[79] Early ultrasound assessment should identify twin pregnancies at increased risk of twin to twin transfusion syndrome.

5.6.5 Perinatal deaths due to Peripartum Hypoxia

Since the introduction of a Preventability Scale[3] for the assessment of preventable factors in deaths from the years 2000-01 onwards, the PIMC has consistently found that a significant proportion of hypoxic peripartum deaths (PSANZ PDC Category 7) have preventable medical factors. Perinatal hypoxia is responsible for a considerable burden of disease in survivors with hypoxic ischaemic encephalopathy.

Methods to assess fetal wellbeing in labour are limited in some sites in WA. MANSmap data showed that 16 of the 30 public obstetric units surveyed in 2008 did not have blood gas testing equipment, or had problems using the equipment for these tests, and two units had neither a cardiotocograph (CTG) machine or blood gas facilities.[34]

Emergency times for 'decision to delivery' by caesarean section vary in different units, as alluded to in Section 5.4.

RANZCOG guidelines for intrapartum care, labour and birth, are readily available on-line: http://www.ranzcog.edu.au/publications/collegestatements.shtml#CObs

These include specific RANZCOG Clinical Guidelines for Intrapartum Fetal Surveillance, which are important for labour and birth suite staff.[81]

Nine of the 30 WA public obstetric units in the 2008 MANSmap survey commented about difficulties with staff training.[34] The questionnaire demonstrated a broad variety of CTG training and experience in WA. The Douglas Inquiry emphasized the importance of training in the interpretation of CTG traces.[109] Subsequent to the identified need for additional training support, SOSU has researched and funded an on-line educational program (K2 Fetal Monitoring Training) in WA which is available to all public hospital staff.[83]

5.6.6 Perinatal deaths due to Fetal Growth Restriction

Fetal growth restriction (PSANZ PDC category 8) is a risk factor for perinatal death, and an important associated finding in a high proportion of otherwise unexplained stillbirths (40-50% in some literature).[110-113]

The PIMC considered that five of the 33 stillbirths with fetal growth restriction had preventable medical factors in WA 2005-07. The majority of deaths were not considered preventable; many of these were unrecognised growth restriction in the absence of clinical signs of fetal growth insufficiency.

Careful assessment of fetal growth is advised in those with risk factors for growth restriction including hypertension, poor obstetric history, smoking or other substance abuse, maternal medical conditions, and thrombophilia. In addition, clinical assessment of growth is more difficult in obese mothers. Consideration should be given to third trimester ultrasound assessment of fetal growth and wellbeing in the presence of obesity and/or other risk factors for growth restriction.

5.6.7 Stillbirths and Infant Deaths due to Spontaneous Preterm Birth

As discussed elsewhere, the proportion of stillbirths attributed to preterm birth (PSANZ PDC category 9) is underestimated using PSANZ classification, where often the classification of cause of death is attributed to the primary reason for early delivery such as perinatal infection or preeclampsia.

Preterm birth (delivery <37 weeks gestational age) creates a huge 'burden of disease', being a leading cause of stillbirth and infant death, as well as a major risk factor for disability.

The proportion of preterm births is of concern, with 7.4% of babies being born preterm in Australia in 2007[6], and the rate is higher in WA, at 8.7% in 2005-07.[5]

Trend data show that the prevalenceof preterm birth in Australia is increasing.[6] A similar increase in the prevalence of preterm birth has been seen in most countries in recent decades.[114]

Whilst the causes and prevention of preterm labour remain challenges, attempts should be made to minimise preterm birth through public education to improve general maternal health and nutrition, avoidance of pregnancy at the extremes of BMI and reproductive age, and minimisation of multiple gestation pregnancies through increased care with assisted fertility treatments. Support should be given to research initiatives to identify the causes and possible interventions to reduce preterm birth.

WA has a good history of in utero transfer of patients with threatened preterm labour. Around 85% of births of very low birth weight babies occurred in KEMH throughout the years 2000-07.[5] This high 'in-born rate' is an important contributor to the high neonatal survival rates seen in WA. The RFDS clinical guidelines for the management of preterm labour and tocolysis provide a detailed description of best clinical practice for rural patients with threatened preterm labour.[115] General guidelines for the management of preterm labour are also available on-line[79]:

http://kemh.health.wa.gov.au/development/manuals/sectionb/index.htm

A single course of antenatal corticosteroids is recommended in women with threatened preterm labour between 24 and 34 weeks gestation.

5.6.8 Unexplained Antepartum Stillbirths

The prevalence of unexplained stillbirth (PSANZ PDC category 10) has remained similar in WA since 2000-01.[5]

The Committee observed that most stillbirths in WA 2005-07 had an appropriate investigative work-up to enquire into the cause of death. Thorough assessments include postmortem examination, placental histopathology, swabs and blood tests where appropriate. The postmortem provides

clinically useful information in most cases, as shown by the autopsy utility scale in this Report. Thorough investigation reduces the proportion of unexplained stillbirths. A standardised definition for unexplained fetal deaths that distinguishes between cases with detailed investigation and those with limited or no investigation would be useful.[116]

Late pregnancy is associated with an increasing risk of stillbirth.[117-121] The Committee suggests the use of a routine ultrasound examination in the third trimester for mothers with risk factors such as obesity, smoking, advanced maternal age and poor obstetric history. Surveillance of post-dates pregnancies is important, with routine fetal heart rate monitoring recommended from 40 or 41 weeks gestational age. See Section 6 for an educational paper and further information on this topic.

The routine monitoring of fetal movements (kick counting) has not been proven, but there is indirect evidence that the stillbirth rate decreases where mothers are informed to seek medical review if they experience decreased fetal movements.[122] There are gaps in research and evidence, but decreased fetal movements may be a sign of a potentially at-risk pregnancy. It is suggested to inform women to seek medical attention if they experience decreased fetal movements. Closer surveillance and assessment of the pregnancy may then be arranged.[123]

Recommendation 11:

Reduce Preterm Birth:

Minimise preterm birth:

a) Reduce multiple gestation pregnancies through increased care with fertility techniques

b) Delay birth until at least 38-39 weeks gestational age where possible.

c) Support research initiatives to identify causes and possible interventions to reduce preterm birth.

Table 68: Risk factors for Unexplained Stillbirth.

■ Maternal age greater than 35 years
■ Smoking
■ Obesity
■ Socio-economic disadvantage
■ Indigenous status
■ Increasing parity
■ Previous small for gestational age
■ Diabetes
■ Anaemia
■ Periodontal disease.

Ref[124]

5.6.9 Infant Deaths with No Obstetric Antecedent

The majority of infant deaths without known obstetric antecedent risks (PSANZ PDC category 11) are sudden unexplained deaths in infancy and deaths due to postnatally acquired infection.

A highly significant reduction in the mortality from SIDS has been a considerable public health achievement in the last decade, primarily based on an education campaign about avoiding the known risk factors of prone sleeping posture, smoking and excessive bedding.[125] However, the same reduction in mortality has not been seen in Aboriginal families, as shown in this Report along with other WA data.[126]

It is also observed that with the reduction in total numbers of SIDS cases since 1991, the deaths that still occur are more likely to have risk factors of smoking, deprived socioeconomic background, co-sleeping (especially on a couch) and preterm birth than in the past.[127]

Co-sleeping is controversial, particularly because of the benefits of breastfeeding which may be facilitated by parent and infant bed-sharing.[128,129] There is an increased risk of sudden infant death in infants bed-sharing with mothers who are smokers, particularly in infants under the age of four months, and in other vulnerable infants born preterm and/or low birth weight. The risk of co-sleeping in the absence of known risk factors such as smoking and preterm birth is very low, but still significant in infants less than 11 weeks of age.[130-137]

It is recommend that parent-infant co-sleeping is avoided when the mother smoked in pregnancy, when either parent has an impaired conscious state, with infants under the age of four months, and with infants born preterm or of low birth weight. Co-sleeping on a couch should be avoided at all times. There is evidence that room sharing in a separate cot (rather bed sharing) with an adult is protective and should be encouragedin the first few months of life.[125,132, 135-138]

Aboriginal Infants

The reduction in sudden unexpected infant deaths seen in non-Aboriginal infants in WA has not been experienced in the Aboriginal population. Further research and efforts to address this, with cultural sensitivity, is required.[139]

Public education

Dissemination of information is required to those most at risk and to staff involved in child care.[140] Useful educational pamphlets for parents and health professionals about SIDS are available from SIDS and Kids. Advice and brochures about co-sleeping are currently being reviewed.[125]

Nutrition:

The importance of good feto-maternal and infant nutrition cannot be underestimated.

The health benefits of breastfeeding are well recognised. There is a strong pro-lactation ‘Baby Friendly Hospital initiative’ which supports initiation of breast feeding, but additional health promotion is required to encourage longer periods of breastfeeding.[141] The WHO recommends that infants are breastfed until at least 2 years of age.[142]

Additional health promotion efforts are recommended, particularly for the most at-risk groups of Aboriginal people and those living in remote areas.

Recommendation 12:

Reduce SIDS:

a) In addition to current 'safer sleeping' education, there should be public education about the increased risks of infant death related to co-sleeping, especially in known higher risk situations:
   - Impaired/intoxicated adult
   - Preterm and growth restricted babies
   - Babies under the age of 4 months.
   - co-sleeping on a couch

b) Parents should be advised that there is a decreased risk of SIDS where parents room-share with their babies in a separate cot for the first few months of life, compared with the baby sleeping in a separate room to its parents.

c) Parents should be advised that Department of Health, WA policy advises avoidance of co-sleeping of mother and infant in hospital.

5.7 Deaths occurring in Planned Home Births

The 12th PIMC Report described six unexpected deaths occurring in planned home births during the five year period of 2000-2004, representing a term perinatal death rate of 6.7 per 1,000 in planned home births compared with 2.1 per 1,000 in planned hospital births in the same period.[4] This statistically significant increase led to a recommendation by the PIMC to review home births in WA. Subsequently, Department of Health, WA commissioned an independent Review of Homebirths in WA in December 2007.[9] The terms of reference for the review were to identify any concerns with the practice of home births in WA and to recommend ways in which the safety of home births could be improved. Specifically, the review was not to question the future of home birth programs in WA. There is currently a State-funded home birth program in WA, the Community Midwifery Program (CMP).

The *Review of Homebirths* made 24 recommendations, as listed in Appendix IV:

Of the recommendations, two pertained to the PIMC:

> **Rec 9:** The method of investigation employed by the Perinatal and Infant Mortality Committee (PIMC) for home and hospital births could be strengthened by adopting the Perinatal Society of Australian and New Zealand (PSANZ) methodology of investigation, categorisation and reporting of perinatal deaths.[143]
>
> **Rec 10:** The WA Government amend the *Health Act 1911* Part XIIIB – Perinatal and Infant Mortality Committee to enable the consideration of, and action upon, broader system-level issues in their reporting including identification of contributing factors that are amenable to organisational change at home and hospital births.

