NEONATAL NETWORK

AIHW

Australian and New Zealand Neonatal Network 1998

NSW PREGNANCY AND NEWBORN SERVICES NETWORK

UNSW

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The University of Sydney

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Australian and New Zealand Neonatal Network 1998

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Contents

Tables

Figures

Abbreviations

AIHW	Australian Institute of Health and Welfare
ANZNN	Australian and New Zealand Neonatal Network
NHMRC	National Health and Medical Research Council of Australia
NPSU	National Perinatal Statistics Unit
WHO	World Health Organisation
APH	Antepartum haemorrhage (a complication of pregnancy)–see definitions
BE	Base excess
BW	Birthweight (in grams)–see definitions
CPAP	Continuous positive airways pressure (a form of assisted ventilation)–see definitions
DOA	Date of admission
DOB	Date of birth
FiO_2	Fractional inspired oxygen level (measures amount of supplemental oxygen)–see definitions
GA	Gestational age (in completed weeks)–see definitions
HMD	Hyaline membrane disease (a respiratory disorder)
ICD.9.CM	International Classification of Diseases, 9th revision, clinical modification
IPPR	Intermittent positive pressure respiration (a form of assisted ventilation)–see definitions
IUGR	Intrauterine growth restriction (a complication of pregnancy)–see definitions
IVF	In vitro fertilisation
IVH	Intraventricular haemorrhage (a brain disorder)–see definitions
Mec Asp	Meconium aspiration syndrome (a respiratory disorder)–see definitions
n	Number
NEC	Necrotising enterocolitis (a gut disorder)–see definitions
NICU	Neonatal Intensive Care Unit
0	Oxygen
$P^2_aO_2$	Partial inspired oxygen (a method of measuring oxygenation)–see definitions
PIH	Hypertension in pregnancy (a complication of pregnancy)–see definitions
PMA	Post menstrual age (gestational age plus chronological age, in weeks)
PPH	Pulmonary hypertension (a respiratory disorder)–see definitions
PPROM	Preterm pre-labour rupture of membranes (a complication of pregnancy)–see definitions
PROM	Prolonged rupture of membranes (a complication of pregnancy)–see definitions
PTL	Preterm labour (a complication of pregnancy)–see definitions
PVL	Periventricular leukomalacia (a brain disorder)–see definitions
ROP	Retinopathy of prematurity (an eye disorder)–see definitions
S_aO_2	Oxygen saturation (a method of measuring oxygenation)
T_cPO_2	Transcutaneous partial pressure of oxygen (a method of measuring oxygenation)
TTN	Transient tachypnoea of the newborn (a respiratory disorder)–see definitions
PO	Post Office
χ_{MH}	Mantel-Haenzel chi-square, testing statistical significance of trends.
ACT	Australian Capital Territory
NSW	New South Wales
NT	Northern Territory
NZ	New Zealand
Qld	Queensland
SA	South Australia
Tas	Tasmania
Vic	Victoria
WA	Western Australia

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Additionally, in 1997 the ANZNN Advisory Committee voted unanimously for each unit to contribute an annual sum for membership of the network and for the annual individual unit report.

We would also like to acknowledge the generous donations received during the year from Phillipa Milne and Associates, David Henderson-Smart and Deborah Donoghue.

The AIHW National Perinatal Statistics Unit is an external unit of the Australian Institute of Health and Welfare and has been based at the University of New South Wales since November 1997.

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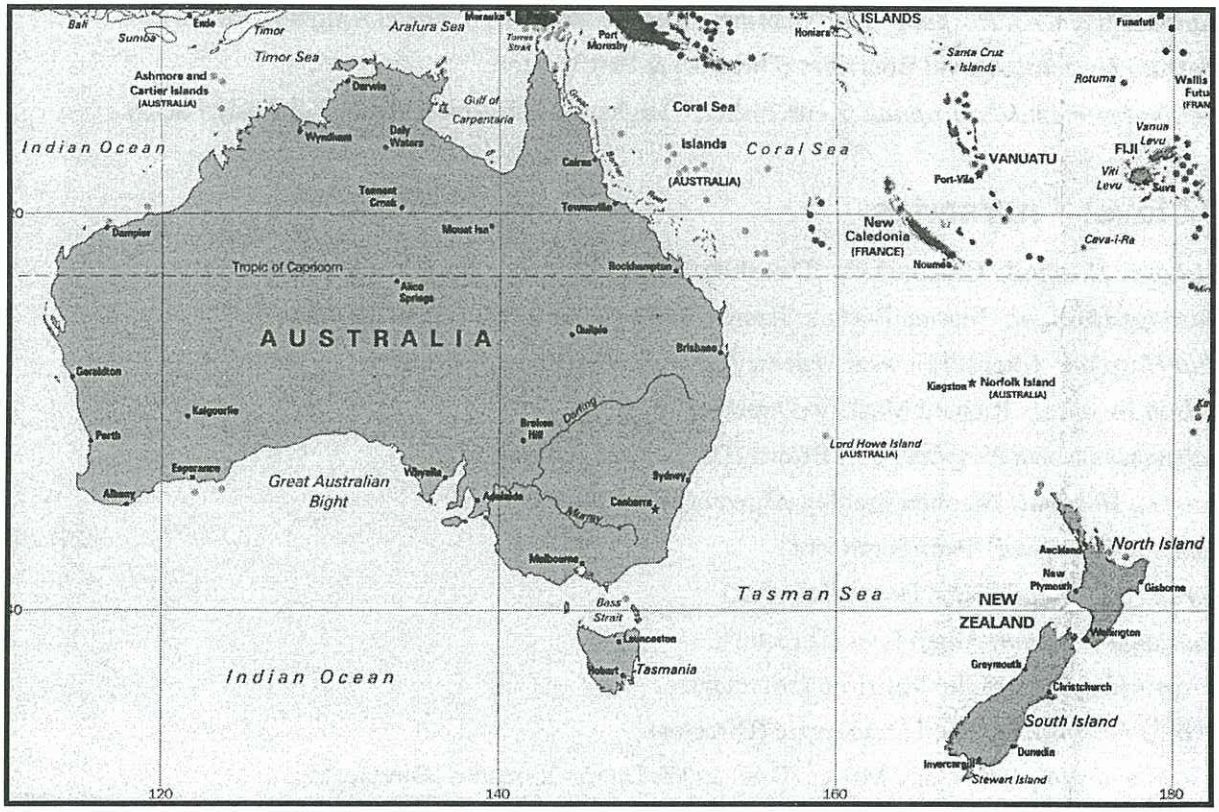

In profile:

Australia is a country of approximately 18.5 million people and has about 250,000 live births per annum. As the smallest continent with an area of 7.5 million square kilometres we are 8 to 10 hours ahead of Greenwich Mean Time. New Zealand is a further two hours ahead of Australia and has a population of 3.6 million with 57,000 births annually and an area of 266,000 square kilometres.

Highlights

- The Australian & New Zealand Neonatal network is a voluntary collaboration of all 29 level III Neonatal Intensive Care Units (NICUs) in both countries. This network continues to conduct an ongoing prospective audit of the most at-risk babies admitted to a NICU. The audit looks at factors that may affect outcomes that can be measured while the baby is in hospital.

- In 1998, a total of 6,408 babies met the criteria of ANZNN's audit of high-risk infants and were admitted to a level III NICU throughout Australia and New Zealand. This represents 2.1% of the total births for the two countries.

- All babies born at less than 32 weeks' gestation (very preterm) are audited; there were 3,084 of these babies admitted to a level III NICU in 1998. The most prevalent maternal condition associated with very preterm birth was preterm labour (35%) followed by preterm pre-labour rupture of the membranes (24%). More than a quarter (27%) of these babies were born from a multiple birth and 56% were boys. NHMRC recommends that mothers about to give birth in this gestational age group receive antenatal corticosteroids to enhance the lung maturity of the fetus and 86% of these babies received this therapy. Most babies (91%) were born in a hospital with a NICU on the premises, which is also recommended by the NHMRC. These babies tended to be born by caesarean section (55%) and then receive endotracheal intubation (53%) in labour ward.

- Once in the nursery, most (86%) of these very preterm infants receive assisted ventilation, with 78% of ventilated infants having respiratory distress syndrome (RDS) as their main diagnosis. Of those ventilated for RDS, most receive exogenous surfactant (88%), again an NHMRC recommended therapy. Various tests are done to check for known morbidities - with head ultrasounds revealing a significant haemorrhage in 6% of babies and examination of the eyes revealing 5% with moderate to severe stages of eye disease.

- All of the above factors occur with increasing frequency as the gestation decreases. Most babies survive with 89% of babies going home but the range is from 28% at 22-23 weeks' to 98% at 31 weeks' gestation. Most babies born at less than 27 weeks' tend to stay in hospital until around their due date, while those born at 28 to 31 week's gestation tend to be discharged home several weeks earlier.

- The other major groups of babies audited includes 3,003 more mature babies who required assistance with their breathing, 129 babies who are not ventilated but required surgery and 172 babies who were greater than 31 weeks at birth but weighed less than 1500 grams and did not need ventilating. These babies were far more heterogenous. Of those receiving respiratory support, 65% had RDS and 27% had non-specific respiratory distress. Only 60% of these babies were born in a perinatal centre and 60% were boys. The majority of these babies survived (93%).

- A further 156 high-risk babies that met our criteria were admitted to a Level II NICU in New Zealand and not transferred to a NICU in the neonatal period. These babies tended to be more mature and were ventilated for shorter periods and generally required less support than babies in level III centres and were less likely to have adverse outcomes. In fact, all preterm babies without a lethal congenital malformation in this group survived.

1 History and structure

1.1 History

In July 1993, the Directors of Australian level III Neonatal Intensive Care Units (NICUs) decided to establish a network to monitor the care of high risk newborn infants by pooling data to provide quality assurance for this resource-consuming care. Such networking, collaboration and cooperation are hallmarks of perinatal care in the region.

The National Health and Medical Research Council's Expert Panel on Perinatal Morbidity had recommended that, 'The Australian Institute of Health and Welfare National Perinatal Statistics Unit, in collaboration with the directors and staff of all neonatal intensive care units, should develop a national minimum data set and implement data collection to monitor mortality and morbidity of infants admitted to such units (Health Care Committee Expert Panel on Perinatal Morbidity, 1995)'.

The prospective data collection commenced for babies born from 1 January 1994. All level III units in Australia and New Zealand have contributed data for babies born from 1 January 1995. In 1998, all Level II units in New Zealand joined the audit as part of a pilot project.

1.2 Structure

The Australian and New Zealand Neonatal Network (ANZNN) was set up under the National Perinatal Statistics Unit, a collaborating unit of the Australian Institute of Health and Welfare (AIHW).

The structure of the ANZNN comprises three Coordinators, an Advisory Committee, a researcher/manager and a project officer. The Coordinators are Associate Professor Paul Lancaster, Director of the AIHW National Perinatal Statistics Unit; Professor David Henderson-Smart, neonatologist at King George V Hospital and Professor of Perinatal Medicine, University of Sydney and the Director of the Centre for Perinatal Health Services Research; Associate Professor Brian Darlow, a neonatologist at Christchurch Women's Hospital and Christchurch School of Medicine, University of Otago, New Zealand.

The Advisory Committee is made up of the Directors (or their nominees) of each participating Australian and New Zealand NICU. The role of the Advisory Committee is to advise and direct the ANZNN, and to approve use of the data. This Committee meets once a year, in association with the Perinatal Society of Australia and New Zealand's annual congress, usually during March. These meetings were held in Alice Springs, Northern Territory in 1998 and Melbourne, Victoria in 1999.

The full-time researcher/manager is currently funded by sponsorship from Abbott Australasia. Deborah Donoghue was appointed to that position in late 1994. Duties include managing the network's administrative and research activities as well as the audit database. With the advent of contributions from individual units and additional funding from Abbott, we were able to employ part-time data entry personnel who in turn have been Kim Smith, Clare Banks and Glenda O'Leary. This position was expanded to the role of Project Officer, with Anne Cust taking up the role in 1999. She is now responsible for data entry and much of the activity associated with the audit.

More information about these above organisations can be found at their websites:

Australian Institute of Health and Welfare:	www.aihw.gov.au
AIHW National Perinatal Statistics Unit:	www.aihw.gov.au/npsu
Centre for Perinatal Health Services Research:	www.usyd.edu.au/cphsr
Australian & New Zealand Neonatal Network:	www.usyd.edu.au/cphsr/anznn

2 Data set

2.1 Registration criteria

The Australian & New Zealand Neonatal Network's (ANZNN) audit of high-risk infants admitted to a Neonatal Intensive Care Unit included all liveborn babies who were admitted to a hospital with a level III Neonatal Intensive Care Unit (NICU) at less than 28 days (and during their first hospitalisation), or who were transferred from a labour ward with the intention of admission to the unit and met the following criteria:

- < 32 completed weeks' gestation; or
- < 1500 grams birth weight; or
- received assisted ventilation (mechanical ventilation including intermittent positive pressure respiration or continuous positive airways pressure) for four or more consecutive hours; or
- received major surgery (i.e. a body cavity was opened).

Hospital of registration is the first NICU that the baby remained in for more than four hours. For the purpose of this report, babies transferred were considered to be admitted to the hospital to which they were transferred from the time the transport team arrived to collect them.

In 1998 all NICUs collected data items on all the above cohort.

2.2 Data set variables

The sixty variables and their definitions for the 1998 audit are listed in Appendix 1.

As reported in previous years most units collected the complete data set and we continue to use the data available for the audit as long as it meets the agreed definitions. In a few instances, some units continue to record only abnormal results, such as grade III retinopathy of prematurity, while normal findings at eye examinations are not recorded.

2.3 Data collection

Data are collected in the hospitals by either the filling out the specific ANZNN forms or by incorporating the ANZNN data items into the local NICU audit. Data are transferred to the ANZNN database either on forms, or electronically. Confidentiality guidelines (Appendix 5) are strictly adhered to with identifying information removed and replaced by codes at the individual units.

2.4 Data verification

Missing or anomalous data are identified and queried soon after entry onto the main database. Quantification of errors and the implementation of practices to minimise errors are continually refined. A data verification study was conducted in 1996 and reported in the 1995 annual report (Donoghue DA 1997).

3 Results

3.1 In general

In 1998, 6,408 babies met the criteria of the Australian and New Zealand Neonatal Network's (ANZNN) audit of high-risk infants and were admitted to one of the 29 level III Neonatal Intensive Care Units (NICUs) throughout Australia and New Zealand. Of these 3,084 infants were born at less than 32 weeks' gestation (Figure 1, Table 1 page 28) and 2,678 were born weighing less than 1500 grams (Table 2). Assisted ventilation was administered to 5,643 infants while 789 received major surgery. A further 156 high-risk babies that met our criteria were admitted to a level II NICU in New Zealand. These babies are described in Section 3.8.

While these data generally represent the sickest babies they do not represent all babies admitted to a NICU, as many require other assistance and observation. In 1998 there were 249,616 livebirths registered in Australia (Australian Bureau of Statistics, 1999) and 57,818 in New Zealand (Statistics New Zealand, 1999) making a total of 307,434 babies. The ANZNN cohort represents only 2.08% of the total births for the two countries. This rate has been increasing slightly each year from 1.8% in 1995.

In this report, babies are referred to as preterm if they are born at less than 37 completed weeks' gestation, and "term" if born at 37 weeks' gestation or more. Data in tables are by gestational age group (adapted from WHO groups and NSW Health role delineation guidelines) and by birthweight group. Data in figures are given by gestational age divisions (Figure 2). Gestation is considered to be well documented in these babies and is the information available prior to the birth.

3.1.1 Neonatal care

Care for the newborn is provided at three levels. 'Level I' care is for normal healthy term babies, some of whom may require short-term observation during the first few hours of life. Level II or 'special care' refers to a nursery that generally deals with babies who are born at 32 to 36 weeks' gestation or weighing about 1500 to 2500 grams at birth. It includes the care for babies who require intravenous therapy or antibiotics, and/or those who are convalescing after intensive care, and/or those who need monitoring of their heart rate or breathing, and/or those who need short-term oxygen therapy.

Level III or intensive care refers to the needs of newborn infants who require more specialised care and treatment. It includes most babies born at less than 32 weeks' gestation or less than 1500 grams birthweight, and others who may require parenteral nutrition, and/or surgery, and/or cardiorespiratory monitoring for management of apnoea or seizures, and/or require assisted ventilation (IPPR orCPAP), and/or supplemental oxygen over 40% or long-term oxygen.

Hospitals with a level III NICU provide all of these levels of care and are referred to in this report as tertiary hospitals. In 1998 there were 29 level III NICUs in Australia and New Zealandwith 995 beds for babies. It is important to note that some hospitals may have other beds for babies that do not come under the auspices of the NICU. Hospitals which do not have a NICU may provide the level II and level I care needed for infants and are referred to as non-tertiary hospitals.

3.1.2 Numbers of babies per unit

The number of babies who met the criteria for this audit of high-risk babies ranged from seventy to more than 450 per annum for each registration NICU (Figure 3) , reflecting both the size of the unit and the mix of patients. The registration NICU is designated as the first NICU in which the baby remains for more than four hours. For example, if a baby born in a hospital with a NICU is transferred to another NICU at two hours of age, say for surgery for a previously diagnosed malformation, the baby is assigned to the second hospital. Every effort has been made to follow babies from hospital to hospital to avoid duplication.

