AUSTRALIA

Report on

Maternal Deaths in Australia

1994-96

AIHW

For health and welfare statistics and information

NHMRC

National Health & Medical Research Council

ISBN 1 86496 0116

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Report on Maternal Deaths in Australia, 1994–96

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ACKNOWLEDGEMENTS

This report has been made possible by the cooperation of members of the medical profession, in particular the members of the Royal Australian and New Zealand College of Obstetricians and Gynaecologists, who either supplied information on patients to State and Territory Maternal Mortality Committees or served on those committees, and the State and Territory Maternal Mortality Committees who then prepared and reviewed the data on deaths. We would also like to thank Peter Day for his assistance in the preparation of average age-standardised mortality rates for this report. We would also like to acknowledge the support of the National Health and Medical Research Council and the Department of Health and Aged Care.

The Advisory Committee would also like to take the opportunity to acknowledge the exceptional and longstanding contribution that Emeritus Professor Norman Beischer has made to the surveillance and reporting of maternal deaths in Australia. His leadership in the preparation of earlier reports and substantial contribution to this current report from a clinical and scientific perspective have assisted in maintaining the highest possible obstetric care standards in Australia.

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PREFACE

The 1994–96 Report on Maternal Deaths in Australia is the eleventh in a series of triennial reports on maternal deaths dating back to 1964. This is an important series of reports that act as a sentinel for obstetric care and safe motherhood experience. The report is based on maternal mortality data across all States and Territories combined, and the AIHW and NHMRC recognise that these data are of variable quality. In an effort to improve ascertainment of maternal deaths, this particular report is based upon three data sources: States and Territories Confidential Death Enquiries, National Hospital Morbidity Database and the AIHW National Mortality Database. Nevertheless, in some cases maternal mortality data may be incomplete. Proper interpretation of these data and valid comparison with maternal mortality data from previous periods are therefore not possible in these circumstances. Improved standardisation of these data will be the aim in future reports.

There were 102 deaths reported to the Advisory Committee (Appendix 1), of which 100 deaths (46 direct, 20 indirect and 34 incidental) satisfied the definition of maternal deaths during pregnancy and the puerperium. This represented an increase of 19.0% in the number of deaths compared with the 1991–93 triennium. Of the 100 deaths, 46 were directly related to pregnancy. This represents an increase from the 27 deaths recorded in the previous triennium and reverses the trend of declining direct maternal deaths seen over the previous 15 years (54, 42, 32, 37, 27, 46). The reason for this increase is not clear and requires further investigation. The leading principal causes of direct maternal deaths remained pulmonary embolism (8), amniotic fluid embolism (8) and pre-eclampsia (7).

The Committee views with concern the increase in the number of maternal deaths, especially the number of direct deaths, the category of deaths resulting from obstetric complications of the pregnant state. The data are difficult to interpret as one-off rises or declines in the number of deaths are not conclusive; and it cannot be determined if the results indicate the beginning of a new trend or are just a normal statistical fluctuation of a very rare event, a maternal death. Both the 1991–93 and 1994–96 triennial figures may be aberrant and their significance will not be clear until the 1997–1999 and probably 2000–2002 figures are available. Therefore, it is critical that there be close monitoring of maternal deaths in the future to determine if there is a real increase and that all maternal deaths be investigated and scrutinised to determine if there are any modifiable or preventable factors.

Improved ascertainment has contributed to the increase in the total number of maternal deaths and partially explains the rise in direct deaths, as does the changing risk profile of women becoming pregnant. Many women are delaying childbirth, while an increasing number of women with complex medical problems are also having children. However, the contribution of other factors to maternal mortality, such as different models of delivery of obstetric care and the organisation of that care, requires further investigation.

The number of indirect deaths was similar to that reported in the last triennium (20 in 1994–96; 21 in 1991–93). The overall maternal mortality ratio was 13.0 per 100,000 confinements and was the highest reported since 1984. The maternal mortality ratios

for direct and indirect deaths were 6.0 and 2.6 per 100,000 confinements respectively. These figures compare favourably with those of 6.1 and 6.1 per 100,000 confinements for direct and indirect deaths respectively, published in the Report on Confidential Enquiries into Maternal Deaths in the United Kingdom for the triennium 1994–96. In Australia in the 1994–96 triennium, the incidental maternal mortality ratio was 4.4 per 100,000 confinements, a ratio that has not fallen over the past seven triennia. However, the number of direct deaths has risen during the 1994–1996 triennium to once again outnumber incidental deaths. The maternal mortality ratio for direct deaths over the 1994–1996 triennium is the highest it has been since 1981.

It is important to note that the risk of maternal death during pregnancy and the puerperium remains small, being 1 in 7,675 confinements in the 1994–96 triennium. Improved general health status and reproductive patterns, together with access to appropriate general and specialised health care has greatly reduced the incidence of maternal mortality in the last century. The incidence of preventable deaths related to avoidable patient and medical factors is now very low. However, the Committee views with concern the increase in the proportion of direct maternal deaths in which avoidable factors were considered to be possibly or certainly present, from 7 (26%) of 27 deaths in 1991–93 to 22 (48%) of the 46 deaths in 1994–96 where avoidability was considered. These data are variable in quality, and it is hoped in future reports assessment of maternal deaths will be standardised. The Committee has produced a standardised maternal death reporting form to be used in future reporting of deaths which should facilitate this objective and minimise the risk of under-reporting the details of avoidability. The adoption of this form by State and Territory Maternal Mortality Committees for the 1997–99 report will support systematic consideration and documentation of avoidable factors for all maternal deaths and enhance expert clinical surveillance.

However, despite overall general improvements, it is important to note that life-threatening complications still occur, often unpredictably. Seeking to avoid loss of women's lives in childbearing, and minimising damage to their health, remain issues of critical importance for obstetric and midwifery practice in Australia. Against this background, the higher maternal mortality rate among Indigenous childbearing women should be of continuing concern to the Australian community, and demands attention as a priority from all relevant agencies.

It is hoped that this report will assist in the development of improved practice in obstetric care and provide information to obstetric care practitioners to improve the quality and safety of health care during pregnancy and the puerperium. The scope of national examination of the health of childbearing women should now be extended to include morbidity associated with pregnancy and childbirth.

Professor William Walters

Chairperson

Advisory Committee on Maternal Mortality and Morbidity

AIMS OF THE REPORT AND DEFINITIONS OF MATERNAL MORTALITY

Aims of the report

The aims of the 1994–96 Report on Maternal Deaths, as agreed by the Advisory Committee on Maternal Mortality and Morbidity are to:

- *provide quality assurance of maternal care during pregnancy and the puerperium*. It is generally accepted that the risk of an adverse patient outcome is present in all health care interventions. While some are known and accepted risks, even when the interventions are performed expertly, adverse outcomes can occur because of mistakes or poor quality care (Department of Health and Aged Care, 1997). The encouragement of effective quality assurance is one important way of reducing the incidence of adverse patient outcomes. Through the provision of case summaries of maternal deaths this report aims to inform and educate health professionals about obstetric care.
- *provide public health surveillance of maternal deaths.*
- *provide an epidemiological overview of trends in maternal deaths across Australia.* With the provision of the age distribution, Indigenous status and parity as well as the comparable female death rate in the wider population, this report provides an important epidemiological overview of maternal deaths across Australia.
- *refine a national standard for the reporting of maternal deaths.* With the clear enunciation of a definition and timeframe for the collection of maternal death information, this report provides a standard which, it is hoped, will promote uniform collection and reporting of maternal deaths throughout Australia.
- *situate Australia in an international context in terms of maternal mortality ratios.* With the provision of maternal mortality ratios which are comparable with those used internationally, this report is able to situate Australia in an international context.
- *provide information to women of reproductive age who are contemplating pregnancy*. Deaths attributable to pregnancy do occur, albeit infrequently. This report provides details of some of the complications of pregnancy which may occur, and is a particularly useful reference for women with pre-existing medical conditions who are contemplating pregnancy.

The 1994–96 Report on Maternal Deaths is the eleventh in the series, and builds upon and continues a high standard of reporting that has been developed in Australia over the previous 30 years.

Australian definitions of maternal mortality

Maternal mortality as defined by the World Health Organization (WHO) is the death of a woman while pregnant or within 42 days of the termination of pregnancy, irrespective of the duration and the site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management. This definition includes deaths of women from terminations of pregnancy, spontaneous abortion, miscarriage and ectopic pregnancy, but excludes deaths from incidental causes. Also excluded are deaths from assisted reproduction technologies where pregnancy has not occurred. ***In all previous reports on maternal deaths in Australia, incidental deaths have been included in the definition of maternal mortality, as have deaths occurring more than 42 days after termination of the pregnancy, when their origin and illness related to the pregnancy.***

However, the timeframe of maternal deaths included in this current report has been altered. There are two reasons for this. Firstly, from a data collection point of view a cut-off time for the collection of maternal deaths is required. Previously, deaths occurring more than 42 days after termination of pregnancy, where the origin and illness were related to the pregnancy, were included in the definition. However, this does not specify a time at which data collectors should cease exploring deaths related to pregnancy. Internationally, a timeframe of 12 months seems to have been adopted which includes "late maternal deaths". Secondly, the variation in definitions of maternal deaths used by the States and Territories in Australia means that uniform data collection has not occurred. Given these deficiencies it has been decided that the lowest common denominator of data provided will be included. Thus, *only deaths among pregnant women or within 42 days of pregnancy being delivered or terminated will be included as maternal deaths in this report*. This definition equates to what are known internationally as "pregnancy-related deaths".

Classification of maternal deaths in Australia

Maternal deaths occurring in Australia are classified into three groups: direct deaths, indirect deaths and incidental deaths.

Table 1 Classifications for maternal deaths occurring in Australia

Direct deaths are those *resulting from obstetric complications of the pregnant state* (pregnancy, labour and puerperium), from interventions, omissions, incorrect treatment, or from a chain of events resulting from any of the above. They are complications of the pregnancy itself. e.g. eclampsia, amniotic fluid embolism, rupture of the uterus, postpartum haemorrhage
Indirect deaths are those *resulting from pre-existing disease* or disease that developed during pregnancy and was not due to direct obstetric causes, but which may have been *aggravated by the physiological effects of pregnancy*. e.g. heart disease, diabetes, renal disease
Incidental deaths are those *due to conditions occurring during pregnancy*, where the pregnancy is unlikely to have contributed significantly to the death, although it is sometimes possible to postulate a distant association. e.g. road accidents, malignancies

It is often difficult for the expert committees to decide whether a death is an indirect or an incidental death. For example, death from a self-administered overdose could be unintentional or suicide, and may or may not have been due to some effect of the pregnant state on the woman.

In this report, *parity* is defined as the number of previous pregnancies resulting in livebirths or stillbirths and excludes the current pregnancy.

Denominators used in calculation of maternal mortality ratios

Maternal mortality ratios reported worldwide tend to use a denominator of livebirths, since in many developing countries these are the best data available. Previous maternal death reports in Australia have used confinements as a denominator in the calculation of maternal mortality rates. This report will provide ratios using both livebirths and confinements to facilitate international comparison.

Confinements are the number of pregnancies of 20 weeks' gestation or more resulting in a livebirth or a stillbirth. Table 2 shows the denominator data of total confinements, livebirths and stillbirths used in this report.

Table 2 Confinements and births by maternal age, Australia, 1994–96

	Age of mother (years)							
Maternal age	**<20**	**20–24**	**25–29**	**30–34**	**35–39**	**>40**	**Not stated**	**All ages**
Confinements	40,667	144,516	251,624	227,666	88,374	14,354	247	767,448
Stillbirths	419	1,053	1,530	1,473	732	170	9	5,386
Livebirths	40,547	144,893	253,535	230,111	89,334	14,426	239	773,085
Total births	**40,966**	**145,946**	**255,065**	**231,584**	**90,066**	**14,596**	**248**	**778,471**

Source: National Perinatal Data Collection, Australian Institute of Health and Welfare (AIHW) National Perinatal Statistics Unit

A *livebirth* is defined as a liveborn infant weighing at least 400 g, or if the weight is not known, born after at least 20 weeks' gestation. Table 2 shows the denominator data of livebirths used in this report.

A *stillbirth* is defined as a stillborn infant weighing at least 400 g, or if the weight is not known, born after at least 20 weeks' gestation. A stillborn infant is one that does not breathe or show any other sign of life after birth.

Furthermore, in line with recent international conventions (WHO, 1999), this report will use the term "maternal mortality ratios" instead of "maternal mortality rates". The most appropriate denominator for estimating maternal mortality rates is the number of women at risk, that is, the number of pregnant or recently pregnant women. However, this figure is not accurately known, the unknown component being the number of pregnancies ending before 20 weeks' gestation. The World Health Organization (WHO) defines maternal mortality ratio as the number of maternal deaths, related to the number of livebirths, as this denominator is available in most countries. In Australia, reliable data are available on the number of pregnancies resulting in a livebirth and those resulting in a stillbirth. In this report, (except in Table 4), the maternal mortality ratios have been calculated as:

$$\frac{\text{Number of maternal deaths} \times 100{,}000}{\text{Total number of pregnancies (resulting in livebirths and stillbirths)}}$$

CHAPTER 1

INTERNATIONAL MEASURES OF MATERNAL MORTALITY

The incidence of maternal mortality remains a significant problem worldwide. There is a significant disparity between developing and developed countries with maternal mortality rates in developing countries reported to be as much as 200 times those in developed countries (Koblinsky, 1995). Despite increasing awareness of the extent of this problem, there is no international standard in either the definition or calculation of maternal mortality rates or ratios.

International definitions of maternal deaths

There are two important criteria which differentiate definitions of maternal deaths—their temporal and causal relationships to pregnancy (Atrash, Alexander & Berg, 1995). Temporally, deaths which have occurred in the 42 days post-pregnancy (equivalent to the puerperium) have been considered maternal deaths. However, recent definitions have tended to increase the timeframe under review to 12 months after the termination of pregnancy. International definitions have also varied in their inclusion of the three main causes of maternal deaths—direct obstetric causes, indirect obstetric causes and incidental or fortuitous causes.[1] The following figure provides details of some of the current definitions in use in the international literature, indicating their temporal and causal relationships to pregnancy.

Figure 1 International definitions of maternal mortality

Term	Causality			Timing
	Direct	Indirect	Incidental	
Maternal death[2]	■	■		0–42 days
Pregnancy-related death[3]	■	■	■	0–42 days
Late maternal death[3]	■	■		43–365 days
Pregnancy-associated death[4]	■	■	■	0–365 days
Obstetric death[5]	■	■		0–365 days
Non-obstetric death[5]			■	0–365 days

Note: shaded areas indicate which of the classifications of maternal death (direct, indirect or incidental) are included in each definition.

[1] 'Fortuitous' is the term given to incidental deaths in the United Kingdom.
[2] A term used in the International Classification of Diseases, 9th edition (WHO, 1978)
[3] A term used in the International Classification of Diseases, 10th edition (WHO, 1992)
[4] A term used by the Centre for Disease Control, United States and the American College of Obstetricians and Gynecologists (ACOG); cited in Atrash, Alexander and Berg (1995)
[5] A term used by Salanave et al. (1999) and Mertz, Parker and Halpin. (1992)

The national report on maternal deaths in Australia has traditionally used a definition of maternal deaths which includes ***pregnancy-related deaths*** and ***late maternal deaths***, although the timing for late maternal deaths has not been clearly specified. However, this 1994–96 report is using a definition of maternal death which equates to the term 'pregnancy-related deaths'.

Calculation of ratios

There has been some suggestion that calculations of the extent of maternal mortality should be considered in terms of ratios, not rates (Al-Meshari et al. 1996). The World Health Organization (WHO, 1999) differentiates between a **maternal mortality ratio**, which represents the risk associated with each pregnancy, and is calculated using a denominator of livebirths, and a **maternal mortality rate** which measures both the obstetric risk and frequency with which women are exposed to this risk, using a denominator of women of reproductive age (15–49 years). Whilst there has been a range of denominators used in the calculation of maternal mortality ratios—livebirths, livebirths and stillbirths, and confinements or maternities—there remain cases in numerators which are not included in these denominators. A prime example of this is the abortive complications which may precipitate maternal deaths, but which are never completely included in the denominators. Another important inclusion in numerators of maternal deaths are dead-on-arrival patients where normal deliveries at home may not have been included in the denominator. Consequently, this report will provide maternal mortality ratios.

With the calculation of maternal mortality ratios across the world using a variety of denominators, international comparison is not often possible. Fortney (1990) has suggested that the variety of definitions and denominators used in developed countries is contextually appropriate, however it is important to report in an internationally standard format (with relevant time periods and a livebirth denominator).

It is worthy of note that such variations in the reporting of maternal deaths also occur nationally. Mertz et al. (1992) found differences between state and national definitions in the United States. Likewise, throughout Australia there are disparities in the definitions used to define maternal deaths, and the denominators used in the calculation of ratios.

International trends in maternal deaths

Grimes (1994) suggests that the primary causes of maternal death in developed countries have moved from the traditional HIT triad of haemorrhage, infection and toxaemia. This is evident in the primary causes of direct maternal death between 1991 and 1996 in Australia which were pulmonary embolism, amniotic fluid embolism and pre-eclampsia. However, the complexity of deaths may well be increasing as more common causes are addressed so that in some cases the "pathology to death" is unclear (Bouvier-Colle et al. 1991).

Indirect causes of maternal death are assuming more prominence (Mertz et al. 1992; Rochat et al. 1998; Department of Health, Welsh Office et al., 1996). Cardiac disease, in some areas, has been reported to be more prevalent than deaths from haemorrhage, genital sepsis or abortion (McFaul et al. 1988). The last triennial report on maternal deaths in Australia found more deaths attributable to cardiovascular disease than any single direct cause. The decrease in direct deaths in previous triennia may have brought about an increased awareness of indirect and incidental causes of maternal deaths.

With the shift of focus from direct causes of maternal death to indirect and incidental causes, has come the identification of some conditions which overlap the causal classifications. Classification differences have been connected with some cancers, stroke, asthma, liver cirrhosis, pneumonia with influenza, anorexia nervosa and many violent deaths such as suicide, homicide and accidents (Gissler et al. 1997; Bouvier-Colle et al. 1991; Beischer, 1992; Högberg & Sandström, 1994).

In the United Kingdom Report on Maternal Deaths, those which have been classified at a local level as incidental (e.g. suicide, cardiac disease, asthma, epilepsy) have been reclassified at a national level into indirect deaths. Although there appear to be inconsistencies in the classification of some maternal deaths in the Australian Report on Maternal Deaths for 1994–96, **the Advisory Committee on Maternal Mortality and Morbidity decided not to reclassify deaths which had been classified by State and Territory Maternal Mortality Committees.**

Australian mortality ratio in an international context

Royston and Armstrong (1989) have reported that ratios of maternal mortality in Australia are comparable to those of Canada, Japan, New Zealand and the USA. Maternal mortality ratios in these countries, like those of western and northern Europe, tend to be around 10 (direct deaths) per 100,000 (livebirths), equal to the lowest in the world. Ratios in southern and eastern Europe are slightly higher and, with the notable exception of Romania with a high rate of abortion-related mortality, are rarely more than 30 deaths per 100,000 livebirths.

The international maternal mortality ratios in Table 3 include *direct and indirect maternal deaths* occurring within 42 days of termination of pregnancy. Ratios will differ from those reported in Australia, since the Australian definition includes direct, indirect *and incidental* maternal deaths occurring within 42 days of pregnancy and uses a denominator of confinements, not livebirths. The ratios reported in Table 3 are revised estimates which compensate for under-reporting and misclassification and thus should only be used with caution for general comparisons.

According to the maternal mortality ratios calculated for the developed countries listed in Table 3, Australia is equal ninth with Denmark and the United Kingdom. Indonesia has by far the highest maternal mortality ratio, whilst Canada, Norway and Switzerland have the lowest maternal mortality ratios. The Australian fertility rate is in line with that of China, with the highest fertility rates seen in Malaysia, Israel and Indonesia and the lowest rates in Italy and Spain.

Maternal mortality ratios[6]

Table 3 International maternal mortality ratios in relation to population size, total fertility rate and probability of dying for females aged 15–59, 1990, 1998

	Total population size (000)	Total fertility rate	Probability of dying for females aged 15–59 (per 1,000)	Maternal mortality ratio (per 100,000)*
Country	**1998**	**1998**	**1998**	**1990**
Australia	18,520	1.8	56	9
Canada	30,563	1.6	61	6
China	1,255,698	1.8	101	95
Denmark	5,270	1.7	96	9
France	58,683	1.7	63	15
Germany	82,133	1.3	66	22
Greece	10,600	1.3	49	10
Indonesia	206,338	2.6	184	650
Ireland	3,681	1.9	66	10
Israel	5,984	2.7	61	7
Italy	57,369	1.2	54	12
Japan	126,281	1.4	50	18
Malaysia	21,410	3.2	107	80
Netherlands	15,678	1.5	65	12
New Zealand	3,796	2.0	79	26
Norway	4,419	1.9	59	6
Singapore	3,476	1.7	78	10
Spain	39,628	1.2	54	7
Sweden	8,875	1.6	63	7
Switzerland	7,299	1.5	60	6
United Kingdom	58,649	1.7	69	9
United States of America	274,028	2.0	79	12

(continued)

[6] International maternal death statistics are often reported as ratios, since the denominator for calculation does not relate directly to cases included in the numerator.

Table 3 (continued) International maternal mortality ratios in relation to population size, total fertility rate and probability of dying for females aged 15–59, 1990, 1998

	Total population size (000)	Total fertility rate	Probability of dying for females aged 15–59 (per 1,000)	Maternal Mortality ratio (per 100,000)*
Country	**1998**	**1998**	**1998**	**1990**
All WHO countries	**5,884,576**	**2.7**	**156**	**430**
Africa	601,783	5.4	428	940
The Americas	802,811	2.4	109	140
Eastern Mediterranean	473,644	4.4	172	440
Europe	870,128	1.6	95	59
South-East Asia	1,485,056	2.9	189	610
Western Pacific	1,651,154	1.9	100	120

Source: World Health Report (1999). World Health Organization: Geneva.
* Per 100,000 livebirths. These are estimates for 1990 which measure the risk of death once a woman has become pregnant.
Total fertility rate = average number of children born to a woman of reproductive age.
Maternal mortality ratio includes direct and indirect deaths.

Table 4 details the 100 maternal deaths as per international reporting conventions. This differs from the standard reporting of maternal deaths in Australia in two ways: first, only direct and indirect deaths are included (incidental deaths are omitted) and second, the denominator is per 100,000 livebirths instead of per 100,000 confinements which includes livebirths and stillbirths. Using this formula, the internationally comparable mortality ratio is 8.5, compared to the 9.0 estimated by WHO for 1990 (Table 3).