Regarding Recommendation 9, the PIMC has already been using the PSANZ classification system for categorisation and reporting of all deaths from January 2000 onwards. However, the use of all the PSANZ methodology for investigation and audit of perinatal deaths is not possible for the PIMC

to institute without a major change to the way in which the PIMC functions. PSANZ recommend that the *PSANZ Clinical Practice Guideline for Perinatal Mortality Audit*[143] should be implemented in all institutions where births occur, and that a perinatal mortality review should take place as soon as possible after a death, once results of core investigations are available. This type of institutional review is at a local level, employing a multidisciplinary team of clinicians directly involved in patient care. This differs to the methodology of the PIMC case investigations which are conducted as an independent review by a Committee without direct patient care. That is, the PIMC performs a statewide review function in addition to reviews performed by local perinatal mortality committees. The PIMC encourages local perinatal mortality committees and quality assurance activities and is supportive of the use of PSANZ methodology to assist in consistency and thorough methodology. There has been limited uptake of this methodology to date, perhaps partly hindered by the lack of an electronic proforma.

The PIMC has developed its own detailed perinatal death review proforma, along with a large electronic database. There are obstacles to changing to a different format although the PIMC may consider changing to PSANZ audit forms if this methodology is adopted by hospitals in WA, and when a suitable electronic platform is developed.

Regarding Recommendation 10, the PIMC has noted problems in communication between home birth carers and hospital staff. The PIMC is also unable to communicate feedback from case investigations to midwives involved in patient care, because the *Health Act 1911* only allows communication to medical staff. The PIMC is supportive of an amendment of the *Health Act 1911* to improve communication and enable greater educational feedback to the multidisciplinary team of health care professionals involved in patient care.

Subsequent to the data made available for the Review of Home births in WA, this 13th PIMC report provides analysis of data for the years 2005-07. There was an increased risk of stillbirth and infant death in term gestation pregnancies in planned home births compared with planned hospital births in the triennium. These results were very similar to those seen in the previous triennium (2002-04). In addition, the Committee analysed deaths in planned home births that were attributed to peripartum hypoxia as a specific group for the first time in 2005-07. Significantly increased risks of death due to peripartum hypoxia (21 fold increased rate of stillbirth and 18 fold increased risk of infant death) were found in the planned home birth group. These findings were similar to those found in a South Australian study for the years 1991-2006, where there was no significant difference in overall perinatal mortality risks, but a seven fold increased risk of intrapartum death and 27 fold higher risk of death due to hypoxic peripartum insult in planned home births compared to planned hospital births.[144] The SA data adjusted for multiple variables but the WA data were unadjusted.

A recent meta-analysis of planned home births from Western nations showed that less medical intervention during planned home births was associated with a tripling of the neonatal mortality rate.[145] Another recent paper from the Netherlands showed that infants of pregnant women at low risk whose labour started in primary care under the supervision of a midwife had a significantly higher risk of perinatal death compared with infants of pregnant women at high risk whose labour started in secondary care under an obstetrician. Those women who were referred by a midwife to

an obstetrician during labour had a 3.66 times higher risk of delivery related perinatal death, and a 2.5 fold higher risk of NICU admission.[146] All of these findings are consistent with the experience in WA.

Recommendation 13:

Reduce Deaths in Home births:

a) Home births are associated with preventable stillbirths and infant deaths. Midwives offering home birth services should obtain informed consent from women to acknowledge that they have been informed of the increased risks of perinatal death associated with home birth.

b) A formal independent audit of implementation of the Recommendations of the Review into Homebirths should be performed. This audit of practice should encompass all home births, whether the midwife is under the auspices of the Community Midwifery Program (CMP) or is independent.

c) There are insufficient data about morbidity associated with homebirth in WA. A prospective cohort study to assess mortality and morbidity outcomes for women with planned home births in WA should be arranged as a priority. This cohort study should be performed by an independent group of researchers.

The Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) and the American Congress of Obstetricians and Gynecologist (ACOG) do not endorse planned home births.[147-149] However, the Royal College of Obstetricians and Gynaecologists (UK) supports home birth in women with uncomplicated pregnancies.[150] Planned home birth is a subject of ongoing controversy.[147-151]

The PIMC recognises that some women will seek a home birth despite increased risks, and so a harm minimisation approach is suggested. The Committee recommends that an independent audit of the implementation of the recommendations of the Review into Homebirths should be performed. In addition, it is recommended that midwives who offer home birth services should obtain written informed consent from women to acknowledge that they have been advised of the associated increased risks of home birth.

5.8 Pathology Investigations into Cause of Death

The investigation into cause of death should take into consideration the clinical picture. However, even where the cause of death appears obvious (e.g. cord prolapse) a broader approach to investigation can identify additional important information. Where the cause of death is unclear, assessment for fetomaternal haemorrhage, amniocentesis for karyotype and infection, HbA1C and other investigations may assist in finding a cause.

There are several protocols for pathology investigations. The Perinatal Society of Australia and New Zealand (PSANZ)[13] has produced guidelines which aim to standardise national practices. These take a very broad approach. Consultants working in the Perinatal Loss Service of KEMH, and the Statewide Obstetric Service (SOSU), suggest the general adoption of these guidelines, but with some minor alterations (see Table 69). It is recommended to perform toxicology screening (drug

and alcohol urine screen) as a routine in the investigation of unexplained stillbirth, and to perform thrombophilia tests selectively rather than on all patients. Thrombophilia tests are best performed in the postnatal follow period (6-12 weeks postnatally) to avoid abnormal test results related to the pregnant state. They are recommended for patients with risk factors such as pre eclampsia, fetal growth restriction, or recurrent fetal loss. Where it is considered likely that a high risk patient will not return for follow-up, it is recommended to perform the tests at the tme of birth.

Optimal investigation of perinatal death includes autopsy. WA has high stillbirth post-mortem examination rates compared with other states and territories in Australia[152], which helps to minimise the number of unexplained stillbirths in this State.

Placental histopathology is recommended as a routine in the investigation of fetal death. Diagnostic amniocentesis is recommended (where possible) for the assessment of fetal death. There is a considerably higher yield for karotype testing (chromosomes) from amniocentesis samples compared with fetal samples taken at the time of autopsy.[153,154]

Autopsy should be strongly encouraged, with compassionate explanation, and reassurance that contact with the baby is available following autopsy. Parents should also be given information about the options for types of autopsy. The Perinatal Pathology handbook provides additional information about arranging autopsy examination.[155] Where parents decline full autopsy, external autopsy by a paediatric pathologist can provide useful clinical information. Some cultures, such as those of Islamic faith, do not permit autopsy. They may, however, agree to an external review as a compromise. Other options for assessment of the baby include a full body xray and ultrasound examination of the baby's brain. The pathologist may be able to speak with the family to achieve some compromise between their beliefs and the investigations available. Communication with Perinatal Pathology is encouraged, to facilitate funeral arrangements and return of ashes.

The majority of tests listed for investigation of stillbirth are applicable to the investigation of neonatal deaths. Consultation with senior staff at KEMH or Princess Margaret Hospital (PMH) is recommended for additional guidance, e.g. for consideration of metabolic studies.

For sudden unexpected deaths in infancy, attention should be paid to the collection of additional information, such as the position of the infant, in keeping with a proforma used by police for such investigations.

Recommendation 14:

Investigate cause of death:

Detailed clinical history and review, pathology investigation and autopsy are recommended for all deaths, even where the cause of death may appear to be obvious.

Table 69: Stillbirths Investigations Algorithm, adapted from PSANZ

CORE INVESTIGATION OF ALL STILLBIRTHS

AT DIAGNOSIS OF FETAL DEATH

Maternal History
- Take full Maternal History
- Ultrasound Scan
- Fetal abnormalities
- Amniotic Fluid Volume Amniocentesis
- Microbiological cultures
- Chromosomal analysis
- Low vaginal/perianal culture

Maternal Blood Tests
- Full Blood Examination and smear for nucleated red cell count
- Group and antibody screen
- Kleihauer test
- Renal Function Tests including Urate
- Liver Function Tests including Bile Acids
- Thyroid Function Test (TSH)
- HbA1c
- Cytomegalovirus, Toxoplasma and Parvovirus B19 serology
- Rubella and syphilis serology if not already done antenatally
- *Consider Thrombophilia Tests – see notes below
- Drug and alcohol toxicology screen (urine)

FOLLOWING BIRTH

Baby
- External examination
- Photographs
- Surface swabs
- Post-mortem examination

Cord/Cardiac Blood Samples
- Full blood examination
- Chromosomal analysis
- Routine Guthrie test

Placenta and Cord
- Macroscopic examination of placenta and cord
- Microbiological Cultures
- Biopsy for chromosomal analysis
- Placental histopathology

FURTHER INVESTIGATIONS BASED ON SPECIFIC CONDITIONS

Fetal Growth Restriction | **Pre-eclampsia** | **Placental vasculopathy/ thrombosis** | **Maternal/family thrombosis history** | **Unexplained fetal death**

Thrombophilia Studies 8 – 12 weeks postpartum

• Anticardiolipin antibodies	→	If positive at birth	→ Repeat
• Lupus anticoagulant	→	If positive at birth	→ Repeat
• APC Resistance	→	If positive	→ Factor V Leiden Mutation
• Fasting Homocysteine	→	if positive	→ mthfr3 Gene Mutation
• Protein C and S deficiency			
• Prothrombin Gene Mutation 20210A			
• Anti-thrombin definciency			

(MTHFR mutation testing should be performed when the following fetal anomalies are identified – cleft lip/palate, neural tube defects or congenital cardiac defects.)

5.9 Resources for Family Support

Grieving families should be offered compassion. Some support services are listed in Table 70. Further information is available in the 'Caring for Families Experiencing Perinatal Loss' bookets.[156]

Table 70: Services providing Support for Families following Stillbirth and Infant Loss

Women's and Newborns Health Service - Services provided through KEMH:
■ The Perinatal Loss Service has been established to provide comprehensive, continuing and coordinated care for families who have experienced perinatal death and pregnancy loss at KEMH. This includes clinical care and counselling support. The PLS provides a statewide consultancy service to support health care professionals who provide clinical care to women experiencing perinatal and pregnancy loss. (08 9340 2222, page 3430). ■ The Perinatal Pathology Department at KEMH offers a state-wide non-coronial perinatal post mortem examination service to families who have experienced the loss of a pregnancy. This includes generating mementos, in the form of photographs, handprints and footprints. A cremation service is available for stillborn babies of less than 28 weeks gestation. http://www.kemh.health.wa.gov.au/services/perinatal_path/index.htm ■ Pastoral Care services at KEMH have brochures to assist parents dealing with grief and loss: http://www.kemh.health.wa.gov.au/services/pastoral_care/index.htm ■ The Social Work Department at KEMH provides support to vulnerable families and patients who are experiencing a crisis. http://www.kemh.health.wa.gov.au/brochures/consumers/wnhs0259.pdf ■ The Department of Psychological Medicine at KEMH provides treatment for pregnant women attending KEMH who have a psychiatric disorder in pregnancy or postnatal depression (Ph 08 9340 1521), whilst the new Mother and Baby Unit functions as a statewide inpatient treatment centre for acute perinatal psychiatric conditions. (Ph: 08 9340 1799; Freecall: 1800 422 588.) www.kemh.health.wa.gov.au/health_professionals/WA_perinatal_mental_health_unit/
Department of Health, WA publications and on-line information resources:
■ **Health Information Resource Service (HIRS)** is situated at KEMH and provides listings of publications and videos on perinatal health and other women's and children's health topics. These can also be obtained on-line: http://www.kemh.health.wa.gov.au/services/hirs/index.htm or by emailing kemh.hirs@health.wa.gov.au ■ **The Women and Newborn Health Library** has compiled a list of Community Support and Resources for Perinatal Emotional Health and Wellbeing: http://www.kemh.health.wa.gov.au/brochures/consumers/wnhs0282.pdf ■ Other information for expectant parents about emotional wellbeing is available from the KEMH website (and may be appropriate in planning another pregnancy): http://www.kemh.health.wa.gov.au/health/emotional_health/help_support.htm

External family support:

SIDS and Kids: 1300 308 307; www.sidsandkids.org

- 24-hour-a-day bereavement support to families who suffer the sudden and unexpected death of a baby or child, regardless of cause including specialised family support groups
- Referrals and support for funerals
- Bereavement resources including a large number of booklets.
- Support groups for families and friends with professional and peer support
- Support for health professionals: 1800 686 786
- Research into the causes of stillbirth, SIDS and other infant deaths
- Public education campaigns

Other agencies: Liaise with local social work staff to identify other appropriate support agencies.