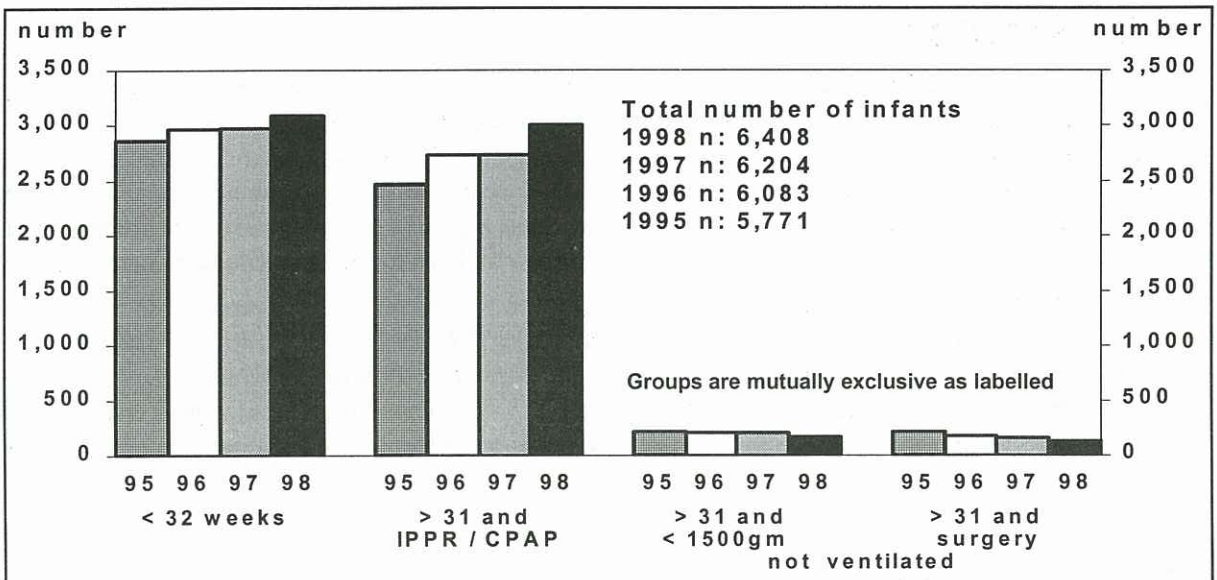

Figure 1: Number of babies in the ANZNN cohort by registration criteria, 1995-1998

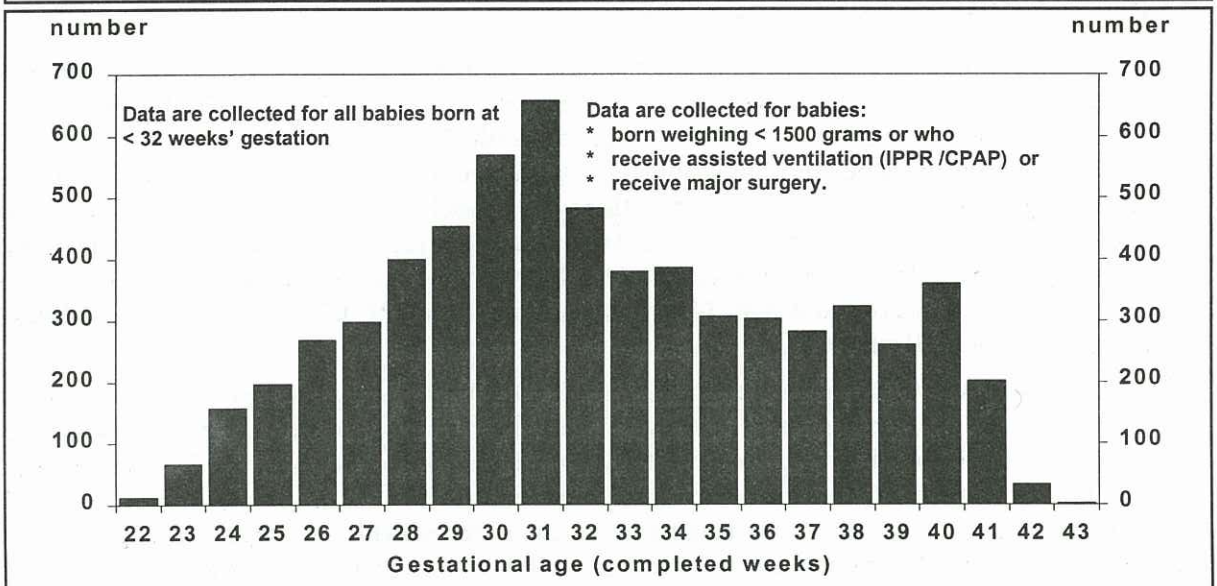

Figure 2: Number of babies in the ANZNN cohort by gestational age, 1998

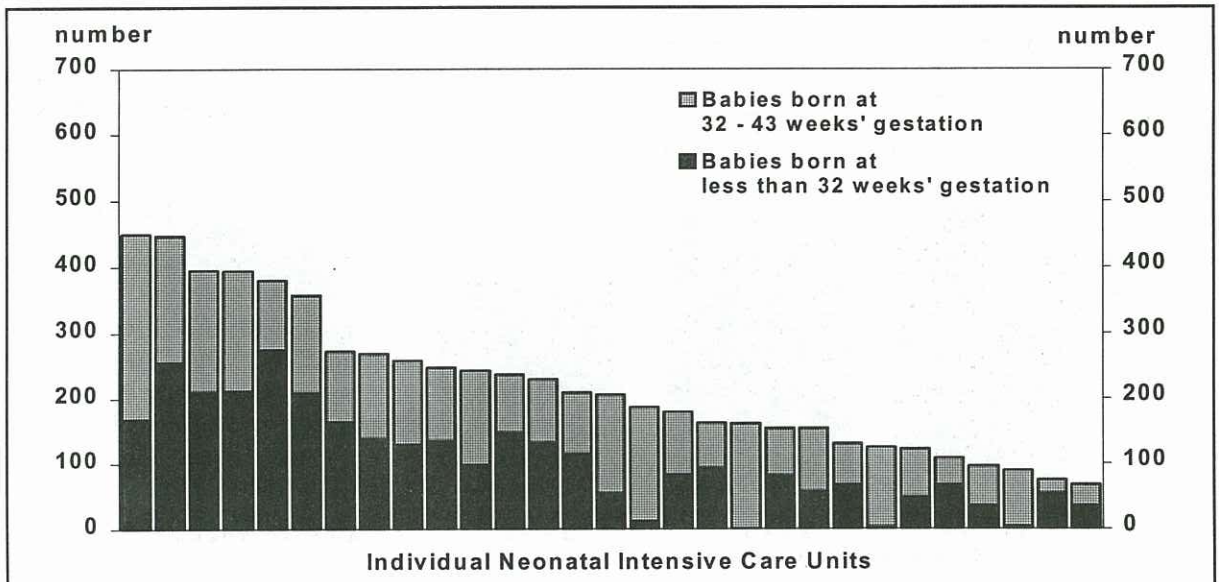

Figure 3: Number of babies in the ANZNN cohort by registration NICU, 1998

3.2 Mother

Factors known to affect the risk of preterm birth are recorded for each baby. For example, when maternal age is either lower or higher than the norm, this can be associated with poor outcome. In the group born at less than 32 weeks' gestation, 6.6% were born to teenage mothers (compared to 5.2% for all Australian births in 1997) and 20.2% were born to mothers over 34 years (Australian figures were 15.0% in 1997; Day, Sullivan, Evans & Lancaster 1999). Additionally, having had a previous baby born preterm is a risk factor for a future preterm birth and 472 (17.4%) babies were born to mothers who were in this category.

Maternal ethnicity was reported for 80.1% of infants and was predominantly reported to be Caucasian (80.4%). Of the babies registered to a NICU in Australia, 4.6% were born to mothers who identified themselves as Aboriginal or Torres Strait Islander, compared to 3.09% for all births in Australia in 1998 (Australian Bureau of Statistics 1999). For New Zealand, 18.7% babies were born to mothers who identified themselves as Maori and 10.6% to Pacific Islander mothers, reflecting the national data (Statistics New Zealand 1999).

3.3 Antenatal

3.3.1 Antenatal corticosteroids

Corticosteroids are administered to the mother prior to a preterm birth to enhance fetal lung maturation. The first randomised controlled trial of its use was conducted in New Zealand in 1970 (Liggins & Howie 1972). Subsequently a systematic review of 34 such trials (the highest level of evidence, Crowley 1999) reported this treatment to be efficacious in helping to mature the baby's lungs and prevent death. The review also demonstrated protective effects for other systems, such as reducing the incidence of necrotising enterocolitis and intraventricular haemorrhage, without any harmful effects for the mother or the baby. In 1996 it was recommended that maternal corticosteroids should be considered in order to improve neonatal outcomes before all births at less than 34 weeks' gestation (NHMRC Clinical Practice Guidelines for Care Around Preterm Birth 1997).

This treatment was given to the mothers of 2,418 (85.5%) babies born at less than 32 weeks' gestation. (Figure 4, Tables 3 and 4; treatment is 'complete' when 2 or more doses of steroids are given with at least one dose 24 hours before the birth. 'Incomplete' is when steroids are given less than 24 hours before the birth or more than a week before the birth; data were available for 91.7% of babies). Trend data for 1995 to 1998 shows a small but significant increase in the use of steroids (Figure 4; $\chi_{MH} = 55.1$, $p<0.001$) and these rates are higher than most published rates from around the world (Crowley 1999). The range of any usage of antenatal steroids for babies who were born in their registration hospital at less than 34 weeks' gestation in 1998 was high with a median of 83.8% and an interquartile range from 79.0% to 91.1%.

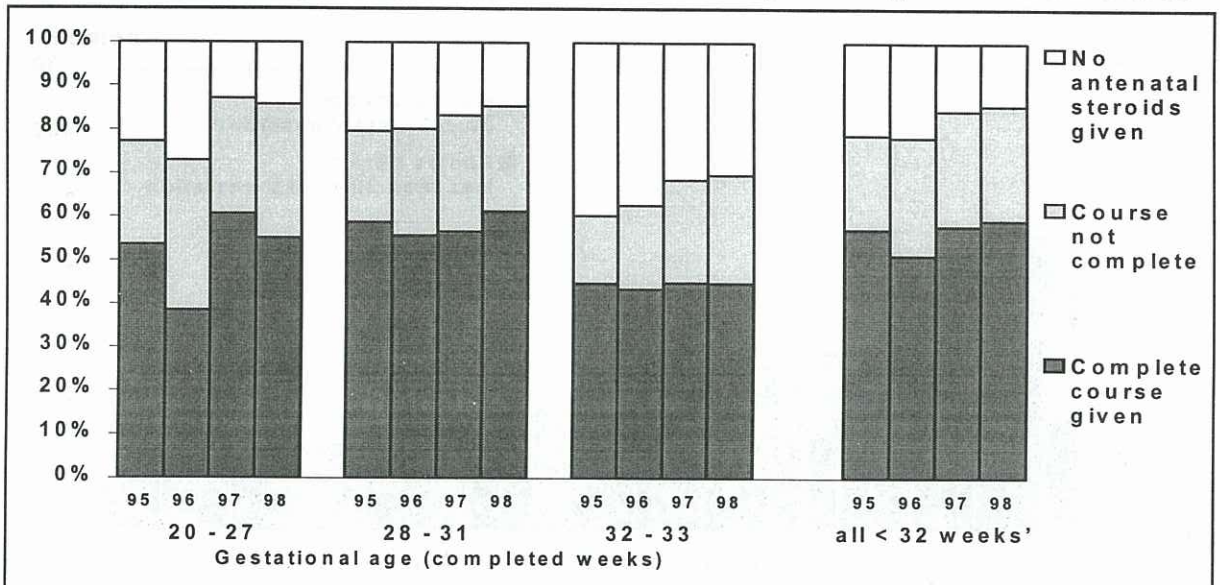

Figure 4: Antenatal corticosteroid use by gestational age, 1995-1998

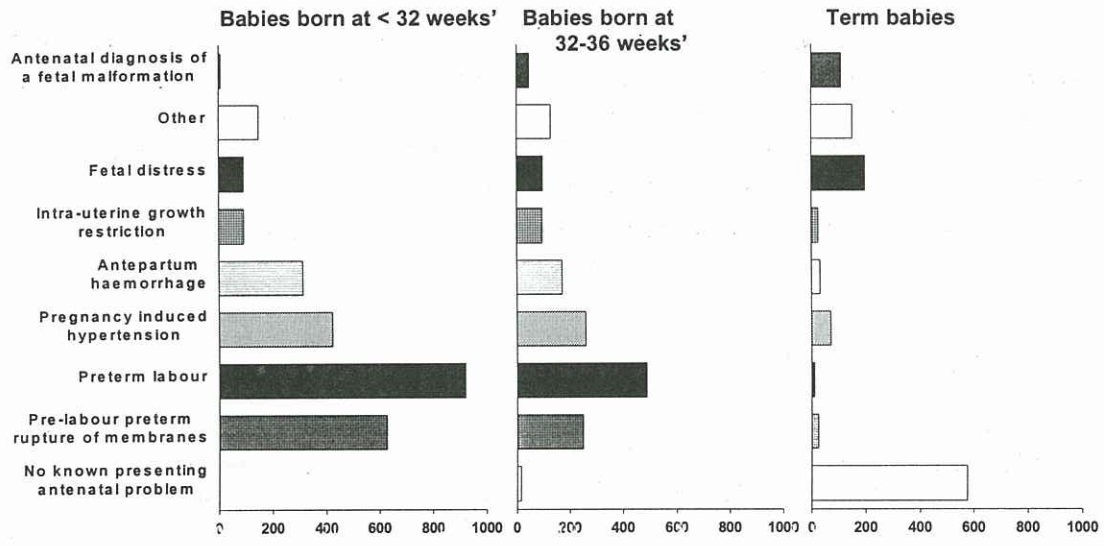

Figure 5: Antenatal problem leading to the infant's birth, 1996-1998

3.3.2 Antenatal problem leading to the birth of the baby

Data were collected on the presenting obstetric problem that led to the mother's last hospitalisation, and thus the baby's birth and subsequent admission to a NICU. Not unexpectedly, preterm labour represented a third (35.0%) of the presenting obstetric problems for those babies born at less than 32 weeks' gestation. Pre-labour, preterm rupture of the membranes made up another quarter (23.8%) of these infants (Figure 5, left bar chart). Data are presented for the number of babies (not confinements) and were recorded in 83.9% of cases.

In the group born at 32 to 36 weeks' gestation, the presenting problem was distributed more evenly over the given range of complications, however preterm labour still represented nearly a third (31.4%) of these problems. Pre-labour, preterm rupture of the membranes and pregnancy induced hypertension each represented 16% of the presenting antenatal problem.

For babies born at term, nearly half (48.0%) had no antenatal problem that could be identified. The new item "antenatal detection of a fetal malformation" was reported to be the presenting antenatal problem for 9.2% of term infants in our cohort. In a few instances, mothers were admitted with 'preterm' antenatal problems and the infant was subsequently born at 'term'.

3.4 Baby

3.4.1 Multiple births

Babies from multiple births have an increased risk of being preterm and of having other morbidities independent of their prematurity (NHMRC Clinical Practice Guidelines for Care Around Preterm Birth 1997). The number of babies born from multiple pregnancies has risen in the last twenty years and has been attributed to fertility drugs and assisted conception (Day, Sullivan Ford & Lancaster 1999).

Overall, a total of 1,246 (19.4%) babies in our cohort were from a multiple birth with 164 (2.6%) babies coming from triplet pregnancies and 7 babies (0.1%) were from two sets of quadruplets (Tables 5 and 6). The proportion of infants from a multiple birth for babies born at less than 32 weeks' gestation is 26.8%. Two-thirds of the triplets (63.4%) were born at less than 32 weeks' gestation and all of the quadruplets. For the babies born at 32 to 36 weeks' gestation, the proportion of babies from a multiple pregnancy dropped to 20.0%. For those born at term, 3.3% were from a multiple birth, a similar proportion to that seen for the entire Australian population in 1997 (2.8%, Australian Bureau of Statistics 1997).

3.4.2 Gender

Slightly more male babies are born than female babies, with boys accounting for 51.3% to 51.4% of all live births in Australia from 1988 to 1998 (Australian Bureau of Statistics, 1999). However, the proportion of males in our data shows a wider differential with predominantly more males (58.1%, n:3,716) than females (41.9%, n: 2,684). An additional five babies were noted to have ambiguous or uncertain gender during the neonatal period and data were unknown for 3 babies.

For those babies born at less than 32 weeks' gestation 1,721 were male (55.8%). This proportion rose to 60.4% for babies born at term.

3.4.3 Place of birth

Babies are usually cared for in the hospital in which they are born. However, some babies may need to be transferred to a hospital with a level III NICU. When this can be anticipated, both the mother and baby may be transferred prior to the birth (in-utero) or the mother can 'book in' at that hospital. The NHMRC Clinical Practice Guidelines for Care Around Preterm Birth (1997) recommend that, wherever possible, births at less than 33 weeks' should occur in a perinatal centre with a NICU.

The majority of babies born at less than 33 weeks' gestation in our cohort were born in a perinatal centre (n: 3,198, 89.5%). This figure has changed little in the past 4 years (Figure 6). With increasing gestational age, this figure decreases. However overall 74.8% of the babies in our cohort were born in a perinatal centre (Tables 7 and 8).

The reason for an infant's transfer after birth may include a precipitous preterm birth in a hospital without a NICU or no bed was available in the hospital of birth. The reason could also include a pre-planned birth in a hospital with a NICU to ensure a managed transfer to a specialised children's unit, or the unexpected need for intensive care treatment in a term baby, such as for meconium aspiration syndrome.

After birth, 1,478 (83.7%) babies were transferred to a level III NICU accompanied by a specialist retrieval team with training for the care of sick newborn (Tables 9 and 10). Nearly half (45.1%, n: 667) of these babies were born at term. A further 175 term babies were transferred by a non-specialist team such as ambulances, flying doctor services and 10 term babies arrived by other means such as being born enroute, in a car etc.

For babies born at less than 28 week's gestation, 101 (94.4% of transferred babies and 10.1% of all babies in that gestational age group) were transported by a specialist team immediately after birth and one baby was transferred by a non-specialist team. Five babies came to the hospital by other means.