Table 4 Number of maternal deaths, and maternal mortality ratio using a livebirths denominator, Australia, 1994–96

	Direct	Indirect	Direct + indirect deaths	Incidental	Total deaths
Number of maternal deaths	46	20	66	34	100
Maternal mortality rate*	6.0	2.6	8.5	4.4	12.9

Sources: State and Territory Maternal Mortality Committees, National Perinatal Data Collection
* Per 100,000 livebirths; note rounding error

The Reports on Confidential Enquiries into Maternal Deaths in the United Kingdom have set a gold standard of reporting on maternal deaths which has been emulated elsewhere. Since the United Kingdom reports include incidental deaths like Australia (although they refer to them as fortuitous), they provide an interesting comparison to

Australia. Table 5 illustrates a similar proportion of direct deaths to Australia (46.0% in Australia; 44.1% in the UK). However the proportions of indirect and incidental deaths are quite different with indirect deaths in the United Kingdom double those of Australia (20.0% in Australia; 44.1% in the UK) while incidental deaths in the United Kingdom are only one-third of those reported in Australia (34.0% in Australia; 11.8% in the United Kingdom). This disparity may partially be explained by the practice of reclassifying incidental deaths (such as suicide, cardiac disease, asthma and epilepsy) into indirect deaths in the United Kingdom.

Table 5 Distribution of maternal deaths by triennium, Australia and United Kingdom, 1982–96

Australia

	Direct		Indirect		Incidental		
Triennium	**No.**	**%**	**No.**	**%**	**No.**	**%**	**Total**
1982–84	42	44.7	25	26.6	27	28.7	94
1985–87	32	37.2	30	34.9	24	27.9	86
1988–90	37	38.5	33	34.4	26	27.1	96
1991–93	27	32.1	21	25	36	42.9	84
1994–96	46	46.0	20	20.0	34	34.0	100

United Kingdom

	Direct		Indirect		Incidental		
Triennium	**No.**	**%**	**No.**	**%**	**No.**	**%**	**Total**
1982–84	138	56.8	71	29.2	34	14.0	243
1985–87	139	55.8	84	33.7	26	10.4	249
1988–90	145	52.4	93	33.6	39	14.1	277
1991–93	128	46.7	100	36.5	46	16.8	274
1994–96	134	44.1	134	44.1	36	11.8	304

Sources: Reports on Maternal Deaths in Australia, 1982–84, 1985–87, 1988–90 and 1991–93. Australian Government Publishing Service: Canberra; Reports on Confidential Enquiries into Maternal Deaths in the United Kingdom, 1982–84, 1985–87, 1988–90, 1991–93 and 1994–96. Department of Health, Welsh Office, Scottish Office Home and Health Department; Department of Health and Social Services, Northern Ireland.

CHAPTER 2

DATA ISSUES—COMPILATION OF MATERNAL DEATHS REPORT, 1994–96

State and Territory Maternal Mortality Committees

This is the eleventh triennial report on maternal deaths in Australia. It covers the years 1994, 1995 and 1996. Each State and Territory has an expert committee that reviews all maternal deaths (Appendix 2). The composition of these committees usually comprises some or all of the following experts—obstetricians, obstetric physicians, midwives, pathologists, neonatologists, general practitioners, epidemiologists, and Indigenous and consumer representatives. Each State and Territory committee has developed different ways to maximise the maternal death notifications; this may include notifications from Health Departments, hospitals, attending practitioners, coroner's office, Registrar of Births, Deaths and Marriages and review of the perinatal and hospital morbidity collections (Appendix 3). Each death is then comprehensively reviewed. The sources of information reviewed include any hospital admissions, autopsy, toxicology, police and coroners' reports, and other ancillary information. The information collected by the States and Territories is of variable quality and timeliness. Type of information collected may include usual residence and place death occurred, date of death, age at death, parity, gestational age at death, country of birth, date of delivery or abortion, number of days postpartum, Indigenous or Torres Strait Islander status, baby outcome, relevant medical history, interventions/procedures, admission to ICU/CCU, blood transfusion, mechanical ventilation and anaesthesia, terminal event, post-mortem conducted, coronial inquest, pathology results, toxicology findings, principal and underlying cause of death, classification of death, any avoidable factors and those present at the terminal event. This information is consolidated into a narrative as a case summary.

The State or Territory Maternal Mortality Committees review confidential reports on each maternal death that has occurred within their jurisdiction. The committees consider each death individually and determine the cause of death where possible. Some of the committees also review the deaths for the presence of any avoidable factors. The State and Territory Maternal Mortality Committees also classify each maternal death as direct, indirect or incidental. A number of the State and Territory committees publish annually the findings of their maternal death review in State reports. This report collates the findings made available by State and Territory committees.

Assessment of avoidable factors

The determination and assessment of avoidable factors by State and Territory Maternal Mortality Committees or their equivalent in the investigation of a maternal death is not standardised for the 1994–96 report. There is no agreed national definition for an avoidable death nor an objective instrument to review them. The accepted definition for an avoidable death is of "some departure from the accepted standard of satisfactory care by the woman, practitioner or institution" which may

have contributed to the death. In the 1994–96 report avoidability was assessed to some extent by seven of the eight States and Territories. The process for assessing avoidability was not standardised across the jurisdictions and in some States it was only indicated in a general sense if an "avoidable factor" was present with no assignment of the category of avoidability. These categories include practitioner (medical or nursing), the medical care facilities/institution or the patient. The review usually includes the place of death, the facilities that were available and the status of the medical attendant/s.

Thus, it is important to note that these data are variable and must be interpreted cautiously in the light of these limitations. The Committee has produced a standardised maternal death reporting form to be used in future reporting of deaths which should facilitate standardised reporting of deaths and minimise the risk of under-reporting the details of avoidability. The adoption of this form by State and Territory Maternal Mortality Committees for the 1997–99 report will support systematic consideration and documentation of avoidable factors on all maternal deaths and enhance the expert clinical surveillance of maternal deaths. The Committee intends reviewing the standards for investigating avoidability when it comes out of recess.

It is also important to emphasise that it is not suggested in cases in which avoidable factors are considered to be present, that death could certainly have been prevented, but that the presence of an avoidable factor is regarded as an indication that the risk of death could have been lessened. This information is critical to ongoing efforts to ensure safe motherhood.

Role of Advisory Committee

The role of the Advisory Committee on Maternal Mortality and Morbidity was to oversee the compilation of all the deaths into a national report. The Committee sought advice from the National Health and Medical Research Council (NHMRC) on the development of the maternal deaths report and the NHMRC indicated that it regarded the preparation of the report as public health surveillance not research. The Committee concurred with this finding but despite this a number of the State and Territory data providers required ethics approval prior to agreement to provide data. For the first time in the production of triennial maternal death reports, the Committee sought and gained ethics approval from the AIHW Ethics Committee and the University of New South Wales Committee on Experimental Procedures involving Human Subjects (CEPIHS) for the review of the deaths and production of the report. All Committee members signed confidentiality undertakings as defined at section 29(1) of the AIHW Act 1987 prior to any access to the data.

The Advisory Committee requested maternal death data from all the States and Territories for the period 1994–96. All States and Territories provided data by May 2000 to the Committee. Data were stored in a secure environment at the National Perinatal Statistics Unit, University of New South Wales under AIHW guidelines. The data received from the States and Territories were variable in detail and quality.

The data were sent without names, addresses, date of birth, date of death nor institution(s) where care or death occurred. Regional level data were not made available to the Committee and a decision was made by the Committee not to categorise data by State and Territory. Due to the very small number of deaths and the sensitive nature of the report all efforts were taken to minimise the identifiability of the cases. The Committee considered that spontaneous recognition may occur but that this small risk did not warrant the use of perturbation in the report. Furthermore, the Committee felt strongly that the integrity and utility of the report would be irreparably damaged by perturbation. It should be noted that all deaths occurred 4–6 years prior to the compilation of the report. The Committee reviewed all deaths but did not reclassify deaths. The direct, indirect and incidental deaths classifications are those assigned by the State and Territory committees and not necessarily the classification of the Advisory Committee.

The Advisory Committee on Maternal Mortality and Morbidity reviewed each death and assigned to it a major cause of death.

The Advisory Committee also reviewed the format of the existing report, and decided to strengthen the epidemiology section and international comparisons on maternal deaths.

Cause of death

Each death was assigned principal and contributory[7] causes of death by the Advisory Committee. This allowed the deaths to be categorised into major groups which facilitates review of best practice in obstetric care. Only deaths that satisfied the inclusion criteria of death occurring during pregnancy or up to 42 days post-pregnancy or post-termination were included in the report. The definition of maternal death used in this report was adopted because at a State and Territory level there is differential ascertainment of deaths occurring between 42 and 365 days post-delivery or termination of pregnancy. There were two maternal deaths that did not satisfy the maternal death definition used in the report. These two late direct maternal deaths are detailed in Appendix 4.

Case summaries

The case summaries presented in this report are summarised from antenatal records, hospital notes, post-mortem reports and coroner's reports. They are de-identified as far as possible, whilst retaining information relevant to the understanding of the causal pathway which resulted in a maternal death. Case summaries are standardised to include age, gravidity, parity (excluding the current pregnancy), gestational age at death, relevant medical history, causes of death and classification as direct, indirect and incidental.

[7] These include the antecedent causes of other significant conditions nominated on the medical certificate of cause of death.

However, there has been a number of changes to the presentation of case summaries when compared to previous reports on maternal deaths in Australia. Whereas previously case summaries have been repeated within each report in all relevant chapters, in this report complete case summaries are only included in the chapter with the principal cause of death. Where there have been contributory causes that relate to each of the chapters, the details of these cases are presented in summary tables to facilitate discussion of each condition. The conditions described in each chapter are considered separately; of the 100 deaths in this triennium, 58 were considered in only one chapter, 27 in two chapters, 10 in three chapters, 4 in four chapters and 1 in five separate chapters. Therefore, the 100 deaths provided 163 cases for discussion. Unlike the direct and indirect deaths, incidental deaths have not been considered in multiple chapters.

Each case summary has been assigned a unique identification number which relates to the primary chapter of inclusion, for ease of reference.

All case summaries of incidental deaths have been included in a single chapter and have not been cross-referenced with other chapters (as have direct and indirect deaths). This has necessitated the removal of the miscellaneous chapter appearing in previous reports and the inclusion of two replacement chapters. Chapter 14 covers 'medical conditions not classifiable elsewhere' and has been added to include any direct or indirect deaths in which the principal or contributory cause does not correlate with any of the other chapter headings in the report. Chapter 15 includes *all incidental deaths*.

Ascertainment of maternal deaths, 1994–96

The reduction in maternal mortality rates in developed countries has led to a focus on more inclusive definitions and more comprehensive collection systems. It is the abortion-related (Bouvier-Colle et al. 1991), indirect and incidental causes that are most likely to have been omitted from maternal mortality statistics based upon routine notification. This makes the inclusion of a pregnancy tick-box, and both primary and underlying causes of death on death certificates an important step in increasing ascertainment of maternal deaths in the future.

Ascertainment studies which have supplemented routine official notifications with record linkage to other official statistics and surveys to clinicians have revealed evidence that the magnitude of maternal mortality in developed countries is still seriously underestimated (Atrash et al. 1995). A recent study by King and Flenady (1999) revealed an under-reporting rate of 34% in Queensland between 1994 and 1997, which was discovered by surveying obstetricians in hospitals throughout the state. King and Flenady's study has contributed eight cases of maternal deaths to this report which were not identified through routine processes of notification.

To maximise the ascertainment of deaths in this triennium two additional data systems were reviewed. The two data systems were the Australian Institute of Health and Welfare (AIHW) National Hospital Morbidity Database (NHMD) and the AIHW National Mortality Database (NMD). The parameters used to search

these databases were women aged 11–54 years with an ICD9 code related to pregnancy (630–677). All relevant separations with a discharge status of death were reviewed to determine if they matched a similar death profile among the data provided by the States and Territories. These data were not matched electronically using the matching software Automatch. The National Death Index was also not used as the confidential death data provided to the NPSU is not identifiable (named) death data.

The AIHW National Mortality Database was reviewed for underlying cause of death for women aged 11–54 years, with an ICD9 (630–677) related pregnancy coding, by age, State of residence and death. There were 75 deaths with a pregnancy code. All data received were de-identified. The confidential death data provided to the NPSU did not have date of birth nor date of death which limited severely any checking or validation of the death data. This meant that attempts to maximise ascertainment of maternal deaths for the triennium were very limited. These were key items required to validate the data across different data sets. The data items would only be used to determine if all deaths were being captured by the different data collections and would not be used in the reporting of data. If a new death was identified the relevant State or Territory committee was notified to review and investigate the possible death.

A similar problem occurred with the use of the NHMD, where the maternal date of birth and actual age in years were not available from some or all States and Territories. This was compounded by the lack of maternal dates of birth and death in the confidential death data provided to the NPSU, which also severely limited any attempts to validate the data. There were also considerable coding errors in the NHMD from one State that led to the data being unusable for two of the three years of the triennium. Analysis of the NHMD revealed initially 158 deaths that had a discharge status of death; of those 48 were excluded due to coding errors from one State, leaving 110 deaths from the NHMD for review. At the time of submitting this report, the NHMD ascertainment exercise had provided two additional maternal deaths to those identified by the State and Territory Maternal Mortality Committees. The two deaths were followed-up by the relevant State and Territory Maternal Mortality Committees and have been included in the report.

The preliminary review of the 102 confidential maternal deaths submitted to the Committee (by State and Territory Maternal Mortality Committees), including the two late deaths that were later excluded (Appendix 4), revealed 70 (69%) cases had a corresponding death reported by the NHMD and/or ABS mortality data. Thirty-two (31%) maternal death cases from the State and Territory Maternal Mortality Committees were not identified in either the NHMD or ABS mortality data. Of the 70 cases, 26 (37%) cases were reported by all three data sets. The data ascertainment for the triennium 1994–96 is ongoing as individual States and Territories are contacted to review possible new maternal deaths identified from either the NHMD or National Mortality Database (NMD).

It is critical that full data items be made available for the purposes of maximising ascertainment in future reports, in particular the dates of maternal birth and death. The surveillance of maternal deaths is a sensitive indicator of pregnancy care and outcomes. To maximise ascertainment of maternal deaths there should be a process in place that allows validation of death data. At a minimum, this should include the three following data sets: State and Territory Maternal Mortality Committees confidential death enquiries, Registrars of Births, Deaths and Marriages/ABS death data, and hospital inpatient data.

Death certificates

Despite the emphasis in the literature on maternal mortality on the inclusion of pregnancy tick-boxes on death certificates, at present a pregnancy tick box is not included on all Australian State and Territory death certificates. In the few States which include a pregnancy tick-box, the timeframe of reference is the last three months, i.e. 'Was the deceased pregnant within the last three months?'. However, definitions of maternal mortality focus upon the 42 days of the puerperium, not three months. Furthermore, the international use of definitions of 'late maternal deaths' and 'pregnancy-associated deaths' assumes the presence of systems of vital registration which identify deaths related to pregnancy which occur within one year of pregnancy (WHO, 1992). Beischer (1992) has long advocated the need for a twelve-month timeframe of pregnancy status recognition on death certificates in Australia.

At present, State and Territory confidential enquiries into maternal deaths are conducted using death certificate data whose primary source is the Registrar of Births, Deaths and Marriages. This information is received, after coding by the ABS according to the International Classification of Diseases[8]. For their data, the ABS relies upon completion of medical certificates of cause of death. In the 1994–96 triennium, for a maternal death to be noted a pregnancy code had to be assigned to the cause of death. This assumes:

- Pregnancy was related to the underlying cause of death (not any of the other multiple causes which may have been present). Until 1997 only the underlying cause of death was recorded in the ABS database. Thus for incidental deaths, where there is no obvious link between the death and the pregnancy, a question of ascertainment is raised. A maternal death 'flag' was introduced in 1994 to address this issue.
- Coding was accurately completed. Direct causes of death are likely to be coded correctly, however indirect causes such as cerebrovascular disorders are coded differently in relation to pregnancy, than in the rest of the population. If mention of pregnancy status is not obvious on the death certificate, such a condition could be miscoded.

[8] See Appendix 3 for maternal death data collection methods for each of the Australian States and Territories.

- Data entry was accurate. There is significantly more room for error in the entering of a numeric code of up to four digits (National Coding Centre, 1996), than where a yes/no response is involved. Extensive edits of the database reduce this possibility.

However, ascertainment of maternal deaths in subsequent triennia should improve with the adoption of coding of multiple causes of death by the ABS in 1997, and an Australian standardised medical death certificate. A standardised certificate is currently being developed and should progressively be introduced to States and Territories over the next few years. The standardised format will include two tick-boxes indicating the existence of a) pregnancy within the last 42 days (six weeks), and b) pregnancy between 42 days and 365 days ago. This increased surveillance should have a significant effect on maternal mortality statistics in Australia. The United States Pregnancy Related Mortality Surveillance System has requested that such information be provided on death certificates after finding that increased attention to pregnancy-related mortality (in the form of pregnancy tick-boxes, and linkage with birth or fetal death certificates) contributed to an observed increase in the number of reported pregnancy-related deaths in the United States between 1987 and 1990 (Berg et al. 1996).

Standardised reporting

The separation of direct and indirect deaths into separate chapters from deaths due to incidental causes has highlighted inconsistencies in the classification of maternal deaths. For instance, some deaths from suicide have been classified as indirect, while others have been classified as incidental . The assessment of whether the death was due to some effect of the pregnant state is often difficult to ascertain.

Given the considerable time devoted to classification of maternal deaths by State and Territory Maternal Mortality Committees, and the summarised nature of the information available at a national level, the Advisory Committee on Maternal Mortality and Morbidity did not reclassify deaths. It is anticipated that inconsistent classification of maternal deaths will be addressed in the future by the development of nationally-agreed terms of reference on maternal death classification and reporting. It is hoped in the future that a proposal for standardised reporting of maternal deaths will be submitted to the National Health Information Management Group for endorsement.

Key indicators such as avoidable factors, Indigenous status and weight have not been collected uniformly across Australia. A standardised Maternal Death Reporting Form has now been developed which should facilitate uniform reporting of maternal deaths in the next triennium. The minimum information sought includes: State of usual residence, State of death and State where the committee reviewed the death, date of death, age at death, parity, gestational age at death, mother's country of birth, date of delivery or abortion, number of days postpartum , Indigenous or Torres Strait Islander status, place of death, baby outcome, relevant medical history, investigations, interventions, procedures, admission to ICU/CCU, blood transfusion,

mechanical ventilation and anaesthesia, terminal event, post-mortem conducted, coronial inquest, toxicology findings, principal and underlying cause of deaths, classification of death, any avoidable factors, those present at the terminal event. This information is supplemented by a case summary of the death. This will allow more standardised reporting of the maternal deaths and enhance the surveillance system.

It is possible that some of the variation in the proportions of deaths classified as direct, indirect or incidental may be attributable to classification procedures. Consequently, it is important that deaths classified as incidental be included to produce a proper overview of deaths which are related to pregnancy.

CHAPTER 3

SUMMARY OF MATERNAL DEATHS FINDINGS, 1994–96

There were 100 deaths in the 1994–96 triennium that satisfied the definition of maternal deaths being used in this report. The maternal mortality ratio was 13.0 deaths per 100,000 confinements. The 100 deaths was a rise of 16 deaths (19.0%) from the previous triennium 1991–93 (Table 6). This is of major concern as it reverses the trend of declining maternal deaths in Australia seen over the previous 15 years.

Table 6 Maternal deaths in each triennium, Australia, 1964–96

Triennium	Total confinements	Maternal deaths	Maternal mortality ratio*
1964–66	667,649	275	41.2
1967–69	713,064	237	33.2
1970–72	790,818	244	30.9
1973–75	726,690	137	18.9
1976–78	678,098	106	15.6
1979–81	682,880	98	14.4
1982–84	713,985	94	13.2
1985–87	726,642	86	11.8
1988–90	754,468	96	12.7
1991–93	769,253	84	10.9
1994–96	767,448	100	13.0

Sources: ABS, AIHW National Perinatal Data Collection, State and Territory Maternal Mortality Committees
* Per 100,000 confinements

Of the 100 maternal deaths, 46 (46.0%) were classified as direct, 20 (20.0%) as indirect and 34 (34.0%) as incidental (Table 7). The rise in deaths seen in this triennium occurred almost exclusively among the direct deaths.

Table 7 Maternal deaths and mortality ratio using a confinements denominator, Australia, 1994–96

	Direct	Indirect	Incidental	Total deaths
Number of maternal deaths	46	20	34	100
Maternal mortality ratio*	6.0	2.6	4.4	13.0

Source: AIHW National Perinatal Data Collection, State and Territory Maternal Mortality Committees
* Per 100,000 confinements

The 46 direct maternal deaths shows an increase of 19 direct maternal deaths when compared to the 27 recorded in the previous triennium. This is the highest number of direct deaths reported since the 1979–81 triennium. The reason for this increase is not clear and requires further investigation. The leading principal causes of direct maternal deaths remained pulmonary embolism (8; 17.4%), amniotic fluid embolism (8; 17.4%) and pre-eclampsia (6; 13.0%) (Table 8). There was one direct maternal death associated with a homebirth.

Table 8 Direct maternal deaths by principal cause, Australia, 1994–96

Cause of death	Number
Pulmonary embolism	8
Amniotic fluid embolism	8
Pre-eclampsia, pregnancy-induced hypertension	6
Ectopic pregnancy	5
Septicaemia	5
Termination of pregnancy	3
Ruptured uterus	2
Primary postpartum haemorrhage	1
Spontaneous abortion	1
Placenta praevia	1
Placental abruption	1
Intracranial haemorrhage	1
Ruptured artery	1
Thrombotic thrombocytopenia	1
Thrombocytopenia	1
Anaesthesia-related	1
Total	**46**

Source: State and Territory Maternal Mortality Committees
Note: Each death has been attributed a single cause as decided by the relevant State and Territory Maternal Mortality Committee. In a significant number multiple factors were present.

There were 20 indirect deaths in the triennium compared to the 21 deaths in the previous triennium. The most common principal cause of indirect death was cardiorespiratory disease, with 10 of the 20 (50%) indirect deaths being in this category (Table 9). Of the 10 cardiorespiratory deaths, 2 deaths were due to mitral and aortic valvular disease. Other important causes were cerebrovascular disease (2), infections (2), suicide (2) and miscellaneous (4) (Table 9). It should be noted that some cases of suicide in this report have been classified as incidental deaths by the various State and Territory committees.

Table 9 Indirect maternal deaths by principal cause, Australia, 1994–96

Cause of death		Number
Cardiovascular disease		**10**
Cardiomyopathy	1	
Myocardial infarction	1	
Cardiac arrhythmia	1	
Pregnancy-induced hypertension	1	
Pre-eclampsia	1	
Dissecting coronary artery aneurysm	1	
Mitral and aortic valvular disease	2	
Eisenmenger syndrome	1	
Septal defects	1	
Infection		**2**
Pneumonia	1	
Septicaemia	1	
Cerebrovascular disease		**2**
Cerebral haemorrhage	2	
Suicide		**2**
Bipolar mood swings	1	
Postpartum depression	1	
Miscellaneous		**4**
Ruptured artery	2	
Diabetes	2	
Total		**20**

Source: State and Territory Maternal Mortality Committees
Note: Each death has been attributed to a single cause as decided by the relevant State and Territory Maternal Mortality Committee. In a significant number multiple factors were present.