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6 Educational and discussion papers

6.1 Newborn Emergency Transport Service of Western Australia

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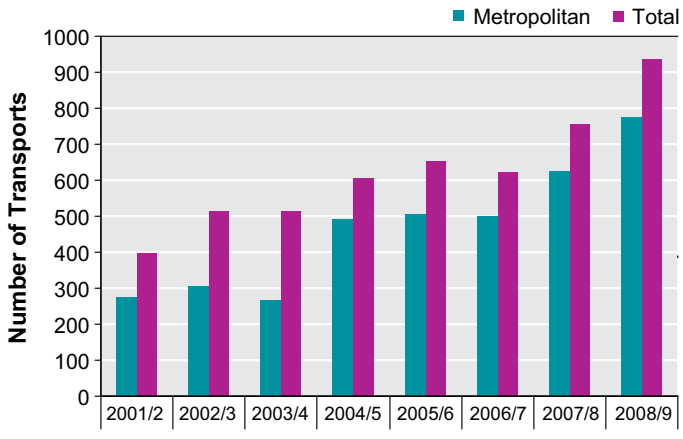
NETS WA is the Newborn Emergency Transport Service of Western Australia, based at the Neonatal Intensive Care Units at Princess Margaret Hospital (PMH) and King Edward Memorial Hospitals (KEMH). It is funded by the Neonatology Clinical Care Unit (NCCU) of the Women's and Newborns' Health Service. Formerly known as WANTS (Western Australian Neonatal Transport Service), NETS WA is a mobile intensive care unit for babies, which provides a state-wide transport service for the retrieval of preterm and sick neonates and young infants to the tertiary Neonatal Intensive Care Units (NICU's) at PMH and KEMH. It also provides telephone advice to doctors, nurses and midwives in outer metropolitan, regional and remote centres throughout WA, and coordinates the back-transfer of neonates to their local hospital.

Transports demand the ability to work unsupervised in foreign environments, dealing with some of the sickest babies. For this reason, NETS provides 2 teams of specialist neonatal -trained staff 24 hours-a-day, 7 days-a-week to perform these transports.

In 2009, there was a significant increase in demand on NETS, with 934 transports performed by the service. Of these, 145 (16%) were from country WA. NETS also conducted 16 interstate transports to Melbourne and Brisbane for complex cardiac surgery.



Diagnoses of transported infants

The majority of referrals are for newborns with acute respiratory distress, usually within the first 48 hours of life. Other conditions include newborns with suspected congenital heart disease, seizures, hypoxic-ischaemic encephalopathy, suspected sepsis, and those requiring urgent surgical assessment. In addition, newborns requiring complex investigations in a specialised paediatric hospital are referred. A steady number of babies are transferred from other hospitals for management of common neonatal conditions such as hypoglycaemia and severe jaundice.

Referring Hospitals

Of the metropolitan hospitals, most referrals come from Joondalup Health Campus (68 referrals), St John of God Subiaco (55 referrals) with Armadale, Peel Health Campus, Rockingham, Osborne Park, St John Of God Murdoch and Glengarry Hospitals all referring significant numbers of babies (approximately 35/year each).

Country referrals come mostly from population centres of Bunbury, Kalgoorlie, Albany and Geraldton.

In 2009, 178 babies were transferred between KEMH and PMH neonatal units. This is a reflection of babies known to have cardiac or surgical conditions or congenital anomalies, being appropriately delivered in the tertiary obstetric unit in KEMH and then transferred to PMH for further management. It also reflects the need to transfer babies to PMH for further investigations such as MRI or EEG and for elective surgical procedures e.g. inguinal hernia repair or laser therapy for retinopathy of prematurity.

Key issues facing NETS

Staffing:

Fortunately, significant improvements have been implemented with Medical Staffing of NETS. Dr Steven Resnick was appointed to the position of Medical Director of NETS in January 2008, and a dedicated 1st on-call roster, staffed by three Neonatal Fellows, was commenced in December 2008. This has allowed most transports to be undertaken by skilled, senior staff, ensuring an improved, safer transport environment.

Unfortunately, nursing staffing remains problematic, in that transport nurses are taken from the pool of nurses working in the PMH NICU, impacting on an already stretched NICU. A roster of dedicated transport nurses would significantly enhance the service.

Transport:

NETS works in close collaboration with both St John Ambulance (SJA) and the Royal Flying Doctor Service (RFDS) which provide road and air transport respectively. Both services are under significant pressure, and are finding it increasingly difficult to respond in a timely fashion to requests for transport.

Road transport, which accounts for over 80% of NETS activity, is presently entirely dependent on SJA. Response times from time of accepting referral to leaving Princess Margaret Hospital to commence retrieval are on average 50 minutes, due to having to wait for an ambulance to be despatched and arrive to us.

Equipment:

NETS possesses 6 specialised transport cots: 2 based at PMH, 1 at KEMH, 1 at Jandakot Airport, 1 in Port Hedland and 1 in Derby. The 6 old transport cots were removed from service during the course of 2008, and replaced with the new Mansell Neocot. These cots are used by virtually all other retrieval services in the country (except for NETS NSW.) Unfortunately, the cots have been disappointing and we have experienced many technical failures with them.

NETS achievements

Telethon grant:

In addressing the above challenges, NETS applied to the Channel 7 Telethon Trust for funding to purchase a purpose-built neonatal ambulance, as well as 2 new neonatal transport cots from NETS NSW. This application was successful and NETS is the very fortunate recipient of a generous grant from Telethon. An agreement was also reached with SJA, which will provide dedicated drivers (stationed at PMH) for the new ambulance. This represents a fundamental change to the way in which NETS will operate in the future. Response times to requests for retrievals will be much quicker, and improved equipment (specialised ambulance and cots) will translate into even better outcomes for patients.

The success of the Telethon grant and a related story on Channel 7 News has substantially increased public awareness of the vital role NETS plays in the community.

Bluey Day Ambulance:

The Bluey Day Foundation donated an ambulance to NETS in 2004. It was based at PMH but is now stationed at KEMH where it is used on a regular basis for back transfers of infants.

Back-transfers of babies from PMH and KEMH to their local hospital, when they no longer require tertiary care has traditionally been performed with a nurse escort in a taxi or hospital car. This newly refurbished vehicle, which has its own driver employed by the NCCU, will provide a much safer, more efficient mode of transporting many of these babies

Call conferencing System

NETS has recently acquired a call-conferencing system, to deal more efficiently with calls for medical assistance. We introduced a new state-wide emergency telephone number (1300 NETS WA - 1300 6387 92.) The new system allows referring staff to receive expert advice from consultant neonatologists (and up to five other call participants) from the outset, and has the potential to significantly reduce errors and streamline the retrieval process.

6.2 Umbilical Cord Blood Gas Analysis

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Umbilical cord blood gas analysis is an objective measurement of neonatal status at delivery, giving an insight into how the fetus responded to the stresses of labour and delivery and providing a potential insight into its future outcome. Multiple academic and clinical organisations advocate umbilical cord blood gas analysis following delivery either in a selective or universal manner.[1-3] Furthermore, umbilical cord blood gas and lactate values are an integral part in the diagnosis and exclusion of many disorders related to intrauterine hypoxic-ischaemic insults, with the absence of umbilical artery metabolic acidaemia effectively excluding birth asphyxia as a diagnosis.[1,2] Additionally, there is evidence in the literature to suggest that universal sampling of umbilical cord blood gases at all deliveries can have significant medicolegal, financial, and educational benefits.[4]

Staff Member Accreditation

Prior to conducting umbilical cord blood gas and/or lactate analysis without supervision, staff members should demonstrate clinical competence in cord blood collection. As part of this an introduction to the local blood gas analyser and/or lactate meter, as well as associated documentation should be covered. Several centres recommend that competence can be achieved by a minimum of three collection and analyses of cord blood supervised by a staff member previously deemed competent.

Equipment Requirements

Arterial and venous samples are collected using one millilitre pre-heparinised plastic syringes and 21 gauge needles. While syringes can be heparinised manually, most units will use prepackaged versions for convenience. Similarly, no particular gauge needle is required as for the most part the vessels are large and easily sampled. That being so, some units use different gauge needles for the arterial and venous samples in order to aid in differentiation of the two vessels, with the smaller gauge typically being used for the umbilical artery due to its smaller diameter.

Given that cord blood sampling and analysis involves a potential biohazard, personal protective equipment should be utilised, primarily gloves, but a face shield or eye protection may be necessary if the cord contains a large volume of blood, as on removal of the needle after sampling the potential exists for blood to spray. Additionally, some individuals place plastic sheets, 'blueys,' down in order to limit any blood that may flow from the cord after sampling, or alternatively conduct sampling on the draining board of a sink.

Four to five clamps, typically Howard Kelly Forceps but possibly disposable plastic cord clamps, are required to clamp and isolate an umbilical cord segment. The fifth clamp, while not strictly necessary, allows the isolated cord segment to be divided into two independent segments ensuring a second opportunity for sampling if the first one is not suitable.

If the sample is to be analysed in a relatively prompt manner then an ice slurry is not necessary; however, if a delay seems likely then an ice slurry should be available in order to minimise any changes in blood gas values over time.