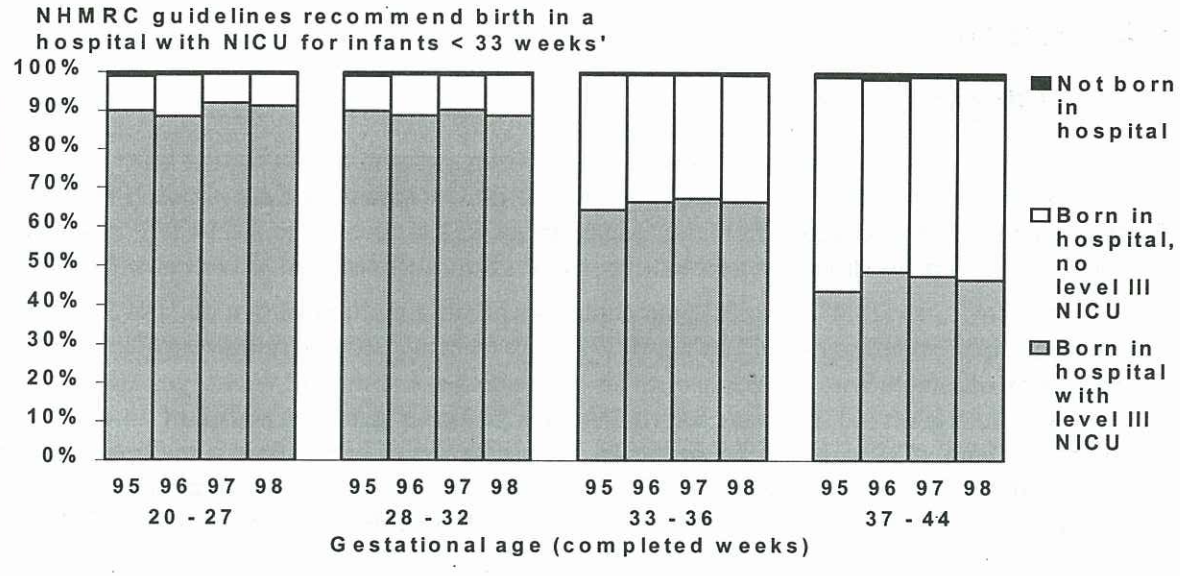

Figure 6: Place of birth by gestational age group, 1995-1998

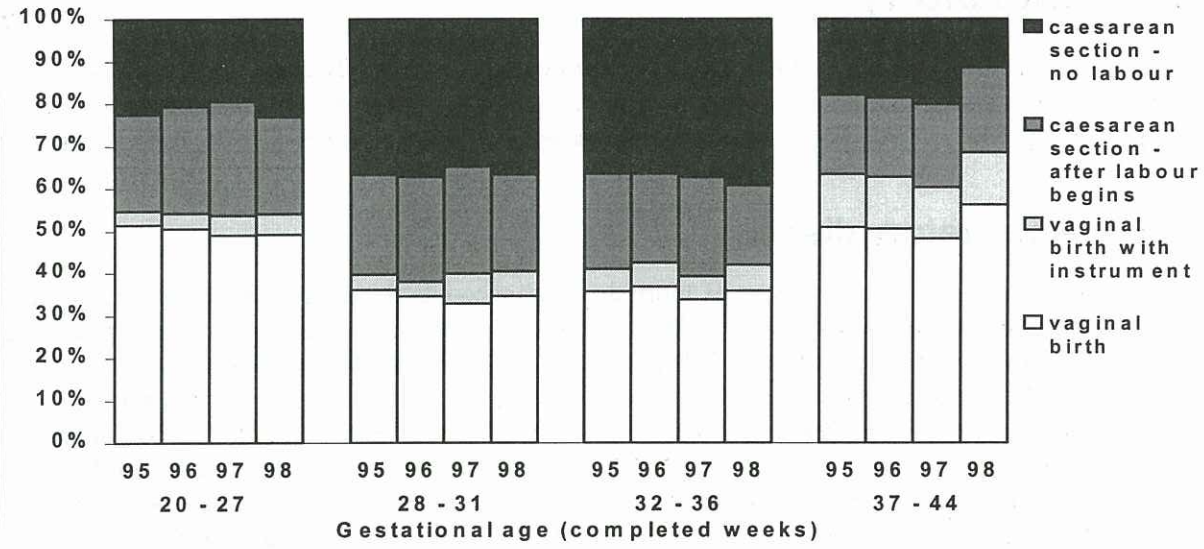

Figure 7: Method of birth by gestational age group, 1995-1998

3.5 Birth

3.5.1 Method of birth

The method of birth for these babies varied with gestational age (Figure 7, Tables 11 and 12). Overall, more than half (53.1%) of the babies were born by caesarean section. Of the caesarean sections, 61.3% occurred before the onset of labour (also known as an 'elective' caesarean) and this proportion was similar for all age groups. For term babies in this high-risk group, 41.0% were born by caesarean section. The overall rate of caesarean section for all confinements in Australia in 1997 was 20.3%. Notably this proportion rose to 45.3% for twin pregnancies, and to 59.5% for babies weighing 1000 to 1499 grams (Day, Sullivan, Ford & Lancaster 1999). Data were available for 96.8% of the ANZNN infants.

At term, babies are usually born with the head presenting first in the vagina (cephalic). For all Australian confinements in 1997, 95.1% of babies had a cephalic presentation and 4.3% were breech (Day, Sullivan, Ford & Lancaster 1999). For babies born at term in our cohort 90.6% presented head first while 7.3% were breech, and 2.1% were transverse or other (data were available in only 77.6% of cases). For the babies born at less than 32 weeks' gestation 1,268 (64.9%) presented as cephalic, 471 (29.4%) were breech and 5.6% were transverse or other. This is similar to the ANZNN data presented for 1995.

3.5.2 Condition at birth

The Apgar score is a clinical indicator (scored from 0 to 10) used to denote a baby's condition at birth. A low Apgar score (i.e. less than 4) at one minute of age is indicative of a baby that needs assistance with their adaptation to extra-uterine life in the form of specialised resuscitation. Fortunately, this is only seen in a small proportion of babies (2.5% of all babies born in Australia in 1997 Day, Sullivan, Ford & Lancaster 1999). In the ANZNN cohort, there were 652 (21.3%) babies born at less than 32 weeks' gestation with such a low Apgar score at 1 minute (data available for 99.1% of babies). For the term group, 336 (22.9%) babies had an Apgar score of less than 4 at 1 minute. This suggests that an increased need for assistance at birth can occur at any gestation, and that all staff attending a birth should be skilled in resuscitation.

For the babies born at less than 32 weeks' gestation in this cohort more than half (52.5%, n: 1,620) were assisted by endotracheal intubation (passing a tube into the windpipe) to aid resuscitation at birth (data available for 97.5% of babies). The NHMRC's Clinical Practice Guidelines for Care Around Preterm Birth (1997) recommend that births occurring at less than 32 weeks' gestation should ideally be attended by a member of the NICU paediatric staff, and those of less than 34 weeks' should have someone in attendance with up-to-date skills in endotracheal intubation. Overall a total of 2,257 (37.0%) babies in our cohort were intubated in labour ward in 1998 (data available for 93.2% of babies).

3.6 Morbidity

There is a high rate of morbidity amongst babies admitted to a level III NICU, principally associated with preterm birth or complications arising in babies born at term such as the need for respiratory assistance or major surgery. This audit focuses on outcome measures that are identifiable while the baby is in hospital.

3.6.1 Respiratory distress

Respiratory distress is a major cause of morbidity and accounts for a large proportion of the use of resources in these high-risk babies. Only 529 (8.7%) babies were noted to have no respiratory disease or reason for respiratory support. Overall, half (52.4%) of the babies had a diagnosis of hyaline membrane disease (HMD, or respiratory distress syndrome). As expected, the proportion of babies with other main causes of respiratory failure changed with gestational age (Figure 8; Note in the 1996-1997 annual report this graph has data for babies born at term transposed with data for babies born at 32-36 weeks'). Since 1997, 'other' has been refined to include neonatal encephalopathy and peri-surgical which now each form 10% of the reason for ventilation for term infants. Data were available for 94.6% of babies.

A total of 2,639 (85.5%) babies born at less than 32 weeks' gestation received mechanical assistance with breathing (Figure 9, intermittent positive pressure respiration (IPPR) and/or continuous positive airways pressure (CPAP)). CPAP alone was the therapy of choice for 18% of these babies). Another 3,004 babies fulfilled our registration criteria of receiving IPPR and/or CPAP giving a total of 5,643 babies ventilated during 1998. Both IPPR and CPAP require specialised nursing, medical and paramedical care and utilise a large component of available resources. The duration of these treatments increases on average, with decreasing gestational age (Tables 13 and 14). Total duration of IPPR for all ventilated babies in 1998 was 25,420 days and CPAP was delivered for 26,949 days, a combined total of 52,369 ventilator 'days' (see Appendix 1 for the definition of a ventilator day). Pulmonary airleak requiring any drainage was seen in 326 babies (5.7% of those ventilated). Half (n: 151) of these babies were in the group born at less than 32 weeks' gestation.

Exogenous surfactant is a treatment primarily for HMD and is given via an endotracheal tube (i.e. baby is intubated). Its efficacy was confirmed by systematic reviews of randomised controlled trials in 1996 (for example, Soll 1999) and this treatment is recommended (NHMRC Clinical Practice Guidelines for Care Around Preterm Birth 1997). In this group there were 2,631 babies who were intubated for more than four hours and had a main respiratory diagnosis of HMD. Exogenous surfactant was given to 2,277 (90.4%, data unavailable for 49 babies) of these babies, an increase from 80% in 1995 and 85.2% in 1996-1997. The range in practice variation for this therapy between the Level III NICUs in babies ventilated for HMD was small (interquartile range 82.6% - 96.2%, median = 90.1%).

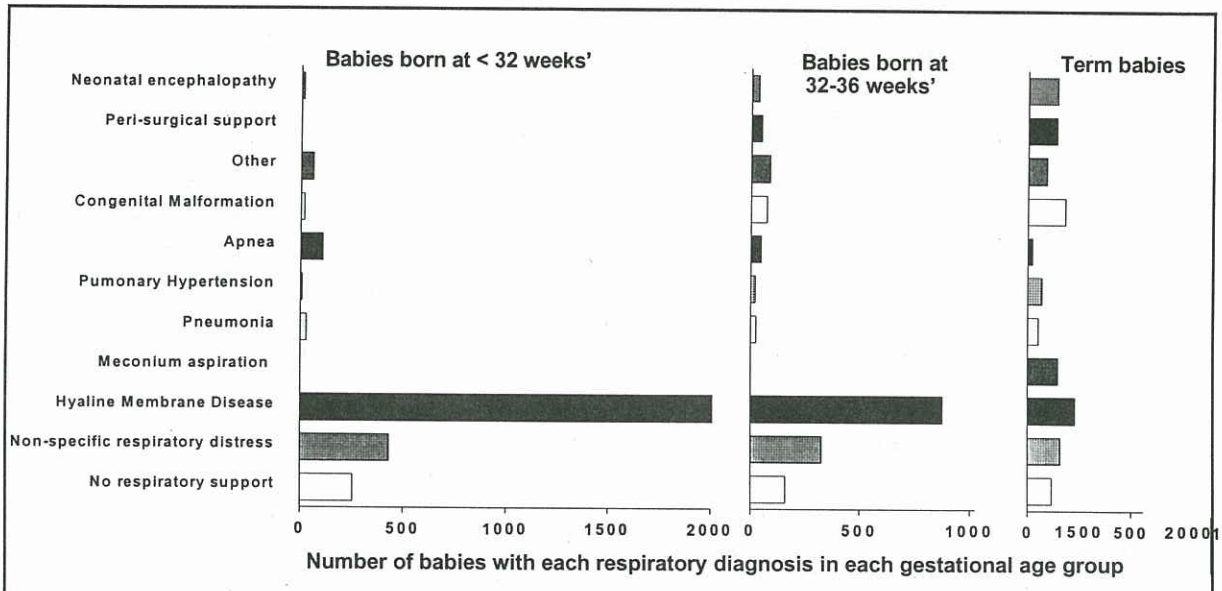

Figure 8: Main respiratory diagnosis by gestational age group, 1998

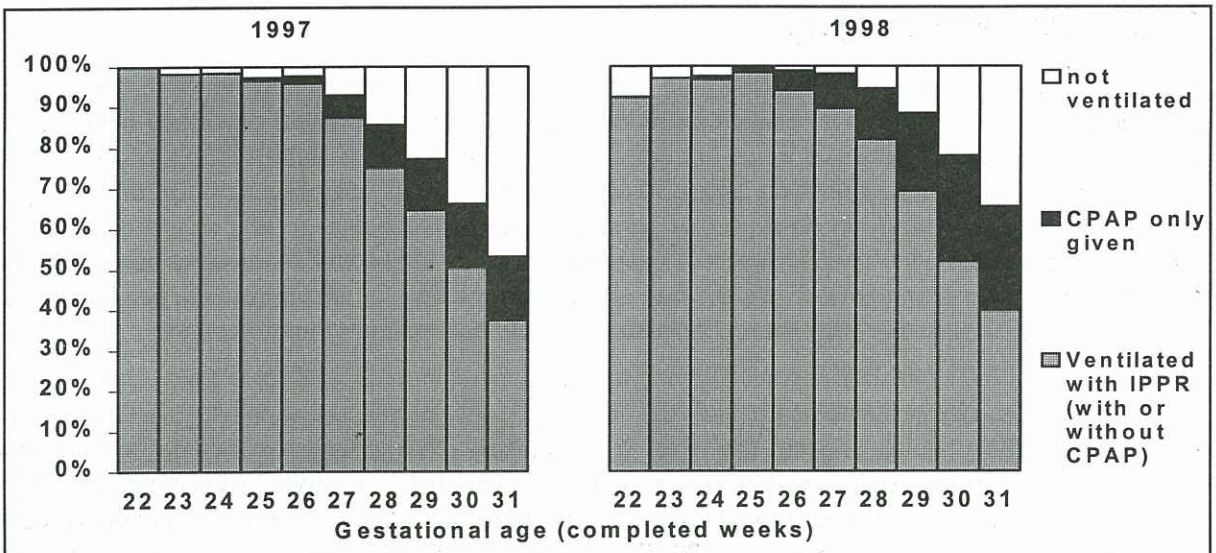

Figure 9: Proportion of babies receiving assistance with breathing (IPPR and/or CPAP) by gestational age group for infants born at < 32 weeks', 1997 and 1998.

An additional 43 babies were treated with exogenous surfactant but extubated before 4 hours of age and 287 had a respiratory diagnosis other than HMD. The type of exogenous surfactant used is now predominantly 'natural' (*Survanta*, 94.9%, Tables 17 and 18).

The monitoring of new technologies is a stated objective of the network (Appendix 5) and to this end we have audited three new forms of respiratory therapy since 1996. High-frequency ventilation is mechanical ventilation given at 8 - 15 breaths per second, in contrast to conventional ventilation which gives about one breath per second. This treatment was given to 424 babies (9.9% of all ventilated babies) and the predominant respiratory diagnosis was HMD (74.3%). The use of this treatment has increased from 258 (5.9%) babies in 1996 and 309 (7.3%) in 1997. Of the babies receiving high-frequency ventilation, 302 (71.2%) were born at < 32 weeks' gestation, and 210 (49.5%) were born at less than 28 weeks'. The use of this therapy was reviewed by Henderson-Smart, Bhuta, Cools et al. 1999.

Nitric oxide is a gas inhaled in very tiny amounts to dilate the pulmonary blood vessels and is used mostly in the treatment of pulmonary hypertension (Barrington & Finer 1999; Finer & Barrington 1999). In 1998, 188 babies (4.4% of ventilated babies) received this therapy of whom 97 (51.6%) were term), an increase from 121 in 1996 and 132 in 1997. The main respiratory diagnoses were HMD (35.1%), pulmonary hypertension (20.2%) and meconium aspiration and congenital malformations each being 13.8%.

Concomitantly, the use of extra corporeal membrane oxygenation (ECMO) has dropped to only four term babies during the year. ECMO involves very specialised care as very sick babies are assisted in oxygenating their lungs with a heart-lung machine. ECMO is offered at only three sites in the region.

Supplemental oxygen requirements also increased with decreasing gestational age (Tables 13 and 14). A total of 84,485 'days' of supplemental oxygen was administered to 5,036 babies while in hospital. Chronic lung disease is defined here as babies born at less than 32 weeks' gestation who require respiratory support (supplemental oxygen and/or assisted ventilation) at 36 weeks post menstrual age (gestational age plus age after birth). There were 577 babies who met this definition (20.5% of survivors, Tables 15 and 16). A total of 252 infants were known to be treated with supplemental oxygen after they were discharged from hospital with the majority (163, 64.7%) of these infants born at less than 28 weeks' gestation.

3.6.2 Neonatal surgery

Surgery in the newborn is a specialised field, carried out in only a limited number of centres such as children's hospitals, or perinatal centres in general hospitals with substantial paediatric departments. Newborn infants undergoing major surgery often need specialist care to stabilise their condition both before, during and after the operation. Some other procedures such as laser treatment for retinopathy of prematurity (section 3.6.4) are conducted at perinatal centres. The babies in this cohort include only those who were admitted to a NICU as part of their first admission to hospital. Many other babies undergo surgery during their first weeks of life but they either go home first, or are admitted to paediatric units such as for cardiac surgery. There were 789 babies who had major surgery in our cohort.

Half (51.2%, n: 404) of the babies receiving surgery were born at term. Half of these term babies (50.4%, n: 204) were born in a perinatal centre and half of them (51.4%, n:105) had an antenatal diagnosis of a fetal malformation, which allowed the birth to be planned close to expert care. Major congenital malformations were detected in most (92.8%, n: 375) of the term babies receiving surgery and 18 (72.0% of the term babies who died) were thought to have died as a direct result of their malformation. Assisted mechanical ventilation was used to treat 291 (72.0%) babies and "peri-surgical' was listed as the main indication for respiratory support in nearly half (43.9%) of these babies, with "congenital malformation" accounting for another 36.1% of babies. Discharge data are known for 94.3% of the survivors. These infants were in hospital for a median of 20 days (interquartile range 14 to 30.25 days), a week longer than the total group of term babies admitted to a NICU (Tables 27 and 28).

3.6.3 Cerebral ultrasound

Ultrasound imaging of the head of very preterm babies is performed to detect both intraventricular haemorrhage (IVH), and the formation of cysts and ventricular dilatation (hydrocephalus). The initial ultrasound is generally done during the first week of life to detect signs of IVH.

For babies born at less than 32 weeks' gestation 2,153 (76.5%) did not have any IVH detected. IVHs are graded according to an internationally recognised method (Papile LA et al. 1978) with grades III and IV of concern as they are markers of possible later disability. Significant haemorrhage (grade III or IV) was detected in 183 (6.5%) of the babies examined (Tables 19 and 20). The reported reduction in significant IVH from 8.0% in 1995 to 5.9% in 1997 has abated, but remains a statistically significant trend (χ_{MH}: 5.98, $p<0.01$; Figure 10). The proportion of babies with a significant grade of IVH in the level III NICUs has increased overall from last year with a median of 6.0% and an interquartile range from 4.5% to 8.7% (for infants born at less than 32 weeks' gestation and alive after the first day of life). A quarter (22.5%) of the 209 (6.9%) babies who did not have an ultrasound had died before their second day of life.