The high number of incidental maternal deaths is similar to the number found in the previous triennium (34 compared to 36 in 1991–93). The leading causes of incidental deaths were injuries (16; 47.1%), neoplasms (5; 14.7%) and cerebrovascular disease (4; 11.8%). There were five deaths (14.7%) in which a cause of death was not determined (Table 10).

Table 10 Incidental deaths by principal cause, Australia, 1994–96

Cause of death			Number
Injury			**17**
Motor vehicle injury		3	
Pedestrian	1		
Passenger	2		
Homicide		6	
Self-administered overdose		1	
Suicide		2	
Concern for baby after fall	1		
Insulin overdose	1		
Drug-related		4	
Burn		1	
Cerebrovascular			**4**
Cerebral haemorrhage		4	
Neoplasm			**5**
Breast		1	
Melanoma		2	
Lung		2	
Infection			**2**
Group A beta haemolytic streptococcus septicaemia		1	
Encephalitis		1	
Unknown cause			**4**
Multiple visceral organ failure		1	
Sudden collapse		1	
Seizure whilst asleep		2	
Miscellaneous			**2**
Asthma		2	
Total			**34**

Source: State and Territory Maternal Mortality Committees
Note: Each death has been attributed to a single cause as decided by the relevant State and Territory Maternal Mortality Committee. In a significant number multiple factors were present.

Maternal mortality ratios

Overall the maternal mortality ratio for this triennium was 13.0 deaths per 100,000 confinements. The direct maternal mortality ratio in 1994–96 was 6.0 deaths per 100,000 confinements; this has increased significantly from the ratio of 3.5 reported in the previous triennium and is closest to the ratio reported for the 1982–84 triennium (Table 11). It is also in contrast to the progressive reduction in direct maternal deaths and maternal mortality ratios since these reports began in the 1964–66 triennium.

Table 11 Maternal mortality ratios by triennium (direct maternal deaths only), Australia, 1964–96

Triennium	Total confinements	Maternal deaths	Maternal mortality ratio*
1964–66	667,649	202	30.3
1967–69	713,064	166	23.3
1970–72	790,818	150	19.0
1973–75	726,690	60	8.3
1976–78	678,098	52	7.7
1979–81	682,880	54	7.9
1982–84	713,985	42	5.9
1985–87	726,642	32	4.4
1988–90	754,468	37	4.9
1991–93	769,253	27	3.5
1994–96	767,448	46	6.0

Sources: ABS, AIHW National Perinatal Data Collection, State and Territory Maternal Mortality Committees
* Per 100,000 confinements (resulting in livebirths or stillbirths)

The changes in the ratios of direct, indirect and incidental maternal deaths over the 11 triennia are also shown in Table 12. The increase in the direct maternal mortality ratio in the 1994–96 triennium is not seen in the indirect and incidental maternal mortality ratios for the period. The indirect maternal mortality rate has remained steady at 2.6 per 100,000 confinements (2.7 in 1991–93) and the incidental mortality rate has dropped from 4.7 per 100,000 confinements in 1991–93 to 4.4 per 100,000 confinements in 1994–96.

Table 12 Direct, indirect and incidental maternal mortality ratios by triennium, Australia, 1964–1996

Triennium	Total	Direct	Indirect	Incidental
1964–66	41.2	30.3	10.9*	
1967–69	33.2	23.3	10.0	
1970–72	30.8	19.0	11.8	
1973–75	18.9	8.3	4.4	6.2
1976–78	15.6	7.7	5.1	2.8
1979–81	14.4	7.9	5.0	1.5
1982–84	13.2	5.9	3.5	3.5
1985–87	11.8	4.4	4.1	3.3
1988–90	12.7	4.9	4.4	3.4
1991–93	10.9	3.5	2.7	4.7
1994–96	13.0	6.0	2.6	4.4

Sources: ABS, AIHW National Perinatal Data Collection, State and Territory Maternal Mortality Committees
Note: Ratios are maternal deaths per 100,000 total confinements.
* In the first three triennia indirect and incidental deaths were not separated.

Age and parity distributions

The age and parity distributions of direct, indirect and incidental maternal deaths are shown in Tables 13–15. Women without a previous liveborn pregnancy outcome were more likely to die from causes directly related to pregnancy than multiparous women (Tables 13–15). Thirty-nine percent of the deaths classified as direct maternal deaths were nulliparous women compared to 35% of the indirect maternal deaths and 29.4% of the incidental deaths. Increasing maternal age was associated with a higher risk of direct and incidental deaths in this triennium.

Table 13 Direct maternal deaths by age and parity*, Australia, 1994–96

	Parity				
Age (years)	0	1–3	>4	Not stated	Total
< 20	2				2
20–24	3	2		2	7
25–29	5	5			10
30–34	3	12			15
35–39	5	4		1	10
> 40		2			2
Total	**18**	**25**	**0**	**3**	**46**

Source: State and Territory Maternal Mortality Committees
* Exclusive of final pregnancy

Table 14 Indirect maternal deaths by age and parity*, Australia, 1994–96

	Parity				
Age (years)	**0**	**1–3**	**>4**	**Not stated**	**Total**
< 20					0
20–24	1	1			2
25–29	3	1			4
30–34	3	9			12
35–39		1		1	2
> 40					0
Total	**7**	**12**	**0**	**1**	**20**

Source: State and Territory Maternal Mortality Committees
* Exclusive of final pregnancy

Table 15 Incidental maternal deaths by age and parity*, Australia, 1994–96

	Parity				
Age (years)	**0**	**1–3**	**>4**	**Not stated**	**Total**
< 20	1			1	2
20–24	3	4		1	8
25–29	2	3	1	1	7
30–34	4	4		2	10
35–39		3	2		5
> 40		1	1		2
Total	**10**	**15**	**4**	**5**	**34**

Source: State and Territory Maternal Mortality Committees
* Exclusive of final pregnancy

Age-standardised rates[9]

The overall age-standardised direct maternal mortality rate has increased from 0.22 in 1991–93 to 0.37 per 100,000 population in this triennium (Table 16). The highest age-standardised rates were experienced by women in the 30–34 years age group. There was a marked decrease in rates in the 20–24 year age group and 30–34 years age groups in the 1991–93 triennium that was not maintained in the 1994–96 triennium.

[9] See Appendix 5 for method of calculation of age-standardised rates.

Table 16 Average age-standardised direct maternal mortality rates, Australia, 1973–96[a]

Triennium	Number of deaths	Average age-standardised direct mortality rates[a] 15–19 years	20–24 years	25–29 years	30–34 years	35–39 years	40–44 years	Total mortality rate [b]
1973–75	66	0.25	1.12	1.16	0.42	0.57	1.01	0.75
1976–78	52	0.22	0.58	0.70	0.80	0.41	0.73	0.58
1979–81	54	0.17	0.81	0.60	0.74	0.39	0.55	0.55
1982–84	42	0.11	0.76	0.63	0.23	0.45	0.08	0.38
1985–87	32	0.20	0.25	0.40	0.52	0.27	0.00	0.28
1988–90	37	0.05	0.35	0.52	0.59	0.26	0.06	0.31
1991–93	27	0.00	0.09	0.44	0.28	0.34	0.16	0.22
1994–96	46	0.11	0.33	0.48	0.69	0.47	0.10	0.37

Sources: State and Territory Maternal Mortality Committees; ABS

(a) Age-standardised rates are expressed per 100,000 population standardised to the Australian 1991 female population aged 15 to 44 years.

(b) Total mortality rate is adjusted to reflect 'not stated' category.

The overall age-standardised indirect maternal mortality rate was 0.16 per 100,000 population in this triennium (Table 17). The highest age-standardised indirect maternal mortality rates, like the direct mortality rates, were amongst women aged 30–34 years.

Table 17 Average age-standardised indirect maternal mortality rates, Australia, 1973–96[a]

Triennium	Number of deaths	Average age-standardised indirect mortality rates[a] 15–19 years	20–24 years	25–29 years	30–34 years	35–39 years	40–44 years	Total mortality rate[b]
1973–75	30	0.06	0.42	0.57	0.31	0.53	0.19	0.35
1976–78	35	0.11	0.64	0.53	0.27	0.25	0.46	0.38
1979–81	34	0.17	0.40	0.65	0.36	0.30	0.09	0.33
1982–84	25	0.12	0.27	0.35	0.30	0.33	0.00	0.23
1985–87	30	0.30	0.20	0.75	0.16	0.11	0.00	0.26
1988–90	33	0.05	0.20	0.52	0.54	0.26	0.06	0.28
1991–93	21	0.15	0.09	0.24	0.32	0.15	0.05	0.17
1994–96	20	0.00	0.10	0.19	0.55	0.09	0.00	0.16

Sources: State and Territory Maternal Mortality Committees; ABS

Age-standardised rates are expressed per 100,000 population standardised to the Australian 1991 female population aged 15 to 44 years.

Total mortality rate is adjusted to reflect not stated category.

The overall average age-standardised maternal mortality rate for direct and indirect deaths was 0.53 per 100,000 population in this triennium (Table 18). This rate is similar to the rates seen in the 1980s. The highest rates were in those aged 30–34 years.

Table 18 Average age-standardised direct and indirect maternal mortality rates, Australia, 1973–96[a]

		Average age-standardised direct mortality rates[a]						
Triennium	Number of deaths	15–19 years	20–24 years	25–29 years	30–34 years	35–39 years	40–44 years	Total mortality rate[b]
1973–75	96	0.31	1.54	1.73	0.74	1.12	1.18	1.10
1976–78	87	0.33	1.22	1.23	1.07	0.65	1.20	0.95
1979–81	88	0.34	1.20	1.25	1.11	0.69	0.63	0.88
1982–84	67	0.23	1.03	0.97	0.53	0.78	0.08	0.61
1985–87	62	0.51	0.46	1.15	0.68	0.38	0.00	0.54
1988–90	70	0.10	0.56	1.04	1.13	0.52	0.11	0.59
1991–93	48	0.15	0.19	0.68	0.60	0.49	0.21	0.39
1994–96	66	0.11	0.43	0.67	1.23	0.56	0.10	0.53

Sources: State and Territory Maternal Mortality Committees; ABS
(a) Age-standardised rates are expressed per 100,000 population standardised to the Australian 1991 female population aged 15 to 44 years.
(b) Total mortality rate is adjusted to reflect not stated category.

The highest maternal death ratios of direct and incidental maternal deaths occurred among women aged 35 years and over, while for indirect deaths it was 30 years and older (Table 19). However, when age-standardised rates are computed the highest maternal mortality rates are in women aged 30–34 years for both direct and indirect deaths (Tables 16–18).

Table 19 Maternal death ratios (direct, indirect and incidental deaths) by age group, Australia, 1994–96

	Age at death (years)						
	<20	**20–24**	**25–29**	**30–34**	**35–39**	**>40**	**All ages**
Number of direct deaths	2	7	10	15	10	2	46
Ratio per 1,000 confinements (Table 2)	0.05	0.05	0.04	0.07	0.11	0.14	0.06
Number of indirect deaths	0	2	4	12	2	0	20
Ratio per 1,000 confinements (Table 2)	0	0.01	0.02	0.05	0.02	0	0.03
Number of incidental deaths	2	8	7	10	5	2	34
Ratio per 1,000 confinements (Table 2)	0.05	0.06	0.03	0.04	0.06	0.14	0.04
Total number	**4**	**17**	**21**	**37**	**17**	**4**	**100**
Ratio per 1,000 confinements	**0.10**	**0.12**	**0.08**	**0.16**	**0.19**	**0.28**	**0.13**

Sources: State and Territory Maternal Mortality Committees; AIHW National Perinatal Data Collection
* Note: Ratio is reported here per 1,000 confinements for ease of comparison with Table 20. Convention for reporting maternal death ratios is per 100,000 confinements.

The average annual female death rates from all causes increases with increasing age (Table 20). When the average annual female death rate is compared with the maternal mortality ratio for the period 1994–96, pregnancy appears to have a protective effect, with a reduced risk of death from any cause for women who are pregnant or recently pregnant (0.13 versus 0.72 per 1,000 confinements; Tables 19, 20). However, as in nine of the ten previous triennia, the *death ratios for women aged 35 years and over were well above the overall ratio.* The ratios in 1994–96 for women aged 35 years and over were treble that in the three age groups below 30 years of age.

Table 20 Average annual female death rates* from all causes by age by triennium Australia, 1964–1996

	Age group (years)						
Triennium	**15–19**	**20–24**	**25–29**	**30–34**	**35–39**	**40–44**	**45–49**
1964–66	0.55	0.63	0.71	1.00	1.61	2.30	3.89
1967–69	0.55	0.57	0.66	0.88	1.41	2.32	3.67
1970–72	0.59	0.59	0.65	0.90	1.42	2.21	3.60
1973–75	0.53	0.51	0.55	0.76	1.27	2.04	3.41
1976–78	0.51	0.52	0.51	0.72	1.12	1.86	3.00
1979–81	0.45	0.53	0.49	0.62	0.92	1.54	2.63
1982–84	0.39	0.47	0.50	0.55	0.85	1.39	2.34
1985–87	0.42	0.52	0.50	0.57	0.80	1.30	2.20
1988–90	0.39	0.48	0.46	0.57	0.78	1.22	2.03
1991–93	0.35	0.43	0.43	0.55	0.77	1.10	1.80
1994–96	0.31	0.37	0.41	0.52	0.74	1.09	1.70

Sources: Australian Institute of Health and Welfare, Australian Bureau of Statistics
* Deaths per 1,000 of the estimated female population for each age group

Maternal deaths by single year, birth outcome and stage of death

Maternal deaths were not evenly distributed over the three-year period with 41.0% of maternal deaths occurring in 1995 (Table 21).

Table 21 Maternal deaths by single year of occurrence, Australia, 1994–96

Year	Number of maternal deaths	Percent	Ratio per year*
1994	34	34.0	13.2
1995	41	41.0	16.0
1996	25	25.0	9.9
Total	**100**	**100.0**	**13.0**

Sources: AIHW National Perinatal Data Collection, State and Territory Maternal Mortality Committees
*Note: Rounding error

Of the 100 maternal deaths, 35 (35.0%) of the women died prior to delivery while 54 (54.0%) died at the time of delivery or in the postpartum period (Table 22).

Table 22 Stage of pregnancy at which maternal death occurred, Australia, 1994–96

Stage of pregnancy	Number of maternal deaths	Percent
Died undelivered	35	35.0
1 day postpartum	11	11.0
2–5 days postpartum	17	17.0
6–10 days postpartum	10	10.0
11–15 days postpartum	8	8.0
16–20 days postpartum	4	4.0
> 20 days postpartum	4	4.0
Not applicable/not stated	11	11.0
Total	**100**	**100.0**

Source: State and Territory Maternal Mortality Committees

In 44 (44.0%) of the maternal deaths the baby or babies were liveborn (Table 23).

Table 23 Birth outcomes (livebirths, stillbirths) amongst maternal deaths, Australia, 1994–96

Birth outcome	Number	Percent
Livebirths	44	44.0
Died in utero	35	35.0
Stillbirths	5	5.0
Terminations/ ectopic pregnancies	9	9.0
Not stated	7	7.0
Total	**100**	**100.0**

Source: State and Territory Maternal Mortality Committees

Indigenous maternal deaths

The Indigenous status (Aboriginal or Torres Strait Islander) of the mother is still not uniformly recorded in all the maternal death reports. In the 1994–96 triennium, Indigenous status was reported in 83 (83.0%) of the 100 deaths compared to 78 (92.3%) of the 84 deaths in the 1991–93 triennium. The differential ascertainment of Indigenous status over the past nine triennia make it difficult to determine if there is a continuing decline in direct Indigenous maternal deaths (Table 24). No information is available for identifying Indigenous maternal deaths before 1970. In the 1994–96 triennium, the deaths of eight Indigenous women accounted for 9.6 per cent of the 83 deaths where Indigenous status was known. An avoidable factor was judged to have been present in three of the direct maternal deaths. There were three direct, one indirect and four incidental Indigenous maternal deaths. The three direct Indigenous maternal deaths is among the lowest number recorded (Table 24). In previous

triennia, the proportion of maternal deaths from all causes in Indigenous women were 7.4 per cent (1970–72), 4.4 per cent (1973–75), 8.5 per cent (1976–78), 15.3 per cent (1979–81), 8.5 per cent (1982–84), 15.1 per cent (1985–87), 14.6 per cent (1988–90), and 10.1 per cent (1991–93).

Table 24 Direct maternal deaths by Indigenous status by triennium, Australia, 1970–96

	Indigenous		Non-Indigenous	
Triennium	**Direct**	**Total**	**Direct**	**Total**
1970–72	13	18	137	226
1973–75	5	6	55	131
1976–78	5	9	47	97
1979–81	6	15	48	83
1982–84	5	8	37	86
1985–87	4	13	28	75
1988–90	11	14	26	82
1991–93	1	9	26	75
1994–96	3	8	38*	75*

Source: State and Territory Maternal Mortality Committees
* There were 17 cases in which Indigenous status was not stated, of which five were direct deaths.

The report from the AIHW National Perinatal Statistics Unit, *Indigenous Mothers and their Babies, Australia, 1994–96* (Day et al., 1999) contains the reported numbers of Indigenous confinements in this triennium. This enables the comparisons of maternal mortality ratios in non-Indigenous and Indigenous women shown in Table 25 to be made. It is important to note there is still considerable underascertainment of Indigenous status in the AIHW National Perinatal Data Collection (NPDC). Any differences should be interpreted with caution because when numerators are very small and the denominators are large, small variations (and chance fluctuations) in the numbers of cases may render the ratios somewhat unstable.

Table 25 Maternal mortality ratios for Indigenous and non-Indigenous women, Australia, 1994–96

Indigenous status	Confinements	Maternal deaths	Mortality ratios per 100,000 confinements*
Indigenous	22,996	8	34.8
Non-Indigenous	744,452	75	10.1
Not stated		17	
Total	**767,448**	**100**	**13.0**

Source: State and Territory Maternal Mortality Committees
* For this triennium, calculations of maternal mortality ratios for Indigenous and non-Indigenous women excluded from the denominator maternal deaths where Indigenous status was missing.

Maternal deaths in overseas-born women

The country of birth is not routinely recorded in the case summaries of maternal deaths. In 1994–96, this information was available in 83 of the 100 deaths (83.0%). There were 21 deaths in overseas-born women; of those 9 were classified as direct, 6 as indirect and 6 as incidental. The women were born in the following 11 countries: United Kingdom (5), New Zealand (4), Vietnam (2), Philippines (2), China (2), Greece (1), Indonesia (1), Tonga (1), Thailand (1), Cambodia (1), and Macedonia (1).

Avoidable factors

In this triennium, an avoidable factor was considered to be possibly or certainly present in 22 (48%) of the 46 direct obstetric deaths, 4 (20%) of the 20 indirect deaths and 2 (6%) of the 34 incidental deaths. In the last triennium the comparable figures were 7 (26%) of 27 direct deaths, 2 (10%) of 21 indirect and 3 (8%) of the 36 incidental deaths. The data on the category of avoidability were available for 16 of the 22 direct maternal deaths where an avoidable factor was identified. In 13 of the deaths, avoidability was ascribed to the medical practitioner and/or hospital care, in 2 deaths to the patient and in the remaining death to both the medical practitioner and the patient. The Committee views with concern the more than doubling of the rate of avoidable factors, especially in the direct maternal deaths (from 7 of 27 to 22 of 46) and advocates a standardised approach to assessing avoidability in future reports and for heightened scrutiny and surveillance of all maternal deaths. The purpose of reporting avoidability is to prevent the recurrence of patient, practitioner and/or institutional factors that increase the risk of death by educating the relevant bodies or implementing measures to prevent their recurrence.

Death summaries

The following chapters provide detailed case summaries of the direct and indirect (Chapters 4–14) and incidental (Chapter 15) maternal deaths by principal cause of death.

CHAPTER 4

TERMINATIONS OF PREGNANCY, SPONTANEOUS ABORTIONS, MISCARRIAGES AND ECTOPIC PREGNANCIES

There were three deaths in which the principal cause of death related to a termination of pregnancy, one death in which the principal cause of death related to a spontaneous abortion and five deaths where the principal cause of death was ectopic pregnancy. All the deaths reported in this chapter were classified as direct deaths by the relevant State and Territory Maternal Mortality Committees.

The development of accurate quantitative assays of serum β-hCG and sensitive ultrasound techniques for examining the site and viability of early pregnancies prompted the review of all early pregnancy direct maternal deaths together.

Terminations of pregnancy

4.1 A 24-year-old woman, para 1, had a termination of pregnancy at 12 weeks' gestation by suction curettage under general anaesthetic. She experienced abdominal pain following termination. She collapsed at home later the same day. Cardiopulmonary resuscitation was initiated by a friend, however she was in asystole upon arrival of the ambulance. She converted to ventricular fibrillation after being given adrenaline, but then reverted to asystole. A mast suit was applied, but on arrival at hospital she was in asystole and did not respond to resuscitation. The cause of death was intra-abdominal haemorrhage due to perforated uterus following termination of pregnancy. This was classified as a **direct** maternal death.

4.2 A 17-year-old woman, para 0, was referred for termination of pregnancy at eight weeks' gestation. A hygroscopic dilator was inserted into the cervix, and she was instructed to return in three days. She presented at the local hospital one day following the insertion of the dilator with abdominal pain and vomiting. She was treated with anti-emetics. Apparently she did not volunteer the history of the insertion of the dilator. The following day she re-presented with persistent pain and fever. An ultrasound scan revealed the presence of the dilator. Her condition rapidly deteriorated and she died despite resuscitative efforts. Autopsy revealed septicaemia secondary to clostridial uterine infection. This was classified as a **direct** maternal death.

4.3 A 33-year-old woman, para 2, had a laparoscopic tubal sterilisation and termination of a pregnancy of about 14 weeks' gestation, by suction curettage, under general anaesthesia, as a day procedure. The woman smoked about 20 cigarettes per day and her weight was 45 kg. Thirteen days after the operations the woman attended a friend's home, retired to bed in the spare room with her son and was found deceased the next day. The woman had no known symptoms or medical history of illness. In spite of a detailed autopsy examination no cause of death was ascertained. This was classified as a **direct** maternal death.

Comment:

Termination of pregnancy can be associated with fatal consequences; those women undergoing this process must be provided with appropriate instructions regarding possible complications, and steps to be taken if such complications appear to be occurring, before discharge from medical care.

Spontaneous abortions

4.4 A 42-year-old woman, gravida 2, para 2 was admitted to hospital after collapsing at home following a vaginal bleed. With a provisional diagnosis of miscarriage the patient was given a blood transfusion (three units of packed cells), IV ergometrine and syntocinon, salbutamol and nebulised with atrovent. Dilation of the cervix and uterine curettage was planned. However four hours after admission the patient suffered two seizures followed by cardiorespiratory arrest. Resuscitation was unsuccessful. Autopsy showed evidence of a second trimester miscarriage. This was classified as a **direct** maternal death.