Cord Blood Collection Procedure

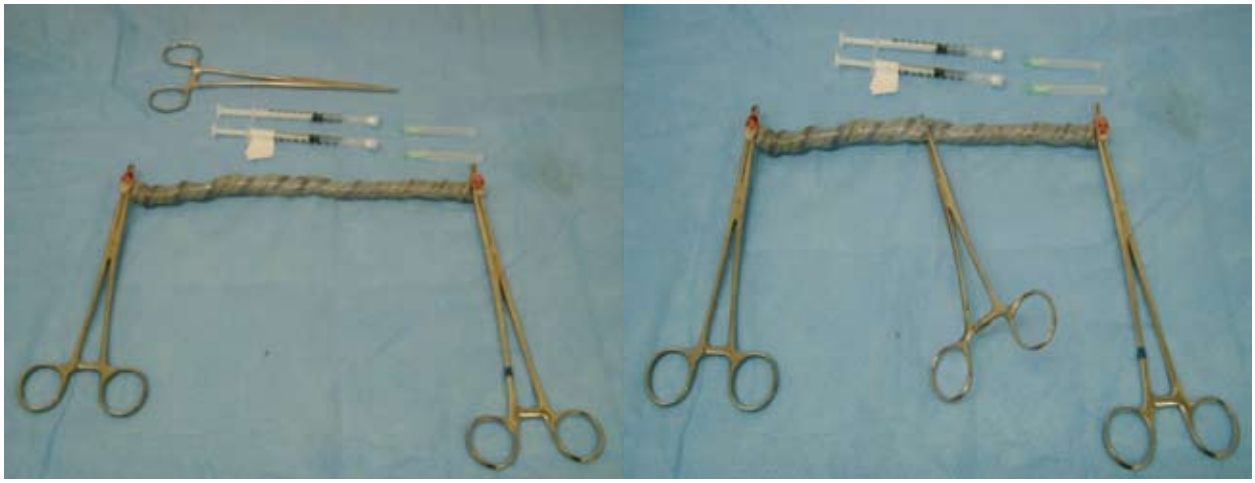
Immediately after delivery of the neonate and while the placenta is still in situ, and ideally prior to the neonate's first breath, four Howard Kelly Forceps or other clamps are to be placed on the cord to isolate a ten to twenty centimetre segment of umbilical cord between them.

In circumstances where there has been a decision to avoid early cord clamping and adopt a physiological approach to the management of third stage, the umbilical cord should be clamped as soon as possible. The effect of delayed cord clamping on blood gas and lactate values is variable with some studies noting no significant difference in the majority of values over two minutes, although other studies have noted significant changes[5]. That being so, if delayed cord clamping is required then analysis can still be performed.

The first clamp should be applied a reasonable distance from the neonate, ideally near the introitus in a vaginal delivery or the uterine incision in a caesarean delivery to allow a sufficient length of cord. Every attempt should be made to obtain a segment at least ten centimetres long.

Between each set of clamps the umbilical cord is cut such that the isolated cord segment is independent of the neonate and the placenta, with the fifth clamp if deemed necessary being placed in the middle of the isolated segment (Figure One). Routine third stage of labour management then proceeds, with cord blood from the placental end of the cord collected for blood type analysis if necessary, following which the placenta is delivered.

Figure One. Isolated umbilical cord segment



The cord needs to be handled with as much care as possible and traction on the clamped segment

of cord should be avoided in order to avoid disrupting endothelial integrity which has the potential to lead to blood clotting.

If pre-heparinised syringes are utilised they will typically contain dry lithium heparin to prevent coagulation in the syringe, thereby allowing for the possibility of any unexpected delay in analysis that may occur. Prior to use and after attaching the needle, the syringe plunger should be moved up and down several times to ensure fluidity of motion and distribution of the heparin. This is particularly important if liquid heparin is being used in the syringes. The acidic nature of heparin means that at least 0.2 ml of umbilical cord blood needs to be collected from each vessel in order to ensure that the heparin concentration is sufficiently diluted to between two and five percent of the total volume of the final heparinised blood sample.

The umbilical cord is laid out straight with the needle inserted along the umbilical vessel parallel to its direction of travel (Figure Two). The arterial sample will be collected first as collection from the artery is more technically difficult due to the smaller lumen, thicker walls and smaller volume of blood. By sampling the artery first the distended umbilical vein will provide support for the arteries making collection easier. The umbilical arteries can be identified by their presence of two vessels typically lying side by side which are smaller in diameter with thicker vessel walls (Figure Three).

Figure Two. Insertion of needle in umbilical artery parallel to direction of vessel.

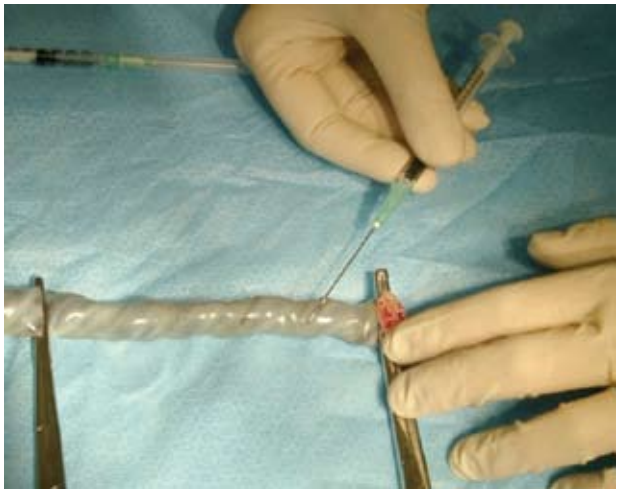
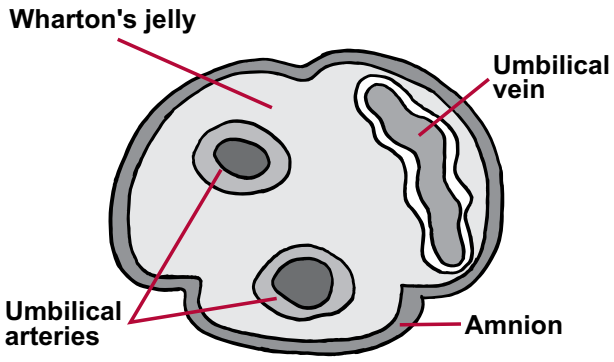


Figure Three. Cross-section of umbilical cord



Once the arterial sample has been collected a larger volume of blood is then drawn from the umbilical vein in order to aid in subsequent sample identification (umbilical artery will have a small sample volume while umbilical vein will have a comparatively larger sample volume). The volume of blood required for analysis depends on the method and type of analysis. Modern handheld lactate meters require only a single drop of blood while blood gas analysers typically require large volumes, although the development of micro-analysis has reduced the volume needed somewhat. Whilst some authors have advocated sampling only the umbilical artery, the majority of authors and organisations strongly advocate obtaining and analysing samples from both the umbilical artery and umbilical vein.[2,6] The syringes should be labelled using patient labels with the vessel (A or V) noted.

All air bubbles need to be removed from the samples by gently rolling the syringe between the attendant's fingers with the syringe in an upright position and the air filter cap fitted; this will also serve to mix the blood and heparin together. If air bubbles are not removed then some blood gas values have been noted to be affected[7] although the magnitude of this effect is not great.

The time between sampling and analysis before statistically significant changes occur is a contentious and a relatively poorly studied area. One study demonstrated that cord blood samples in a heparinised syringe remain stable for blood gas assessment for up to an hour following collection at room temperature,[8] while other studies have noted significant changes within thirty minutes.[9] Consequently, it is recommended that analysis be performed as soon as possible after collection. If significant delays are expected then placing the syringes on ice can act to mitigate any changes that may occur; however, if analysis is to occur relatively soon after delivery then ice is not necessary. If sampling of the vessels is delayed then the cord segment should be placed on ice until sampling and analysis can be conducted.

Interpretation of Umbilical Cord Blood Gas and/or Lactate Results

While collecting umbilical cord blood samples is relatively easy, confirmation that samples have been taken correctly from the umbilical artery and umbilical vein can be checked by the Westgate et al. criteria.[6] The Westgate criteria are based on a series of minimum arteriovenous pH and pCO2 differences, which in turn are based on the physiological background of placental diffusion of hydrogen ions and carbon dioxide. The criteria have two parts: 1) Arterial pH is less than venous pH by at least 0.022 units, and 2) arterial pCO2 values are greater than venous pCO2 values by at least 3.75 mmHg. If the sample results do not meet the criteria of one arterial and one venous sample, as above, the collection and analysis should be repeated on the second segment of isolated cord. Unfortunately, to date no one has established a similar set of criteria for umbilical lactate analysis alone.

Reference ranges for umbilical arterial and venous blood gas and lactate values can be found in Table One. The best reflection of neonatal/fetal biochemical status is from the umbilical arteries as they drain the fetal circulation to the placenta, while the umbilical vein drains the placenta, transporting blood back to the fetus and thus gives an indication on the degree of placental function. Acidaemia is best indicated by the umbilical artery pH value with a pH of less than 7.10 being considered a 'physiological acidaemia' while a pH less than 7.00 being considered a 'pathological acidaemia'.[2,6,10]

Table One. Reference ranges for umbilical arterial and venous blood gas and lactate values

Umbilical Artery Values	Median (95th Percentile)
pH	7.268 (7.120, 7.354)
pO_2	16.30 mmHg (6.20, 27.60)
pCO_2	55.10 mmHg (41.90, 73.53)
Bicarbonate	24.30 mmol/L (18.80, 28.20)
Base Excess	-3.00 mmol/L (-9.30, 1.50)
Lactate	3.70 mmol/L (2.00, 6.70)
Umbilical Venous Values	**Median (95th Percentile)**
pH	7.352 (7.231, 7.354)
pO_2	27.90 mmHg (16.40, 40.00)
pCO_2	40.40 mmHg (28.80, 53.30)
Bicarbonate	21.80 mmol/L (17.20, 25.60)
Base Excess	-3.00 mmol/L (-8.30, 2.60)

Note: Based on a cohort of 19,646 deliveries greater than twenty weeks gestation at King Edward Memorial Hospital, Perth, Western Australia.[4]

Generally fetal or neonatal acidaemia is classified as a respiratory, metabolic, or mixed respiratory and metabolic acidaemia. Respiratory acidosis occurs when carbon dioxide accumulates within the fetus while metabolic acidosis develops when insufficient fetal oxygenation causes a change from aerobic to anaerobic metabolism. The classification of acidaemia is typically based on the pCO_2 and base excess concentrations of the fetal blood (Table Two.). Respiratory acidaemia independent of metabolic acidaemia is seldom associated with significant neonatal or long-term morbidity and mortality; however, if respiratory acidaemia occurs over a prolonged period then metabolic acidaemia can develop. The difference between the arterial and venous pCO2 values can give some indication to the time course of the insult producing the acid-base abnormality. In acute insults there is insufficient time for carbon dioxide to diffuse across the placenta resulting in a substantial higher arterial pCO_2 value than its venous counterpart (greater than 25 mmHg).[2] In more chronic situations carbon dioxide has sufficient time to diffuse across the placenta and thus equilibrate between the arterial and venous vessels.

Table Two. Classification of fetal and neonatal acidaemia based on umbilical artery values

Acidaemia Type	Arterial pCO_2	Arterial Base Excess
Respiratory	≥ 80 mmHg	> -12 mmol/L
Metabolic	< 80 mmHg	≤ -12 mmol/L
Mixed Respiratory Metabolic	≥ 80 mmHg	≤ -12 mmol/L

Umbilical cord lactate analysis has not been as extensively evaluated as blood gas analysis; although evidence suggests that it has equivalent utility to blood gas values in predicting short term adverse neonatal outcome.[11] Furthermore, numerous studies have noted significant correlations between umbilical artery lactate values and other early indicators of neonatal/fetal condition (i.e. Apgar scores, arterial pH values, and arterial base excess values).[12]

Summary

The availability of umbilical cord blood gas values provides a wealth of information on the neonate at delivery as well as an insight into the period prior to delivery including a reflection of the biochemical and metabolic occurrences during labour. As a consequence of this, the use of umbilical cord blood analysis is increasing as the benefits become increasingly apparent. Additional information and references are available from the authors on request.