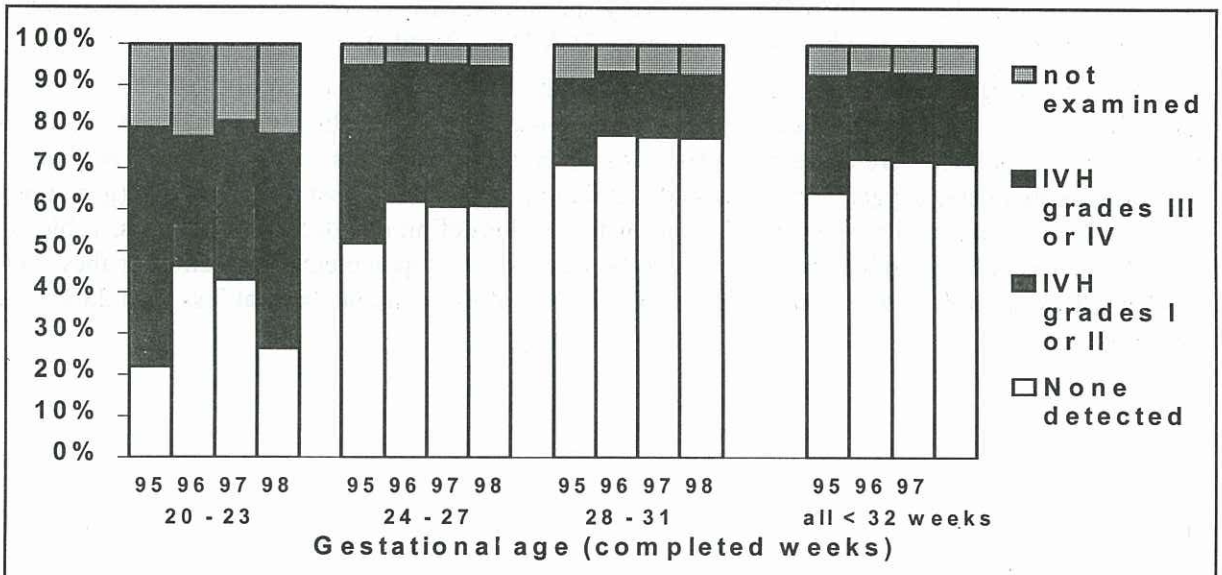

Figure 10: Intraventricular haemorrhage by gestational age group, 1998

Figure 10 has been reproduced as an insert to allow you a clearer view of the differentiation between IVH grades I and II and IVH grades III and IV.

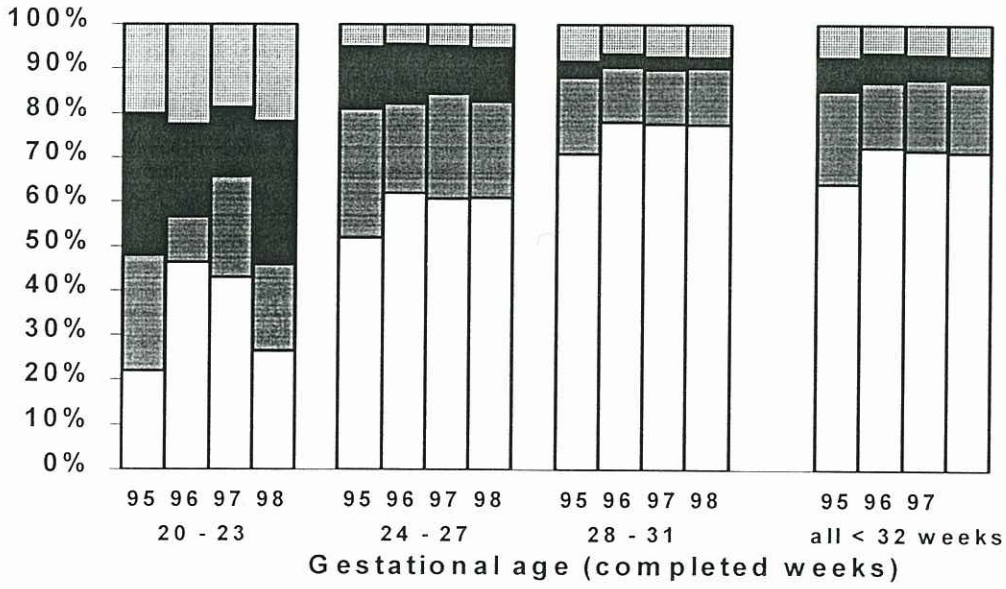

Figure 10: Intraventricular haemorrhage by gestational age group, 1998

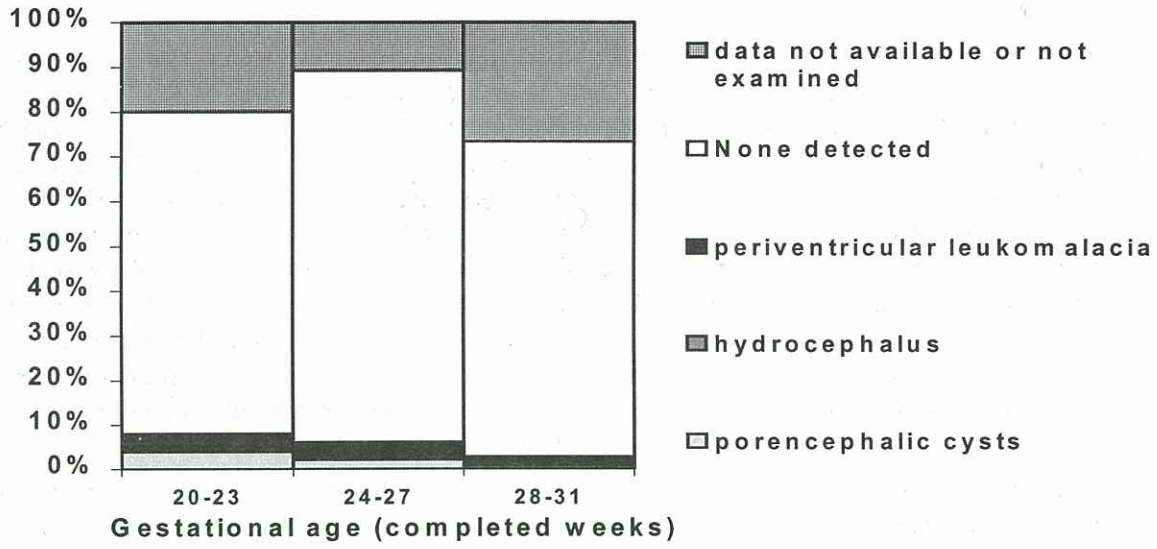

Figure 11: Late head ultrasound results by gestational age group, 1998

A later ultrasound is done to detect cystic lesions (periventricular leukomalacia or porencephalic cysts) and ventricular dilatation (hydrocephalus). For all 5,882 infants alive after day 28 who did not have hydrocephalus at birth due to a congenital malformation, only 151 (2.6%) had a major abnormality on head ultrasound (data not available for 48.8% of babies). Of the 2,758 babies who were also born at less than 32 weeks data were available for 26.7% of babies. No abnormality on ultrasound was noted for 1,909 (69.2%) babies (Figure 11) and hydrocephalus was uncommon in this group (n: 36; 1.3%). Porencephalic cysts were noted in 35 (1.3%) and periventricular leukomalacia in 65 (2.4%) babies. Encephaloclastic porencephaly was not reported in any infants (Harding et al. 1998).

3.6.4 Neonatal infection

Systemic infection is another severe morbidity for neonates with an attributable mortality rate around 10% (Isaacs, Barfield, Grimwood et al. 1995). In this cohort, infection is recorded as the number of separate episodes of proven systemic infection at any time and from any site (such as blood (septicaemia), cerebrospinal fluid (meningitis), urine (urinary tract infection) or lung (pneumonia; see Isaacs et al. 1995)). This includes early and late infection.

No systemic infection was reported for 80.1% of our high-risk cohort, and this proportion dropped to 70.9% for babies born at less than 32 weeks' gestation. However, half (50.0%) of babies born at less than 28 weeks' gestation had at least one major infection during their hospitalisation. There was a large variation between units in the percentage of babies known to have at least one infection, with an interquartile range from 12.2% to 22.2% (median: 18.75%) which may reflect the variation in gestational age mix between these units.

3.6.5 Necrotising enterocolitis

Necrotising enterocolitis (NEC) is a disease of the gut, usually affecting the large intestine (colon) and is an important cause of death and morbidity in preterm infants and occasionally in term infants. Its cause is unknown, although studies have associated it with a variety of factors including very low gestational age and ischaemic events.

There were 144 babies proven to have NEC in this cohort with 120 (83.3%) of those babies born at less than 32 weeks' gestation. Mortality in these babies was high (25.7%). The reported occurrence of this disease varies greatly from centre to centre and year to year. The rates seen in babies born at less than 32 weeks in our cohorts have been 3.89% in 1998, 3.0% in 1997, 7.8 % in 1996 and 4.0% in 1995.

3.6.6 Eye examinations

Eye examinations are carried out to monitor the vascularisation of the eye which when disrupted, can result in retinopathy of prematurity (ROP). There is an international staging of ROP (International Committee for the Classification of Retinopathy of Prematurity, 1984). If a baby's eye reaches threshold Stage III plus or Stage IV, treatment with a laser or cryotherapy may be necessary. A total of 2,277 babies fell into the group that are examined in most NICUs and thus are reported in our data for 1998. This group includes those who were born at less than 31 weeks' gestation or born weighing less than 1250 grams who survived to go home (n: 2,261) and those who died after their eyes were fully vascularised (37 weeks post menstrual age; an additional 16 babies). Of these 2,277 babies, 1,298 (73.2%) were known to have no ROP (Tables 21 and 22). For 504 babies (22.1%) the results of the examination were not available, or the babies fell outside the local criteria for an eye examination or an examination was not performed. Other babies may have their eyes examined, but this is at the discretion of the neonatologist, and those babies are not reported here. No cases of ROP were detected in these babies.

Overall, significant eye disease (Stage III or IV) was seen in 90 babies (5.1% of those with results noted) and treatment was reported for 48 of these babies. Our data did not report the incidence of threshold disease for these babies and thus cannot differentiate those with Grade III disease who need treatment. It should also be noted that the worst stage of eye disease is recorded, even if the retinopathy resolves to a lower stage with subsequent development of the eye.

3.7 Outcome

3.7.1 Survival

Overall, the majority of babies in this high-risk cohort survived to go home (91.2%). Survival is dependent on many factors, including gestation and birthweight. These data are presented as survival to discharge home by week of gestational age and by birthweight group (Figures 12 and 13, Tables 23 and 24). To provide a comprehensive picture these data are reported as survival to 7 days, to 28 days (neonatal death) and to discharge home, making note of the presence of lethal congenital malformations (a major congenital malformation that contributes to the death of the baby). There has been no real change in survival rates in the past 4 years (Figure 12, $\chi_{MH} > 0.05$ for the 6 gestational age epochs). More than 95% survival is seen for babies born at 29 to 36 weeks' gestation, then falls at term. When death occurred, it was in the first two days of life for 173 (30.6%) babies and within a week for 306 (54.1% of deaths). Lethal congenital malformations were reported for 142 (25.1%) babies. These data differ from that usually reported for State or National populations as they represent only those babies admitted to a level III NICU and do not include babies who were stillborn, died in labour ward or who died in hospitals without a NICU.

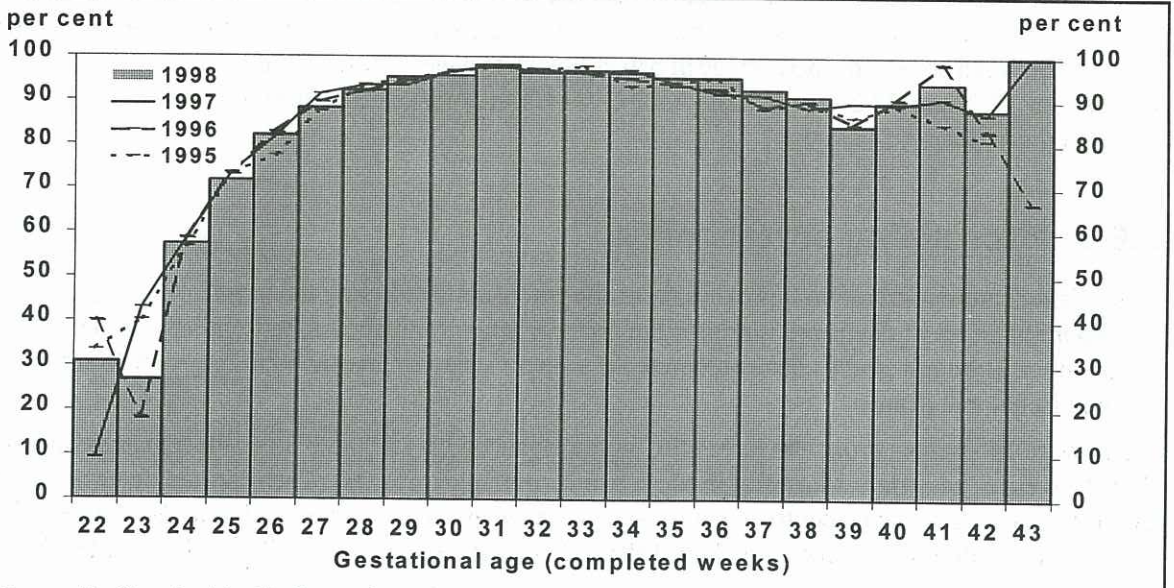

Figure 12: Survival to discharge from hospital by gestational age group, 1995-1998

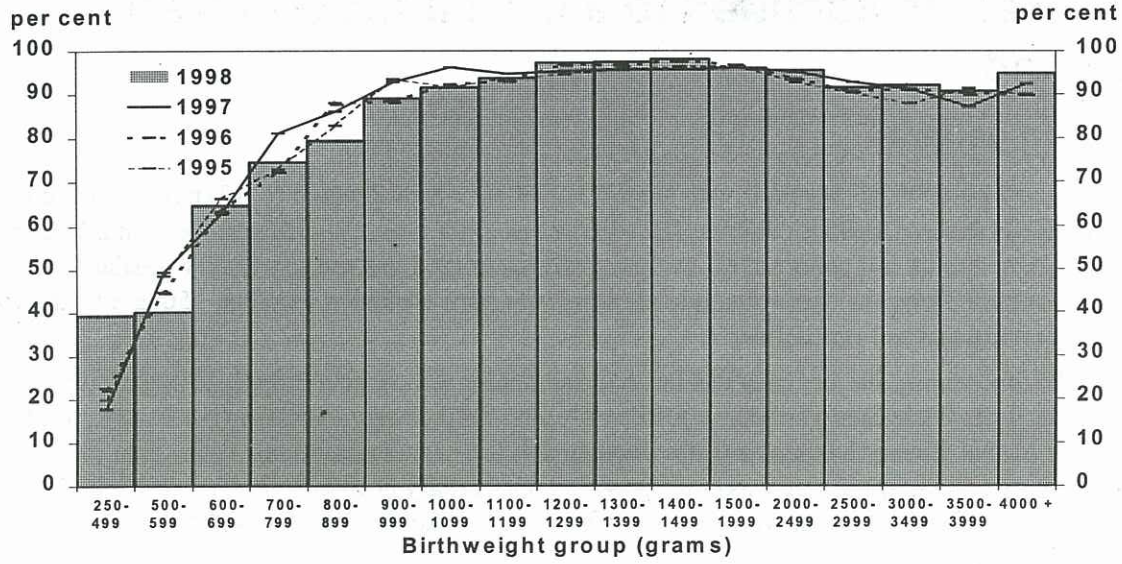

Figure 13: Survival to discharge from hospital by birthweight group, 1995-1998

3.7.2 Discharge from registration NICU

After their stay in newborn intensive care, babies go to a level II nursery in either the same hospital or another centre. In 1998, nearly half of all babies (46.8%, n: 2,541) were transferred to nurseries in other hospitals (Level I or II care) prior to their discharge to home (Tables 25 and 26). Some babies (2.9% of total, but 13.4% of those transferred) went to other hospitals with a NICU for surgery, or because that centre was closer to home or occasionally because their birth hospital did not have a level III bed available.

3.7.3 Going home

The total amount of time spent in hospital is related to many factors (especially maturity at birth) and there is wide variation in an individual's length of stay (Tables 27 and 28). However, surviving extremely preterm babies are usually discharged home around their due date (term equivalent age, Figure 14) and preterm babies usually go home a little before term. Term babies who receive intensive care for respiratory support or surgery tend to stay in hospital for one to three weeks. For all babies born in Australia, most (85.4%) went home before 7 days (Day, Sullivan, Ford & Lancaster 1999). Over the period 1995 to 1998, there has been little change in the median length of stay when considering time in hospital against gestational age at birth (Figure 14). These data are for all survivors and includes time spent in peripheral hospitals.

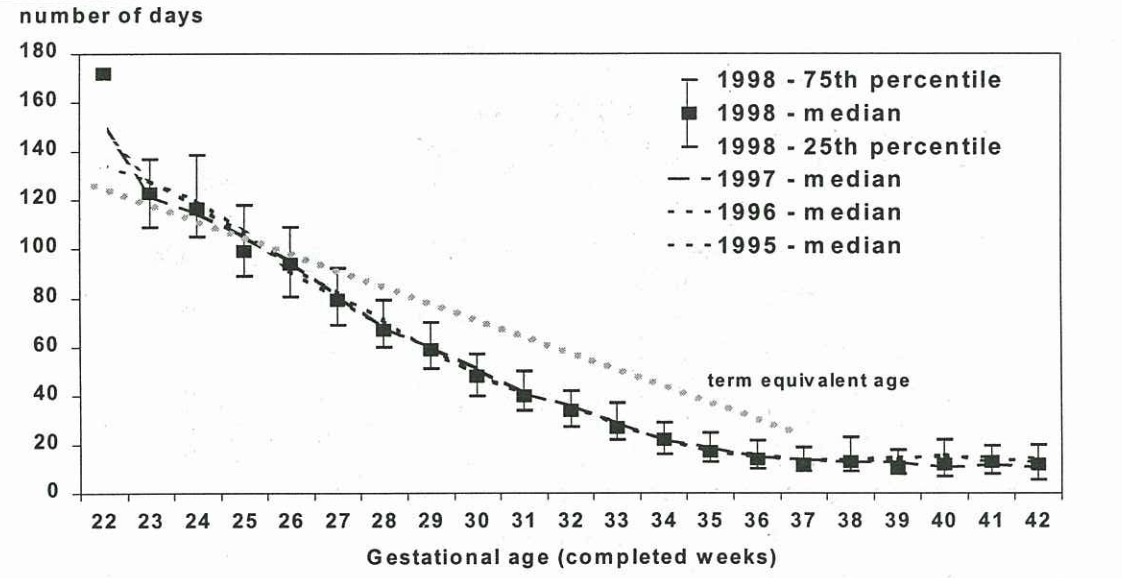

Figure 14: Median number of days to discharge to home by gestational age, 1995-1998

3.8 Babies admitted to a level II NICU in New Zealand

3.8.1 In general

Since January 1st 1998, all hospitals with level II nurseries in New Zealand (n: 13) have contributed data to the ANZNN audit of high-risk infants. The registration criteria were unchanged (Section 2.1), allowing the network to audit a full cohort of all liveborn babies admitted to a nursery in New Zealand who were born at less than 32 weeks' gestation, and all who were born weighing less than 1500g a birth, and all babies receiving assisted ventilation.