Ectopic pregnancies

4.5 A 29-year-old woman, para 3, collapsed at home at eight weeks' gestation. She was taken to a rural centre. Circulatory failure was treated with intravenous fluids. Ten hours following admission she was transported by air to a provincial hospital where a laparotomy was immediately performed. An ectopic pregnancy was excised and a huge haemoperitoneum drained. She was given massive blood and plasma transfusions. Post-operatively, she developed Adult Respiratory Distress Syndrome. She was transferred to a metropolitan general hospital, where she progressively deteriorated and developed septic shock. Autopsy showed massive cerebral infarction due to cerebrovascular thromboembolism from mitral valve vegetations. Contributory factors were adult respiratory distress syndrome, following prolonged hypovolaemia due to ruptured ectopic pregnancy. This was classified as a **direct** maternal death.

4.6 A 38-year-old woman had an ectopic pregnancy diagnosed and was treated conservatively with methotrexate. She developed profound anaemia and a haemoperitoneum and laparotomy was performed. The woman then developed a massive pulmonary thromboembolism and died one day later despite embolectomy. This was classified as a **direct** maternal death.

4.7 A 35-year-old woman, primigravida, having had pregnancy confirmed approximately two weeks previously, developed abdominal pain which did not resolve with panadol. Four hours later she lost consciousness and was pronounced dead on arrival at hospital. Postmortem examination revealed a ruptured interstitial ectopic pregnancy and a massive intra-abdominal haemorrhage. This was classified as a **direct** maternal death.

4.8 A 22-year-old woman, para 1, was found dead at home. She was not known to be pregnant at the time of death. She had experienced lactational amenorrhea

since the birth of a child nine months previously. One day prior to death she developed abdominal pain, vomiting and diarrhoea and was seen at a hospital, where a provisional diagnosis of viral gastroenteritis was made. She was not admitted and continued to have vomiting and diarrhoea, and was found dead the following morning. Autopsy revealed a left ectopic pregnancy with a large volume of free blood in the peritoneal cavity. This was classified as a **direct** maternal death.

4.9 A 35-year-old woman, para 0, developed low abdominal "period-like" pain at six weeks' gestation one evening whilst on a boat. During the night she was found semi-conscious, shaking, complaining of pins and needles and vomiting. A medic attended when they arrived on land at sunrise and she was transferred to a district hospital. She was resuscitated and intubated on arrival at the airport. Resuscitation was abandoned when there was evidence of brain death. Postmortem examination revealed a ruptured ectopic pregnancy. This was classified as a **direct** maternal death

Comment:

The differential diagnosis of abdominal pain in a woman of reproductive age should include the possibility of ectopic pregnancy, prompting the measurement of serum β-hCG.

CHAPTER 5

PRE-ECLAMPSIA/ECLAMPSIA (PREGNANCY-INDUCED HYPERTENSION)

There were nine deaths with pre-eclampsia, eclampsia or pregnancy-induced hypertension as the principal cause of death. There were an additional 11 deaths in which these conditions were contributory factors. Twenty deaths represents a significant rise in hypertensive deaths compared to nine deaths in 1991–93 and 13 deaths in 1988–90. Of the nine deaths judged to have been caused principally by pre-eclampsia or eclampsia, two were classified as indirect maternal deaths.

Pre-eclampsia/ eclampsia

5.1 A 27-year-old woman, with a previous normal delivery, had a normal antenatal course except for oedema of her hands and feet from 38 weeks' gestation and slight headache at 40 weeks' gestation. After induction of labour at 41 weeks, she had a normal delivery and returned home later on the day of delivery. A domiciliary midwife visited her on four days during the first postnatal week. Her partner later reported that she complained of blurred vision on the fourth day and of abdominal right upper quadrant pain on the sixth day. On the seventh day she became nauseated, and then confused, and on admission to hospital was jaundiced with petechiae and right upper quadrant tenderness. She was anaemic, thrombocytopenic and her liver enzyme levels were elevated. A provisional diagnosis of Haemolysis, Elevated Liver enzymes and Low Platelet count (HELLP) syndrome was made and treatment was aimed at restoring platelets and electrolyte and acid-base balance. However, later that day she went into cardiac arrest and resuscitation was unsuccessful. Autopsy findings were consistent with the clinical diagnosis. This was a direct death from thrombotic thrombocytopenia or severe pre-eclampsia. The former diagnosis is more likely and demonstrates that serious complications of the puerperium may still occur after discharge from hospital. This was classified as a **direct** maternal death.

5.2 A 32-year-old woman, primigravida, was diagnosed in early pregnancy with aortic incompetence, mitral stenosis and mitral incompetence consistent with past rheumatic heart disease. She had cardiac assessments to 28 weeks' gestation. She was admitted to hospital at 38 weeks' gestation in early labour, complaining of increasing shortness of breath. She was found to have a blood pressure of 200/120 and 4+ proteinuria. Cardiac arrest occurred 30 minutes after admission. A Caesarean section was carried out 3.5 hours later, resulting in a stillbirth. The patient was assessed to have hypoxic brain damage. She was ventilated for five days after delivery and died 11 days postpartum. The cause of death was considered to be pre-eclampsia and rheumatic heart disease. This was classified as a **direct** maternal death.

5.3 A 22-year-old woman, gravida 4, after a threatened miscarriage at 10 weeks' gestation, was admitted to a rural hospital at 35 weeks' gestation in preterm labour. After two days she was discharged on oral ventolin and amoxil. She was readmitted to hospital three weeks later with spontaneous rupture of membranes and 'early tightening'. On admission, blood pressure was 110/75

but she was unable to pass urine. A urine sample was not obtained during labour. Five hours after admission she underwent an emergency Caesarean section for cephalopelvic disproportion. Blood pressure was 100/60 before the procedure, 120/70 after the procedure and rose to 158/89 half an hour later. There was improvement with bolus administration of analgesic infusion. However, an hour and a half after the completion of the Caesarean section, the patient vomited and 12 hours later had a seizure. At this point examination of the urine showed 'solid protein'. After a further seizure four hours later the patient was transferred to a level 4 and then to a level 6 hospital. The death certificate indicated that death was due to intracerebral haemorrhage following eclampsia. This was classified as a **direct** maternal death.

5.4 A 31-year-old woman, primigravida, with an uneventful pregnancy to 34 weeks' gestation was admitted to hospital with mild pregnancy-induced hypertension (blood pressure 150/98) and no proteinuria. Her blood pressure settled and she was discharged home that day. In the next week her blood pressure was checked on three occasions at the community midwives' outpatient program. On day seven after discharge, she developed a headache of increasing severity and had a blood pressure of 134/90. She was admitted unconscious the same day with a provisional diagnosis of intracerebral haemorrhage and a BP of 260/150. She was intubated and given hydralazine, midazolam, thiopentone, dilantin and naxolone. An emergency lower segment Caesarean section was performed and a liveborn infant delivered. One litre of retroplacental blood clot was present. A CAT scan showed a large intracranial haemorrhage. A craniotomy was carried out, at which time cerebral arteriovenous malformations were noted. The patient did not regain consciousness and was declared brain dead and died the following day. Autopsy showed a massive blood clot in the basal region and temporal areas of both cerebral hemispheres; and blood clots in ventricles of both hemispheres. The cause of death was massive subarachnoid and intracerebral haemorrhage following severe hypertension occurring as a complication of pregnancy. This was classified as a **direct** maternal death.

5.5 A 29-year-old woman, primigravida, had an uneventful pregnancy until 39 weeks' gestation when she was admitted with severe epigastric pain, headache, and signs of severe pre-eclampsia. An urgent Caesarean section was performed for severe pre-eclampsia. With treatment of diazoxide and valium intraoperatively blood pressure decreased to 190/100. A large retro-placental clot was noted at delivery. There was approximately 300 ml blood loss during the operation, with a further sudden vaginal loss whilst awaiting transfer to a major hospital. Upon transfer the patient developed generalised bleeding. A hysterectomy was carried out and transfusions were given. The cause of death was found to be extensive diffuse severe haemorrhage. This was classified as a **direct** maternal death.

5.6 A 22-year-old woman, primigravida, with an uneventful pregnancy to 35 weeks' gestation, was admitted to hospital with threatened preterm labour.

She was discharged after 24 hours. Upon review two days later proteinuria (2+) and hypertension (BP 125/95) were present. The patient declined admission. Five days later she was admitted to hospital with pre-eclampsia which was treated with metoclopramide, nifedipine and Haemaccel infusion before she was transferred. Caesarean section was performed later that day, delivering a live male infant weighing 2,250 g. Acute renal failure developed and was treated with haemodialysis. Pulmonary oedema, disseminated intravascular coagulation, pancreatitis and bacterial peritonitis developed and were treated with peritoneal lavage, daily plasmapheresis, diuretics, anti-epileptics, antihypertensives, antibiotics, and transfusions of packed cells, platelets, FFP and cryoprecipitate. Her clinical status improved but she developed a reaction to the platelet transfusion, followed by metabolic acidosis and hypotension. She died nine days following delivery. Multiple causes of death were noted including cardiac failure, adult respiratory distress syndrome, pancreatitis, pre-eclampsia, acute renal failure and fatty liver of pregnancy. This was classified as a **direct** maternal death.

5.7 A 31-year-old woman, gravida 2, para 1, was admitted to hospital in preterm labour at 31 weeks' gestation. She was given IV tocolytic and steroids. However, she laboured rapidly and delivered the following day. Following delivery, the patient was noted to have a diastolic blood pressure reading of between 110–120, with 4+ proteinuria, drowsiness, headache and vomiting. A diagnosis of HELLP syndrome was made, and she was treated with hydralazine. Neurological observations in the labour ward failed to improve and five hours after delivery the patient was found to be unrousable, with the right pupil dilated and unreactive. She was transferred to the intensive care unit. A CAT scan revealed an intracerebral haematoma. After an angiography, the woman was taken to the operating theatre to evacuate the clot. However, cerebral bleeding from the site of an arterio-venous malformation could not be controlled. After a blood transfusion, the patient developed severe cerebral oedema. She was transferred to the intensive care unit and extubated. Her condition deteriorated until her death two days postpartum from respiratory failure. The cause of death was found to be due to an intracerebral haematoma arising from an arterio-venous malformation, and pre-eclampsia. This was classified as an **indirect** maternal death.

Table 26 Maternal deaths in which pre-eclampsia was a contributory cause of death

Case number	Age	Principal cause	Contributory causes
10.1	26	Anaesthesia related to Caesarean section	Pre-eclampsia
11.4	27	Pulmonary embolism	Severe pre-eclampsia, Caesarean section
11.5	28	Pulmonary embolism	Severe pre-eclampsia, Caesarean section
12.5	34	Amniotic fluid embolism	Pre-eclampsia, postpartum haemorrhage, Caesarean section
14.6	32	Thrombocytopenia	Pre-eclampsia, myocarditis, postpartum haemorrhage, Caesarean section

Comment:

There was considerable discussion about the cause and classification of death in Cases 5.4 and 5.7. There is an argument for these cases to have a different principal cause of death or classification. However, according to the guidelines informing this report the cases have been presented in Chapter 5.

Pregnancy-induced hypertension

5.8 A 37-year-old woman, gravida 5, para 3, with a history of hepatitis B and C, had a cervical suture inserted at 12 weeks' gestation. She developed hypertension at 34 weeks' gestation and was treated with propranolol. After induction of labour at 38 weeks' gestation she had a normal vaginal delivery. Day two postpartum she had a sudden onset of a severe headache and became unconscious two and a half hours later. A provisional diagnosis of subarachnoid haemorrhage was made and the patient was intubated, ventilated and transferred to another hospital where a frontal Burr hole was carried out. She continued to deteriorate and died three days after delivery. The cause of death at autopsy was found to be intraventricular and subarachnoid haemorrhage following hypertension. This was classified as a **direct** maternal death.

5.9 A 37-year-old woman, para 2, with mild hypertension, had labour induced at term, followed by a spontaneous delivery. Syntometrine was used for the third stage of labour. Shortly after delivery she became severely hypertensive, and collapsed. A CAT scan revealed a ruptured cerebral artery aneurysm and extensive subarachnoid haemorrhage. An autopsy was not performed. This was classified as an **indirect** maternal death.

Table 27 Maternal deaths in which pregnancy-induced hypertension was a contributory cause of death

Case number	Age	Principal cause	Contributory causes
8.5	36	Sepsis	Hypertension, diabetes, postpartum haemorrhage
11.7	20	Pulmonary embolism	Pregnancy-induced hypertension
11.8	31	Pulmonary embolism	Occasional high blood pressure, postpartum haemorrhage
14.5	30	Diabetes mellitus	Pregnancy-induced hypertension, ruptured cerebral artery aneurysm

Hypertension

Table 28 Maternal deaths in which hypertension was a contributory cause of death

Case number	Age	Principal cause	Contributory causes
8.7	22	Viral pneumonia	Gestational diabetes
14.4	27	Diabetes	Hypertension, urinary tract infection

Comment:

The number of deaths in this triennium attributable solely and directly to pre-eclampsia and eclampsia was very low and suggests that management of these disorders is effective in Australia. In almost all deaths, there were significant complicating conditions that could not be anticipated, or there was refusal of admission by the patient. As in previous reports, cerebral haemorrhage is a recurring terminal event in pre-eclampsia. It is always necessary to treat severe hypertension acutely in women with pre-eclampsia. All women with this disease are at risk of intracranial haemorrhage, and some will prove to have unsuspected cerebral vascular abnormalities. Timely reduction in blood pressure may reduce the incidence of cerebral haemorrhage. However, this also involves the cooperation and acceptance by the women of this treatment. Further information on hypertension in pregnancy can be found in the Consensus Statement of the Australasian Society for the Study of Hypertension in Pregnancy (Brown et al. 2000).

One woman had rheumatic heart disease, which was a major contributing factor to her death which resulted from cardiac failure associated with severe pre-eclampsia (Case 5.2).

In two cases, pre-eclampsia was certainly present, with very severe hypertension in one, but the final cause of death was haemorrhage from a cerebral arteriovenous malformation in each (Cases 5.4, 5.7).

In one 22 year-old, eclampsia occurred 12 hours after delivery by Caesarean section, with a further seizure four hours later. Intracerebral haemorrhage had occurred. (Case 5.3).

A large abruption was followed by DIC, hysterectomy and then haemorrhagic death in a woman who presented with very severe pre-eclampsia involving the liver (Case 5.5).

Another 22 year-old developed proteinuric pre-eclampsia but refused admission. Delivery by Caesarean section was necessary five days later but was followed by renal failure requiring dialysis, then a terminal series of events including DIC, pulmonary oedema and peritonitis (Case 5.6).

In addition to these six cases, there were two whose death was attributed to pulmonary embolus, which is a factor associated with pre-eclampsia (Cases 11.4 and 11.5). The increasing recognition of thrombophilic states associated with severe pre-eclampsia suggests that units re-assess their guidelines/protocols for administration of thromboprophylaxis after Caesarean section in women with pre-eclampsia. These two cases were associated with severe early-onset pre-eclampsia. One of these women had widespread progressive systemic sclerosis (scleroderma) as a pre-existing disease. This disorder is known to carry a high risk of superimposed early severe pre-eclampsia.

Major haemorrhage associated with disseminated intravascular coagulation has long been recognised as a risk with pre-eclampsia. Any indication of coagulopathy with this disease demands careful observation and may require correction.

As the dangers of eclampsia, cerebral haemorrhage and pulmonary embolism complicating pre-eclampsia persist into the postpartum period, continued observation after delivery is needed.

With pre-eclampsia, severe epigastric pain may indicate hepatic involvement and is a sign of severe disease.

CHAPTER 6

CARDIORESPIRATORY DISEASE

This chapter has replaced the cardiovascular disease chapter from previous reports. The change in name to cardiorespiratory disease highlights the contribution of respiratory disease to maternal deaths.

Cardiovascular disease continued to be a significant cause of maternal death in the triennium 1994–96. Eight maternal deaths occurred in which cardiovascular disease was the principal cause. This is similar to the 1988–90 incidence, after an increase to 12 deaths in the 1991–93 triennium. The principal causes of death were: mitral and aortic valvular disease (2), cardiomyopathy (1), myocardial infarction (1), arrhythmia (1), dissecting aneurysm of coronary artery (1), Eisenmenger syndrome (1) and atrial septal defect (1). On six occasions the maternal death occurred following delivery.

There were five deaths in which cardiorespiratory disease was a contributory cause of death. Case summaries included in this chapter are split into two sections—cardiac complications and respiratory complications.

Cardiac complications

Cardiomyopathy

6.1 A 32-year-old woman, para 1, with a history of hypertension, pulmonary sarcoidosis and low oxygen saturation, was delivered by Caesarean section at 28 weeks' gestation because of severe fetal distress shown by cardiotocography. Postoperative hypoxia necessitated intubation and ventilation and transfer to an intensive care unit. She failed to respond to intensive therapy and also developed evidence of septicaemia; she died 19 days after delivery. Autopsy revealed chronic heart disease and a pericardial effusion. The causes of death were considered to be cardiomyopathy and hypertension with associated infarction of vital organs. This was classified as an **indirect** maternal death.

Myocardial infarction

6.2 A 30-year-old woman, gravida 4, para 3, who was a heavy smoker, had a normal vaginal delivery of a live female infant weighing 3,990 g after spontaneous onset of labour. On postpartum day four she attended her GP and commenced treatment with bromocriptine. After taking the medication the patient felt unwell, complaining of 'pins and needles', restlessness and shortness of breath. She collapsed on day five. Autopsy revealed the cause of death as acute myocardial infarction following coronary artery thrombosis. This was classified as an **indirect** maternal death.

Table 29 Summary of cases in which cardiorespiratory disease was principal cause of death, Australia, 1994–96

Type of disease	Age of patient (years)	Principal cause of death	Time of death	Contributing factor
Cardiomyopathy	32	Cardiomyopathy	19 days post-Caesarean section	Hypertension
Myocardial infarction	30	Myocardial infarction	5 days post-delivery	Coronary artery thrombosis
Arrhythmia	28	Cardiac arrhythmia	29 weeks gestation	Viral pneumonia
Dissecting aneurysm of the coronary artery	31	Dissecting aneurysm of coronary artery	6 days post-delivery	
Mitral valve disease	32	Mitral incompetence and stenosis	20 weeks gestation	
Mitral valve obstruction	33	Obstruction to mitral valve by adherent thrombosis	10 days post-Caesarean	
Eisenmenger syndrome	22	Cardiopulmonary failure	2 days post-Caesarean	Eisenmenger syndrome
Septal defect	29	Progressive pulmonary thrombosis	3 weeks post-delivery	

Arrhythmia

6.3 A 28-year-old woman, para 3, had a past history of Wolff-Parkinson-White syndrome. This was characterised by episodes of supra-ventricular tachycardia, which required medical therapy in previous pregnancies. Catheter ablation of the accessory pathway was under consideration, but this pregnancy intervened. She was not currently on medication and was managing the arrhythmia with a modified Valsalva manoeuvre. This pregnancy was uneventful until 29 weeks' gestation when she suddenly collapsed. There was no improvement in her condition despite resuscitation, and an emergency Caesarean section was performed. A 500 ml "old" retroplacental clot was found and the amniotic fluid was heavily blood stained. Resuscitation was ceased post-delivery. Autopsy revealed no evidence of pulmonary embolism or myocarditis. There were changes suggestive of viral pneumonia. This was classified as an **indirect** maternal death.

Dissecting aneurysm of the coronary artery

6.4 A 31-year-old woman, para 3, weight 95 kg, developed headaches and chest pain six days after a normal delivery of a 4,130 g healthy infant. She had a history of severe migraine and was given pethidine by IM injection as had been required on other occasions. She died at home about two hours later. Autopsy revealed a dissecting aneurysm of the coronary artery as the cause of death. This was classified as an **indirect** maternal death.

Mitral and aortic valvular disease

6.5 A 32-year-old woman, para 2, with a history of rheumatic fever, and known mitral valve disease, was admitted at 17 weeks' gestation to a coronary care unit with chest pain, and was treated successfully for early congestive cardiac failure and discharged from hospital. Three weeks later she was found dead at home. Autopsy confirmed mitral incompetence and stenosis. This was classified as an **indirect** maternal death.

6.6 A 33-year-old woman, primigravida, with porcine mitral valve replacement 18 months previously, had an elective Caesarean section at 39 weeks' gestation because of breech presentation and contracted pelvis. She did not receive anticoagulation therapy and went home eight days after delivery. She developed numb arms ten days after delivery but did not call for medical attention and died at home. Autopsy revealed obstruction to the mitral valve by an adherent thrombus (0.8 cm) continuous with a large ball thrombus (4 x 3 x 3 cm). This was classified as an **indirect** maternal death.

Eisenmenger syndrome

6.7 A 22-year-old woman, primigravida with known Eisenmenger syndrome and acute fetal distress at 35 weeks' gestation, was delivered by Caesarean section

with Intensive Care monitoring. Cardiopulmonary failure occurred 24 hours after an 'uncomplicated' Caesarean section and defied skilled resuscitative efforts. Death occurred two days after delivery. The baby survived. This was classified as an **indirect** maternal death.

Septal defect

6.8 A 29-year-old woman, para 0, with a past history of severe pulmonary hypertension and a large atrial septal defect became increasingly short of breath at 23 weeks' gestation. She was referred to a cardiology unit and was found to have right to left shunting and was hypoxic in room air. A heart–lung transplant was to be arranged after delivery. Labour was induced at 35 weeks because of the deteriorating cardiac condition. Labour and delivery took place in an intensive care unit with Swan Ganz catheterisation, nitric oxide and nebulised prostacyclin. Labour lasted 12 hours and a live baby was delivered by vacuum extraction. She became increasingly hypoxaemic. Death occurred three weeks postpartum due to progressive pulmonary thrombosis despite anticoagulation. An autopsy was not performed. This was classified as an **indirect** maternal death.

Table 30 Maternal deaths in which cardiac complications were contributory causes of death

Case number	Age	Principal cause	Contributory causes
5.2	32	Pre-eclampsia	Rheumatic heart disease
14.6	32	Thrombocytopenia	Myocarditis, pre-eclampsia, postpartum haemorrhage, Caesarean section

Comment:

Heart disease is no less dangerous in young women than in any other group of the population. These deaths all occurred in women with pre-existing heart problems, most of whom would have survived without the haemodynamic and other changes of superimposed pregnancy.

As in previous reports, the dire significance of pulmonary hypertension is underlined by the two deaths reported (Cases 6.7, 6.8). In each, death in the peripartum period occurred despite delivery in an Intensive Care Unit with state of the art resuscitative and monitoring facilities. The presence of primary pulmonary hypertension constitutes a contraindication to pregnancy. Women with this condition should be strongly advised to have preconception counselling.