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6.3 Overview: The Management of Perinatal Loss

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The management of perinatal loss is not standardised across units in WA. Following a needs' analysis (Western Australian Metropolitan Perinatal Loss Needs' Analysis Project 2009), the Statewide Obstetric Support Unit (SOSU) and KEMH Perinatal Loss Service (PLS) produced an educational package to assist obstetric and midwifery staff to improve and standardise clinical care in WA. The Project assisted in implementation of the Department of Health, WA maternity service policy.[i] This educational package includes a large Perinatal Loss Resource Folio with relevant paperwork for reporting deaths, brochures regarding perinatal loss and autopsy, the 'Caring for Families Experiencing Perinatal Loss' booklet, the informative 'Perinatal Pathology Handbook,' along with an eLearning package which has been developed by the PLS and SOSU and is hosted by the SOSU website.[ii] These resources provide guidance in best clinical practice and investigations into death. They are largely based on the PSANZ guidelines[iii] along with relevant local additions. Hard copies of the folios have been provided to all public obstetric units in WA, and electronic versions are also available.

The Perinatal Loss Resource Folio contents may be accessed on-line: http://www.kemh.health.wa.gov.au/services/SOSU/MPLNAP.php

The e-learning package may be accessed at: http://www.kemh.health.wa.gov.au/services/SOSU/education.php?PHPSESSID=5e3e80df65acfc5eef2f8e871271911c

There are approximately 30,000 births, 200 stillbirths and 60-70 neonatal deaths each year in WA. The perinatal mortality rate (>20 weeks gestation stillbirths plus neonatal deaths) is almost 10 per 1000 total births. Neonatal death rates have continued to fall steadily over time, but the stillbirth rate has remained relatively static for the past two decades.

'Approximate' Risks of:	
Maternal death	1 in 10 000
Perinatal death	1 in 100
Miscarriage	1 in 6, age 18-25 and rising to 40% at age 40 years.

[i] Improving Maternity Services: Working Together Across Western Australia: A Policy Framework, Health WA, Jan 2008. Online: on the health Networks website: www.healthnetworks.health.wa.gov.au/maternitycare

[ii] Caring for Families Experiencing Perinatal Loss, Statewide Obstetric Support Unit, July 2009; (http://kemh.health.wa.gov.au/services/SOSU/MPLNAP.php) Perinatal Pathology Handbook is available: http://www.kemh.health.wa.gov.au/services/SOSU/MPLNAP.php

[iii] The Perinatal Mortality Special Interest Group of the Perinatal Society of Australia and New Zealand. (2004). Clinical Practice Guideline for Perinatal Mortality Audit, PSANZ

The leading cause and risk categories of stillbirth in WA are congenital abnormalities, prematurity due to spontaneous preterm delivery and 'unexplained'. The leading causes of neonatal death are prematurity, congenital abnormalities and perinatal infection. WA has one of the highest perinatal autopsy rates in Australia (around 60%), and this is reflected in a lower proportion of unexplained stillbirths in WA. It is estimated that the number of unexplained stillbirths is now about ten times that of SID deaths in Australia. The high proportion of unexplained stillbirths is likely to be a barrier to further reducing stillbirth rates. Thus, the thorough investigation into the cause of every stillbirth, including autopsy examination and placental histopathology, is strongly recommended.

Important risk factors for stillbirth are advanced maternal age, smoking, obesity, nulliparity and prolonged pregnancy.

Is the patient suitable for your unit?

- Most low-medium risk patients with perinatal loss can be cared for locally.
- Transfer may be appropriate due to risk factors. Please liaise with consultant obstetric staff or the PLS prior to arranging the transfer of a patient (KEMH: Ph (08) 9340 2222).

Induction and delivery key points:

- Vaginal birth is generally preferable to caesarean section following fetal death.
- There is usually no need to rush.
- Provide parents with information and involve them in decision making.
- A written perinatal care plan is recommended, with a copy for the patient.
- Provide continuity of care giver for women experiencing perinatal death where possible.
- Allow time for parents to make important decisions, such as:
  - Induction of labour following diagnosis of serious congenital abnormality
  - Induction of labour following fetal death
  - Resuscitation or non-resuscitation at the margins of viability
  - Withdrawal of life support
- Adequate analgesia should be considered.
- Fetal death is often identified by ultrasound imaging. Where there is suspicion or diagnosis of fetal death, it is recommended that a support person accompanies them during the ultrasound examination.
- Breaking bad news should be done in a private quiet room, allowing time for parents to ask questions, and offering sympathy. The most experienced practitioners should be available for these difficult conversations.
- Show respect for the family and baby
- Use the baby's name, where given
- Explain how the baby may look
- Handle the baby gently, as you would a live baby
- Consider any special cultural needs or whether an interpreter is required

- Attention to details, such as referring to a deceased baby by name, can assist in providing sensitive care. Using 'teardrop' markers on doors and files can help avoid insensitive actions, such as staff noisily entering a room where a baby has died.
- Consult KEMH for additional advice (KEMH: Ph (08)9340 2222).

Maternal Investigations

- Maternal investigations should be in line with those suggested by PSANZ, with due consideration to the circumstances, i.e. some investigations may have a very low yield in a given situation.

Examination of baby and placenta

- The baby should be carefully checked, weighed and measured as performed for a livebirth, with a detailed description of the baby's general appearance and an anatomy check.
- The state and weight of the placenta should be noted. The placenta should be sent to histopathology as a routine, except when parents object. The placenta may be examined and returned to the parents if this is desired.

Grief management

Grief comprises many emotions including numbness, denial, anger, bargaining, sadness, denial, guilt and acceptance. With the first knowledge that the baby's death has occurred disbelief and numbness are usual, and people commonly experience a surreal state. It is difficult to concentrate, understand or remember things in this period. It is a difficult time to make decisions.

Staff are encouraged to express their sorrow for what has happened. Offering sympathy is not an admission of guilt or error. Do not withhold expressions of sympathy and/or regret due to fear of medicolegal reprisal.

Some contact with the baby is usual and gentle support should be offered for the parents to have contact with their baby, without coercion. Mementos such as photographs, locks of hair and hand and footprints are recommended. A deceased baby's appearance may rapidly deteriorate so keeping the baby cool and taking early photographs is encouraged. Parents may decline the offer of mementos, but it is suggested that mementos are made and stored in the patient notes for future access. It is not uncommon for families to request mementos some years after the event.

It is recommended that all parents are routinely referred to social work and pastoral care (chaplaincy) workers as these allied health workers bring specific skills to support. Discuss whether the family would like to arrange a blessing or baptism service, and how this may be arranged.

Consider whether a referral to specialised mental health services is appropriate, particularly when there are pre-existing mental health issues.

Community supports for families include general practitioners, child/community/school health nurses, Aboriginal and other health workers, religious chaplains and other counselling and support agencies, such as SIDS and Kids. Consider the special needs of women with different cultural and religious backgrounds and refer to appropriate community support agencies.

Reporting requirements

There are a number of reporting requirements and audit activities for perinatal death. One clinical incident can give rise to several reporting requirements. Discuss with senior staff whether an AIMS or Sentinel event report is required, whether the Coroner needs to be informed (not required for stillbirths) and reporting requirements relevant to the particular unit.

Investigation into Cause of Death and Postnatal Care

Autopsy is strongly recommended. Different types of autopsy are available. Where incisional postmortem is declined, it is worth seeking consent for a careful external postmortem examination by an experienced perinatal pathologist.

See *'Caring for Families Experiencing Perinatal Loss'* and the *'Perinatal Pathology Handbook'* for details of other recommended investigations, arranging an autopsy and necessary paperwork.

Self Care

Self care is important to promote adjustment, integration of the experience and resilience in practice. Consider the need to talk about what has happened. Debriefing and staff counselling may be appropriate. It is also beneficial to provide feedback to staff about the cause of death. Discuss with senior staff or SOSU for further help.

Further information and references:

- SOSU, Ph (08)9340 1605 or sosu@health.wa.gov.au
- Belinda Jennings, Perinatal Loss Service: KEMH Ph (08) 9340 2222 and page coordinator, or speak to on call obstetric registrar for urgent advice.

6.4 Management of the Post-Term Pregnancy

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Gestational age at delivery is an important contributor to perinatal outcomes. Neonates who deliver preterm or post-term are at increased risk of significant morbidity and mortality. Prolonged pregnancy extends beyond 40 weeks gestational age. Post-term pregnancy is defined as lasting greater than 42 weeks or 294 days after the first day of the last menstrual period (LMP). It is therefore vital to have accurate dating to make the diagnosis. Post-term pregnancy occurs in 1% of pregnancies in Australia, with statistics in other countries varying depending on the accuracy of dating methodology. (1)

Risk Factors

Several risk factors have been identified. Lower socioeconomic groups have a higher incidence, hypothetically due to inaccurate or late dating. (2) Nulliparity and previous post term pregnancies are the most important risk factors. Patients with a history of one post term pregnancy have 2-3 times the risk of subsequent post term pregnancy. The chance of post-term pregnancy after two previous post-term deliveries is four times the background risk in the general population. (3) Maternal genetic factors appear to play a role, with increased concordance of post-term pregnancies in monozygotic than dizygotic twins and increased incidence in women who were themselves the result of a post-term pregnancy. (3, 4) Paternal genes also have some influence on outcomes, with a Danish study showing that the recurrence rate decreased if the subsequent pregnancy was with a different partner. (5) Raised BMI in the first trimester is also a significant risk factor (6), as is male gender of the fetus. (7)

Rare causes contributing to post-term pregnancy are placental sulphatase deficiency and anencephaly in the absence of polyhydramnios. (8)

Complications

Post term pregnancy is associated with a number of complications, both maternal and fetal.

Maternal complications

Increasing gestational age is associated with increasing risk of caesarean section, with 21.7% of deliveries at >42 weeks gestational age being by caesarean, compared with 9% at 40 weeks gestational age. At 41 weeks gestational age the caesarean section rate is 14%. (9) This increase in incidence is thought to be due to a number of factors, including fetal macrosomia causing cephalopelvic disproportion and oligohydramnios causing non-reassuring CTG due to cord compression. There is also a significant increase in operative delivery rates, with 17.4% of women requiring operative delivery at >42 weeks gestation and 13.3% at 41 weeks gestation compared to 10.9% at 40 weeks gestational age. (9)

Rates of other complications also increase with gestational age. Published data showed the risk of postpartum haemorrhage increases from 3.1% at 40 weeks to 5.0% at >42 weeks. (9) Third and fourth degree tears increase from 4.6% at 40 weeks to 9.1% at >42 weeks and chorioamnionitis rates increase from 3.6% at 40 weeks to 6.0% at >42 weeks. (9) These complications were also significantly increased at 41 weeks gestational age, although to a lesser extent, and the trend was evident in all modes of delivery. Prolonged labour (>24 hours) and endomyometritis are also more likely with prolonged pregnancy. (9)

Fetal complications

Post-term pregnancy carries a higher risk of perinatal mortality. At >42 weeks gestational age the perinatal mortality is 4-7/1000, in contrast to perinatal mortality of 2-3/1000 at term. This risk continues to increase to four-fold at 43 weeks and five to seven-fold at >44 weeks gestational age. (10, 11) The main factors contributing to this increased mortality appear to be asphyxia, meconium aspiration, placental insufficiency and intrauterine infection. (12)

Amniotic fluid volume reaches a maximum at 24 weeks, stabilises, and then decreases after 37 weeks gestational age. Decreased amniotic fluid is associated with decreased fetal movement and non-reassuring fetal heart rate tracing. There are several hypotheses about the mechanism of this reduction but it is important to note that although reduced amniotic fluid may be normal in post term pregnancies, actual oligohydramnios is not. The passage of meconium prior to delivery is also more common in post-term pregnancies and this increases the chance of meconium aspiration syndrome.