Some infants receiving surgery may still be unaccounted for if they went directly to a paediatric hospital or a cardiac unit. The babies who were transferred to a level III centre within the first 28 days of life were registered to that tertiary hospital and are described in the previous sections. These data refer to only those babies whose hospital stay was entirely within non-tertiary hospitals, or who were transferred to a level III NICU after 28 days, or who were transferred to a children's hospital without being admitted to a level III nursery.

These criteria were fulfilled by 156 babies (10.3% of all babies born in New Zealand and registered to the ANZNN audit of high-risk infants in 1998, Figure 15). Of these, 40 (25.6%) were born at less than 32 weeks' gestation, 29 (18.6%) were born weighing less than 1500 grams, 137 (87.8%) babies received assisted ventilation and one baby received major surgery. The number of babies registered to each level II centre ranged from none to 40.

3.8.2 Antenatal

Antenatal corticosteroids were administered to the mothers of 85% of babies born at less than 32 weeks' gestation, with 61% receiving a complete course. However these data were available for only 67.5% of babies.

The most common presenting antenatal obstetric problem which led to the baby's birth was recorded for 75% of babies. The most common problems for each age group were similar to the group registered to Level III units; preterm pre-labour rupture of membranes (44.4%) for those born at less than 32 weeks', and preterm labour (34%) for babies born at 32-36 weeks'. For babies born at term, 52.5% had no identifiable antenatal problem.

The majority of babies (88%) were booked at the hospital where they were born (data available for 85.3% of babies).

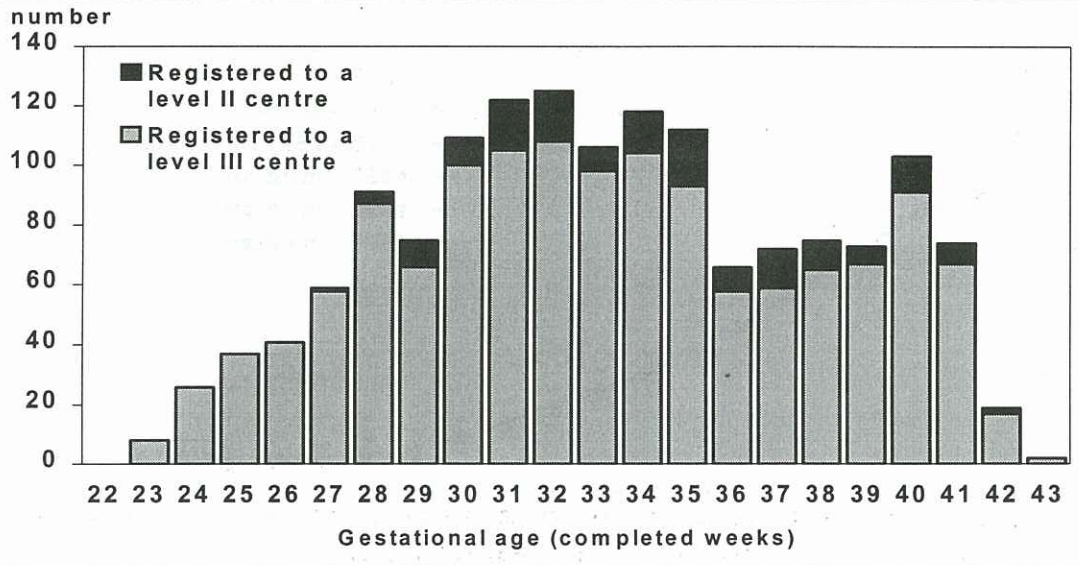

Figure 15: Infants registered to ANZNN high-risk audit of infants admitted to level II and level III NICUs, by gestational age, 1998

3.8.3 Baby and birth

The median gestational age for these babies was 34 completed weeks' (interquartile range 31 - 37; range 27 - 42). There were 40 babies born at less than 32 weeks' gestation, 66 babies born at 32 - 36 weeks' gestation, and 50 babies born at term. The median birthweight was 2148 grams (interquartile range 1633 - 3064; range 850 - 5255). There were 29 babies born weighing less than 1500 grams, 61 babies born weighing 1500 - 2499 grams, and 66 babies born weighing at least 2500 grams.

Similar to the level III cohort at term, 60.3% of these babies were boys and 39.7% were girls. The plurality of these infants reflected their gestation, with 23 (14.7%) babies from a twin pregnancy. This figure varied with the gestational age group; 20% for babies born at less than 32 weeks', 19.7% for babies born at 32 - 36 weeks', and 4% for babies born at term.

Overall, only 20 (12.8%) babies had a low Apgar score (i.e. less than 4) at one minute of age. However, this was more prevalent for babies born at term (24%) than for babies born at 32 - 36 weeks' (9.1%) and for babies born at less than 32 weeks' (5%). No preterm babies had a low Apgar at five minutes.

3.8.4 Morbidity

The main reason for respiratory support in these infants was respiratory distress syndrome (67.5% for babies born at less than 32 weeks' gestation and 47.4% for those born at 32 - 36 weeks'). 'Non-specific' respiratory distress was the most common diagnosis for babies born at term (34%). Assisted ventilation was received by 137 (87.8%) babies for a combined total of 472 ventilator 'days' and the median number of days ventilated was 2 days (interquartile range 1 - 4). For babies receiving assited ventilation, 64.3% of those born at less than 32 weeks' gestation received IPPR and/ or CPAP, whilst the majority (67.9%) of babies born at more than 31 weeks' gestation received CPAP only. Supplemental oxygen therapy was received by 115 (78.2%) of babies for a median of four days (interquartile range 2 - 7; data available for 147 (94.2%) babies). One baby was discharged home on oxygen.

Systemic infection was seen in 18 (11.5%) babies, however, there was a large variation between infants born at less than 32 weeks' gestation (25%) and those born at 32 weeks' or more (6.9%).

3.8.5 Outcome

A total of 147 (94.2%) babies in this cohort survived to go home, again reflecting the more mature gestation of these infants and their overall lower risk. Of the nine babies who died, nearly half (44.4%) had a major congenital malformation that contributed to their death. All deaths occurred within seven days. Excluding those with lethal congenital malformations, all preterm babies and 90% of term babies survived.

The median length of stay in hospital for babies born at less than 32 weeks' was 47 days (interquartile range 36.5 - 58.75); for babies born at 32 to 36 weeks' the median stay was 24 days (interquartile range 15 - 30.5) and 7.5 days (interquartile range 6 - 10.75) for term babies. Discharge data were available for 146 (99.3% of survivors) babies.

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5 Tables

Table 1: Number of babies in each gestational age group, 1998

Gestational age (completed weeks)	Number in 1998	Cumulative per cent 1998
21	—	—
22	13	0.20
23	67	1.25
24	157	3.70
25	197	6.77
26	269	11.0
27	299	15.6
28	400	21.9
29	454	29.0
30	570	37.9
31	658	48.1
(All babies <32 weeks')	*(3,084)*	

Gestational age (completed weeks)	Number in 1998	Cumulative per cent 1998
32	483	55.7
33	380	61.6
34	386	67.6
35	307	72.4
36	303	77.1
37	283	81.6
38	323	86.6
39	261	90.7
40	360	96.3
41	202	99.4
42	33	99.9
43	3	100.0
44	—	—
All babies	**6,408**	

Note: ANZNN cohort includes all babies born at less than 32 weeks' completed gestation. Those above this gestation must be born at less than 1500 grams birthweight, or must require assisted ventilation or major surgery.

Table 2: Number of babies in each birthweight group, 1998

Birthweight group (grams)	Number in 1998	Cumulative per cent 1998
250-499	33	0.51
500-599	92	1.95
600-699	167	4.56
700-799	219	7.97
800-899	254	11.9
900-999	293	16.5
1000-1099	262	20.6
1100-1199	316	25.5
1200-1299	326	30.6
1300-1399	356	36.2
1400-1499	360	41.8
(All babies < 1500g)	*(2,678)*	

Birthweight group (grams)	Number in 1998	Cumulative per cent 1998
1500-1999	1,113	59.2
2000-2499	777	71.3
2500-2999	646	81.4
3000-3499	628	91.2
3500-3999	391	97.3
4000 and over	175	100.0
All babies	**6,408**	

Note: ANZNN cohort includes all babies born at less than 1500 grams. Those above this gestation must be born at less than 32 week's gestation, or must require assisted ventilation or major surgery.

Table 3: Antenatal corticosteroid use by gestational age group, babies < 34 weeks' gestation, 1998

Antenatal steroid use	20-23	24-27	28-31	32-33	Babies < 34 weeks'
			Number		
None	20	114	276	228	638
Incomplete course	17	193	337	144	691
Course completed	32	499	1,157	335	2,023
Course completed >7 day	—	61	122	44	227
Unknown	11	55	190	112	368
All babies	**80**	**922**	**2,082**	**863**	**3,948**
			Per cent		
None	29.0	13.2	14.6	30.3	17.8
Incomplete course	24.6	22.3	17.8	19.2	19.3
Course completed	46.4	57.6	61.2	44.6	56.5
Course completed >7 day	—	7.1	6.4	5.9	6.4
All babies	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Notes

1. Corticosteroids given antenatally via any route to the mother at a time likely to enhance fetal lung maturation is considered 'complete' when more than one dose of corticosteroids is given, and first dose was given more than 24 hours and less than 8 days before the baby's birth.
2. 'Unknown' data are excluded from per cent calculations.

Table 4: Antenatal corticosteroid use by birthweight group, babies < 2500 g, 1998

Antenatal steroid use	250-499	500-749	750-999	1000-1249	1250-1499	1500-1999	2000-2499	Babies < 2500 g
				Number				
None	4	46	78	115	159	250	409	1,061
Incomplete course	5	74	122	129	129	185	61	705
Course completed	17	204	364	395	463	484	151	2,078
Course completed >7 day	—	17	45	39	47	73	39	260
Unknown	7	30	45	60	84	121	117	464
All babies	**33**	**371**	**654**	**738**	**882**	**1,113**	**777**	**4,568**
				Per cent				
None	15.4	13.5	12.8	17.0	19.9	25.2	62.0	25.9
Incomplete course	19.2	21.7	20.0	19.0	16.2	18.6	9.2	17.2
Course completed	65.4	59.8	59.8	58.3	58.0	48.8	22.9	50.6
Course completed >7 day	—	5.0	7.4	5.7	5.9	7.4	5.9	6.3
All babies	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Notes

1. Corticosteroids given antenatally via any route to the mother at a time likely to enhance fetal lung maturation is considered 'complete' when more than one dose of corticosteroids is given, and first dose was given more than 24 hours and less than 8 days before the baby's birth.
2. 'Unknown' data are excluded from per cent calculations.

Table 5: Plurality by gestational age group, all babies, 1998

Plurality	20-23	24-27	28-31	32-33	34-36	37-44	All babies
			Number				
Singleton	65	687	1506	654	833	1417	5,162
Twins	11	205	499	185	145	30	1,075
Triplets	4	26	74	24	18	18	164
Quadruplets	—	4	3	—	—	—	7
Unknown	—	—	—	—	—	—	—
All babies	**80**	**922**	**2,082**	**863**	**996**	**1465**	**6,408**
			Per cent				
Singleton	81.3	74.5	72.3	75.8	83.6	96.7	80.6
Twins	13.7	22.2	24.0	21.4	14.6	2.1	16.8
Triplets	5.0	2.8	3.6	2.8	1.8	1.2	2.5
Quadruplets	—	0.5	0.1	—	—	—	0.1
All babies	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Note: 'Unknown' and 'not available' data are excluded from per cent calculations.

Table 6: Plurality by birthweight group, all babies, 1998

Plurality	250-499	500-749	750-999	1000-1249	1250-1499	1500-1999	2000-2499	2500-2999	3000-3499	3500-3999	4000+	All babies
						Number						
Singleton	24	284	485	516	590	858	649	595	605	384	172	5,162
Twins	8	76	136	199	248	227	117	45	13	3	3	1,075
Triplets	1	11	27	22	44	28	11	6	10	4	—	164
Quadruplets	—	—	6	1	—	—	—	—	—	—	—	7
Unknown	—	—	—	—	—	—	—	—	—	—	—	—
All babies	**33**	**371**	**654**	**738**	**882**	**1,113**	**777**	**646**	**628**	**391**	**175**	**6,408**
						Per cent						
Singleton	72.7	76.5	74.2	69.9	66.9	77.1	83.5	92.1	96.3	98.2	98.3	80.5
Twins	24.1	20.5	20.8	27.0	28.1	20.4	15.1	7.0	2.1	0.8	1.7	16.8
Triplets	3.0	3.0	4.1	3.0	5.0	2.5	1.4	0.9	1.6	1.0	—	2.6
Quadruplets	—	—	0.9	0.1	—	—	—	—	—	—	—	0.1
All babies	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Note: 'Unknown' and 'not available' data are excluded from per cent calculations.

Table 7: Level of hospital of birth by gestational age group, all babies, 1998

Level of hospital	20-23	24-27	28-31	32-33	34-36	37-44	All babies
			Number				
Not born in a hospital	1	4	10	8	7	22	52
Hospital, no level III NICU	6	77	188	161	373	755	1,560
Hospital with level III NICU	73	840	1,884	691	612	681	4,781
Unknown	—	1	—	3	4	7	15
All babies	**80**	**922**	**2,082**	**863**	**996**	**1,465**	**6,408**
			Per cent				
Not born in a hospital	1.3	0.4	0.5	0.9	0.7	1.5	0.8
Hospital, no NICU	7.5	8.4	9.0	18.7	37.6	51.8	24.4
Hospital with a NICU	91.2	91.2	90.5	80.4	61.7	46.7	74.8
All babies	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Note: 'Unknown' data are excluded from per cent calculations.

Table 8: Level of hospital of birth by birthweight group, all babies, 1998

Level of hospital	250-499	500-749	750-999	1000-1249	1250-1499	1500-1999	2000-2499	2500-2999	3000-3499	3500-3999	4000+	All babies
						Number						
Not born in a hospital	—	2	3	4	10	5	5	6	7	7	3	52
Hospital, no NICU	1	28	52	69	101	155	242	290	328	202	92	1,560
Hospital with a NICU	32	340	599	665	770	951	528	348	289	180	79	4,781
Unknown	—	1	—	—	1	2	2	2	4	2	1	15
All babies	**33**	**371**	**654**	**738**	**882**	**1,113**	**777**	**646**	**628**	**391**	**175**	**6,408**
						Per cent						
Not born in a hospital	—	0.5	0.5	0.5	1.1	0.4	0.7	0.9	1.1	1.8	1.7	0.8
Hospital, no NICU	3.0	7.6	7.9	9.4	11.5	14.0	31.2	45.0	52.6	51.9	52.9	24.4
Hospital with a NICU	97.0	91.9	91.6	90.1	87.4	85.6	68.1	54.1	46.3	46.3	45.4	74.8
All babies	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Note: 'Unknown' data are excluded from per cent calculations.

Table 9: Transport type for babies transferred immediately after birth to registration hospital, by gestational age group, 1998

Transportation method	20-23	24-27	28-31	32-33	34-36	37-44	All babies
			Number				
Non-specialised transport[(a)]	—	6	23	18	55	185	287
Specialist transport team[(b)]	9	92	184	157	369	667	1,478
All babies	**9**	**98**	**207**	**175**	**424**	**852**	**1,765**
Non-specialised transport[(a)]	—	6.1	11.1	10.3	13.0	21.7	16.3
Specialist transport team[(b)]	100.0	93.9	88.9	89.7	87.0	78.3	83.7
All babies	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

(a) Infant is transferred from any other hospital, by a non-specialist transfer method, including transport by ambulance.

(b) A specialist neonatal transport retrieval team using appropriate equipment retrieves infant.

Note: These data represent those babies who qualify for the ANZNN cohort only, and do not include neonates who are transferred to a paediatric intensive care unit, or who are transferred after the perinatal period.

Table 10: Transport type for babies transferred immediately after birth to registration hospital, by birthweight group, 1998

Transportation method	250-499	500-749	750-999	1000-1249	1250-1499	1500-1999	2000-2499	2500-2999	3000-3499	3500-3999	4000+	All babies
						Number						
Non-specialised transport[a]	—	2	6	4	11	25	40	63	69	41	26	287
Specialist transport team[b]	2	36	61	72	97	154	234	271	290	185	76	1,478
All babies	**2**	**38**	**67**	**76**	**108**	**179**	**274**	**334**	**359**	**226**	**102**	**1,765**
						Per cent						
Non-specialised transport[a]	—	5.3	9.0	5.3	10.2	14.0	14.6	18.9	19.2	18.1	25.5	16.3
Specialist transport team[b]	100.0	94.7	91.0	94.7	89.8	86.0	85.4	81.1	80.8	81.9	74.5	83.7
All babies	**—**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

(a) Infant is transferred from any other hospital, by a non-specialist transfer method, including transport by ambulance.

(b) A specialist neonatal transport retrieval team using appropriate equipment retrieves infant.

Note: These data represent those babies who qualify for the ANZNN cohort only, and do not include neonates who are transferred to a paediatric intensive care unit, or who are transferred after the perinatal period.