There was no common theme in the remaining five cardiac deaths. One woman with a porcine prosthetic heart valve developed thrombosis of the valve in the puerperium (Case 6.6). Many patients with tissue valves are not anticoagulated, but the postpartum period presents significant thrombotic risk. Thromboprophylaxis should be considered in patients with tissue valves, even though they present less risk than artificial valves.

One death followed postpartum myocardial infarction associated with the use of bromocriptine by a heavy smoker (Case 6.2). This drug has the propensity to cause arterial spasm and its association with cardiac events in the postpartum period is well reported, particularly in elderly women, those with hypertension or cardiac disease, and smokers.

Death occurred in one woman with mitral stenosis who had recently received medical treatment for heart failure (Case 6.5). When cardiac failure associated with mitral stenosis occurs in pregnancy, balloon mitral valvotomy should be considered as the tendency to pulmonary oedema is worsened by the advancing pregnancy with its attendant volume expansion.

Another death followed sudden collapse in a woman with known Wolff-Parkinson-White syndrome and previous episodes of arrhythmia requiring medical therapy (Case 6.3). Her final pregnancy led to deferral of plans for definitive treatment by catheter ablation of the accessory pathway. Despite previously requiring drug treatment, she was not on medication at the time of death.

In Case 6.4 death appears to have been entirely unpredictable, with autopsy demonstrating a ruptured coronary artery aneurysm six days after delivery.

Preconception counselling is necessary for all women with significant heart (or lung) disease. In some, pregnancy should not occur. In others, corrective invasive treatment before or during pregnancy will reduce the risk of death. Women often need reassurance about the safety of their medication in pregnancy, to prevent cessation of previously effective pharmacological therapy.

Respiratory complications

There were no deaths in which the principal cause of death was attributed to respiratory complications.

Table 31 Maternal deaths in which respiratory complications were contributory causes of death

Case number	Age	Principal cause	Contributory causes
4.5	29	Ectopic pregnancy	Adult Respiratory Distress Syndrome
9.1	28	Placental abruption	Adult Respiratory Distress Syndrome, Caesarean section
11.2	39	Pulmonary embolism	Asthma

Comment:

There were two incidental deaths in which the primary cause of death was found to be asthma (Cases 15.1 and 15.2).

CHAPTER 7

INTRACRANIAL HAEMORRHAGE

Intracranial haemorrhage was the primary cause of death in three cases (the same as the last triennium), and contributed to five other deaths.

7.1 A 19-year-old woman, para 0, had a forceps delivery of a live male baby weighing 2,985 g, at 39 weeks' gestation. Breastfeeding was discontinued after three days. A swollen left calf was noted seven days after delivery, but Doppler ultrasound studies of both legs revealed no abnormality. Twenty-three days after delivery she presented with persistent headache and recent onset of confusion, slurred speech, and spasticity in her right arm. A CAT scan showed a cerebral intraventricular haemorrhage. She was transferred to a neurosurgical unit where she died five days later. The diagnosis of cerebral infarction secondary to dural sinus thrombosis was confirmed at autopsy. This was classified as a **direct** maternal death.

7.2 A 35-year-old woman developed headache and nausea seven hours after normal uneventful delivery of her second child; her blood pressure was normal but 20 minutes later she collapsed and was clinically dead. She was resuscitated and a CAT scan confirmed the diagnosis of intracerebral haemorrhage. An arteriovenous malformation in the cerebellum was treated surgically but the woman did not regain consciousness and died eight days after delivery. This was classified as an **indirect** maternal death.

7.3 A 31-year-old woman, para 1, had a subarachnoid haemorrhage at 26 weeks' gestation. A CAT scan showed a large cerebral aneurysm, which was successfully clipped. Her condition deteriorated and she was ultimately classified as brain dead. As the fetus was still alive, Caesarean section was performed. Death occurred soon after respiratory support was withdrawn. The infant died aged 34 hours. This was classified as an **indirect** maternal death.

Table 32 Maternal deaths in which intracranial haemorrhage was a contributory cause of death

Case number	Age	Principal cause	Contributory causes
5.4	31	Pre-eclampsia	Intra-cerebral haemorrhage, placental abruption
5.7	31	Pre-eclampsia	Intra-cerebral haematoma
5.8	37	Pregnancy-induced hypertension	Subarachnoid haemorrhage
5.9	37	Pregnancy-induced hypertension	Ruptured cerebral artery aneurysm
14.5	30	Diabetes mellitus	Ruptured cerebral artery aneurysm, pregnancy-induced hypertension

There were four incidental deaths in which the cause of death was related to intracranial haemorrhage (Cases 15.3, 15.4, 15.5, 15.6). Two of the deaths involved ruptured aneurysms and two deaths resulted from intracerebral haemorrhage.

Comment:

The most common cause of spontaneous subarachnoid haemorrhage in women less than 25 years of age is an arterio-venous malformation, while in women above this age, congenital arterial berry aneurysms are the most common cause. Intracranial haemorrhage of subarachnoid type occurs in one–five pregnant women per 10,000 births. The clinical presentation is often characterised by severe headache of sudden onset, as illustrated in three of the patients in this chapter.

Of the 11 deaths involving intracranial haemorrhages, 5 (45%) occurred during pregnancy, and 6 occurred postpartum (55%). A recent study (Sameshima & Nagaya, 1999) of intracranial haemorrhages in Japan found that half of primary intracranial haemorrhages occurred during pregnancy, 20% during labour, and 30% postpartum.

The management of the pregnant patient suspected of having a subarachnoid haemorrhage should be the same as that of the non-pregnant patient.

CHAPTER 8

INFECTIONS

During the triennium 1994–96, there were ten maternal deaths in which infection was a principal or a contributory cause of death, six fewer than in the previous triennium. Of these ten deaths, infection was considered to be the principal cause of death in seven cases.

Table 33 Deaths in which infection was a principal or contributory cause, by triennium, Australia, 1985–96

	Number of deaths by year			
Type of infection	**1985–87**	**1988–90**	**1991–93**	**1994–96**
Sepsis associated with abortion	3			1
Sepsis following Caesarean section			3	
Pneumonia	5	5	4	2
Pneumonia secondary to other disease		3		
Pneumonia associated with pre-eclampsia		4		
Pneumonia associated with hypertension			1	
Pulmonary embolus secondary to sepsis			2	
Pulmonary tuberculosis			1	
Septicaemia	4	1	4	7
Meningitis	1			
Adult respiratory distress syndrome		2		
Acutre pyelonephritis	2			
Acute myocarditis				
Pelvic infection, caval thrombosis		1		
Bowel obstruction and septicaemia		1		
Miscellaneous			1	
Total	**15**	**17**	**16**	**10**

Source: State and Territory Maternal Mortality Committees

Deaths from septicaemia have now become the most frequent cause of death from infection, overtaking pneumonia. Six deaths were judged to have been principally caused by septicaemia, compared to two deaths attributed to pneumonia.

Septicaemia

There were six deaths principally caused by septicaemia, and a further two deaths in which septicaemia was a contributory cause of death.

8.1 A 32-year-old woman, para 2, went into spontaneous labour following a flu-like illness and delivered vaginally at 37 weeks' gestation. The infant was stillborn. Soon after delivery, she developed a transient fever of 39°C which was treated with paracetamol. Two and a half hours later, she was afebrile and "anxious to go home". She was discharged from the hospital, but was readmitted the

following day moribund, and died of *Streptococcus pyogenes group A* septicaemia. This was classified as a **direct** maternal death.

8.2 A 26-year-old woman, para 1, experienced, spontaneous rupture of the fetal membranes at 26 weeks' gestation. She was transferred to a tertiary referral centre where, two days after admission, she developed fever, rigors and fetal tachycardia. A single dose of IV antibiotics was given prior to Caesarean section. Three and a half hours following delivery, she developed convulsions and cardiorespiratory arrest. Blood cultures and placental swabs grew *Escherichia coli*. The cause of death was septicaemia. This was classified as a **direct** maternal death.

8.3 A 37-year-old woman, gravida 2, para 2, with an unknown record of antenatal care, was admitted for a normal vaginal delivery at term. She developed fever (38.4°C) about six hours postpartum and despite treatment with antipyretics and analgesics spiking fever continued. On day four postpartum, she had a marked neutropenia and thrombocytopenia. She was transferred to another hospital and died on day five postpartum. An autopsy revealed purulent exudate covering the endometrial surface and multiple organ haemorrhages. *Streptococcal pyogenes* was isolated from the blood culture and vaginal swabs. The cause of death was found to be septicaemia following puerperal endometritis. This was classified as a **direct** maternal death.

8.4 A 31-year-old woman, primigravida, was admitted to hospital at 30 weeks' gestation with a one-day history of abdominal pain, vomiting and diarrhoea. She was febrile, with abdominal and uterine tenderness, and was treated for gastroenteritis with mild dehydration. She developed increasing pain and severe respiratory distress with cyanosis and hypotension. Fetal death in utero was noted. An attempt to induce labour was unsuccessful. Despite intensive care including ventilation, transfusions and antibiotics for disseminated intravascular coagulation and renal failure, she progressed to multi-organ failure and died undelivered. *Streptococcus pyogenes* was isolated from maternal blood taken before death and from tissues at autopsy. There was inflammation of the uterus and placenta suggesting an ascending infection from the vagina. The cause of death was overwhelming streptococcal septicaemia complicated by diffuse intravascular coagulation. This was classified as an **indirect** maternal death.

8.5 A 36-year-old woman, gravida 2, para 0, was admitted to hospital at 32 weeks' gestation with hypertension. She had a history of asthma, obesity and diabetes which had previously been diet controlled, but was insulin dependent during the pregnancy. The patient was treated with antihypertensives, with poor control, and she developed significant proteinuria. She was induced at 34 weeks' gestation with Prostin, and later Syntocinon. Rapid labour ensued and she was delivered with Barnes forceps due to increasing hypertension. The patient had asthmatic attacks during labour which were treated with nebulised Ventolin. Diabetic control was good. Postpartum haemorrhage followed with

manual removal of the placenta piecemeal as it was morbidly adherent. IV antibiotics were given after delivery for 2–3 days. On postpartum day two, the patient was anaemic (haemoglobin value 67 g/L), but not transfused due to her wishes. She continued to have night sweats even though the fundus was involuting and not tender. On postpartum day seven the patient felt cold, was anxious and started to hyperventilate. She went into cardiac arrest and did not respond to resuscitation. Postmortem examination found the cause of death to be sepsis, with anaemia and retained fragments of a morbidly adherent placenta as contributing factors. This was classified as a **direct** maternal death

8.6 A 26-year-old woman, para 2, had a history of irritable bowel syndrome. Her previous pregnancy was complicated by gestational diabetes and threatened premature labour. She presented to the GP in a large regional centre early in the current pregnancy. Her antenatal course was complicated by an episode of presumed renal colic at 31 weeks' gestation which was treated with Keflex, and she was subsequently found to have a small renal stone. She developed gestational diabetes again in the current pregnancy and subsequent management showed good diabetic control. She was admitted at 35 weeks' gestation with threatened preterm labour which settled with Salbutamol. She was examined at 37 weeks' gestation at which time her cervix was found to be 4 cm dilated and she went into spontaneous labour thereafter. A high vaginal swab was routinely taken at this time. Labour progressed normally, with the delivery of a liveborn infant. On the second day postpartum the patient complained of leg pain. Despite an absence of clinical signs, upon persistent symptoms, a venogram was performed the following day returning normal results. Leg pain increased in an otherwise normal clinical setting. On postpartum day four the patient became febrile, with back pain. Her painful leg became swollen and blue with weak pulses, and her other leg also became painful. A diagnosis of septicaemia was made and blood cultures were taken, broad-spectrum, high-dose antibiotics commenced and transfer arranged to a major hospital intensive care unit. Despite attempted correction of coagulation disorder, inotrophic and ventilatory support and continued antibiotics, the patient became progessively more hypotensive until she died. A postmortem confirmed multi-system failure associated with *Streptococcus pyogenes* septicaemia. This was classified as a **direct** maternal death.

Table 34 Maternal deaths in which septicaemia was a contributory cause of death

Case number	Age	Principal cause	Contributory causes
4.2	17	Termination of pregnancy	Septicaemia
6.1	32	Cardiomyopathy	Septicaemia, Caesarean section

Pneumonia

There was one death where pneumonia was considered to be the principal cause of death and another in which pneumonia was a contributory cause of death.

8.7 A 22-year-old woman, para 1, was admitted to a base hospital at 36 weeks' gestation with gestational diabetes and hypertension. She had a history of rheumatic fever and pre-eclamptic toxaemia in a previous pregnancy. She was a heavy smoker. She was anaemic (Hb 89 g/L). This was treated with folic acid tablets and vitamin B12 injections. Two days after admission, she experienced sudden onset of severe right upper quadrant abdominal pain. She was given IV Amoxycillin and/oral Roxithromycin for a suspected respiratory tract infection. A chest X-ray showed no consolidation but increased markings consistent with bronchitis. Her condition deteriorated. It was felt that she was not in a fit state for anaesthesia for operative delivery and she died three days later. Autopsy showed adult respiratory distress syndrome and pneumonia, probably of viral origin. This was classified as an **indirect** maternal death.

Table 35 Maternal deaths in which pneumonia was a contributory cause of death

Case number	Age	Principal cause	Contributory causes
6.3	28	Wolff-Parkinson-White syndrome	Viral pneumonia, placental abruption

Comment:

There was one incidental death in which the primary cause of death was *group A beta haemolytic streptococcus* septicaemia (Case 15.7) and one incidental death in which *Staphylococcus aureus* septicaemia contributed to the death (Case 15.28).

CHAPTER 9

UTEROPLACENTAL HAEMORRHAGE

In previous maternal death reports all haemorrhages except non-hypertensive intracranial haemorrhages have been grouped together. However, this report has renamed the haemorrhage chapter to include only "uteroplacental haemorrhages" to emphasise the importance of understanding the normal mechanism of haemorrhage control from the placental bed.

There were five cases in which uteroplacental haemorrhage was the principal cause of death (Tables 8 and 9), and 11 other cases in which uteroplacental haemorrhage was a contributory cause of death, the numbers in the previous five triennia being 15, 23, 22, 21 and 16 respectively. The five deaths were associated with placental abruption (1), ruptured uterus (2), placenta praevia (1), and postpartum haemorrhage (1). Only one of the uteroplacental haemorrhages involved a Caesarean section. It is noteworthy that disseminated intravascular coagulation was a complication in three of the five cases.

Table 36 Summary of deaths in which uteroplacental haemorrhage was a principal or contributory cause of death, Australia, 1994–96

Category	Number of cases	Significant contributing factors present
Postpartum haemorrhage	5	Induction (1)
		Group B Streptococcus(1)
		Pre-eclampsia (2)
		Thrombocytopenia (1)
		Diabetes (1)
Placental abruption	4	Pregnancy-induced hypertension (1)
		Wolff-Parkinson-White syndrome (1)
		Viral pneumonia (1)
Amniotic fluid embolism	3	Pre-eclampsia (1)
Ruptured uterus	2	Induction (1)
		Advanced pregnancy in unicornuate uterus (1)
Placenta praevia	2	
Total	**16**	

Placental abruption

9.1 A 28-year-old woman, primigravida, had an uneventful pregnancy to 29 weeks' gestation. She was admitted to hospital with oesophagitis and pneumonia and was treated with cifloxacin, panadeine, cisapride, and ventolin and pulmicort inhalers. She was admitted again at 35 weeks' gestation with general malaise and constipation, and then readmitted at 36 weeks' gestation with decreased fetal movements, malaise, cough and "borderline gestational diabetes". An antepartum haemorrhage occurred the following day. Placental abruption was diagnosed and a Caesarean section

performed. A postpartum haemorrhage occurred which could not be controlled and disseminated intravascular coagulation was diagnosed. The patient was transferred to another hospital about two hours after delivery. Coagulopathy persisted, and the postpartum period was complicated by hypothermia, oliguria and hypoglycemia. Eleven days after the Caesarean section the patient developed adult respiratory distress syndrome requiring tracheostomy. A laparotomy was performed on day 15 for suspected intra-abdominal bleeding and death occurred later that day from multi-organ failure. At autopsy the cause of death was found to be multi-organ failure including adult respiratory distress syndrome, and disseminated intravascular coagulation. This was classified as a **direct** maternal death.

Table 37 Maternal deaths in which placental abruption was a contributory cause

Case number	Age	Principal cause	Contributory causes
5.4	31	Pre-eclampsia	Placental abruption, intracranial haemorrhage
6.3	28	Wolff-Parkinson-White syndrome	Placental abruption, viral pneumonia
12.1	30	Amniotic fluid embolism	Placental abruption

Ruptured uterus

9.2 A 31-year-old woman, para 1, with a history of previous induction of labour at term for pregnancy-induced hypertension, was admitted at 42 weeks' gestation for prostaglandin induction. Six hours later she collapsed following rupture of the membranes. She was resuscitated, intubated and transferred to the intensive care unit. A clinical diagnosis of amniotic fluid embolus was made. Disseminated intravascular coagulation developed and she died five hours after rupture of membranes had occurred. Autopsy revealed the cause of death as ruptured uterus. There was evidence of extensive haemorrhage within the uterus and surrounding soft tissue. There was no evidence of amniotic fluid embolism. This was classified as a **direct** maternal death.

9.3 A 36-year-old woman, para 0, with a history of a previous ectopic pregnancy and salpingectomy and three miscarriages, presented at 33 weeks' gestation with abdominal pain. She was referred from a rural to a provincial hospital and treated for biliary colic with analgesics and was discharged after two days. She returned to the rural hospital two days later with severe abdominal pain and was admitted. Three days later when the abdominal pain worsened, arrangements were made for aerial transport back to the provincial hospital. However she became shocked and died before transfer. Autopsy revealed gall stones and an advanced pregnancy in a ruptured unicornuate uterus. This was classified as a **direct** maternal death.

Comment:

It should be clear to all health professionals that the use of uterotonic agents (including prostaglandin preparations) is associated with a small risk of uterine rupture, including rupture of a uterus not previously scarred.

Placenta praevia

9.4 A 30-year-old woman, para 1, died undelivered, shortly after admission to hospital at 34 weeks' gestation, from massive haemorrhage due to a major degree of posterior wall placenta praevia which was proven at autopsy. This was classified as a **direct** maternal death.

Table 38 Maternal deaths in which placenta praevia was a contributory cause of death

Case number	Age	Principal cause	Contributory causes
12.7	40	Amniotic fluid embolism	Placenta praevia

Postpartum haemorrhage

9.5 A 22-year-old woman, gravida 2, para 0, was admitted to hospital following an uneventful pregnancy for a post-dates induction of labour which resulted in a normal vaginal delivery of a liveborn infant. The patient suffered an immediate postpartum haemorrhage of approximately 600 ml. She was treated with IV Syntocinon and Hartmann's solution. Approximately four hours later she suffered another postpartum haemorrhage of approximately 400 ml, which was treated with a further Syntocinon infusion. The placenta was recorded to be complete. Over the next two days the patient had moderate lochia rubra loss and reported feeling 'dizzy'. On postpartum day 3 she experienced a third postpartum haemorrhage of 500 ml and complained of feeling faint and cold. She was treated with IV fluids, bed rest and Haemaccel 2 units. The patient signed a medical release declining blood transfusion under any circumstances. An IV Syntocinon infusion was titrated to blood loss. She continued to have moderate loss of lochia rubra. On day four, with haemoglobin value 55g/L, the intravenous catheter was removed. On day five, with haemoglobin 59g/L the patient was discharged home on iron tablets. She was re-admitted to hospital on day 11 following a further postpartum haemorrhage of 500 ml. Cervical dilatation and uterine curettage were carried out and placental tissue was removed. The patient was kept cool, intubated, sedated and paralysed after the procedure to reduce oxygen requirements and maintained on Haemaccel, inotropic support and IV fluids. She was transferred for hyperbaric oxygen treatment. She received three treatments, but rapidly deteriorated over the next two days and developed cardiac failure secondary to gross anaemia and died on day 13 postpartum. A postmortem examination was not carried out and the cause of death was

deemed to be cardiac failure due to severe anaemia secondary to postpartum haemorrhage. This was classified as a **direct** maternal death.

Table 39 Maternal deaths in which postpartum haemorrhage was a contributory cause of death

Case number	Age	Principal cause	Contributory causes
5.5	29	Pre-eclampsia	Extensive diffuse severe haemorrhage, Caesarean section
8.5	36	Sepsis	Postpartum haemorrhage, diabetes, hypertension
11.8	31	Pulmonary embolism	Postpartum haemorrhage, occasional high blood pressure
12.3	32	Amniotic fluid embolism	Postpartum haemorrhage
12.5	34	Amniotic fluid embolism	Postpartum haemorrhage, pre-eclampsia, Caesarean section
12.6	32	Amniotic fluid embolism	Postpartum haemorrhage
14.6	32	Thrombocytopenia	Postpartum haemorrhage, pre-eclampsia, myocarditis, Caesarean section

Comment:

Postpartum haemorrhage in its subacute form, is easily underestimated. The presence of ongoing excessive blood loss must lead to prompt exclusion of retained products of conception and unrecognised genital tract trauma. Preceding anaemia and clotting failure consequent upon amniotic fluid embolism mitigate against successful treatment.

CHAPTER 10

DEATHS ASSOCIATED WITH ANAESTHESIA OR CAESAREAN SECTION

There were 21 direct or indirect deaths in which anaesthesia had been given or a Caesarean section performed. The deaths were classified into the following three categories:

deaths primarily related to the administration of an anaesthetic or to the Caesarean section (4 deaths)

deaths associated with, but not primarily related to, Caesarean section (excludes incidental deaths) (12 deaths)

deaths where Caesarean section was performed in the hope of salvaging the fetus in a recently dead or moribund mother (5 deaths).

Category 1: Deaths related to anaesthesia or Caesarean section

Death principally caused by administration of an anaesthetic (1 case)

10.1 A 26-year-old woman, primigravida, with pre-eclampsia at 38 weeks' gestation, had a Caesarean section under spinal anaesthesia with intrathecal morphine for postoperative analgesia, after failed induction of labour with Prostin. The operation was uneventful and the woman was returned to the ward two hours later. She was found unrousable 16 hours after delivery. Although resuscitated, there was evidence of severe cerebral hypoxia, and ventilatory support was withdrawn 3.5 days after delivery. Autopsy showed evidence of hypoxic brain damage. This was classified as a **direct** maternal death.

Deaths primarily related to Caesarean section (3 cases)

Table 40 Maternal deaths in which Caesarean section was a contributory cause leading to pulmonary embolism

Case number	Age	Principal cause	Contributory causes
11.3	34	Pulmonary embolism	Caesarean section
11.5	28	Pulmonary embolism	Caesarean section, severe pre-eclampsia
11.6	35	Pulmonary embolism	Caesarean section

Comment:

During the triennium, there were approximately 150,000 Caesarean sections with four instances where the death was attributed primarily to the operation or to the anaesthetic. Although not taking into account any consideration of morbidity, the rate of one death per 37,500 cases is a useful index of the safety of Caesarean section in modern obstetric care.