A known complication of prolonged pregnancy is postmaturity or dysmaturity syndrome. This occurs in approximately 20% of post-term pregnancies. These neonates show signs of late-onset wasting, thought to be due to placental insufficiency. Up to 40% of post-term placentas will show signs of infarcts, calcification and fibrosis. Postmaturity syndrome is classified in three stages. Stage one symptoms are an alert facial expression, recent weight loss with decreased subcutaneous fat and loss of muscle mass and loose, wrinkled skin with desquamative changes. In stage two there is added green meconium staining of skin and umbilicus with increased risk of fetal distress and hypoxia. With stage three dysmaturity syndrome there is yellow staining of nails, skin and umbilicus, revealing prolonged exposure to meconium. (13, 14) There has been some association with long-term neurological sequelae, with one large Danish study concluding there is an increased risk of early epilepsy. (15) Other studies have not found any adverse neurological outcomes with long-term follow-up. (16)

Another significant complication of post-term pregnancy is macrosomia. Approximately 25% of neonates will weigh more than 4000grams and between 2.5 and 10% will weigh more than 4,500 grams. (17) These neonates are at increased risk of the complications of macrosomia, including altered glucose and bilirubin metabolism, hypoglycaemia, polycythemia and hypothermia. They are also at increased risk of birth trauma such as shoulder dystocia, brachial plexus injury, fractures, cephalopelvic disproportion and subsequent caesarean section and sequelae of operative delivery such as cephalhaematoma and subdural haematoma. However, there is no evidence to support induction just to prevent macrosomia. (18)

Management

There are two main methods of management as pregnancy goes past term 41 weeks: induction or expectant management with fetal monitoring. If electing to manage expectantly, induction is indicated if the fetal surveillance is not reassuring or spontaneous labour does not occur. There is still some debate as to whether the evidence supports induction or expectant management, and if induction is indicated, at what gestational age.

Induction

The evidence shows that both induction and expectant management have a low risk of complications and good perinatal outcomes in the low risk pregnancy. However, there does appear to be a significant improvement in outcomes when labour is induced. Several large multi-centre randomised controlled trials showed a reduction in fetal and maternal morbidities, reduced medical costs and reduced likelihood of caesarean section with the induction of post-term pregnancies. (19, 20) These differences have been demonstrated with induction as early as 41 weeks gestational age. The most recent Cochrane review in 2010 analysed 19 trials and showed a small but significant reduction in perinatal deaths with induction at 41 weeks when compared with expectant management. This study also revealed an increase in caesarean section rates with a policy of induction between 37 and 40 weeks gestational age. There were no differences in caesarean section rates between patients in which labour was induced or managed expectantly at 41 or 42 weeks. (20) There are a number of other trials that support these conclusions and some that show a significant reduction in caesarean section rates with a policy of induction. (20) However, other trials have shown an increase in caesarean section rates with induction at post-term, rather than expectant management. (21)

Most trials comparing induction and expectant management included only women with unfavourable cervices, and usually initiated induction once the cervix became favourable. Most centres favour induction in post-term pregnancies when the cervix is favourable because the risk of failed induction is low. However, those studies that included women with favourable cervices in the expectant management group did not demonstrate any worse outcomes in the expectant group, although the results were not analysed according to cervical status.

Methods of Induction

Non-pharmacologic interventions

A number of non-pharmacological interventions have been suggested to prevent and treat post-term pregnancy. There are some studies that show a benefit to serial membrane sweeping at term. These studies showed increased chance of favourable cervix, increased rates of spontaneous labour and decreased gestational age at delivery and one showed a benefit to membrane sweeping over prostaglandin use. (22, 23) However, another study showed no difference in induction rates, although the interval from recruitment to delivery was shortened in the treatment group. Although there were no significant complications from membrane sweeping, many women did report discomfort with the procedure. (24) A trial to discover if acupuncture is helpful in post term pregnancy failed to demonstrate any improvement in time to delivery. (25) A small study where women were given castor oil to induce labour did show a marked increase in spontaneous labour

in the castor oil group, but further studies would be needed for any confidence in this result. (26) Sexual intercourse has often been proposed as a method of avoiding post-term pregnancies. One observational study that recorded coital activity from 36 weeks gestational age did show a reduction in average gestational length, post-term pregnancy and need for induction with higher frequency of intercourse. (27)

Prostaglandins

There are a number of agents that may be used for induction in the post-term pregnancy. The most commonly used agent for cervical ripening in most trials of post term pregnancy is prostaglandin gel. This has been demonstrated to improve Bishop's score, decrease length of labour and dose of oxytocin required and to improve caesarean section rates in a number of trials. (28-30) However, one placebo-controlled trial was unable to replicate any reduction in caesarean section rates or length of time from induction to delivery. (31) These trials do not all use the same standardised regimen of prostaglandins and it is important to note that uterine hyperstimulation is a possible complication with higher doses. (32, 33)

Expectant management

When choosing to manage the post-term pregnancy expectantly, it is standard to perform close antenatal monitoring. There is no clear evidence that this reduces the risk of unexpected stillbirth but it would be impossible to produce a trial whereby one group is not monitored. There is some inconsistency about the time of commencing monitoring. A number of studies showed an increase in complications as pregnancies approached 42 weeks gestational age. (21, 34-37) Several trials suggested an improvement in perinatal outcomes with antenatal surveillance at 41 weeks gestational age, however, there is as yet no evidence to commence surveillance at 40 weeks. (38-40)

The studies that have been performed in this area varied widely in the type and frequency of antenatal monitoring. The options that have been studied include non-stress CTG, biophysical profile, CTG and amniotic fluid volume assessment only or contraction stress testing. Cochrane review has been unable to establish any particular method as superior. (34) Oligohydramnios does appear to be predictive of poor outcome and therefore should be monitored, with delivery planned if there is evidence of oligohydramnios or fetal compromise. (41-43)

Oligohydramnios has been defined as either maximum vertical pocket (MVP) <2-3cm or amniotic fluid index (AFI) of less than 5. Either of these definitions appears to be reasonable. (44)

Studies have shown umbilical artery Doppler flow studies have no proven benefit in monitoring post-term pregnancy. It should not be used for this indication alone. (45, 46) Although there is not yet any universally supported monitoring regimen, most centres advise twice-weekly or more frequent testing. This takes into account that amniotic fluid volume can change rapidly, over 24 to 48 hours. (43)

Intrapartum management

Fetal heart rate abnormalities and the passage of meconium are more likely in the post-term pregnancy and it is therefore advisable to have continuous heart rate monitoring for these patients. (47) Spontaneous or induced accelerations are still predictive of a non-acidotic fetus even in post-term pregnancies.

Summary

- Both maternal and fetal complications increase after 40 weeks gestational age, even though the pregnancy is not officially 'post-term' until 42 weeks gestational age.
- Risk factors for post-term pregnancy include late ultrasound dating, lower socio-economic status, obesity, personal or family history of post-term pregnancy and male gender of fetus.
- Maternal complications include increased caesarean rates, operative delivery, genital tract trauma, PPH and chorioamnionitis. These increase with each week beyond the due date.
- Fetal complications also increase with each passing week beyond the 40 weeks gestational age mark. The most significant of these is perinatal mortality, but other complications include meconium aspiration syndrome, post-maturity syndrome, macrosomia and related birth injuries. There is some debate about long-term neurological sequelae.
- Most centres now induce labour by 42 weeks gestational age as the evidence shows this is associated with decreased perinatal mortality without an increase in caesarean section rates. However, there is some disagreement whether to induce labour at 41 weeks gestational age or even earlier. There is not enough evidence to show which gestational age is the best time for induction.
- If deciding not to induce labour, standard practice is to perform close fetal surveillance. Regimens differ, but a reasonable level of surveillance appears to be biweekly CTG with ultrasound examination to assess amniotic fluid volume. Again, it is unclear when this surveillance should start, but most centres would commence at 41 weeks gestational age, or earlier.
- Umbilical artery Doppler flow studies do not appear to have a role in fetal surveillance for the indication of post-term pregnancy alone.
- Delivery should be expedited if fetal surveillance shows signs of oligohydramnios or fetal compromise
- Continuous intrapartum monitoring should be standard practice in women beyond 42 weeks gestational age.

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7 Appendices

7.1 Appendix I: Abbreviations and Definitions

ABS	Australian Bureau of Statistics
AFI	amniotic fluid index
AIHW	Australian Institute of Health and Welfare
AIMS	Advanced Incident Management System
AMA	Australian Medical Association
APH	antepartum haemorrhage
CI	confidence interval
CMP	Community Midwifery Program
CTG	cardiotocograph
DV	domestic violence
EDPH	Executive Director of Public Health
GBS	Group B Streptococcus
GDM	gestational diabetes mellitus
GP-obstetrician	General Practitioner with obstetric skills
GTT	glucose tolerance test
HIE	hypoxic ischaemic encephalopathy
IVF	in vitro fertilisation
KEMH	King Edward Memorial Hospital
MANSmap	Maternity and neonatal services map of Western Australia
MVP	maximum vertical pocket (amniotic fluid)
NAI	non-accidental injury
NETS	Neonatal Emergency Transport Service
NHMRC	National Health and Medical Research Council
NPDC	National Perinatal Data Collection
p	probability value (statistics)

PIMC	Perinatal and Infant Mortality Committee of Western Australia
PMH	Princess Margaret Hospital
PSANZ	Perinatal Society of Australia and New Zealand
PSANZ PDC	Perinatal Society of Australia and New Zealand Perinatal Death Classification
PSANZ NDC	Perinatal Society of Australia and New Zealand Neonatal Death Classification
r	correlation coefficient (statistics)
RFDS	Royal Flying Doctor Service
RANZCOG	The Royal Australian and New Zealand College of Obstetricians and Gynaecologists
RR	relative risk
SEIFA	Socio-economic Indexes for Areas
SIDS	Sudden Infant Death Syndrome
SIDS and kids	Support group for families affected by sudden infant or childhood death
SJA	St John Ambulance Service
SOSU	Statewide Obstetric Support Unit
SUDI	sudden unexplained death in infancy
TSI	Torres Strait Islander
TTTS	Twin to twin transfusion syndrome
WA	Western Australia
W&NHN	Women's and Newborn's Health Network
WANTS	Western Australian Neonatal Transport Service
WARM	Western Australian Review of Mortality
WHO	World Health Organization

Definitions:

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.
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.
Stillbirth/Fetal Death:	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.
Stillbirth rate:	The number of stillbirths per 1,000 total births.
Neonatal death:	The death of a liveborn infant within 28 days of birth.
Neonatal mortality rate:	The number of deaths of liveborn infants under 28 days of age per 1,000 livebirths.
Perinatal death:	A stillbirth or neonatal death
Perinatal mortality rate:	The number of fetal and neonatal 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).
Infant mortality rate:	The number of deaths of infants under one year of age per 1,000 livebirths
Post-neonatal death:	The death of a liveborn infant occurring in the remainder of the first year (28 – 364 days).
Post-neonatal mortality rate:	The number of deaths of liveborn infants from 28 days to one year of age per 1,000 livebirths.