Table 11: Method of birth by gestational age group, all babies, 1998

Mode of birth	20-23	24-27	28-31	32-33	34-36	37-44	All babies
			Number				
Vaginal	70	421	714	265	372	644	2,486
Vaginal – with instruments	4	45	120	49	63	142	423
Caesarean section – emergency (labour)	2	226	473	166	176	231	1,274
Caesarean section - elective (no labour)	4	227	762	367	345	316	2,021
Unknown	—	3	13	16	40	132	204
All babies	**80**	**922**	**2,082**	**863**	**996**	**1,465**	**6,408**
			Per cent				
Vaginal	87.5	45.8	34.5	31.3	38.9	48.3	40.1
Vaginal – with instruments	5.0	4.9	5.8	5.8	6.6	10.7	6.8
Caesarean section – emergency (labour)	2.5	24.6	22.9	19.6	18.4	17.3	20.5
Caesarean section - elective (no labour)	5.0	24.7	36.8	43.3	36.1	23.7	32.6
All babies	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Note: 'Unknown' data are excluded from per cent calculations.

Table 12: Method of birth by birthweight group, all babies, 1998

Mode of birth	250-499	500-749	750-999	1000-1249	1250-1499	1500-1999	2000-2499	2500-2999	3000-3499	3500-3999	4000+	All babies
						Number						
Vaginal	16	183	211	221	302	442	329	267	255	176	84	2,486
Vaginal – with instruments	1	10	36	40	48	74	45	52	56	43	18	423
Caesarean section – emergency (labour)	6	63	140	182	195	242	143	107	94	66	36	1,274
Caesarean section – elective (no labour)	10	114	264	292	331	335	235	174	169	70	27	2,021
Unknown	—	1	3	3	6	20	25	46	54	36	10	204
All babies	**33**	**371**	**654**	**738**	**882**	**1,113**	**777**	**646**	**628**	**391**	**175**	**6,408**
						Per cent						
Vaginal	48.5	49.5	32.4	30.1	34.4	40.4	43.7	44.5	44.4	49.6	50.9	40.1
Vaginal – with instruments	3.0	2.7	5.5	5.4	5.5	6.8	6.0	8.7	9.8	12.1	10.9	6.8
Caesarean section – emergency (labour)	18.2	17.0	21.5	24.8	22.3	22.1	19.0	17.8	16.4	18.6	21.8	20.5
Caesarean section - elective (no labour)	30.3	30.8	40.6	39.7	37.8	30.7	31.3	29.0	29.4	19.7	16.4	32.6
All babies	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Note: 'Unknown' data are excluded from per cent calculations.

Table 13: Respiratory support by gestational age group, all babies, 1998

Type of respiratory support		20-23	24-27	28-31	32-33	34-36	37-44
IPPR	n	77	868	1,198	449	622	1,050
	median (days)	4	12	3	3	3	3
	interquartile range	2–25	3–28	2–6	2–4	2–4	2–5
	no IPPR (n)	3	54	878	413	372	413
	data not available	—	—	6	1	2	2
CPAP	n	20	722	1,325	467	476	509
	median (days)	7.5	16.5	3	2	2	1
	interquartile range	3–30	6–29	2–8	1–4	1–3	1–3
	no CPAP (n)	60	198	732	384	517	950
	data not available	—	2	25	12	3	6
Oxygen	n	74	876	1,614	627	756	1,089
	median (days)	5.5	44	5	3	4	3
	interquartile range	2–35	9–78	2–23	2–6	2–6	2–7
	no oxygen (n)	4	22	425	570	135	176
	data not available	2	24	43	57	105	200
All babies		**80**	**922**	**2,082**	**863**	**996**	**1,465**

Note: Median and range (days) are for all babies who received this therapy.

Table 14: Respiratory support by birthweight group, all babies, 1998

Type of respiratory support		250-499	500-749	750-999	1000-1249	1250-1499	1500-1999	2000-2499	2500-2999	3000-3499	3500-3999	4000+
IPPR	n	31	353	572	506	437	573	496	458	446	275	117
	median (days)	8	16	8	4	3	2	3	3	3	3	3
	interquartile range	3–50	2–34	3–21	2–7	2–5	2–4	2–4	2–4	2–4	2–5	2–5
	no IPPR (n)	2	18	82	230	442	538	281	185	182	115	58
	data not available	1	—	—	2	2	2	—	2	—	1	—
CPAP	n	13	230	521	522	502	609	411	274	228	136	69
	median (days)	4	19	14	6	3	2	2	2	2	1	1
	interquartile range	2–15	6–36	5–27	2–16	1–7	1–4	1–3	1–3	1–3	1–2	1–2
	no CPAP (n)	19	140	131	205	365	490	366	367	399	252	106
	data not available	1	1	2	11	15	14	—	5	1	3	—
Oxygen	n	28	346	603	608	608	830	606	503	478	291	135
	median (days)	7	31	34	11	5	3	4	4	4	3	4
	interquartile range	3–134	5–86	6–71	3–44	2–21	1–7	2–6	2–7	2–8	2–7	2–8
	no Oxygen (n)	3	12	36	111	253	237	103	58	58	47	23
	data not available	2	13	15	19	21	46	68	85	92	53	17
All babies		**33**	**371**	**654**	**738**	**882**	**1,113**	**777**	**646**	**628**	**391**	**175**

Note: Median and range (days) are for all babies who received this therapy.

Table 15: Oxygen dependency by gestational age group, all babies, 1998

Oxygen dependency	20-23	24-27	28-31	32-33	34-36	37-44	All babies
Oxygen therapy at day 28	23	616	394	45	24	39	1,141
Per cent survivors with oxygen therapy on day 28	92.0	81.4	19.6	5.4	2.5	2.9	19.3
Chronic lung disease	17	344	216	—	—	—	577
Per cent of survivors with chronic lung disease [a]	77.3	48.9	11.0	—	—	—	21.4
Oxygen therapy after discharge to home	11	152	50	10	11	18	252
Data not available	2	24	43	57	104	200	430
All babies	**80**	**922**	**2,082**	**863**	**996**	**1,465**	**6,408**

(a) Chronic lung disease is defined as requiring respiratory assistance, ie supplemental oxygen and/or mechanical ventilation and/or continuous positive airways pressure) at 36 weeks post menstrual age (PMA, gestational age plus chronological age) for babies born at less than 32 weeks' gestation.

(b) Calculated as the total number with Chronic Lung Disease as a percentage of those alive at 36 weeks PMA who have oxygen therapy information available (n: 2,693).

Note: 'Not available' data are excluded from per cent calculations.

Table 16: Oxygen dependency by birthweight group, all babies, 1998

Oxygen dependency	250-499	500-749	750-999	1000-1249	1250-1499	1500-1999	2000-2499	2500-2999	3000-3499	3500-3999	4000+	All babies
Oxygen therapy at day 28	12	210	390	248	134	72	23	19	24	6	3	1,141
Per cent survivors with oxygen therapy on day 28	85.7	93.8	71.3	35.9	15.5	6.7	3.1	3.2	4.1	1.7	1.8	19.3
Chronic lung disease [a]	12	146	226	102	59	29	2	1	—	—	—	577
Per cent of survivors with chronic lung disease [b]	92.3	66.4	42.6	16.9	9.3	4.5	4.1	33.3	—	—	—	21.4
Oxygen therapy after discharge to home	8	65	88	32	13	14	7	9	12	4	—	252
Data not available	2	13	15	19	21	46	68	85	92	53	17	431
All babies	**33**	**371**	**654**	**738**	**882**	**1,113**	**777**	**646**	**628**	**391**	**175**	**6,408**

(a) Chronic lung disease is defined as requiring respiratory assistance, ie supplemental oxygen and/or mechanical ventilation and/or continuous positive airways pressure) at 36 weeks post menstrual age (PMA, gestational age plus chronological age) for babies born at less than 32 weeks' gestation.

(b) Calculated as the total number with Chronic lung disease as a percentage of those alive at 36 weeks PMA who have oxygen therapy information available (n: 2,693).

Note: 'Not available' data are excluded from per cent calculations.

Table 17: Exogenous surfactant use by gestational age group, all babies, 1998

Surfactant use	20-23	24-27	28-31	32-33	34-36	37-44	All babies
			Number				
None	8	179	1,095	508	550	1,023	3,363
Exosurf	2	3	41	26	19	21	112
Survanta	70	731	867	261	318	208	2,455
Other / both	—	3	6	—	4	7	20
Unknown	—	6	73	68	105	206	458
All babies	**80**	**922**	**2,082**	**863**	**996**	**1,465**	**6,408**
			Per cent				
None	10.0	19.6	54.5	63.9	61.7	81.3	56.5
Exosurf	2.5	0.3	2.0	3.3	2.1	1.7	1.9
Survanta	87.5	79.8	43.2	32.8	35.7	16.5	41.3
Other / both	—	0.3	0.3	—	0.5	0.6	0.3
All babies	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Note: 'Unknown' data are excluded from per cent calculations.

Table 18: Exogenous surfactant use by birthweight group, all babies, 1998

Surfactant use	250-499	500-749	750-999	1000-1249	1250-1499	1500-1999	2000-2499	2500-2999	3000-3499	3500-3999	4000+	All babies
						Number						
None	9	64	173	335	524	673	421	371	385	275	133	3,363
Exosurf	—	2	—	11	22	27	22	11	8	8	1	112
Survanta	24	302	469	377	294	349	260	170	137	53	20	2,455
Other / both	—	—	2	2	5	1	1	3	3	3	—	20
Unknown	—	3	10	13	37	63	73	91	95	52	21	458
All babies	**33**	**371**	**654**	**738**	**882**	**1,113**	**777**	**646**	**628**	**391**	**175**	**6,408**
						Per cent						
None	27.3	17.4	26.9	46.2	62.0	64.1	59.8	66.9	72.2	81.1	86.4	56.5
Exosurf	—	0.5	—	1.5	2.6	2.6	3.1	2.0	1.5	2.4	0.7	1.9
Survanta	72.7	82.1	72.8	52.0	34.8	33.2	36.9	30.6	25.7	15.6	13.0	41.3
Other / both	—	—	0.3	0.3	0.6	0.1	0.2	0.5	0.6	0.9	—	0.3
All babies	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Note: 'Unknown' data are excluded from per cent calculations.

Table 19: Intraventricular haemorrhage by gestational age group, babies born at < 32 weeks' gestation, 1998

Head ultrasound result	20-23	24-27	28-31	Babies < 32 weeks'
		Number		
None	22	557	1574	2,153
Grade I	5	127	204	336
Grade II	11	71	61	143
Grade III	9	42	24	75
Grade IV	18	68	22	108
Not examined	10	49	150	209
Data not available	5	8	47	60
All babies	**80**	**922**	**2,082**	**3,084**
		Per cent		
None	33.9	64.4	83.5	76.5
Grade I	7.7	14.7	10.8	11.9
Grade II	16.9	8.2	3.2	5.1
Grade III	13.8	4.8	1.3	2.7
Grade IV	27.7	7.9	1.2	3.8
All babies	**100.0**	**100.0**	**100.0**	**100.0**

Note: 'Not examined' and 'not available' data are excluded from per cent calculations.

Table 20: Intraventricular haemorrhage by birthweight group, babies born at < 1500 g, 1998

Head ultrasound result	250-499	500-749	750-999	1000-1249	1250-1499	Babies < 1500 g
			Number			
None	16	191	441	540	680	1,868
Grade I	4	45	78	84	84	295
Grade II	2	28	48	40	16	134
Grade III	2	24	20	13	14	73
Grade IV	4	47	29	16	6	102
Not examined	2	29	30	31	66	158
Data not available	3	7	8	14	16	48
All babies	**33**	**371**	**654**	**738**	**882**	**2,678**
			Per cent			
Grade I	14.3	13.4	12.7	12.1	10.5	11.9
Grade II	7.1	8.4	7.8	5.8	2.0	5.4
Grade III	7.1	7.2	3.2	1.9	1.8	3.0
Grade IV	14.3	14.0	4.7	2.3	0.7	4.1
All babies	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Note: 'Not examined' and 'not available' data are excluded from per cent calculations.

Table 21: Results of eye examination for ROP for babies born at < 31 weeks' gestation or < 1250 g, by gestational age group, 1998

Eye examination result	20-23	24-27	28-31	32-44	Eligible babies
			Number		
No ROP	5	351	897	45	1,298
Stage I	3	102	71	2	178
Stage II	5	158	43	1	207
Stage III	6	61	12	—	79
Stage IV	2	8	1	—	11
Received therapy	*7*	*38*	*3*	—	*48*
Not examined / data not available	1	44	419	40	504
Babies eligible for exam.	**22**	**724**	**1,443**	**88**	**2,277**
			Per cent		
No ROP	23.8	51.6	87.6	93.7	73.2
Stage I	14.3	15.0	6.9	4.2	10.0
Stage II	23.8	23.2	4.2	2.1	11.7
Stage III	28.6	9.0	1.2	—	4.5
Stage IV	9.5	1.2	0.1	—	0.6
Babies eligible for exam.	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Notes

1. Indicates worst stage of ROP seen
2. 'Not examined and data not available' data are excluded from per cent calculations.
3. 'Babies eligible for exam.' includes all infants born at less than 31 weeks' gestation or less than 1250 grams who survived, plus the 16 babies in this group who died after 37 weeks post menstrual age (when the eye should be fully vasularised). This may not comply with local experience and thus local criteria for eye examination, which may artificially elevate the number of babies in the 'not examined or data not available' category.

Table 22: Results of eye examination for ROP for babies born at < 31 weeks' gestation or < 1250 g, by birthweight group, 1998

Eye examination result	250-499	500-749	750-999	1000-1249	1250-1499	1500-2999	Eligible babies
				Number			
No ROP	4	76	305	455	314	144	1,298
Stage I	1	37	69	55	12	4	178
Stage II	2	65	92	41	5	2	207
Stage III	3	37	32	5	2	—	79
Stage IV	1	4	5	1	—	—	11
Received therapy	*3*	*24*	*18*	*3*	—	—	—
Not examined / data not available	2	17	59	136	398	341	29
Babies eligible for exam.	**13**	**229**	**555**	**693**	**503**	**284**	**2,277**
				Per cent			
No ROP	36.3	34.7	60.6	81.7	94.3	96.0	73.2
Stage I	9.1	16.9	13.7	9.9	3.6	2.7	10.0
Stage II	18.2	29.7	18.3	7.3	1.5	1.3	11.7
Stage III	27.3	16.9	6.4	0.9	0.6	—	4.5
Stage IV	9.1	1.8	1.0	0.2	—	—	0.6
Babies eligible for exam.	**100.0**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table 23: Survival to discharge by gestational age, all babies, 1998

Gestational age (weeks)	All babies admitted	No. with discharge home data	No. with lethal cong malform.	No. alive at 7 days	No. alive at 28 days	No. alive at discharge	Per cent survival at discharge
21	—	—	—	—	—	—	—
22	13	13	—	5	4	4	30.8
23	67	64	—	37	21	18	26.9
24	157	147	2	118	101	90	57.3
25	197	185	1	174	154	141	71.6
26	269	251	1	249	235	221	82.2
27	299	279	4	280	267	264	88.3
28	400	357	7	386	377	370	92.5
29	454	404	4	446	436	433	95.4
30	570	502	12	555	551	545	95.6
31	658	595	3	653	648	646	98.2
32	483	435	6	471	466	466	96.5
33	380	350	8	374	368	368	96.8
34	386	350	6	380	377	373	96.6
35	307	278	9	300	295	293	95.4
36	303	280	10	292	291	289	95.4
37	283	258	13	274	263	262	92.6
38	323	295	15	309	299	294	91.0
39	261	245	20	237	223	220	84.3
40	360	331	15	333	328	323	89.7
41	202	186	5	195	191	190	94.1
42	33	31	1	31	29	29	87.9
43	3	3	—	3	3	3	100
44	—	—	—	—	—	—	—
All babies	**6,408**	**5,839**	**142**	**6,102**	**5,927**	**5,842**	**91.2**

Note: Per cent survival to discharge is calculated from 'number alive at discharge' divided by 'all babies admitted' (the number of babies admitted to the level III NICUs). Hence, the survival calculations include those babies with congenital malformations that are considered to have directly contributed to their death. Where babies have been transferred to a peripheral hospital and the date of discharge to home is not available (8.9% of all babies), these babies have been assumed to have survived to go home.

Table 24: Survival to discharge by birthweight group, all babies, 1998

Birthweight group (grams)	All babies admitted	No. with discharge home data	No. with lethal cong malform.	No. alive at 7 days	No. alive at 28 days	No. alive at discharge	Per cent survival at discharge
250-499	33	33	—	20	14	13	39.4
500-599	92	85	2	59	44	37	40.2
600-699	167	156	3	132	119	108	64.7
700-799	219	202	2	193	174	163	74.4
800-899	254	236	1	225	212	202	79.5
900-999	293	272	8	283	271	261	89.1
1000-1099	262	239	8	255	244	240	91.6
1100-1199	316	275	4	306	299	296	93.7
1200-1299	326	288	2	320	318	317	97.2
1300-1399	356	323	2	354	349	347	97.5
1400-1499	360	319	2	356	353	353	98.1
1500-1999	1,113	1,008	15	1,090	1,078	1,070	96.1
2000-2499	777	714	19	757	744	743	95.6
2500-2999	646	588	34	615	597	592	91.6
3000-3499	628	581	22	601	586	579	92.2
3500-3999	391	357	16	365	357	355	90.8
4000 +	175	163	2	171	168	166	94.9
All babies	**6,408**	**5,839**	**142**	**6,102**	**5,927**	**5,842**	**91.2**

Notes

1. Per cent survival to discharge is calculated from 'number alive at discharge' divided by 'all babies admitted' (the number of babies admitted to the level III NICUs). Hence, the survival calculations include those babies with congenital malformations that are considered to have directly contributed to their death. Where babies have been transferred to a peripheral hospital and the date of discharge to home is not available, these babies have been assumed to have survived to go home.
2. Data are divided into 100 grams group from 500 grams to 1500 grams, then 500 grams groups.

Table 25: Place transferred to and level of hospital if transferred, by gestational age group, all babies, 1998

Hospital level	20-23	24-27	28-31	32-33	34-36	37-44	All babies
			Number				
Not transferred	69	539	906	400	514	904	3,332
Level 1 or 2 hospital	7	273	1,059	422	412	368	2,541
Hospital with NICU (level III)	—	43	47	20	31	71	212
NICU in children's hospital	4	66	63	20	35	114	302
Data not available	—	1	7	1	4	8	21
All babies	**80**	**921**	**2,075**	**862**	**992**	**1457**	**6,408**
			Per cent				
Not transferred	86.3	58.5	43.7	46.4	51.8	62.0	52.2
Level 1 or 2 hospital	8.7	29.6	51.0	49.0	41.5	25.3	39.8
Hospital with NICU (level 3)	—	4.7	2.3	2.3	3.1	4.9	3.3
NICU in children's hospital	5.0	7.2	3.0	2.3	3.5	7.8	4.7
All babies	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Notes

1. Where an infant was transferred many times, the level of hospital was recorded for the stay of most significance, or as the level 1 or 2 transfer if this was not apparent. This was to allow computation of stay in level 3 NICUs compared to step-down or level 1 or 2 stay.
2. 'Not transferred' refers to babies who went home from or died in their hospital of registration.
3. 'Not available' data are excluded from per cent calculations.