The known association between Caesarean section and postoperative thromboembolism should direct clinicians to assessing whether a patient undergoing

Caesarean section is at increased risk, and in such circumstances to consider thromboprophylaxis.

Category 2: Deaths associated with but not primarily related to Caesarean section (excludes incidental deaths)

There were 12 women in this group.

Table 41 Maternal deaths associated with but not causally related to Caesarean section (excluding incidental deaths)

Case number	Age	Principal cause	Contributory causes
5.3	22	Pre-eclampsia	Caesarean section, intracerebral haemorrhage
5.5	29	Pre-eclampsia	Caesarean section, extensive diffuse severe haemorrhage
5.7	22	Pre-eclampsia	Caesarean section
6.1	32	Cardiomyopathy	Caesarean section, septicaemia
6.6	33	Previous mitral valve replacement	Caesarean section
6.7	22	Eisenmenger syndrome	Caesarean section
8.2	26	Septicaemia	Caesarean section
9.1	28	Placental abruption	Caesarean section, Adult Respiratory Distress Syndrome
11.4	27	Pulmonary embolism	Caesarean section, severe pre-eclampsia
12.5	34	Amniotic fluid embolism	Postpartum haemorrhage, pre-eclampsia, Caesarean section
13.1	34	Suicide	Caesarean section, diabetes
14.6	32	Thrombocytopenia	Caesarean section, intra-peritoneal haemorrhage, myocarditis, pre-eclampsia

Comment:

Most of the women in this category were desperately ill before the operation commenced.

There was one incidental death which was associated with but not causally related to Caesarean section (Case 15.30).

Category 3: Caesarean section in recently dead or moribund women

In this category, the Caesarean section can be considered to be entirely coincidental to the maternal death.

There were three direct and two indirect deaths in which Caesarean sections were carried out on dead or moribund women.

Table 42 Caesarean sections amongst dead or moribund women (direct and indirect deaths only), Australia, 1994–96

Case number	Age	Principal cause	Contributory causes
5.2	32	Pre-eclampsia	Rheumatic heart disease
5.4	31	Pre-eclampsia	Intra-cerebral haemorrhage, placental abruption
6.3	28	Wolff-Parkinson-White syndrome	Viral pneumonia, placental abruption
7.3	31	Cerebral aneurysm	
12.8	30	Amniotic fluid embolism	

There were a further eight incidental deaths in which Caesarean sections were performed on dead or moribund women. Although incidental deaths have not been included in other sections of this or earlier chapters, the number of cases warrant inclusion here.

Table 43 Caesarean sections amongst dead or moribund women (incidental deaths only), Australia, 1994–96

Case number	Age	Principal cause
15.3	22	Cerebral haemorrhage
15.4	39	Cerebral haemorrhage
15.5	27	Cerebral haemorrhage
15.18	21	Motor vehicle accident
15.20	20	Motor vehicle accident
15.22	37	Metastatic lung carcinoma
15.24	29	Metastatic melanoma
15.28	30	Drug-related

Table 44 summarises the birth outcome of Caesarean sections performed on dead or moribund women (direct, indirect and incidental deaths).

Table 44 Summary of Caesarean sections and birth outcome among recently dead or moribund women, Australia, 1994–96

Cause of death	Number of patients	Perinatal outcome
Intracranial haemorrhage	6	6 liveborn, 1 died the following day
Motor vehicle injury	2	2 stillbirths
Neoplasm	2	2 unspecified
Rheumatic heart disease	1	Stillbirth
Cardiac arrhythmia	1	Unspecified
Amniotic fluid embolism	1	Livebirth
Total	**13**	**7 livebirths, 3 stillbirths**

CHAPTER 11

PULMONARY THROMBOEMBOLISM

There were eight deaths in which pulmonary thromboembolism was judged to be the principal cause of death. One other death report recorded thromboembolism as a contributing factor. All nine deaths were classified as direct maternal deaths. Four of the deaths followed Caesarean section.

11.1 A 23-year-old woman became pregnant after in-vitro fertilisation (IVF) and embryo transfer. She developed deep venous thrombosis in her left leg, 21 days later. She was treated with heparin but suffered massive pulmonary thromboembolism 29 days after embryo transfer and died, in spite of treatment, in an intensive care unit. She had a past history of deep venous thrombosis seven years previously. This was classified as a **direct** maternal death from antenatal thromboembolism.

11.2 A 39-year-old woman, gravida 3, para 1, had a prepregnancy history of asthma requiring intermittent treatment with Intal, and two previous miscarriages. She had a cold and persistent cough noted at 21 weeks' gestation, which had resolved by the time of an antenatal visit at 25 weeks' gestation. At 31 weeks' gestation, the woman complained of tiredness, shortness of breath and coughing on exertion. At 33 weeks' gestation she fainted at home, complaining of breathlessness. She took Intal, and although advised to go to hospital, declined and instead agreed to see her GP the following morning. Two days later the woman fainted again and admission to hospital was arranged. Cardiac arrest occurred during the ambulance transfer. Resuscitation was unsuccessful. Postmortem examination revealed thromboembolism of the right and left pulmonary arteries and a deep venous thrombosis in the right leg. This was classified as a **direct** maternal death.

Following Caesarean section

11.3 A 34-year-old woman, para 1, weight 112 kg, had a difficult (due to adhesions) repeat Caesarean section performed, under general anaesthesia, at 42 weeks' gestation for fetal distress. The infant's birthweight was 4,550 g. The woman was ambulant the following day but developed chest pain and collapsed 36 hours after delivery. She was transferred to an intensive care unit but died soon afterwards. Autopsy revealed pulmonary thromboembolism as the cause of death. This was classified as a **direct** maternal death.

11.4 A 27-year-old woman, primigravida, had a history of untreated scleroderma. At 28 weeks' gestation she developed severe oligohydramnios. A week later, she developed severe pre-eclampsia associated with breathlessness, and was treated with an antihypertensive drug and a diuretic. Elective Caesarean section was performed and a live male was delivered. Thereafter her respiratory condition improved and she was discharged from hospital in a satisfactory condition on the sixth postpartum day. She was readmitted 17 days later after having collapsed at home. A diagnosis of pulmonary embolism was made and heparin therapy commenced, but she deteriorated

and died the next day. Autopsy demonstrated massive acute pulmonary embolism, with pulmonary oedema, evidence of pulmonary embolism several weeks earlier, and/organising thrombus in the pelvic veins. There was also evidence of widespread progressive systemic sclerosis. The death was classified as a **direct** maternal death from massive pulmonary embolism.

11.5 A 28-year-old woman, para 2, developed severe pre-eclampsia at 28 weeks' gestation. She was delivered by Caesarean section and discharged well on day nine. On day 14, she collapsed and died suddenly. Autopsy showed pulmonary thromboembolism. This was classified as a **direct** maternal death.

11.6 A 35-year-old woman, gravida 1, para 0, with a history of previous miscarriage, was admitted at 32 weeks' gestation after an uneventful pregnancy with a three-day history of vaginal blood spotting and a one-day history of abdominal pain. Ultrasound scan revealed a transverse lie of the fetus but no placenta praevia,. She was treated with corticosteroids and/oral salbutamol. Labour commenced spontaneously two days after admission. Due to a footling breech presentation, the patient was delivered by lower segment Caesarean section. She collapsed one day later with hypotension. A provisional diagnosis of intra-abdominal bleeding was made. Laparotomy revealed no bleeding, but a pulmonary angiogram demonstrated a pulmonary embolus. Following cardiac arrest during the angiogram, resuscitation and pulmonary embolectomy were carried out. Postoperatively the patient developed coagulopathy and anoxic encephalopathy. She died six days after the embolectomy. Autopsy revealed the cause of death to be pulmonary embolism. This was classified as a **direct** maternal death.

Following vaginal birth

11.7 A 20-year-old woman, para 0, with mild pregnancy-induced hypertension, had labour induced at term, followed by a spontaneous delivery. There were no intrapartum or apparent postpartum problems, and she was discharged five days after delivery. She was readmitted 13 days later with leg pain, which was thought to be sciatica. The evening of admission, she had a sudden episode of chest pain, collapsed, failed to respond to attempts at resuscitation and died. Autopsy showed pulmonary embolus with extensive thrombus in the femoral and posterior iliac veins with inflammation around the sciatic nerve. This was classified as a **direct** maternal death from pulmonary thromboembolism.

Table 45 Summary of deaths in which pulmonary thromboembolism was a principal or contributory cause by triennium, Australia, 1964–96

Triennium	During pregnancy	Post-abortion/ miscarriage	After operation — ectopic pregnancy	After vaginal birth	After Caesarean section	Total	Total number of deaths	Percent of total
1964–66	3	6	0	22	13	44	275	16.0
1967–69	15	0	0	23	5	43	237	18.1
1970–72	5	2	1	10	4	22	244	9.0
1973–75	4	0	0	6	1	11	137	8.0
1976–78	7	0	0	3	3	13	106	12.2
1979–81	1	0	0	1	6	8	98	8.1
1982–84	1	0	0	1	2	4	94	4.2
1985–87	2	0	0	3	2	7	86	8.1
1988–90	3	1	0	3	5	12	96	12.5
1991–93	2	0	0	2	4	8	84	9.5
1994–96	2	0	1	2	4	9	100	9.0

11.8 A 31-year-old woman, para 2, weighing 117 kg, reported an uneventful pregnancy other than 'occasional high blood pressure' and varicose veins of the right leg. She was admitted to hospital following spontaneous onset of labour at 41 weeks' gestation and had a normal vaginal delivery followed by a postpartum haemorrhage of approximately 700 ml. During labour she was treated with a single bolus of hydralazine and with intravenous Ampicillin for Group B Streptococcal colonisation. Her haemoglobin value during labour was 86g/L and she was not transfused. She was discharged to a level 1 hospital on the first day postpartum with a haemoglobin of 90g/L, taking oral iron. There was no record of admission to the hospital. Eighteen days postpartum at home, the patient awoke at 4.00 a.m. and subsequently collapsed in the kitchen. Ambulance officers were unsuccessful in their attempts at resuscitation. Autopsy revealed the cause of death to be pulmonary embolism, with microscopic findings of thromboemboli present in the pulmonary arteries and thrombus in the myometrial and large uterine veins. This was classified as a **direct** maternal death.

Table 46 Maternal deaths in which pulmonary thromboembolism was a contributory cause

Case number	Age	Principal cause	Contributory causes
4.6	38	Ectopic pregnancy	Pulmonary thromboembolism

Comment:

Of the eight deaths attributed to pulmonary embolism in this triennium, all but two occurred after delivery (Cases 11.1, 11.2). Their timing displayed a bimodal pattern with two deaths in the first seven days postpartum (Cases 11.3, 11.6) and four occurring from 13–18 days postpartum, all of these four after discharge from hospital (Cases 11.4, 11.5, 11.7. 11.8).

The two antepartum deaths were quite different. One occurred in a young woman four weeks from conception after an IVF pregnancy. She had a history of venous thrombosis at the age of 16, suggesting an underlying thrombophilia (Case 11.1). The other death was of a woman aged 39 years with a two-week history of dyspnoea and fainting compounded initially by refusal of hospital admission (Case 11.2).

As usual in these cases, four of the six deliveries were by Caesarean section (Cases 11.3, 11.4, 11.5, 11.6). In two of these the Caesarean had been performed at 28 weeks' because of severe pre-eclampsia (Cases 11.4, 11.5), and one of these women had scleroderma as an underlying medical problem leading to the pre-eclampsia.

The weight of two of these women exceeded 110 kg. If the case of ectopic pregnancy who died of pulmonary embolism is included as a ninth death, four of the women were aged between 34–39 years.

CHAPTER 12

AMNIOTIC FLUID AND AIR EMBOLISM

Amniotic fluid embolism

There were eight deaths which were classified as resulting principally from entry of amniotic fluid and contents into the maternal circulation. In the ten previous triennia the proportion of maternal deaths resulting from amniotic embolism were 12 of 275, 14 of 237, 7 of 244, 5 of 137, 7 of 106, 3 of 98, 6 of 96, 2 of 86, 4 of 96 and 5 of 84, compared with 8 of 100 in the 1994–96 triennium.

Amniotic fluid embolism classically presents as sudden cardiorespiratory arrest or as postpartum haemorrhage associated with blood coagulation failure. Those women who do not show the cardiorespiratory phase (which is often fatal) usually present with haemorrhage and blood coagulation failure.

12.1 A 30-year-old woman, para 1, with a previously uneventful pregnancy to term, was found collapsed at home. On arrival of the ambulance she was found to be unconscious with pupils fixed and dilated, apnoeic and in asystole. Resuscitation was commenced and the patient was transferred to hospital. After unsuccessful resuscitation, the patient was declared deceased 25 minutes after arrival at hospital. She died undelivered. Autopsy revealed amniotic fluid embolism following placental abruption. This was classified as a **direct** maternal death.

12.2 A 38-year-old woman, para 3, was seen once at 26 weeks' gestation at an antenatal clinic. She elected to have a home birth. The membranes ruptured spontaneously at 37 weeks' gestation. She stayed at home awaiting the onset of labour. Three days after the membranes had ruptured, she collapsed after experiencing a prolonged uterine contraction. She was taken to a provincial hospital but could not be resuscitated. Autopsy revealed evidence of amniotic fluid embolism and chorioamnionitis. This was classified as a **direct** maternal death.

12.3 A 32-year-old woman, gravida 2, para 1, had an uneventful pregnancy to 36 weeks' gestation when she was admitted to hospital following an unclassified antepartum haemorrhage with threatened premature labour. She was discharged ten days later. The patient was re-admitted at 39 weeks' gestation with a further antepartum haemorrhage. Upon examination she was afebrile, with a blood pressure of 130/88, with breech presentation. She collapsed suddenly 15 hours after admission. Attempts at resuscitation were unsuccessful. The postmortem revealed amniotic fluid embolism as the cause of death. This was classified as a **direct** maternal death.

12.4 A 31-year-old woman, gravida 3, para 1, after a normal antenatal course, experienced some lower abdominal pain, followed by spontaneous rupture of membranes at term. While she was being taken to hospital, the pain became severe, she gasped for air and appeared to have a fit. After initial resuscitation attempts at the hospital she was transferred to intensive care facilities but was dead on arrival, undelivered, 45 minutes after rupture of membranes. Autopsy

revealed amniotic squames within intrapulmonary and uteroplacental vessels, and amniotic fluid embolism was established as the cause of death. The fetus had evidence of acute asphyxia. This was classified as a **direct** maternal death.

12.5 A 34-year-old woman, para 0, with pre-eclampsia, had a Caesarean section performed at 38 weeks' gestation for obstructed labour and fetal distress. The infant was born alive. Severe postpartum haemorrhage associated with uterine atony failed to respond to oxytocic agents, massive blood transfusion and hysterectomy. Disseminated intravascular coagulopathy developed and the woman died the day after delivery. At autopsy, amniotic fluid embolism was considered to be the probable cause of the haemorrhage. This was classified as a **direct** maternal death.

12.6 A 32-year-old woman, para 2, went into labour at term following spontaneous rupture of the membranes. During the second stage of labour she became semiconscious, with agitation and tachypnoea. She was quickly delivered by forceps; this was followed by severe postpartum haemorrhage. She was taken to theatre for examination under anaesthesia to exclude ruptured uterus. She had a cardiac arrest shortly afterwards and could not be resuscitated. Autopsy revealed evidence of amniotic fluid embolus. This was classified as a **direct** maternal death.

12.7 A 40-year-old woman, gravida 1, para 1, presented at 34 weeks' gestation to a major public hospital following referral from a metropolitan district hospital with an antepartum haemorrhage. Minor placenta praevia was noted. A repeat ultrasound examination 2 weeks later showed resolution, and the patient was discharged. The patient's membranes ruptured spontaneously at home at 39 weeks'. Within ten minutes of membrane rupture the woman complained of feeling sick, faint, could not think clearly and collapsed on the bed. During private transport to her district hospital she seemed unable to speak and was moaning in pain. Upon arrival at hospital, uterine contractions and fetal bradycardia were observed. The patient's conscious state was impaired. Transfer to a major hospital was planned but delivery became imminent and was completed by vacuum extraction. Brisk haemorrhage followed the delivery of the placenta and a missing cotyledon was removed. Usual measures for management of third stage were implemented and the patient was transferred. Blood loss before transfer was estimated at three litres. A cardiac arrest occurred in transit. No doctor was present during transfer. On arrival at the major hospital the patient was in extremis without palpable pulse or blood pressure. She was resuscitated, transfused, coagulation factors administered and when sufficiently stable but still bleeding, taken to theatre and an abdominal hysterectomy was performed. Postoperatively, she was transferred to an intensive care unit at another major hospital. Life support was maintained until a CAT scan was performed which showed infarction of all branches of her left cerebral artery. Despite continued support, multi-organ failure resulted in her death 13 days postpartum. The causes of death were postpartum haemorrhage and multi-organ failure which

are thought to have followed an amniotic fluid embolism although this was not confirmed at autopsy. This was classified as a **direct** maternal death.

12.8 A 30-year-old woman, gravida 4, para 2, was admitted to hospital at 40 weeks' gestation in established labour. Artificial rupture of the membranes revealed meconium staining and there was persistent fetal bradycardia. At around 6 cm dilation the patient suffered a seizure whilst being prepared for delivery. An emergency Caesarean section was performed rapidly as the woman had cardiorespiratory arrest. A live male baby was delivered. The mother developed disseminated intravascular coagulation and failed to respond to maximum cardiorespiratory support and resuscitation. Two hours after delivery she was declared deceased. Postmortem examination showed the cause of death to be amniotic fluid embolism. This was classified as a **direct** maternal death.

Air embolism

In this triennium there were no cases of air embolism.

Comment:

In previous triennial reports it has been stated, repetitively, that in cases of amniotic fluid embolism the woman is often a multipara in strong labour with a large baby. None of the eight cases in this triennium match this description. Accordingly the case summaries of all 73 cases of amniotic fluid embolism in this and the 10 previous triennial reports were reviewed to see if the clinical pattern had changed. In the 70 cases in which parity was recorded there were 14 nulliparas, 16 para 1, 17 para 2, 11 para 3 and 12 women who were para 4 or more, although in this series there was no grand multipara (para 4 or more) in the last six triennia.

In the 73 cases, 27 women died undelivered and only one of them had haemorrhage associated with blood coagulation failure. In this triennium five of the eight women experienced cardiorespiratory collapse before labour commenced (Cases 12.1, 12.2, 12.3, 12.4, 12.7) and three of them had experienced rupture of the membranes and onset of abdominal pain at about the same time. Generalised convulsions sometimes occur in women with this clinical presentation as was noted in Cases 12.4 and 12.8. Analysis of these cases provides few clues for prevention of maternal death especially in women who experience cardiorespiratory collapse, even when in hospital with adequate facilities available. However, it should be kept in mind that when a woman is resuscitated following cardiorespiratory failure, the attendants have due warning to prepare for massive haemorrhage, possibly associated with blood coagulation failure, when she is delivered.

Conversely, in this series, 20 of the 46 women who died after delivery had postpartum haemorrhage associated with blood coagulation failure, as was recognised in Case 12.5 and 12.8 in the 1994–96 triennium. In Case 12.6 the woman also had severe postpartum haemorrhage, which from the history of intrapartum collapse may have been anticipated. These cases illustrate that disseminated

intravascular coagulopathy should be excluded, and treated appropriately when recognised, in all patients with severe haemorrhage occurring during or after delivery. In some cases there is no preceding episode of cardiorespiratory collapse. Many of these cases illustrate that heroic resuscitative efforts can be ineffective once haemorrhage occurs especially in association with blood coagulation failure.

It is noteworthy that the first signs of amniotic fluid embolism can occur during Caesarean section. This occurred in Case 12.5 in the present triennium and in 10 of the 73 cases in this and previous triennia. In such cases amniotic fluid embolism may be confused with cardiorespiratory arrest due to the acid aspiration syndrome, pulmonary thromboembolism or anaesthetic difficulties.

It may be noted that an autopsy diagnosis of amniotic fluid embolism often requires a pathologist with special training in obstetric pathology and use of the appropriate stains to show the presence of mucin and fetal squames in the pulmonary arterioles. In patients who survive a clinical episode of amniotic fluid embolism it is very difficult to establish the diagnosis with certainty.

CHAPTER 13

DEATHS FROM PSYCHIATRIC CAUSES, SUICIDE AND/OR SELF-ADMINISTERED OVERDOSE

In the two deaths reported in this chapter the principal cause of death was suicide and the State and Territory Maternal Mortality Committees classified them as *indirect* maternal deaths. In this triennium, in which there were 100 maternal deaths, there were two other cases of suicide and one of self-administered drug overdose which were classified as incidental deaths and thus these are reported in Chapter 15 which includes all 34 cases of incidental deaths.

Readers should be aware that in the preparation of this report, the authors did not reclassify cases but were bound by the direct, indirect and incidental classification as judged by the relevant State or Territory committee after full consideration of all available clinical details.

The clinical details of several cases in this report are not clear-cut. Differentiation between murder, suicide and accidental deaths is sometimes not possible with the data available to the expert committees or the police and coronial courts that have also investigated them. Moreover, the relevance of pregnancy to a murder, suicide or accident may be unknown to the committee. A pregnancy complication (e.g. hyperemesis and/or its drug management) could result in an accident and pregnancy itself could have precipitated the act of suicide or murder (e.g. a woman could commit suicide because of puerperal depression which would, if this was known, be classified as a direct maternal death). This shows that classification of such cases as direct, indirect (e.g. if there is previous psychiatric disease) or incidental deaths can be artificial and misleading. *This is why in Australia*, *all maternal deaths*, *including incidental deaths*, *are reported*. In this context it may be noted that in the Report on Confidential Enquiries into Maternal Deaths in the United Kingdom 1994–1996 (Department of Health, Welsh Office, 1998), some deaths previously classified as 'fortuitous' deaths (their synonym for incidental deaths) have been reclassified as indirect deaths: "In this enquiry all cases of cardiac disease, asthma and epilepsy are coded as indirect, as are cases of suicide unless obviously occurring in women with longstanding previous psychiatric history" (p. 3). We believe the best strategy for reporting maternal deaths is to report all cases of direct, indirect and incidental deaths, in the hope that analysis will result in formation of strategies for prevention which can then be implemented.

Suicide

13.1 A 34-year-old woman, gravida 2, para 1, had a history of insulin dependent diabetes mellitus, bipolar mood swings over the previous 16 years and admission to a psychiatric unit the previous year following overdose of melleril and insulin. A Caesarean section was performed and a liveborn infant delivered. The woman was transferred to a psychiatric unit on day 13 postpartum following threats of suicide. She was found to be depressed and anxious and was transferred back to a general hospital on day 15 postpartum on prozac, melleril, protophane and actrapid insulins. On day 18 postpartum the patient jumped from the third floor hospital balcony. The autopsy revealed

injuries consistent with the fall and the cause of death was suicide. This was classified as an **indirect** maternal death.