7.2 Appendix IIa: Stillbirths and Infant Deaths by Primary PSANZ PDC, WA 2005-07

PSANZ PDC		Type of Death			Total Deaths	All Deaths
		SB	NND	PNND		%
1	**Congenital Abnormality**				**193**	**21.3**
	1.1 Central nervous system	55	12	7	74	8.1
	1.2 Cardiovascular system	21	13	12	46	5.1
	1.3 Urinary system	7	4	1	12	1.3
	1.4 Gastrointestinal system	5	1	3	9	1.0
	1.5 Chromosomal	50	7	5	62	6.8
	1.6 Metabolic	1	3	2	6	0.7
	1.7 Multiple/non-chromosomal	30	4	3	37	4.1
	1.81 Musculoskeletal	6	1	0	7	0.8
	1.82 Respiratory	1	2	1	4	0.4
	1.83 Diaphragmatic hernia	0	3	1	4	0.4
	1.84 Haematological	0	0	1	1	0.1
	1.85 Tumours	2	1	0	3	0.3
	1.88 Other specific congenital abnormality	0	1	1	2	0.2
2	**Perinatal Infection**				**48**	**5.3**
	2.11 Group B Streptococcus	4	2	0	6	0.7
	2.12 E coli	5	2	0	7	0.8
	2.18 Other bacterial	6	5	0	11	1.2
	2.19 Unspecified bacterial	3	2	0	5	0.6
	2.21 Cytomegalovirus	5	1	0	6	0.7
	2.8 Other specific organism	0	0	1	1	0.1
	2.9 Other unspecified organism	10	2	0	12	1.3
3	**Hypertension**				**29**	3.2
	3.1 Chronic hypertension: essential	1	0	0	1	0.1
	3.2 Chronic hypertension: secondary	2	0	0	2	0.2
	3.5 Pre-eclampsia	21	4	1	26	2.9
	3.51 With thrombophilia	3	0	0	3	0.3
	3.6 Pre-eclampsia superimposed on chronic	2	1	0	3	0.3
	3.9 Unspecified hypertension	1	0	0	1	0.1
4	**Antepartum Haemorrhage**				**44**	4.8
	4.1 Placental abruption	36	5	2	43	4.7
	4.2 Placental praevia	0	1	0	1	0.1
	4.3 Vasa praevia	1	0	0	1	0.1
	4.9 APH of undetermined origin	1	0	0	1	0.1
5	**Maternal Conditions**				**35**	3.9
	5.2 Diabetes mellitus	16	0	0	16	1.8
	5.3 Maternal injury	1	1	0	2	0.2
	5.31 Accidental	2	0	0	2	0.2
	5.32 Non-accidental maternal injury	3	0	1	4	0.4
	5.4 Maternal sepsis	0	1	0	1	0.1
	5.5 Antiphospholipid syndrome	3	0	0	3	0.3
	5.8 Other specified maternal conditions	5	1	1	7	0.8
6	**Specific perinatal conditions**				**71**	7.8

	6.1 Twin-twin transfusion syndrome	30	7	0	37	4.1
	6.2 Fetomaternal haemorrhage	6	2	0	8	0.9
	6.3 Antepartum cord complication	12	0	0	12	1.3
	6.4 Uterine abnormality	7	0	0	7	0.8
	6.64 Alloimmune thrombocytopenia	0	0	1	1	0.1
	6.7 Idiopathic hydrops	5	0	0	5	0.6
	6.8 Other specific perinatal conditions	1	0	0	1	0.1
7	**Hypoxic peripartum death**				**27**	3.0
	7.1 With intrapartum complications	2	5	1	8	0.9
	7.11 Uterine rupture	0	3	0	3	0.3
	7.18 Other	1	0	0	1	0.1
	7.2 Evidence of non-reassuring fetal status in normally grown infant	4	0	2	6	0.7
	7.9 Unspecific hypoxic peripartum death	5	4	0	9	1.0
8	**Fetal Growth Restriction**				**51**	5.6
	8.1 With evidence reduced vascular perfusion on Doppler and/or placental histopathology	20	3	2	25	2.8
	8.2 With chronic villitis	1	0	0	1	0.1
	8.3 No placental pathology	13	0	0	13	1.4
	8.4 No examination of placenta	5	2	1	8	0.9
	8.8 Other specified placental pathology	3	0	0	3	0.3
	8.9 Unspecified or not known whether placenta examined	1	0	0	1	0.1
9	**Spontaneous preterm birth**				**144**	15.9
	9 Spontaneous preterm	0	0	1	1	0.1
	9.1 With intact membranes or rupture <24 hrs before delivery	1	0	1	2	0.2
	9.11 With chorioamnionitis on placental histopathology	2	1	0	3	0.3
	9.12 Without chorioamnionitis on placental histopathology	0	3	0	3	0.3
	9.17 No signs chorioamnionitis, no examination of placenta	0	0	1	1	0.1
	9.19 Unspecified or not known whether placenta examined	0	1	0	1	0.1
	9.2 With ruptured membranes >=24 hrs before delivery	9	5	1	15	1.7
	9.21 With chorioamnionitis on placental histopathology	5	1	0	6	0.7
	9.22 Without chorioamnionitis on placental histopathology	1	1	0	2	0.2
	9.29 Unspecified or not known whether placenta examined	2	2	0	4	0.4
	9.3 Membranes rupture of unknown duration before delivery	2	8	0	10	1.1
	9.31 With chorioamnionitis on placental histopathology	6	3	0	9	1.0
	9.32 Without chorioamnionitis on placental histopathology	2	2	0	4	0.4
	9.33 With clinical evidence of chorioamnionitis, no examination of placenta	0	1	0	1	0.1
	9.39 Unspecified or not known whether placenta examined	32	47	3	82	9.0

10	**Unexplained antepartum death**				**109**	12.0
	10.1 With evidence of reduced vascular perfusion on Doppler studies and/or placental histopathology	7	0	0	7	0.8
	10.2 With chronic villitis	5	0	0	5	0.6
	10.3 No placental pathology	63	0	0	63	6.9
	10.4 No examination of placenta	12	0	0	12	1.3
	10.8 Other specified placental pathology	13	0	0	13	1.4
	10.9 Unspecified or not known whether placenta examined	9	0	0	9	1.0
11	**No obstetric antecedent**				**71**	7.8
	11.1 Sudden Infant Death Syndrome (SIDS)	0	0	1	1	0.1
	11.11 SIDS Category IA: classic features of SIDS present and completely documented	0	0	9	9	1.0
	11.12 SIDS Category IB: classic features of SIDS present but incompletely documented	0	0	1	1	0.1
	11.13 SIDS Category II: Infant deaths that meet Category I except for one or more features	0	8	26	34	3.7
	11.2 Postnatally acquired infection	0	0	12	12	1.3
	11.3 Accidental asphyxiation	0	2	1	3	0.3
	11.4 Other accident, poisoning or violence (postnatal)	0	3	6	9	1.0
	11.8 Other specified	0	0	1	1	0.1
	11.9 Unknown/undetermined	0	1	0	1	0.1

Abbreviation notes for Appendices IIa, IIb, IIIa, IIIb:

SB stillbirth

NND neonatal death

PND perinatal death

PNND post-neonatal death

7.3 Appendix IIb: Stillbirths and Infant Deaths by Secondary PSANZ PDC, WA 2005-07

Secondary PSANZ PDC codes were applied for those deaths where two distinct major PSANZ categories were applicable.

PSANZ PDC		Type of Death			Total Deaths	All Deaths
		SB	NND	PNND		%
1	**Congenital Abnormality**				**19**	13.3
	1.1 Central nervous system	1	1	0	2	1.4
	1.2 Cardiovascular system	0	1	1	2	1.4
	1.3 Urinary system	1	0	0	1	0.7
	1.5 Chromosomal	3	2	5	10	7.0
	1.7 Multiple / non-chromosomal	1	0	3	4	2.8
	1.85 Tumours	0	0	1	1	0.7
2	**Perinatal Infection**				**6**	4.2
	2.11 Group B Streptococcus	0	3	0	3	2.1
	2.19 Unspecified bacterial	2	0	0	2	1.4
	2.9 Other unspecified organism	1	0	0	1	0.7
3	**Hypertension**				**11**	7.7
	3.4 Gestational hypertension	2	0	0	2	1.4
	3.5 Pre-eclampsia	4	3	0	7	4.9
	3.6 Pre-eclampsia superimposed on chronic	1	0	0	1	0.7
	3.9 Unspecified hypertension	1	0	0	1	0.7
4	**Antepartum haemorrhage**				**6**	4.2
	4.1 Placental abruption	2	1	0	3	2.1
	4.2 Placenta praevia	0	0	1	1	0.7
	4.3 Vasa praevia	1	0	0	1	0.7
	4.9 APH of undetermined origin	0	1	0	1	0.7
5	**Maternal Conditions**				**55**	38.5
	5.2 Diabetes mellitus	7	1	3	11	7.7
	5.3 Maternal injury	0	0	1	1	0.7
	5.32 Non-accidental maternal injury	1	0	0	1	0.7
	5.4 Maternal sepsis	8	0	0	8	5.6
	5.5 Antiphospholipid syndrome	2	0	1	3	2.1
	5.8 Other specified maternal conditions	17	12	2	31	21.7
6	**Specific perinatal conditions**				**8**	5.6
	6.1 Twin-twin transfusion syndrome	1	0	1	2	1.4
	6.2 Fetomaternal haemorrhage	1	0	0	1	0.7
	6.3 Antepartum cord complication	2	0	0	2	1.4
	6.4 Uterine abnormality	3	0	0	3	2.1
7	**Hypoxic peripartum death**				**2**	1.4
	7 Hypoxic peripartum death	1	0	0	1	0.7
	7.18 Other intrapartum complication	0	1	0	1	0.7
8	**Fetal Growth Restriction**				**7**	4.9
	8.3 No placental pathology	1	0	0	1	0.7
	8.4 No examination of placenta	0	3	2	5	3.5
	8.8 Other specified placental pathology	1	0	0	1	0.7