Table 26: Place transferred to and level of hospital if transferred, by birthweight group, all babies, 1998

Hospital level	250-499	500-749	750-999	1000-1249	1250-1499	1500-1999	2000-2499	2500-2999	3000-3499	3500-3999	4000+	All babies
						Number						
Not transferred	32	246	349	338	384	495	392	370	382	234	110	3,332
Level 1 or 2 hospital	1	77	232	341	463	569	329	207	183	97	42	2,541
Hospital with NICU (level III)	—	12	29	26	14	23	30	32	21	17	8	212
NICU in children's hospital	—	35	42	31	18	25	25	34	38	40	14	302
Data not available	—	1	2	2	3	1	1	3	4	3	1	21
All babies	**33**	**371**	**654**	**738**	**882**	**1,113**	**777**	**646**	**628**	**391**	**175**	**6,408**
						Per cent						
Not transferred	97.0	66.5	53.5	45.9	43.7	44.5	50.5	57.5	61.2	60.3	63.2	52.2
Level 1 or 2 hospital	3.0	20.8	35.6	46.4	52.7	51.2	42.4	32.2	29.3	25.0	24.1	39.8
Hospital with NICU (level 3)	—	3.2	4.5	3.5	1.6	2.1	3.9	5.0	3.4	4.4	4.6	3.3
NICU in children's hospital	—	9.5	6.4	4.2	2.0	2.2	3.2	5.3	6.1	10.3	8.1	4.7
All babies	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Notes

1. Where an infant was transferred many times, the level of hospital was recorded for the stay of most significance, or as the level 1 or 2 transfer if this was not apparent. This was to allow computation of stay in level 3 NICUs compared to step-down or level 1 or 2 stay.
2. 'Not transferred' refers to babies who went home from or died in their hospital of registration.
3. 'Not available' data are excluded from per cent calculations.

Table 27: Total days until discharge home from hospital by gestational age group, 1998

Days to discharge	20-23	24-27	28-31	32-33	34-36	37-44
Median (days)	124	92	52	32	18	12
Interquartile range	109–162	78–111	44–66	25–40	13–26	8–21
All survivors with discharge data	**19**	**656**	**1,770**	**756**	**867**	**1,205**

Notes

1. Discharge data is available for 5,273 (90.4%) of surviving babies
2. Data are for all babies, regardless of level of hospital at discharge

Table 28: Total days until discharge home from hospital by birthweight group, 1998

Days to discharge	250-499	500-749	750-999	1000-1249	1250-1499	1500-1999	2000-2499	2500-2999	3000-3499	3500-3999	4000+
Median (days)	146	109	85	63	48	36	22	16	11.5	12	12
Interquartile range	123–171	93–126	70–101	51.5–74	39–60	29–44	17–29	11–23	8–18.3	7–19	7–18
All survivors with discharge data	**13**	**201**	**496**	**611**	**766**	**965**	**680**	**534**	**532**	**321**	**154**

Notes

1. Discharge data is available for 5,273 (90.4%) of surviving babies
2. Data are for all babies, regardless of level of hospital at discharge

Appendix 1
Definitions of data items in 1998

1.1 Definition format

Definitions at the time of the 1998 data collection are presented. They have been prepared in a format similar to that used by the Australian National Data Dictionary. For brevity we have only presented the sections relating to the definition, classification or coding methods used, guide for use and additional comments. The full definitions are available from ANZNN.

1.2 Minimum dataset variables:

Registration hospital:
The first hospital with an Neonatal Intensive Care Unit (NICU) that the baby remains in for longer than four hours.
Classification / coding:
Numeric code representing the registration hospital.
Guide for use:
If baby is transferred, she/he is considered to be in the next hospital from the time the transport team arrives to collect her/him. If the baby dies within four hours, she/he is registered to unit where she/he dies.

Maternal age:
Age in completed years of the woman giving birth on the date of her baby's birth.
Classification / coding:
2-digit number representing the number of completed years.

Previous preterm birth:
This mother has had a previous birth that was at less than 37 completed weeks gestation and more than 20 completed weeks, regardless of outcome.
Classification / coding:
0 = no previous preterm birth
1 = yes, there was a previous preterm birth
* = unknown

Previous perinatal death:
This mother has had a previous perinatal loss.
Classification / coding:
0 = no previous perinatal death
1 = yes, has had a previous perinatal death
* = unknown
Guide for use:
A perinatal loss is when an baby with a birthweight of more than 400 grams or a gestational age of > 20 completed weeks died during the first 28 days of life.

Assisted conception in this pregnancy:
The type of infertility treatment used during the conception or used to conceive this pregnancy.
Classification / coding:
0 = *Unknown* - information not available.
1 = *None* - no infertility treatment used for this pregnancy.
2 = *Hyperovulation* - any hormone therapy used to stimulate ovulation.
3 = *IVF / GIFT etc.* - any method of in-vitro fertilisation. Includes in-vitro fertilisation, gamete intra-fallopian transfer, zygote IFT, etc.
4 = *Other* - other infertility treatment not mentioned above, including artificial insemination.
Guide for use:
Disregard any treatment for a previous pregnancy.

Ethnicity of mother:
Ethnic origin of the mother of baby, as identified by the mother.
Classification / coding:
0 = *Unknown* - information not available.
1 = *Aboriginal or Torres Strait Islander* - is a person of Aboriginal or Torres Strait Islander descent who identifies as an Aboriginal or Torres Strait Islander and is accepted as such by the community with which she is associated. i.e. Aboriginality is determined by patient self-identification
2 = Asian - includes all whose ethnic background originates from the countries of Asia, South East Asia & Indian subcontinent. Includes say Fijian Indian
3 = *Caucasian* - includes all of Caucasoid heritage, including European, Russian, Middle Eastern and Arabic.
4 = *Other* - includes African Negroes, American Blacks and Indians, Inuit and Melanesian. There is a separate category for Polynesian.
5 = *Other Polynesian* - all of Polynesian background
6 = *Maori* - a person of Maori descent who identifies as a Maori

Source of referral:
Source of referral to the NICU where baby is registered
Classification / coding:
0 = *unknown* - information not available.
1 = *Booked at tertiary obstetric hospital* - Mother booked into a hospital with a NICU and was not transferred during the most recent admission.
2 = *In-utero transfer from obstetric hospital* - Mother transferred during most recent admission, baby in-utero.
3 = *Ex-utero retrieval* - Baby retrieved from any other hospital by a specialist neonatal transport retrieval team using appropriate equipment.
4 = *Ex-utero transfer* - Baby transferred from any other hospital, by a non specialist transfer method. This includes transport by ambulance.
5 = *Other* - includes born in transit, not booked.
6 = *Booked at this level II unit* - Mother booked into a hospital this hospital.
7 = *In-utero transfer to this level II unit* - Mother transferred during most recent admission, baby in utero.
Guide for use:
Use most recent referral if more than one.

Presenting antenatal problem:
The antenatal complication that the mother presented with, in this pregnancy, that started the train of events that lead to the baby's birth.
Classification / coding:
0 = *Unknown* - presenting problem unknown.
1 = *Preterm pre-labour rupture of membranes*- confirmed spontaneous rupture of membranes (ROM) occurring prior to the onset of labour, and before 37 completed weeks' gestation. ROM is defined as the obvious gush or clear amniotic fluid from the vagina, or (if fluid is available) by differentiation with urine and vaginal secretions[11]
2 = *Preterm labour* - see 'Preterm Labour'.
3 = *Hypertension in Pregnancy* - see 'Hypertension in pregnancy'.
4 = *Antepartum Haemorrhage* - see 'Antepartum haemorrhage'.
5 = *Suspected intrauterine growth restriction* - see 'suspected intrauterine growth restriction'.
6 = *Fetal distress* - see 'Fetal distress'.
7 = *Other* - see 'Other antenatal complication'.
8 = *None* - No presenting antenatal problem, must be born at term.
9 = *Antenatal diagnosis of fetal malformation* - see 'antenatal diagnosis of fetal malformation'
Guide for use:
Only one complication to be chosen. If the baby is preterm there must be a presenting problem.

Other antenatal complications:
The presence of any other antenatal complications, in addition to that listed in presenting antenatal problem
Classification / coding:
0 = no other antenatal complications present
1 = yes other antenatal complications were present
* = unknown

Prolonged rupture of membranes:
Confirmed spontaneous rupture of the membranes (ROM) for more than 24 hours before birth of the baby. ROM is diagnosed by the obvious gush of clear amniotic fluid from the vagina, or (if fluid is available) by differentiation with urine and vaginal secretions[11]
Classification / coding:
0 = no, membranes not ruptured or ruptured < 24 hrs
1 = yes, membranes ruptured for more than 24 hours
* = unknown

Preterm labour:
The presence of regular painful contractions, leading to progressive effacement and dilatation of the cervix eventually leading to the birth of the baby[5]; and commencing before 37 completed weeks' gestation.
Classification / coding:
0 = no, labour did not begin in the preterm period
1 = yes, labour commenced in the preterm period
* = unknown

Hypertension in pregnancy:
Hypertension in pregnancy is defined as a systolic blood pressure (BP) ≥ 140 mmHg and/or a diastolic BP ≥ 90 mmHg, or rise in systolic BP of 25 mmHg and/or rise in diastolic BP of ≥ 15 mmHg from a BP reading before conception or in the first trimester (confirmed by 2 readings six hours apart) [1].
Classification / coding:
0 = no hypertension in pregnancy detected
1 = yes, hypertension in pregnancy diagnosed
* = unknown

Antepartum haemorrhage:
Significant haemorrhage in the time from 20 weeks gestation to the end of second stage of labour. This excludes a 'show'.
Classification / coding:
0 = no antepartum haemorrhage noted
1 = yes, antepartum haemorrhage
* = unknown

Suspected intrauterine growth restriction:
Suspected growth restriction of this fetus, a condition of the fetus in which it fails to reach its genetically predetermined full growth potential due to intrinsic or extrinsic factors[14] based on more than one obstetric ultrasound.
Classification / coding:
0 = no intrauterine growth restriction present
1 = yes, suspected intrauterine growth restriction
* = unknown

Fetal distress:
Any 'distress' of this fetus leading to intervention by the obstetric team.
Classification / coding:
0 = no intervention necessary
1 = yes, obstetric intervention required
* = unknown

Antenatal diagnosis of fetal malformation:
Fetal malformation diagnosed prior to birth by any method
Classification/coding:
0 = no fetal malformation was detected prior to birth
1 = yes, fetal malformation detected prior to birth
* = unknown

Other antenatal complication:
Other significant antenatal complication, not specified
Classification / coding:
0 = no other significant antenatal complication
1 = yes, other significant antenatal complication
* = unknown

Antenatal corticosteroids for fetal lung enhancement:
Corticosteroids given antenatally via any route to the mother at a time likely to enhance fetal lung maturation. Excludes steroids given for other reasons.
Classification / coding:
0 = *Unknown* - information not available.
1 = *None* - corticosteroids not ever given during this pregnancy at a time likely to enhance fetal lung maturation.
2 = *less than 24 hours* - first dose given at < 24 hours prior to this baby's birth.
3 = *Complete* - more than one dose of corticosteroids given, and first dose was given more than 24 hours and less than 8 days before baby's birth.
4 = *more than 7 days* - steroids given > 7 days before the baby's birth.
Guide for use:
If two courses given, and one is fulfils the 'complete' criteria, use 'complete'. If the information of the time of doses given is not available, but two doses are known to have been given appropriately, also use 'complete'.

Plurality:
The total number of births resulting from this pregnancy
Classification / coding:
0 = *Singleton* - only one baby born.
1 = *Twins* - two babies
2 = *Triplets* - three babies
3 = *Quads* - four babies
4 = *More*! - Quintuplets, sextuplets etc.,
Guide for use:
Plurality of a pregnancy is determined by the number of live births or by the number of fetuses that remain inutero at 20 weeks' gestation and that are subsequently born separately. In multiple pregnancies or, if gestational age is unknown, only live births of any birthweight or gestational age, or fetuses weighing 400 gram or more are taken into account in determining plurality. Fetuses aborted before 20 completed weeks or fetuses compressed in the placenta at 20 or more weeks are excluded.

Birth order:
The order of each baby of a multiple birth.
Classification / coding:
A single digit numeric field representing birth order.
0 = singleton.
1 = First of a multiple birth
2 = Second of a multiple birth.
3 = Third of a multiple birth, etc.

Date of birth:
Date of birth of the patient.
Classification / coding:
DD / MM / YYYY

Admission date:
The date on which an inpatient or same-day patient commences an episode of care.
Classification / coding:
DD / MM / YYYY

Sex:
The sex of the patient.
Classification / coding:
0 = *Unknown* - information not available.
1 = *Male* -
2 = *Female* -
3 = *Ambiguous* - or indeterminate.

Birthweight:
The first weight of the baby (stillborn or liveborn) obtained after birth (record in grams)
Classification / coding:
4 digit numbered field representing birthweight in grams
Guide for use:
The weight is usually measured to the nearest five grams and obtained within one hour of birth, or shortly after the baby has been admitted.

Gestational age:
The estimated gestational age of the baby in completed weeks as determined by clinical assessment immediately after birth.
Classification / coding:
2 digit numbered field representing the number of completed weeks.
Guide for use:
Derived from clinical assessment. Accurate information on the date of the last menstrual period (LMP) may not be available for every pregnancy. In these circumstances, clinical estimates of gestational age can be obtained during pregnancy or by examination of the baby immediately after birth.

Hospital of birth:
The name of the hospital in which the baby was born
Classification/coding:
numeric code as for registration hospital.
Guide for use:
Must be coded as when place of birth is "non-tertiary hospital" or "tertiary hospital"

Place of birth:
Place of baby's birth
Classification / coding:
0 = *unknown* - information not available
1 = *Non tertiary hospital* - born in a hospital without a neonatal intensive care nursery .
2 = *Tertiary hospital* - Born in a hospital with a Level 3 neonatal intensive care nursery.
3 = *Home birth* - birth planned for and occurred at home.
4 = *Born before arrival* - baby was born at home (unplanned), or in an ambulance, a car etc.

Presentation at birth:
Presenting part of the fetus (ie at lower segment of the uterus) at birth.
Classification / coding:
0 = *Unknown* - information not available, not stated
1 = *Cephalic* - including face and brow
2 = *Breech* - legs or feet were facing the cervix
3 = *Other* - includes transverse.

Mode of birth:
Mode of birth
Classification / coding:
0 = *Unknown* - information not available.
1 = *Vaginal* - Vaginal birth, includes vaginal breech
2 = *Instrument* - vaginal birth using instrument. Includes forceps, rotations, and vacuum extractions.
3 = *Caesarean section in labour* - caesarean performed after the commencement of labour (regular painful contractions, leading to progressive effacement and dilatation of cervix, eventually leading to the birth of the baby). Also known as emergency caesarean section.
4 = *Caesarean section, no labour* - caesarean section performed prior to labour commencing. Also known as elective caesarean section.

Apgar (1 minute):
Numerical score to evaluate the baby's condition at 1 minute after birth.
Classification / coding:
2 digit numeric field representing the Apgar scores.
Guide for use:
The score is based on the five characteristics of heart rate, respiratory condition, muscle tone, reflexes and colour.

Apgar (5 minute):
Numerical score to evaluate the baby's condition at 5 minutes after birth.
Classification / coding:
2 digit numeric field representing the Apgar scores
Guide for use:
as for Apgar (1 minute)

Intubated at resuscitation:
An active measure taken shortly after birth to establish independent respiration and heart rate, or to treat depressed respiratory effort by endotracheal intubation.
Classification / coding:
0 = no, intubation not necessary in labour ward
1 = yes, intubation necessary in labour ward
* = unknown
Guide for use:
This does not include intubation for tracheal aspiration or intubation in the NICU after resuscitation has been completed.

Major congenital malformations:
A structural abnormality (including deformation) was present at birth that was diagnosed prior to discharge to home.
Classification / coding:
0 = no major congenital malformations noted
1 = yes, major congenital malformations noted
* = unknown
Guide for use:
An exclusion list of minor abnormalities is supplied in Appendix A.

Specified congenital malformations:
Specified structural abnormalities (incl. deformation) that were present at birth that were diagnosed prior to discharge to home.
Classification / coding:
ICD-9-CM
Guide for use:
An exclusion list of minor abnormalities is supplied in Appendix A.

Temperature on admission:
Temperature on admission to Neonatal Intensive Care Unit or soonest to admission to registration unit. Use rectal temperature or, if not available per axillae.
Classification / coding:
3-digit numbered field representing temperature measured in degrees Celsius correct to 1 decimal place.
Guide for use:
If the baby is transported from a peripheral area by a specialist neonatal retrieval team, admission (for the purpose of this study) is considered to commence when the retrieval team arrive at the baby's bedside. If the baby is more than twelve hours old at admission to the registration unit or when specialist neonatal team arrives (whichever is earlier) write 'M' to denote 'missing'. If an admission temperature is not recorded, write 'M'. If electronic data entry does not allow 'M', then a data set marked as 'complete' with this field marked as missing, will indicate that the data is not available.

Highest appropriate inspired oxygen (FiO_2):
Highest appropriate FiO_2 recorded as percentage, between admission to NICU and 12 hours after birth. Appropriate range is when arterial PaO_2 or $TcPO_2$ is 50-80 mmHg; or if FiO_2 is more than 25%, SaO_2 is 88-95%; or if FiO_2 is less than 25%, SaO_2 is more than 88%.
Classification / coding:
3 digit numbered field representing FiO_2 recorded as a percentage.
Guide for use:
As for "temperature on admission".

Lowest appropriate inspired oxygen (FiO_2):
Lowest appropriate FiO_2 recorded as percentage, between admission to NICU and 12 hours after birth. Appropriate range as for 'Highest appropriate FiO_2'.
Classification / coding:
3 digit numbered field representing FiO_2 recorded as a percentage.
Guide for use:
As for "temperature on admission".