13.2 A 25-year-old single woman, para 0, had a history of mild anaemia and was a smoker. At 35 weeks' gestation she moved from a large rural centre to closer promixity to a major hospital for delivery. The labour and delivery were straightforward. On postpartum day two the patient expressed anxiety about discharge. Despite her reluctance, she was assessed by members of the social work department and plans were made for contact with the domiciliary nursing service after her discharge from hospital. She was discharged four days after delivery. The domiciliary nurse visited the next day and thought no-one was at home. The patient had committed suicide. The baby was found to be well. This was classified as an **indirect** maternal death.

There were two cases of suicide (Cases 15.8 and 15.9) and one case of self-administered drug overdose (Case 15.10) which were classified as incidental deaths and can be found in Chapter 15.

Comment:

Viewed in retrospect these cases indicate the importance of a secure environment, adequate psychiatric opinion and appropriate arrangements when there are problems such as those experienced by these two women.

CHAPTER 14

MEDICAL CONDITIONS NOT CLASSIFIABLE ELSEWHERE

This is a new chapter for the maternal deaths report which includes any deaths from direct or indirect causes where the principal cause of death or other contributory causes could not be adequately classified in the other principal cause of death chapters.

The conditions included in this chapter were cases of ruptured artery causing intra-abdominal haemorrhage (3), prepregnancy diabetes (4), gestational diabetes (2), thrombotic thrombocytopenic purpura (1), thrombocytopenia (1), gallstones (1) and migraine (1). Of the 13 deaths reported in this chapter, 6 deaths were judged to have been principally caused by a condition not classifiable elsewhere in the report; only 2 of these 6 deaths were classified as direct maternal deaths.

Ruptured artery

14.1 A 26-year-old woman, para 0, went into labour at 38 weeks' gestation and delivered spontaneously within six hours with no apparent complications. An episiotomy had been performed and extended through the external anal sphincter. This was repaired. There were no problems overnight and she was seen the next morning, 16 hours after delivery, on a routine ward round. No abnormalities were noted. She collapsed 15 minutes after being seen, with signs of intra-abdominal bleeding. She was taken to theatre and at laparotomy a massive retroperitoneal haemorrhage was found, eventually located to be coming from a rupture of the left external iliac artery. Despite aortic compression and ligation of the left external iliac artery, she died during the operation. An obstetrician, general surgeon and a vascular surgeon were present. Autopsy revealed a rupture of the left external iliac artery. Examination of the abdominal and pelvic blood vessels showed no evidence of arteritis. Special stains for mucopolysaccharide in the aorta showed no underlying pathology. There were no other abnormal findings. This was classified as a direct maternal death.

14.2 A 30-year-old woman, para 3, weighing 102 kg, had an uneventful vaginal delivery at term. Fifteen hours after delivery the patient vomited and complained of abdominal pain. At 20 hours after delivery she had a generalised seizure but responded well to Haemaccel and blood transfusions. Twenty-two hours after delivery she was noted to have a left parauterine mass which was diagnosed as a broad ligament haematoma. Abdominal pain increased, and a laparotomy was carried out to evacuate the haematoma. Bleeding was noted from the region of the left kidney, however nephrectomy and application of aortic clamps failed to control the bleeding. After several cardiac arrests during the laparotomy the patient died in the operating theatre. Autopsy revealed the cause of death as rupture of the left renal artery associated with myxoid degeneration of the renal artery. This was classified as an indirect death.

14.3 A 31-year-old woman, primigravida, had an uncomplicated ventouse delivery at a country hospital after a long second stage. She complained of faintness, slight shoulder and back pain about five hours after delivery. Her observations were stable until six hours later when pain became more severe and she collapsed, with some chest pain and shortness of breath. Resuscitation was commenced, and a provisional diagnosis of intra-abdominal haemorrhage was made. She was given blood and frozen plasma transfusions, and an adrenaline infusion. A laparotomy was performed which demonstrated a massive haemorrhage in the upper abdomen, thought to be from a ruptured splenic artery aneurysm. This bleeding could not be controlled and the woman died about 16 hours after delivery. Autopsy confirmed the provisional diagnosis made at operation and cause of death was rupture of a splenic artery aneurysm. This was classified as an **indirect** death.

Diabetes

14.4 A 27-year-old woman, primigravida, had a prepregnancy history of insulin-dependent diabetes with multiple admissions for poor control, hypertension, gastric ulcer and a left salpingo-oophorectomy. She was treated for hypertension at six and ten weeks' gestation, and for a suspected urinary tract infection at 16 weeks' gestation. She was admitted to hospital at 20 weeks' gestation with gastritis, and discharged five days later. She was found dead at home three days after being discharged from hospital. The coroner found death occurred from hypoglycaemia due to insulin-dependent diabetes and pregnancy. This was classified as an **indirect** maternal death.

14.5 A 30-year-old woman, gravida 3, para 1, with insulin-dependent diabetes mellitus, had regular antenatal care from six weeks' gestation with repeated assessments of fetal welfare from 32 weeks' gestation. At 35 weeks' she had a glycosylated haemoglobin of 7.3%. She was admitted at 37 weeks' gestation for monitoring of blood pressure and diabetes. Renal function was found to be deteriorating, and pregnancy-induced hypertension was diagnosed. Following the spontaneous onset of labour at 39 weeks' gestation, and augmentation of labour with Syntocinon infused intravenously, a live baby was delivered with the assistance of low forceps application due to a delay in the second stage of labour. After an uneventful recovery, the patient was discharged from hospital three days postpartum. She was readmitted to hospital 17 days postpartum with a five-day history of headache and drowsiness, and having had a seizure. Two more seizures followed. The patient was intubated, ventilated and given IV diazepam. A cerebral CAT scan showed a left haemorrhagic infarct and subarachnoid haemorrhage. The infarct later extended. Hypertension persisted and Klebsiella urinary tract infection was diagnosed. Brain death was confirmed on the twenty-second postpartum day. The cause of death was cerebral haemorrhagic infarction due to rupture of a cerebral artery aneurysm. This was classified as an **indirect** maternal death.

Table 47 Maternal deaths in which diabetes was a contributory cause of death

Case number	Age	Principal cause	Contributory & associated causes
8.5	36	Septicaemia	Insulin-requiring diabetes, pregnancy-induced hypertension, postpartum haemorrhage
8.6	26	Septicaemia	Gestational diabetes
8.7	22	Viral pneumonia	Gestational diabetes, hypertension
13.1	34	Suicide	Insulin-dependent diabetes, Caesarean section

Thrombocytopenia

14.6 A 32-year-old woman, para 1, was referred to a base hospital at 35 weeks' gestation because of suspected fetal growth restriction. She was found to have severe thrombocytopenia and proteinuria, without hypertension. Admission to the base hospital was advised, but the patient declined. She re-presented that night with chest pain, tachypnoea and fetal distress and was delivered by emergency Caesarean section. Post-operatively she rapidly deteriorated with cardiorespiratory failure and was admitted to an intensive care unit. Two hours post-operatively, she had severe persistent vaginal bleeding, which did not respond to ergometrine, uterine compression and intramyometrial PGF2α. She died despite resuscitation. Autopsy revealed acute myocarditis and pericarditis. There was recent intraperitoneal haemorrhage. The thrombocytopenia was thought to be pregnancy-induced. This was classified as a **direct** maternal death.

Table 48 Maternal deaths in which other medical conditions (not classified elsewhere) were contributory causes of death

Case number	Age	Principal cause	Contributory causes
5.1	27	Thrombotic thrombocytopenic purpura	Pre-eclampsia
6.4	31	Dissecting aneurysm of coronary artery	Migraine
9.3	36	Ruptured uterus	Gallstones

In addition to the above 13 cases there were a number of deaths associated with medical conditions not classified elsewhere which were classified as incidental deaths. These included neoplasms (5) (Cases 15.21–15.25), drug-related deaths (4) (Cases 15.27–15.30) and encephalitis (1) (Case 15.26) and are presented in Chapter 15.

Comment:

The first two cases of **intra-abdominal haemorrhage** (rupture of external iliac artery and renal artery respectively) are the only cases of these complications resulting in maternal death in the 11 triennia, 1964–1996, in which there were approximately 8 million confinements in Australia. For perspective *in the last ten triennia combined there*

were 1,457 maternal deaths in Australia, and intra-abdominal haemorrhage accounted for 21 (dissecting aneurysm of the aorta, 13 (known Marfan syndrome in 3); rupture of an aneurysm of the aorta, 3 (Marfan syndrome 1); rupture of an aneurysm of the splenic artery, 3; rupture of the splenic vein in a woman with cirrhosis and portal hypertension, 1; and in 1 woman the ruptured vessel resulting in the haemoperitoneum could not be found at autopsy.

Rupture of the external iliac artery in pregnancy can be the initial presentation of the Ehlers-Danlos syndrome, 'a group of connective tissue disorders involving defects in collagen synthesis' (Brees & Grii, 1995). Review of the literature indicates that the possibility of a ruptured renal artery aneurysm should be considered in pregnant women with evidence of retroperitoneal haemorrhage (Yang & Hye, 1996).

There is extensive literature concerning **spontaneous rupture of an aneurysm of the splenic artery** which seems to have a predilection to occurrence during pregnancy and remains a life-threatening complication, with a maternal mortality rate of approximately 25% (Caillouette & Merchant, 1993). A diagnosis of ruptured splenic artery aneurysm should be considered in any pregnant woman who complains of the sudden onset of severe left upper abdominal pain regardless of whether pain or shock is prominent at the time of evaluation (Caillouette & Merchant , 1993).

In this triennium 5 of the 100 mothers who died had **prepregnancy diabetes mellitus**, which contributed significantly to the death in 2 of the 4 cases reported in this chapter and probably also to the case reported in Chapter 15 in which the cause of death was found to be suicide following insulin overdose. In the previous 10 triennia there have been a total of 13 maternal deaths in women with diabetes mellitus. In the 1970–72 triennium there were four deaths and we repeat the advice then given to readers that 'close supervision by a physician expert in the management of diabetes (and its complications) is necessary in dealing with pregnant diabetic patients'. In Obstetric teaching hospitals with referral of women with diabetes to a special clinic, the incidence of such mothers in the obstetric population is about 4 in 1,000. In this triennium these women accounted for a disproportionate number of maternal deaths.

In Case 14.6 the thrombocytopenia was considered to be the primary disorder although it can also present as a complication of severe pre-eclampsia. The development of the cardiorespiratory failure and uncontrollable postpartum haemorrhage, together with the autopsy findings of myocarditis and pericarditis, provide the picture of a constellation of life-threatening complications. Prevention of such a death requires early diagnosis and therapeutic intervention before the lethal chain of events described in this case become established.

CHAPTER 15

INCIDENTAL DEATHS

This chapter includes all of the deaths classified as incidental in nature. Incidental deaths are those due to conditions occurring during pregnancy, where the pregnancy or its direct effects upon the woman or her partner, is unlikely to have contributed significantly to the death, although it is sometimes possible to postulate a distant association (for example, homicides, accidents). It is often difficult for the expert committees to decide whether a death is an indirect or an incidental death (or even a direct death as when a woman with perhaps unrecognised puerperal depression commits suicide). Indirect deaths are those resulting from pre-existing disease which may have been aggravated by the physiological effects of pregnancy (for example, heart disease, diabetes, renal disease). A disease that developed for the first time during pregnancy and was not due to direct obstetric causes can also cause an indirect maternal death (for example, cardiac disease, intracranial haemorrhage, asthma, epilepsy).

The above considerations are always important in an overview of all causes of maternal deaths. They are especially relevant in the results reported for the 1994–96 triennium because this report contains a number of incidental deaths that could have been classified as indirect (for example, the first seven deaths in this chapter due to asthma, intracranial haemorrhage and infection).

In the 1994–96 triennium 34 (34.0%) of the 100 deaths were classified as incidental deaths. The principal causes of incidental deaths were: homicide (6), neoplasms (5), motor vehicle and other injuries (4), intracranial haemorrhage (4) and drug-related (4). There were four deaths from unexplained causes.

Many maternal deaths have several complications and so appear in several chapters of this report. This applies to the 46 direct maternal deaths and 20 indirect maternal deaths. *However the 34 incidental maternal deaths are considered in Chapter 15 alone*, even when, for example, the woman died from intracranial haemorrhage, or infection, or conditions which are included in Chapters 7 and 8 exclusively for deaths classified by the expert committees as direct or indirect deaths.

Cardiorespiratory disease

15.1 A 35-year-old woman, para 5, with a history of tubal ligation, reanastomosis and severe and recurrent asthma requiring numerous hospital admissions, was admitted at 21 weeks' gestation with asthma. She was subsequently moved to intensive care where she required ventilation. Three days after admission a chest X-ray revealed pneumonia with right basal lung collapse and consolidation. She was transferred to another hospital on day four. On day five one pupil was noted to be dilated. She continued to deteriorate neurologically over the next 12 days to brain death on day 16 after admission. Ventilatory support was subsequently withdrawn. The cause of neurological deterioration was not identified despite extensive investigation. Autopsy identified asthma and pregnancy as predisposing conditions for the development of resistant pneumococcal pneumonia. This then led to pituitary

microabcesses, hypotension secondary to sepsis, multiple brain haemorrhages, and a rise in intracranial pressure and eventual brainstem coning. The cause of death was attributed to cerebral oedema following respiratory failure due to asthma. This was classified as an **incidental** death.

15.2 An 18-year-old woman with a history of asthma requiring repeated admission to hospital, awoke at 36 weeks' gestation with severe breathlessness which did not respond to inhaled salbutamol. An ambulance was called and the patient was found to be in cardiorespiratory arrest. Cardiopulmonary resuscitation was commenced and maintained during transfer to hospital. On admission the patient was intubated and ventilated. Her pupils were noted to be fixed and dilated, and fetal heart sounds were absent. Resuscitation was unsuccessful. Autopsy revealed congested pleural surfaces and over-expanded lungs. The cause of death was asthma. This was classified as an **incidental** death.

Comment:

These two cases and to a lesser extent Case 8.5 in Chapter 8, illustrate that asthma is an important medical disease that can deteriorate during pregnancy and influence its outcome. These results emphasise the need for women with severe asthma to have their medication regimen reviewed when pregnant and to have a crisis plan to cope with a sudden severe episode.

Intracranial haemorrhage

15.3 A 22-year-old woman, para 2, and a heavy smoker, had an uneventful pregnancy to 35 weeks' gestation when she was admitted with a headache. She was diagnosed with a migraine, pethidine was given, and she was discharged two days later. The patient was readmitted later the same day with a headache of increasing severity. A brain CAT scan showed normal results and she was discharged again two days later. Eleven days later she was readmitted unconscious with a history of collapse, convulsion and vomiting. After a diagnosis of cerebral haemorrhage had been made, a Caesarean section was performed and a liveborn female infant was delivered. Postoperatively the mother was transferred to an intensive care unit but was certified as brain dead and died the following day. Postmortem examination revealed cerebral haemorrhage from rupture of a berry aneurysm of the right middle cerebral artery. This was classified as an **incidental** death.

15.4 A 39-year-old woman, para 4, with an uneventful pregnancy to 39 weeks' gestation, was admitted to hospital after collapsing and fitting at home. A CAT scan revealed an extensive intracerebral haemorrhage. An urgent Caesarean section was performed and a liveborn baby delivered. Death occurred 13 hours after admission when the patient was declared brain dead and ventilatory support was withdrawn. Autopsy confirmed intracerebral haemorrhage following rupture of an aneurysm at the trifurcation of the right middle cerebral artery as the cause of death. This was classified as an **incidental** death.

15.5 A 27-year-old woman, para 2, who was a heavy smoker, was admitted to hospital at 38 weeks' gestation after being found unconscious at home. On admission she was deeply unconscious with fixed dilated pupils and minimal response to stimuli. A brain CAT scan showed free subarachnoid blood, diffuse cerebral oedema and a small haematoma, with evidence of marked increase in intracranial pressure. Life support was maintained until the delivery of a liveborn female infant by Caesarean section, and withdrawn postoperatively. The cause of death was a subarachnoid haemorrhage. This was classified as an **incidental** death.

15.6 A 24-year-old woman, para 2, after complaining of a headache for two days experienced a 20-minute event where she lost balance, dragged her right leg and then lost consciousness. She then presented to the local district hospital, at 22 weeks' gestation, deeply comatose with neck stiffness. She was intubated after developing twitching of the right eye. She was transported to a major hospital but on arrival was considered brain dead. A CAT scan confirmed a large left intracerebral haemorrhage. As the fetus was alive, life support was continued. However, the fetal heart beat was lost and life support was withdrawn. This death was not reported to the coroner, nor is there evidence of a postmortem examination being performed. The cause of death was intracerebral haemorrhage. This was classified as an **incidental** death.

Comment:

These case reports offer little scope for prevention. They comprised two cases each of ruptured aneurysm and subarachnoid haemorrhage similar to cases reported in Chapter 7.

Infection

15.7 A 32-year-old woman, gravida 2, para 1 had recently returned to Australia with multiple skin ulcers after 12 months work in Asia. At eight weeks' gestation she presented to hospital with vaginal bleeding, fever, skin ulcers, vomiting and diarrhoea. On examination she was found to be hypotensive, shocked, dyspnoeic, and in acute renal failure. A diagnosis of septic abortion was made, and cervical dilatation and uterine curettage were carried out the next day following a spontaneous abortion. The patient was treated with intubation, ventilation, inotropic support and initially the antibiotics flucloxacillin, metronidazole and cephtriaxone, followed by penicillin when a positive culture for *Group A beta haemolytic streptococcus* was found. Complications included metabolic acidosis, disseminated intravascular coagulation, atrial fibrillation and adult respiratory distress syndrome. Her condition continued to deteriorate and the patient died eight days after admission. At autopsy the cause of death was attributed to G*roup A beta haemolytic streptococcus* septicaemia. This was classified as an **incidental** death.

Comment:

This case is complicated and the expert committee did not consider that the septic abortion justified the label of direct death and so the case was excluded from Chapter 4.

Suicide

15.8 A 24-year-old woman, primigravida, approximately seven months' pregnant, was found dead with a gun nearby. She had a fallen onto her stomach four days earlier, and had been taken to hospital and advised that the baby was unharmed. The next day she had felt unwell and was diagnosed by her local doctor as having a viral illness. No treatment was given. The following day she developed vomiting which settled by the next morning. The family reported that she was very concerned the fall may have harmed the baby. The cause of death was suicide by gunshot to the head. This was classified as an **incidental** death.

15.9 A 26-year-old woman, gravida 3, para 1, was found dead at home at seven weeks' gestation. She had a history of insulin-dependent diabetes with diabetic retinopathy, hypoglycaemic brain damage following an apparent overdose of insulin, and two previous terminations of pregnancy. A suicide note was found. Postmortem results found severe diabetic nephrosclerosis, autolysis of the pancreas and a very high insulin level of 158 μU/ml. Cause of death was found to be suicide following insulin overdose. This was classified as an **incidental** death.

Comment:

See Chapter 13.

Self-administered overdose

15.10 A 28-year-old woman, had an uncomplicated termination of pregnancy at eight weeks' gestation in a day care clinic. She was admitted to hospital three days post-termination with pelvic pain. Laparoscopy was performed showing no abnormal findings. She continued to complain of pain requiring narcotic analgesics. Extensive investigation failed to reveal an organic explanation. She received intensive emotional support and counselling. After returning to hospital from weekend leave, she experienced a seizure and cardiac arrest and died 35 days post-termination of pregnancy. Autopsy showed no specific findings. Toxicology studies showed very high levels of codeine and paracetamol. This was classified as an **incidental** death.

Comment:

This case was excluded from Chapter 4 because it was labelled as an incidental death. This case illustrates the importance of including incidental deaths in maternal

mortality reports and emphasises the relevance of the statements presented in Chapter 13.

Other conditions/events not classifiable elsewhere

Homicide

15.11 A 31-year-old woman, para 0, approximately six months pregnant, died at home from incision injuries to the head, neck, chest and abdomen. The death appeared to be a murder–suicide. This was classified as an **incidental** death.

15.12 A 25-year-old woman, primigravida, in the late stages of pregnancy, was found dead at home with a gunshot wound to the head. Autopsy revealed fetal death attributable to intrauterine hypoxia. The maternal injury was inconsistent with self-infliction and the deaths appeared to be a murder–suicide. This was classified as an **incidental** death.

15.13 A 32-year-old woman was found dead at home with head injuries and bruises and abrasions to the arms. Postmortem examination revealed skull factures and extensive traumatic injury to the brain. The woman had undergone a termination of pregnancy two weeks previously. The cause of death was homicide. This was classified as an **incidental** death.

15.14 A 43-year-old woman, para 1, was found asphyxiated at 18 weeks' gestation. Her death was considered to be a homicide. This was classified as an **incidental** death.

15.15 A 23-year-old woman, para 1, at approximately five months' gestation, died as a result of head injuries. Her death was considered to be a homicide. This was classified as an **incidental** death.

15.16 A 34-year-old woman, para 2, at 30 weeks' gestation, was covered in blood when she flagged down a motorist on a major rural highway. She was intoxicated, with a head injury and wanted to go to hospital. She ceased breathing before police arrived. Her death was considered a homicide. This was classified as an **incidental death**

Comment:

The total of six homicides was the highest recorded in any triennium in Australia, the number reported in the 10 trienna from 1964–66 to 1991–93, being nil, nil, 1, 2, 4, 2, 1, 5, 3 and 4 respectively. Ascertainment of cases may explain reported differences and in one study retrospective audit increased the number of maternal deaths by 100% over official vital statistics (Dye et al. 1992). Another study from the USA (Dannenberg et al., 1995) found that homicide and other injuries are major contributors to maternal mortality and should be, but rarely are, included routinely in maternal mortality surveillance systems. Table 5 shows that in the United Kingdom the proportion of maternal deaths classified as incidental (fortuitous) has averaged 13.4 per cent in the last five reported triennia in comparison with 32.1 per cent in Australia. In the 1994–96 maternal death report from the United Kingdom

only 3 of the 268 deaths were classified as due to murder (Department of Health, Welsh Office, 1998).

In one of the six cases (Case 15.13) the woman had undergone termination of pregnancy two weeks before she died and the case was classified as incidental and was therefore excluded from Chapter 4.

Traffic and other injuries

Burns

15.17 A 22-year-old woman was found dead at home at 8 weeks' gestation. She had suffered a burn to her right foot at 5.5 weeks' gestation, and a skin graft had been carried out under general anaesthetic five days later. Anticoagulation was considered prior to surgery, but was not given due to the early stage of her pregnancy. The patient collapsed at home 15 days postoperatively. On arrival of the ambulance her pupils were fixed and dilated. Resuscitation was attempted unsuccessfully. Postmortem examination revealed recent thromboses of the inferior vena cava, the iliac veins, and the periuterine venous plexus with total occlusion of the pulmonary vessels by a massive thromboembolus. The cause of death was pulmonary thromboembolism. This was classified as an **incidental** death.