9	Spontaneous preterm birth				25	17.5
	9 Spontaneous preterm	0	3	2	5	3.5
	9.1 With intact membranes or rupture <24 hrs before delivery	0	2	1	3	2.1
	9.11 With chorioamnionitis on placental histopathology	0	1	1	2	1.4
	9.12 Without chorioamnionitis on placental histopathology	1	1	1	3	2.1
	9.17 No clinical signs chorioamnionitis, no examination placenta	0	1	0	1	0.7
	9.22 Membranes rupture >=24 hrs before delivery without chorioamnionitis on placental histopathology	0	0	1	1	0.7
	9.27 Membranes rupture >=24 hrs before delivery, with no clinical signs of chorioamnionitis, no examination of placenta	0	0	1	1	0.7
	9.29 Membranes rupture >=24 hrs before delivery; Unspecified or not known whether placenta examined	0	0	1	1	0.7
	9.31 Membranes rupture unknown duration before delivery, with chorioamnionitis on placental histopathology	1	0	0	1	0.7
	9.32 Membranes rupture unknown duration before delivery, without chorioamnionitis on placental histopathology	1	0	0	1	0.7
	9.39 Membranes rupture unknown duration before delivery, unspecified, or not known whether placenta examined	3	1	2	6	4.2
10	**Unexplained antepartum death**				**3**	2.1
	10.3 No placental pathology	2	0	0	2	1.4
	10.8 Other specified placental pathology	1	0	0	1	0.7

7.4 Appendix IIIa: Infant Deaths by Primary PSANZ NDC, WA 2005-07

PSANZ NDC		Type of Death		Infant Deaths	
		NND	PNND	N	%
1	**Congenital Abnormalities**			**95**	30.6
	1.1 Central nervous system	12	7	19	6.1
	1.2 Cardiovascular system	13	11	24	7.7
	1.3 Urinary system	2	1	3	1.0
	1.4 Gastrointestinal system	1	4	5	1.6
	1.5 Chromosomal	7	6	14	4.5
	1.6 Metabolic	3	2	5	1.6
	1.7 Multiple / non chromosomal syndromes	3	4	8	2.6
	1.8 Other congenital abnormality	1	0	1	0.3
	1.82 Respiratory	2	0	2	0.6
	1.83 Diaphragmatic hernia	3	1	4	1.3
	1.84 Haematological	0	2	2	0.6
	1.85 Tumours	1	0	1	0.3
	1.88 Other specified congenital abnormality	1	1	2	0.6
	1.9 Unspecified congenital abnormality	5	0	5	1.6
2	**Extreme Prematurity (typically <24 weeks)**			**63**	20.3
	2.1 Not resuscitated	4	0	4	1.3
	2.2 Unsuccessful resuscitation	4	0	4	1.3
	2.9 Unspecified or not known whether resuscitation attempted	51	2	55	17.7
3	**Cardio-respiratory disorders**			**19**	6.1
	3.1 Hyaline membrane disease/ Respiratory distress syndrome (RDS)	2	0	2	0.6
	3.2 Meconium aspiration syndrome	2	0	2	0.6
	3.3 Primary persistent pulmonary hypertension	1	1	2	0.6
	3.4 Pulmonary hypoplasia	3	0	3	1.0
	3.5 Chronic neonatal lung disease (typically bronchopulmonary dysplasia)	2	5	7	2.3
	3.8 Other	2	1	3	1.0
4	**Infection**			**28**	9.0
	4.1 Bacterial	0	1	1	0.3
	4.11 Congenital bacterial	9	0	9	2.9
	4.12 Acquired bacterial	0	9	9	2.9
	4.22 Acquired viral	0	5	5	1.6
	4.5 Fungal	1	0	1	0.3
	4.9 Unspecified organism	3	0	3	1.0
5	**Neurological**			**38**	12.3
	5 Neurological unspecified	2	0	2	0.6
	5.1 Hypoxic ischaemic encephalopathy/ perinatal asphyxia (typically >24 weeks gestation or >600g birthweight)	20	4	24	7.7
	5.2 Intracranial haemorrhage	12	0	12	3.9
6	Gastrointestinal			9	2.9
	6.1 Necrotising enterocolitis	5	4	9	2.9

7	**Other**			**62**	20.0
	7.11 SIDS Category IA	0	8	8	2.6
	7.13 SIDS Category II	9	27	36	11.6
	7.2 Multisystem failure	1	0	1	0.3
	7.3 Trauma	3	5	8	2.6
	7.8 Other specified	4	2	6	1.9
	7.9 Unknown/undetermined	0	1	1	0.3
	7.91 Unclassified sudden infant death	1	0	1	0.3
	7.92 Other unknown/ undetermined	0	1	1	0.3

7.5 Appendix IIIb: Infant Deaths by Secondary PSANZ NDC, WA 2005-07

Secondary PSANZ NDC codes were applied for those deaths where two distinct major PSANZ categories were applicable.

PSANZ NDC		Type of Death		Infant Deaths	
		NND	PNND	N	%
1	**Congenital Abnormalities**			**14**	45.2
	1.2 Cardiovascular system	1	0	1	3.2
	1.5 Chromosomal	2	6	8	25.8
	1.7 Multiple / non chromosomal	0	4	4	12.9
	1.85 Tumours	0	1	1	3.2
2	**Extreme Prematurity (typically <24 weeks)**			**3**	**9.7**
	2.2 Unsuccessful resuscitation	2	1	3	9.7
3	**Cardio-respiratory disorders**			**4**	12.9
	3.2 Meconium aspiration syndrome	1	0	1	3.2
	3.4 Pulmonary hypoplasia	1	0	1	3.2
	3.5 Chronic neonatal lung disease	0	1	1	3.2
	3.8 Other	1	0	1	3.2
4	**Infection**			**4**	12.9
	4.22 Viral	0	1	1	3.2
	4.8 Other infection	0	1	1	3.2
	4.9 Unspecified organism	2	0	2	6.5
5	**Neurological**			**5**	16.1
	5.1 Hypoxic ischaemic encephalopathy / perinatal asphyxia	2	0	2	6.5
	5.2 Intracranial haemorrhage	2	1	3	9.7
7	**Other**			**1**	3.2
	7.8 Other	1	0	1	3.2

7.6 Appendix IV: Recommendations of the Review of Homebirths in Western Australia

Rec 1: Perinatal deaths in women choosing homebirth, particularly those that are determined or suspected to have occurred during the intrapartum period, be considered a sentinel event and subjected to Root Cause Analysis (RCA) by the appropriate clinical governance body for the service involved.

Rec 2: Midwives who work in homebirth practice and offer Complementary and Alternative Medicines (CAM) be appropriately educated and credentialed in their use.

Rec 3: All ambulance requests for assistance at homebirths be classified as Priority 1 by the WA St John's Ambulance Service.

Rec 4: The Statewide Homebirth Policy (2001) should be reviewed as a matter of urgency.

Rec 5: The Women's and Newborns' Network develop policy with respect to the roles and responsibilities of childbearing women who choose homebirth, their support people and doulas in labour and CMP/independent practising midwives when women are transferred to from homebirth to hospital.

Rec 6: The Women's and Newborns' Network develop policy in relation to women who choose homebirth and decide not to undertake selective antenatal tests and/or recommended management practices in pregnancy, labour and birth. This includes:

- screening for group B streptococcus and diabetes
- management of the third stage of labour
- decisions regarding newborn care including vitamin K, neonatal immunisations,
- newborn screening tests

Rec 7: The process of developing and implementing the guidelines for the CMP must be expedited as a matter of urgency. In particular, the guidelines for clinicians must include clear direction in relation to:

- Entry criteria for the CMP.
- Processes for consultation and referral and specific planning and documentation of decisions.
- Criteria for transfer to hospital.
- Roles and responsibilities of midwives after transfer to hospital.
- Criteria for observations in labour and standards for documentation.

Rec 8: The WA Department of Health implements a more robust system for maintaining the currency of the list of current practising independent midwives who provide homebirth services. Consideration should be given to this role being transferred to the WA Nurses and Midwives Board in the future.

Rec 9: The method of investigation employed by the Perinatal and Infant Mortality Committee (PIMC) for home and hospital births could be strengthened by adopting the Perinatal Society of Australian and New Zealand (PSANZ) methodology of investigation, categorisation and reporting of perinatal deaths.iv

Rec 10: The WA Government amend the *Health Act 1911* Part XIIIB – Perinatal and Infant Mortality Committee to enable the consideration of, and action upon, broader system-level issues in their reporting including identification of contributing factors that are amenable to organisational change at home and hospital births.

Rec 11: The WA Nurses and Midwives Board should consider legislation to ensure that midwives who provide homebirth services have access to professional indemnity insurance in order to maintain registration.

Rec 12: The WA Nurses and Midwives Board should consider a system of requiring annual Midwifery Practice Review or other forms of continuing professional development for renewal of registration for independent practising midwives.

Rec 13: A formal facilitated risk assessment of the Community Midwifery Program be undertaken utilising AS/NZS 4360: 2004 to ensure that adequate controls are in place and to identify any additional controls not covered by the terms of reference of this review.

Rec 14: Documentation standards for the CMP must improve in line with legal and professional guidelines.[2] This includes:

- Documentation of the counselling and recording of the decision made by women in relation to antenatal screening including alternative strategies and management plans.
- Education programs need to be designed and implemented to address eficiencies in the standard of clinical documentation.
- Continuation of regular audits of the standard of documentation with the outcomes presented back to the CMP midwives.

Rec 15: Information for women who choose homebirth needs to be developed by the CMP in collaboration with the Women's and Newborns' Network. This should include information about

- Entry criteria for homebirth
- Safety and risks of homebirth
- Consultation and referral processes which may lead to hospital transfer

Rec 16: A process for ongoing evaluation and annual reporting of outcomes and experiences of women who access the CMP needs to occur. This includes:

- A satisfaction survey to be undertaken independently on a regular basis.
- A robust and independent mechanism to manage complaints.

[iv] Perinatal Society of Australia and New Zealand Clinical Practice Guideline for Perinatal Mortality; Second Edition, Version 2.2, April 2009.

Rec 17: The Perinatal Data Collection should be revised to provide a vehicle whereby women's choices and the outcomes of different models of care (eg. planned homebirth) can be tracked and reported. A minimum data set is included in Appendix F. The outcomes should include morbidity for women who choose a home and hospital birth so that accurate comparisons can be made. The process for collating and publishing the outcomes from the Perinatal Data Collection should be appropriately resourced to ensure that the reports are published in a timely manner.

Rec 18: All midwives, including independent practising midwives, need to be aware of the access to, and avail themselves of the opportunities for, continuing professional development including the management of obstetric and neonatal emergencies.

Rec 19: Before the end of the current memorandum of understanding (MOU) between the CMWA and the NMAHS, the relationship between the CMP and its major stakeholders need to be explored to ensure that all elements of quality (including safety) are optimised. Clarification about the various clinical, administrative and governance roles and responsibilities needs to occur.

Rec 20: A Community Midwifery Program could be established in the South West area (Bunbury and Busselton) as this area currently has women accessing homebirth outside the public health system.

Rec 21: All stakeholders be informed regarding homebirth and respect the choices that women make.

Rec 22: All stakeholders recognise that women will exercise their choice to use water during labour which may also include a choice to give birth in water at homebirths and hospital births. To achieve this:

- policies and protocols to support the use of water for labour and birth should be developed and implemented.
- training and support should occur for midwives caring for women who use water during labour and birth.
- ongoing audit and evaluation should occur.

Rec 23: All stakeholders recognise the need for strategies to address women's decisions in relation to their next birth after a caesarean section (NBAC) and develop models of care that support vaginal birth after caesarean section, particularly access to information, continuity of carer and a respect for women's capacity for decision making.

Rec 24: Hospital-based midwifery continuity of carer models (midwifery group practices) be established for women of all risk factor status so that women could have access to continuity and do not choose homebirth only as a means to access continuity.

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