Comment:

This case was excluded from Chapter 11 because the expert committee classified it as an incidental death.

Motor vehicle injuries

15.18 A 21-year-old woman, para 1, at 38 weeks' gestation, was a rear-seat passenger (middle position) in a car when it veered to the wrong side of the highway and collided with another vehicle. She was taken to hospital. A stillborn infant was delivered by Caesarean section. The woman died from multiple injuries to the brain, abdomen and pelvis. This was classified as an **incidental** death.

15.19 A 38-year-old woman, para 2, in early pregnancy, was run over by a motor vehicle. She was dead on arrival at the local hospital. This was classified as an **incidental** death.

15.20 A 20-year-old woman, primigravida, was the front-seat passenger in a motor vehicle accident at approximately 30 weeks' gestation. Upon admission to hospital she was noted to have fixed, dilated pupils and paradoxical respiration. Obstetric ultrasound revealed a live fetus. One hour later, while awaiting a CAT scan of the head, the patient developed tachycardia and a distended abdomen. Haemoperitoneum was found at emergency laparotomy, and a ruptured spleen was removed. A stillborn male infant was delivered by Caesarean section. Coagulopathy developed and the patient died in the

operating theatre. Autopsy revealed extensive haemorrhage, rib and pelvic fractures. The cause of death was multiple injuries following a car accident. This was classified as an **incidental** death.

Comment:

The number of deaths from traffic injuries in the 11 triennia from 1964–67 were 2, 8, 7, 15, 5, 3, 8, 4, 8, 10 and 3 respectively. Designation of avoidability, apart from failure to wear a seat-belt or when a driver is shown to have excessive blood levels of drugs or alcohol, is difficult since many 'accidents' are potentially avoidable, some more so than others. The result in this triennium must be judged to be satisfactory from the point of view of road trauma involving pregnant women. There were 13 deaths from road traffic accidents in the United Kingdom in the 1994–96 triennium (Department of Health, Welsh Office, 1998) illustrating that their low proportion of incidental maternal deaths (11.8 per cent compared with 34.3 per cent in Australia, Table 5) is not due to failure to include deaths from road traffic accidents. After Sweden and Finland, Australia has the lowest national road traffic accident fatality rate per 10,000 registered motor vehicles[10]. In Victoria the seat-belt legislation became operative at the end of 1970. The number of motor vehicle accident deaths (including pedestrians) was 1,061 in 1970, 681 in 1985 and 390 in 1998, although the number of vehicles has increased enormously in this 28-year period.

Neoplasms

15.21 A 33-year-old woman, primigravida, was found at 18 weeks' gestation to have a poorly differentiated carcinoma with squamous differentiation in an axillary swelling. Mediastinal nodes and hilar enlargement were also noted and it was thought that the lung was the primary source. She developed signs and symptoms of secondaries. The growth-retarded fetus died in utero at 27 weeks' and she died three weeks after delivery. The cause of death was carcinoma of the lung with widespread metastases. This was classified as an **incidental** death.

15.22 A 37-year-old woman, para 3, with a history of excision of a melanoma two years previously, presented at 20 weeks' gestation. She had a one-month history of respiratory symptoms which on investigation were found to be due to metastatic lung carcinoma. Fine needle aspirate of a mediastinal mass failed to detect the origin of the carcinoma. She was given palliative radiotherapy. She was delivered by emergency Caesarean section at 28 weeks' gestation because of deteriorating maternal condition, and she died four hours after delivery. An autopsy was not performed. This was classified as an **incidental** death.

[10] Personal communication (2000) Officer in Charge, Statistics Section, Transport Accident Commission, Victoria.

15.23 A 36-year-old woman, para 2, had a history of carcinoma of the breast with positive nodes treated with mastectomy, chemotherapy and radiotherapy in the previous 2 years. After an uneventful pregnancy to 20 weeks' gestation the patient developed signs of metastatic breast cancer with dermatomyositis, hepatomegaly and bone pain. She was admitted at 32 weeks' gestation for an elective delivery and proceeded to have a spontaneous and precipitous labour with assisted delivery of a liveborn infant. She subsequently developed anorexia, severe liver and back pain, ascites, ileus and metabolic encephalopathy and died nine days postpartum. An autopsy was not performed. This was classified as an **incidental** death.

15.24 A 29-year-old woman, para 0, with known metastatic melanoma, was referred to a tertiary hospital for elective Caesarean section. She died soon after the operation. An autopsy was not performed. This was classified as an **incidental** death.

15.25 A 31-year-old woman was referred to a base hospital with abdominal pain and abnormal liver function tests. On investigation, she was found to have disseminated melanoma (initial lesion removed from her arm five years previously). She had a spontaneous delivery at term of a healthy infant. She died eight days later from the effects of the malignancy. An autopsy was not performed. This was classified as an **incidental** death.

Comment:

The number of deaths in this group in the ten triennia beginning with 1964–67 were 12(1), 8, 20(5), 5(1), 7, 3(2), 11, 3, 6 and 5 the figures in parentheses denoting the number of deaths from choriocarcinoma or complication of hydatidiform mole. Malignant neoplasms are rare in pregnancy and the case details provided illustrate some of the unusual presentations that occur. Women with a past history of breast carcinoma or melanoma may seek counselling concerning the risk of recurrence during pregnancy, due to such pregnancy. Fortunately such women have usually made their own decision to proceed since the literature does not provide such consensus that any individual woman can be given definitive advice (Grin et al. 1996).

Encephalitis

15.26 A 31-year-old woman, para 1, developed headache, ataxia and deteriorating conscious state with focal neurological signs at 15 weeks' gestation. The diagnosis was acute demyelinating encephalitis. After craniotomy and insertion of a shunt, the pregnancy continued until intrauterine death occurred at 18 weeks'. The woman's condition deteriorated and she died two days later, undelivered. This was classified as an **incidental** death.

Comment:

This case was excluded from consideration in Chapter 8 because the expert committee coded it as an incidental death.

Drug-related

15.27 A 41-year-old woman, gravida 5, para 4, currently on a methadone program, and noted to be in poor general health, was admitted to hospital at 24 weeks' gestation following a diagnosis of cholecystitis and ultrasound diagnosis of fetal death in utero. She was found to have hepatitis C. After being commenced on ceftriaxone, gentamycin, flagyl, adrenaline infusion, fresh frozen plasma, blood and platelets, a cholecystectomy and hysterotomy were carried out. Disseminated intravascular coagulation was diagnosed, however treatment was unsuccessful. Blood cultures grew *Staphylococcus aureus*. The cause of death was disseminated intravascular coagulation associated with acute haemorrhagic pericarditis, staphylococcal septicaemia and fetal death in utero. This was classified as an **incidental** death.

15.28 A 30-year-old woman, gravida 5, para 0, who was a heavy smoker and heroin user, was admitted to hospital in a moribund condition at 31 weeks' gestation. She was intubated and a CAT scan revealed a large intracerebral haemorrhage. Her condition failed to improve with neurosurgery and brain death was diagnosed later that day. As the fetus was still alive, Caesarean section was performed and the mother died shortly after respiratory support was withdrawn. The infant survived and progressed well. This was classified as an **incidental** death.

15.29 A 26-year-old woman, gravida 4, para 3, had a history of gestational diabetes in previous pregnancies which was controlled by diet. She was briefly admitted to hospital at 27 and 28 weeks' gestation for recurrent urinary tract infections which were treated with antibiotics. She had induction of labour at 38 weeks' gestation for fetal macrosomia secondary to gestational diabetes. A liveborn infant was delivered. The postnatal course was uneventful and she was discharged on day four. Fourteen days after delivery she was found dead at home after a party. Autopsy revealed a blood alcohol concentration of 0.378%, and active chronic pyelonephritis apparently associated with ureteric reflux. Although a postmortem culture showed *Escherichia coli* in the urine, this was considered unlikely to have contributed to her death. The cause of death was attributed to acute alcohol toxicity. This was classified as an **incidental** death.

Comment:

These three case records illustrate the sad vicissitudes and medical complications that can be associated with drug addiction and excessive alcohol consumption. Classification of several of these cases was difficult, particularly Case 15.27 in which the septicaemia warranted consideration for inclusion in Chapter 8.

Unknown cause

15.30 A 31-year-old woman, para 2, with a history of asthma and liver haemorrhage possibly associated with oral contraceptive use, was admitted at six weeks' gestation with acute abdominal pain, palpitations, shortness of breath and light vaginal bleeding. She was admitted to an intensive care unit with a diagnosis of dehydration following hyperemesis and possible infection. Her case was reviewed by renal, cardiology and gastroenterology physicians 24 hours after admission. She developed acidosis, renal failure, hyperglycaemia and coagulopathy. Despite intensive care treatment she died 46 hours after admission. The cause of death was noted as multiple visceral organ failure of unknown cause. This was classified as an **incidental** death.

15.31 A 24-year-old woman, para 0, with a twin pregnancy as a result of ovulation induction, collapsed and died suddenly at 15 weeks' gestation. Autopsy revealed no explanation for the death. This was classified as an **incidenta**l death.

15.32 A 31-year-old woman, para 0, at approximately 17 weeks' gestation, in an apparently uneventful pregnancy experienced a seizure while asleep. Resuscitation was attempted unsuccessfully. Autopsy revealed no specific explanation. Histology revealed chronic hepatitis; virology indicated chronic hepatitis C infection. This was classified as an **incidental** death.

15.33 A 19-year-old woman, para 0, was found unconscious, having seizures. She was thought to be 20 weeks' pregnant. There was no known history of medical or neurological problems. She was admitted to an intensive care unit with status epilepticus, and disseminated intravascular coagulopathy, with multiple organ failure and fetal death. Hysterotomy was undertaken, but she developed Adult Respiratory Distress syndrome and irreversible neurological damage. Life support was withdrawn. Autopsy failed to establish a cause of death. This was classified as an **incidental** death.

15.34 A 29-year-old woman, para 7, was re-admitted to the emergency department at nine days postpartum, four days after discharge following Caesarean section. She had abdominal pain and vomiting and underwent appendectomy. At the operation she had evidence of appendicitis. She made an uneventful recovery and was ready for discharge 11 days after the operation. She was last seen by nursing staff to be well and ambulant about one hour before being found dead in bed. Despite massive efforts she could not be resuscitated. Postmortem examination did not reveal the cause of death, although high levels of morphine were found in some tissues. A coronial inquiry found that death occurred from unspecified natural causes. This was classified as an **incidental** death.

Comment:

The moment of death from indeterminable cause may be utterly unpredictable, yet imminent in clinically normal women. For example, in the 1979–81 triennium such a

woman at 38 weeks' gestation climbed into bed and died while talking. Diseases such as epilepsy, asthma and insulin-dependent diabetes mellitus can occur, even with severe manifestations, for the first time during pregnancy. It is also true that women with an apparently normal pregnancy may have generalised seizures and die during pregnancy, without evidence of hypertension or pre-eclampsia. In the past some such cases have been classified as death from epilepsy. For example, in the 1976–78 report of maternal deaths in Australia it was stated in the section on miscellaneous deaths that 'one patient died from an unobserved epileptic seizure'. This secures a place in the table listing causes of death but achieves little else. Such cases should be collected in a separate section as in this report, and autopsy material preserved, so that future research may uncover one or more important pathological processes, possibly treatable, at present unknown to medical science.

Postscript

In this chapter, one of the 34 women had a Caesarean section in the usual course of obstetric care (Case 15.34) and eight others had the operation performed when they were moribund or dead (Cases 15.3, 15.4, 15.5, 15.18, 15.20, 15.22, 15.24, 15.28).

APPENDIX 1

MEMBERSHIP OF THE ADVISORY COMMITTEE ON MATERNAL MORTALITY AND MORBIDITY

Professor William A W Walters *(Chairman)*	Chairman, New South Wales Maternal and Perinatal Committee
Professor Lesley Barclay	National Health and Medical Research Council representative
Dr Jan Batt	Representative, Tasmanian Maternal Mortality Committee
Emeritus Professor Norman Beischer	Chairman, Victorian Consultative Council on Obstetric and Paediatric Mortality and Morbidity (until February 2000)
	Chairman, The Medical Research Foundation for Women and Babies (from March 2000)
Professor Michael Bennett	Representative, New South Wales Maternal and Perinatal Committee
Sister Alison Bush	Indigenous representative, King George V Hospital, New South Wales
Professor David Ellwood	Representative, Australian Capital Territory Maternal, Perinatal, Infant Mortality and Morbidity Committee
Dr Jane Ford	*(Secretariat)* Senior Research Officer, Australian Institute of Health and Welfare National Perinatal Statistics Unit
Ms. Merryl Green	Consumer representative, Maternity Alliance
Dr William Hague	Obstetric Physician University of Adelaide
Professor Michael Humphrey	Representative, Royal Australian and New Zealand College of Obstetricians and Gynaecologists
Dr Kathy Innes	Representative, Royal Australian College of General Practitioners (until May 2000)
Ms. Linda Jones	Representative, Australian College of Midwives

Associate Professor James King	Chairman, Queensland Council on Obstetric and Paediatric Morbidity and Mortality (until June 2000)
	Chairman, Victorian Consultative Council on Obstetric and Paediatric Mortality and Morbidity (from July 2000)
Professor Jeremy Oats	Chairman, Queensland Council on Obstetric and Paediatric Morbidity and Mortality (from July 2000)
Dr Margaret O'Brien	Representative, Northern Territory Maternal and Child Health Committee
Professor Jeffrey Robinson	Chairman, South Australian Maternal, Perinatal and Infant Mortality Committee
Dr Elizabeth Sullivan	Director Operations, Australian Institute of Health and Welfare National Perinatal Statistics Unit
Associate Professor Barry Walters	Representative, Maternal Mortality Committee of Western Australia
Dr Ross Wilson	Representative, Royal Australian College of General Practioners (from June 2000)

APPENDIX 2

MEMBERSHIP OF THE STATE AND TERRITORY MATERNAL MORTALITY COMMITTEES

The composition and titles of the State and Territory Maternal Mortality Committees for the period 1994–96 were as follows:

New South Wales Maternal and Perinatal Committee

1994

Professor W Walters
(Co-chairperson)
Professor M Bennett
(Co-chairperson)
Professor D Henderson-Smart
(Co-chairperson)
Dr J Arnold
Dr D Barclay
Dr H Chiltern
Dr A Child
Dr C de Costa
Dr C Fisher
Ms P Mulholland
Dr E Murphy
Professor P Russell
Dr B Spurrett
Dr L Taylor
Professor B Trudinger

1995–96

Professor W Walters
(Co-chairperson until June 1995,
Chairperson from July 1995)
Professor M Bennett
(Co-chairperson until June 1995)
Professor D Henderson-Smart
(Co-chairperson until June 1995)
Dr G Angus
Dr S Arbuckle
Dr A Berry
Ms S Botham
Dr A Child
Dr J Daniels
Dr C de Costa
Assoc. Professor W Giles
Dr J Hobbs
Dr P Knowlden
Dr D Mulcahy
Ms P Mulholland
Dr E Murphy
Ms M Pym
Dr L Sutton
Dr L Taylor
Professor B Trudinger
Ms P Waterson

Victorian Consultative Council on Obstetric and Paediatric Mortality and Morbidity, Maternal Mortality Subcommittee

Professor N A Beischer
(Chairperson)
Dr D W Fortune
Dr D Johnson
Dr W H Kitchen
Ms S Murray
Professor R J Pepperell
Dr P M Renou
Mr I C Ross

Queensland Committee for the Maternal Mortality Subcommittee

Dr I Thomas
(Chairperson)
Ms M Barton *(Midwife)*
Dr D Cave *(Obstetrician)*
Ms V Flenady *(Research Officer)*
Dr R Hemsley *(Obstetrician)*
Dr J King
(Obstetrician/ epidemiologist)
Dr I Stephens *(Anaesthetist)*
Ms M McLeod
(Consumer representative, 1995–96)

South Australian Maternal, Perinatal and Infant Mortality Committee Maternal Subcommittee

Professor J Robinson *(Chairperson)*
Dr J Biggins *(General practitioner)*
Dr T Yee Khong *(Obstetrician)*
Assoc. Professor A. MacLennan *(Perinatal pathologist)*
Dr B Wheatley *(Obstetrician)*
Ms L White *(Midwife)*
Dr A Chan *(Medical Secretary)*

Maternal Mortality Committee of Western Australia

Professor C A Michael *(Chairperson)*
Dr P Hugo
Dr A Cumming (until January 1996)
Dr T Jeffery (from January 1996)
Dr L Farrell (from January 1996)
Dr H McGlashan *(Deputy member)*
Ms Y Strawbridge (until June 95) *(provisional member)*
Ms D Gasbarro (June–Dec 95) (provisional member)
Dr M D Jones *(provisional member)*
Dr K Alexander *(provisional member)*
Dr R J Kirk *(provisional member)*
Mr T Jongen *(provisional member)*
Mrs C Burgess *(provisional member)*
Dr D Mildenhall *(provisional member)*
Ms J Watson *(provisional member)*
Ms L Colvin *(provisional member)*
(from January 1996)

Tasmanian Maternal Mortality Committee

The committee did not meet during the 1994–96 triennium although there were two maternal deaths reported.

Northern Territory Maternal and Child Health Committee

The committee did not meet during the 1994–96 triennium although there was one maternal death reported.

Australian Capital Territory Maternal, Perinatal, Infant Mortality and Morbidity Committee

The committee did not meet during the 1994–96 triennium although there was one maternal death reported which was reviewed at hospital level.

APPENDIX 3

DATA COLLECTION

State and Territory committees collect maternal deaths data through a variety of formal and informal channels. Sources of data include direct information from hospitals; postmortem and coroners' reports; midwives' reports; medical practitioners' reports; clinical case notes; newspaper reports; and by word of mouth.

Each State or Territory has a slightly different data collection methodology.

In New South Wales the Director General of Health has instructed all hospitals to notify maternal deaths. Information is also obtained from the Register of Births, Deaths and Marriages via the Australian Bureau of Statistics and there is an arrangement with the Coroner's office to provide reports for all maternal deaths.

The Northern Territory information regarding maternal deaths comes from the Midwives' Data Collection, monthly medical superintendent reports and the Coroner's office. Hospital morbidity are also checked.

In South Australia, hospitals provide data through the completion of incident report forms. The Coroner's office asks doctors to inform them of maternal deaths and midwives must complete a supplementary birth record data form for all births that are ≥ 20 weeks' gestation or birth-weight > 400 g. Other data sources include pathologists and the attending practitioner.

In Queensland all deaths, including maternal deaths, are reported via the Registrar General's office to the Australian Bureau of Statistics, where deaths are coded according to the International Classification of Diseases (ICD9). A quarterly report is provided via the Queensland Government Statistician's office to the Council Secretariat. In addition, Coroner's autopsy reports of maternal deaths are received from the State Centre for Forensic Pathology. Information about maternal deaths is also received by informal mechanisms.

Victoria has no organised system with hospitals to provide maternal deaths data. A variety of sources are used including death certificates from the Registrar of Births, Deaths and Marriages; midwives' reports; and newspaper reports. Case histories are built up from postmortem reports, police reports and confidential medical reports.

In Western Australia there is no organised system with hospitals. Sources include notification by the attending practitioner and death certificates. Case histories are gathered from hospital and attending medical practitioner clinical case notes and by coronial and postmortem reports.

The small populations of Tasmania and the Australian Capital Territory ensure that detailed information is easily retrieved from hospitals, the coroner's office and attending practitioners.

APPENDIX 4

LATE DEATHS

There were two deaths submitted to the Advisory Committee which occurred beyond the timeframe specified for maternal deaths (up to 42 days post pregnancy or termination) in the 1994–96 triennium. Both cases were classified as direct maternal deaths and were thus directly related to pregnancy. However, the technology was available to prolong their lives beyond the 42 days of the puerperium. It is important to note that in developing countries such technology would not be available, and these cases would almost certainly be included in maternal mortality statistics.

A4.1 A 34-year-old woman, primigravida, was noted in early pregnancy to have a large uterine fibroid. She was transferred to a major obstetric hospital at 31 weeks with threatened preterm labour. A Caesarean section was performed at 37 weeks, under regional anaesthesia, due to the fibroid causing an unstable lie with the head unable to enter the pelvic. A classical incision was required. A 25 cm fibroid was confirmed to be present in the pelvis. The use of heel pads was the only anti-embolus step taken. On postpartum day one the patient collapsed and after resuscitation was transferred to a major general hospital where a thoracotomy and pulmonary embolectomy was performed. Before transfer the pupils were fixed and dilated. There was evidence of severe anoxic encephalopathy with no evidence thereafter of awareness of her surroundings. There was a long course of care for the patient's highly dependent state thereafter, which included a feeding gastrostomy and insertion of a permanent epidural to administer Baclofen for muscle spasm. A hysterectomy was carried out as the fibroid was causing ureteric obstruction. Long-term care continued in a high intensity nursing home before the patient died of a chest infection, 31 weeks postpartum. The underlying cause of death was pulmonary embolus. This was classified as a **direct** maternal death.

A4.2 A 27-year-old woman, primigravida, with a history of shortness of breath and palpitations for many years and twin pregnancy, was admitted for induction of labour at 36 weeks' gestation. Both twins were delivered by vacuum extraction. On the seventh day postpartum the mother was transferred to another hospital for continuing postnatal care. She was re-admitted to hospital 11 weeks postpartum with increasing shortness of breath. A provisional diagnosis of cardiomyopathy was made following echocardiogram. She was treated with digoxin and lasix. An episode of ventricular tachycardia was treated with lignocaine infusion. Five days later the patient was transferred to another hospital with a diagnosis of postpartum cardiomyopathy. She spent two months in a coronary care unit during which time she had three cardiac arrests. Daily medication included 5 mg lisinopril and 7 mg warfarin. One month later she was re-admitted to hospital with palpitations, breathlessness and subclinical sarcoidosis. An ECG showed sinus rhythm with sinus arrhythmia and evidence of a probable recent anteroseptal myocardial infarction. She remained stable until two days after her admission when she died from cardiac arrest secondary to her postpartum cardiomyopathy. This was classified as a **direct** maternal death.

APPENDIX 5

AGE-SPECIFIC AND AGE-STANDARDISED RATES

Age-specific rates

Age–specific mortality rates are calculated by dividing the number of deaths occurring in each specified age group by the corresponding population at risk in the same age group in a specified time period expressed as a rate per 100,000 confinements.

Age-standardised rates (AS Rate)

Incidence and mortality rates are often adjusted to enable comparisons between populations that have different or changing age structures. This effectively removes the influence of age structure on the summary rate, described as the *age-standardised* rate. There are two different methods used to age adjust. In this report we have used direct standardisation in which average triennium age-specific maternal mortality rates are multiplied by each constant age-specific population (the Australian 1991 Female Population Standard) and divided by 100,000. The expected number of cases in each age group are derived in this way, summed and divided by the total standard population and multiplied by 100,000 to give the age-standardised rate (AIHW & AACR, 1999). Age-standardised, age-specific mortality rates are similarly derived except that the denominator population is the age-specific population of the standard population.

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