Worst base excess:
Worst base deficit (mmol/l) recorded between admission to NICU and 12 hours after birth.
Classification / coding:
3 digits correct to one decimal place. May have negative values.
Guide for use:
As for "temperature on admission".

Main respiratory diagnosis:
Main indication for respiratory support of baby
Classification /coding:
0 = *Unknown* - information not available
1 = *Normal* - normal lungs. No respiratory disease and no respiratory support.
2 = *Non specific* - any non-specific respiratory distress in term and preterm babies requiring support (combines "TTN" and "immature lung").
3 = *Hyaline membrane disease* - increasing respiratory distress or O_2 requirements, or need for ventilator support from the first 6 hours of life with a CXR showing generalised reticulogranular pattern ± air bronchogram.
4 = *Meconium aspiration* - Respiratory distress presenting from immediately after birth to 12 hours of age. Hypoxia, tachypnoea, gasping respirations, and often signs of underlying asphyxia. CXR: over-expansion of lungs with widespread coarse, fluffy infiltrates[6].
5 = *Pneumonia* - respiratory distress with proven or suspected infection (toxic blood count), and CXR showing persisting opacities.
6 = *Persistent pulmonary hypertension* - echocardiac (shunting or clinical evidence (O_2 requirement unexplained by CXR or loud P_2, or differential pre and post ductal $TCPO_2$).
7 = deleted.
8 = *Apnoea* - recurrent pauses in breathing of more than 20 seconds, or for less than 20 seconds and associated with bradycardia or desaturation requiring intervention.
9 = *Congenital abnormality* - Congenital abnormality was the primary reason for respiratory distress, e.g. diaphragmatic hernia (abnormality needs to be listed under congenital malformation field).
10 = *Other* - unspecified other respiratory disease.
11 = *Peri surgical* - indication for resp. support is surgical intervention. Must have neonatal surgery.
12 = *Newborn encephalopathy* - a syndrome of disturbed neurological function in an baby with difficulties in initiating or maintaining respiration, depression of tone reflexes or consciousness and often with seizures[12a]
Guide for use:
For a diagnosis other than 'normal' the baby must have received some form of respiratory support (supplemental oxygen therapy and/or assisted ventilation for more than four consecutive hours, or died prior to four hours).
If more than one diagnosis is possible, use the condition that was most serious, eg severe HMD requiring surfactant replacement and mechanical ventilation plus later apnoea requiring CPAP would be coded as 'HMD'. However, diaphragmatic hernia with mild HMD would be coded as 'congenital abnormality'.

Exogenous surfactant:
The dose of any type of exogenous surfactant used to treat this baby.
Classification / coding:
0 = *Unknown* - information not available
1 = *None* - no exogenous surfactant ever given
2 = *Exosurf* - any treatment using "Exosurf"
3 = *Survanta* - any treatment using "Survanta"
4 = *Other* - other artificial surfactant given
Guide for use:
Includes incomplete administration.

Air leak requiring drainage:
The presence of any form of air leak requiring drainage (either transient or continuous drainage). Pulmonary airleaks may include pneumothorax, pulmonary interstitial emphysema, pneumomediastinum, pneumopericardium, pneumoperitoneum, and subcutaneous or surgical emphysema[12].
Classification / coding:
0 = no air leak requiring drainage present.
1 = yes, air leak requiring drainage
* = unknown

Days of intermittent positive pressure ventilation (IPPR):
Total number of days of IPPR via an endotracheal tube, at any rate. Four consecutive hours in any one 24 hour period constitutes a day.
Classification / coding:
3 digit numbered field representing IPPR days
Guide for use:
The highest level of assisted ventilation therapy for any 24 hour period is used. For example, if the baby has 8 hours of CPAP, then 5 hours of IPPR, then 11 hours of head box oxygen in any one 24 hour period, this is recorded as one 'IPPR' day.

Days of continuous positive airways pressure (CPAP):
Total number of days of CPAP via any route. Four consecutive hours in any one 24 hour period constitutes a day.
Classification / coding:
3 digit numbered field representing CPAP days
Guide for use:
as for Days of IPPR.

High frequency ventilation:
Assisted mechanical ventilation presented at high frequency (ie where small tidal volumes are presented at frequencies more than or equal to 4Hz) initiated as respiratory support for this baby[7].
Classification/coding:
0 = no high frequency ventilation ever initiated
1 = yes, high frequency ventilation ever initiated
* = unknown

Nitric oxide (NO):
NO used in any form or dose for respiratory support of the baby.
Classification / coding:
0 = no, nitric oxide therapy never used
1 = yes, nitric oxide therapy used
* = unknown

Extra corporeal membrane oxygenation (ECMO):
An extra corporeal circuit established to divert baby's blood to a membrane lung for oxygenation initiated for the baby[3].
Classification/coding:
0 = no, ECMO never initiated
1 = yes, ECMO initiated
* = unknown

Date of final added oxygen (O_2) therapy:
Date supplemental O_2 finally ceased (appropriately).
Classification / coding:
DD / MM / YYYY
Guide for use:
Four consecutive hours in any one 24 hour period constitutes a day. Any route of O_2 administration is used. If O_2 is ceased, and then the baby requires more supplemental O_2 for the same illness, use final day of all the days that supplemental O_2 was used. However, do not include days of O_2 for subsequent illnesses such as oxygenation after surgery, RSV etc. If the baby never received supplemental O_2 leave blank. If the baby received only say, 5 hours of O_2 on day one, use the date of birth. If the baby received O_2 after discharge from hospital use the discharge date here.

Chronic lung disease:
The baby received any respiratory support (ie supplemental oxygen (O_2) or any form of assisted ventilation) for a chronic pulmonary disorder on the day the baby reached 36 weeks' post menstrual age (PMA).
Classification / coding:
0 = no chronic lung disease.
1 = yes, baby did require respiratory support for a chronic pulmonary disorder at 36 weeks PMA.
* = unknown
Guide for use:
Four consecutive hours in any one 24 hour period constitutes the use of supplemental O_2 or respiratory support on that day. The day the baby reaches 36 weeks is considered to be the infant's gestational age (completed weeks) plus chronological age in days. For example, an baby born at 28 weeks' and four days' gestation on January 1st, is 36 weeks' PMA on 26th February. This item is for infants born at less than 32 weeks' gestation only.

Home oxygen (O_2) therapy:
Supplemental O2 was used by the baby at home after discharge from hospital.
Classification / coding:
0 = no supplemental oxygen used at home
1 = yes, home oxygen therapy
* = unknown
Guide for use:
Must have required supplemental O_2 in hospital; date of final added O_2 therapy must be date of discharge to home.

Proven necrotising enterocolitis (NEC):
Diagnosis of NEC is definite.
Classification / coding:
0 = no NEC proven
1 = yes, NEC proven
* = unknown
Guide for use:
Definite NEC defined as having at least four of the symptoms listed below, plus a profile consistent with definite NEC as listed below, plus the baby warranted treatment which included nil by mouth and antibiotics. NEC symptoms must include at least one systemic sign (apnoea, bradycardia, lethargy or temperature instability) and one intestinal sign (residuals > 25% of previous feed on two consecutive occasions, abdominal distension, vomiting or faecal blood) and may also include dilated bowel. A profile consistent with definite NEC includes at least one of the following: abdominal wall cellulitis and palpable abdominal mass, or pneumatosis intestinalis, or portal vein gas, or a persistent dilated loop on serial X-rays, or a surgical or post mortem diagnosis [2].

Number of episodes of proven infection:
The total number of separate episodes of proven bacteria, fungal or viral systemic infections.
Classification / coding:
2 digit number representing the number of episodes of proven infection.
Guide for use:
Systemic sepsis is defined as a clinical picture consistent with sepsis, and either a positive bacterial or fungal culture of blood and/or cerebrospinal fluid, or a positive urine culture by sterile collection only. Infections with coagulase-negative staphylococci, and other potential contaminants, or group strepto-coccal antigen detected in urine were included only if the baby was considered clinically septic and there was supporting evidence such as raised white cell count or thrombocytopenia. Viral infections are proven by culture and/or haematological results consistent with infection (adapted from [10]).

Neonatal surgery:
Did this baby have major surgery.
Classification / coding:
0 = no
1 = yes
* = unknown

Maximum grade of intraventricular haemorrhage (IVH):
Worst level of IVH seen on either side by either ultrasound or post mortem examination.
Classification / coding:
0 = *None* - ultrasound/post mortem shows no IVH.
1 = *Grade 1* - subependymal germinal matrix haemorrhage.
2 = *Grade 2* - IVH with no ventricular dilatation.
3 = *Grade 3* - IVH with ventricle distended with blood.
4 = *Grade 4* - intraparenchymal haemorrhage[3].
5 = *Not examined* - by ultrasound or post mortem.

Date of late head ultrasound:
Date of the worst cerebral ultrasound scan.
Classification / coding:
DD / MM / YYYY

Ventricular index:
Ventricular index measured (in mm) as the furthest lateral extent of each ventricle from the midline measured at the level of Foramen of Monro as described by Levene[12].
Classification/coding:
2 digit number representing the ventricular index in millimeters.
Guide for use:
To be recorded when ventricular dilatation thought likely (see definition for ventricle size - dilatation). This data will be coded as in item 'ventricle size' using norms for gestation from Levene[12].

Ventricle size:
Ventricular size at the ultrasound closest to six weeks of age as in above date. Ventricular index (mm) is measured as the furthest lateral extent of each ventricle from midline measured at level of Foramen of Monro[12]
Classification / coding:
0 = *Unknown* - information not available, includes not scanned.
1 = *No dilatation* - ventricle size <= to 97th centile.
2 = *Dilatation* - ventricle size > 97th centile, but < 4 mm greater than 97th centile.
3 = *Hydrocephalus* - ventricle size > 4 mm larger than 97th centile, or hydrocephalus present that required a shunt or any form of drainage (permanent or transient).

Cerebral cystic formations :
Changes in brain parenchyma seen at the worst scan.
Classification / coding:
0 = *Unknown* - information not available, includes not scanned.
1 = *No cysts* - none seen on ultrasound
2 = *Porencephalic cyst(s)* - Parenchymal lesions corresponding to grade 4 IVH.
3 = *Periventricular leukomalacia* - refers to ischaemic brain injury affecting the periventricular white matter in the boundary zones supplied by terminal branches of the both the centripetal and centrifugal arteries[8].
4 = *Encephaloclastic porencephaly* - relatively late development on cerebral ultrasound scan of extensive dense & cystic lesions involving the periphery of brain.

Eye examination completed:
The examination of the eyes for ROP was completed beyond the period when eye disease likely.
Classification / coding:
0 = no, eye examination not completed
1 = yes, eyes examined beyond period when disease is likely.
* = unknown

Retinopathy of prematurity (ROP):
Worst stage of ROP in either eye prior to going home.
Classification / coding:
0 = *None seen* - no changes seen
1 = *Stage I* - Demarcation line.
2 = *Stage II* - Ridge.
3 = *Stage III* - Ridge with extra-retinal fibrovascular proliferation.
4 = *Stage IV* - Retinal detachment [9].
5 = *Not examined* - no eye examination performed.

Therapy for retinopathy of prematurity:
Any therapy used to treat retinopathy of prematurity i.e. laser or cryotherapy.
Classification / coding:
0 = no therapy for ROP received
1 = yes, therapy given for ROP
* = unknown

Died:
The death of this baby prior to discharge from hospital.
Classification / coding:
0 = no, survived to discharge to home.
1 = yes, died
* = unknown

Date of death:
Date of death of baby if occurred prior to discharge to home.
Classification / coding:
DD / MM / YYYY

Post Mortem:
A post mortem examination was performed.
Classification / coding:
0 = no post mortem performed
1 = yes, a post mortem was performed
* = unknown

Immediate cause of death :
Immediate cause of death
Classification / coding:
unspecified free field
Guide for use:
To be described in morbid anatomical terms

Death due to congenital malformation:
The death of the baby may be directly attributed to the congenital malformation.
Classification/coding:
0 = no
1 = yes, death attributable to a congenital malform.
* = unknown
Guide for use:
Must be coded as having a congenital malformation and for having died.

Transferred to another hospital:
The baby was transferred to another hospital nursery before going home.
Classification / coding:
0 = no, never transferred
1 = yes, transferred
* = unknown

Specify hospital of transfer:
Specify the name of the hospital to which the baby was transferred.
Classification / coding:
unspecified free field
Guide for use:
If the baby is transferred many times, say to another hospital for surgery and then back, or for specialist assessment, and then is transferred to a peripheral hospital, use the latter.

Date of transfer:
Date on which a newborn baby completes an episode of care after birth in the hospital of registration. Formal separation is the administrative process by which a hospital records the completion of treatment and / or care and accommodation of a patient.
Classification / coding:
DD / MM / YYYY
Guide for use:
If the baby is transferred many times, say to another hospital for surgery and then back, or for specialist assessment, and then is transferred to a peripheral hospital, use the latter. Use the most significant date.

Discharge date:
Date on which a same-day patient or an inpatient completes an episode of care.
Classification / coding:
DD / MM / YYYY
Comment:
All data collection ceases when the baby is discharged to home.

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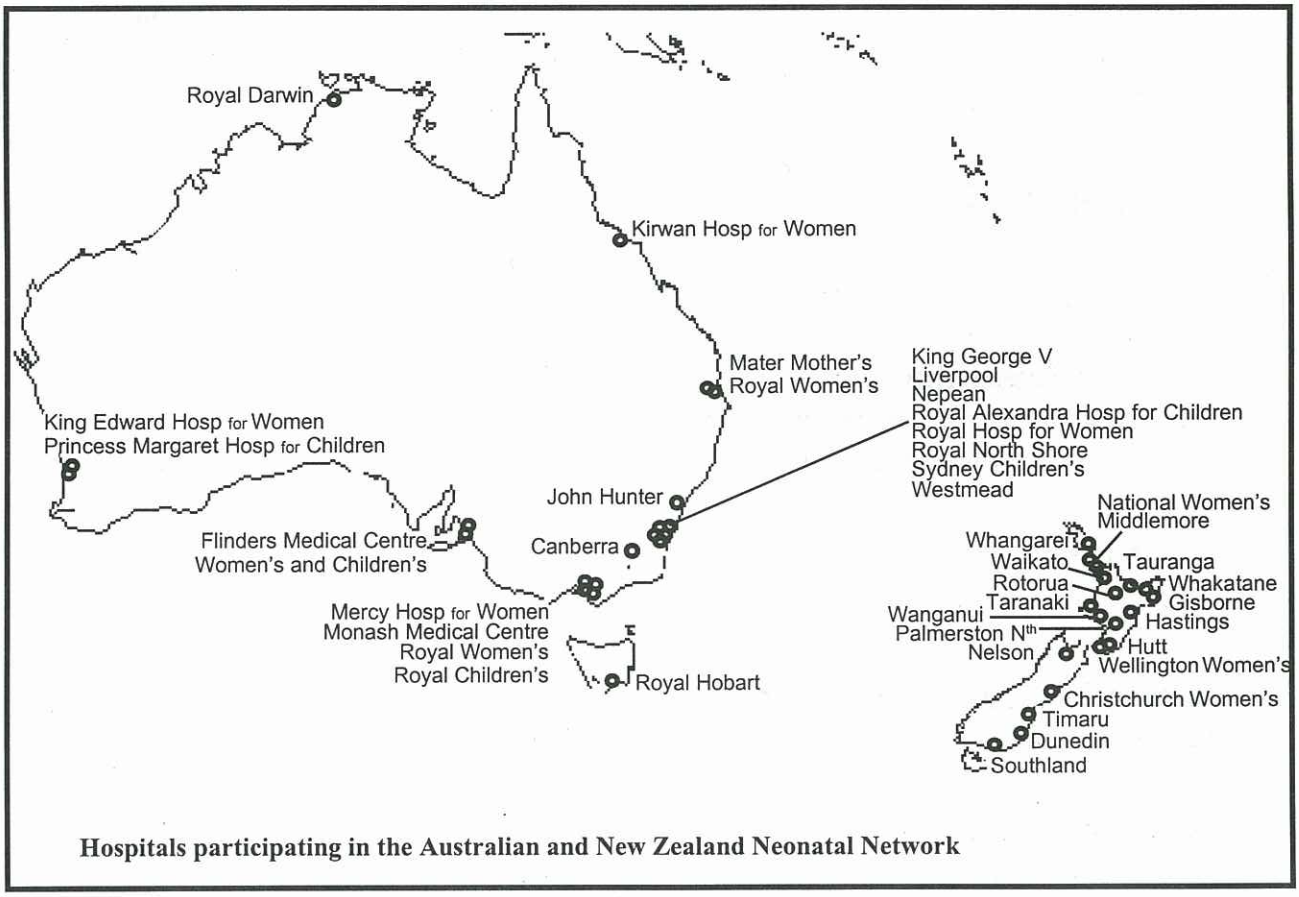
Appendix 2
Hospitals participating in ANZNN

	Number of livebirths	Number of beds for newborn infants
New South Wales		
John Hunter Hospital	3,599	29
King George V Hospital	4,376	32
Liverpool Health Service	3,331	23
Nepean Hospital	3,057	28
Royal Alexandra Hospital for Children	*Children's centre*	24
Royal Hospital for Women	3,657	34
Royal North Shore Hospital	2,094	32
Sydney Children's Hospital	*Children's centre*	20
Westmead Hospital	4,328	39
Victoria		
Mercy Hospital for Women	5,040	54
Monash Medical Centre	4,554	44
Royal Children's Hospital	*Children's centre*	23
Royal Women's Hospital	5,673	58
Queensland		
Kirwan Hospital for Women	1,699	34
Mater Misericordiae Mother's Hospital	7,627	60
Royal Women's Hospital	4,230	66
South Australia		
Flinders Medical Centre	2,399	35
Women's and Children's Hospital	4,095	44
Western Australia		
King Edward Memorial Hospital for Women	5,109	60
Princess Margaret Hospital for Children	*Children's centre*	20
Tasmania		
Royal Hobart Hospital	2,084	16
Australian Capital Territory		
The Canberra Hospital	2,378	24
Northern Territory		
Royal Darwin Hospital	1,440	18

	Number of livebirths	Number of beds for newborn infants
New Zealand		
Christchurch Women's Hospital	3,378	26
Dunedin Hospital	1,749	16
Middlemore Hospital	5,064	20
National Women's Hospital	7,618	59
Waikato Hospital	3,138	26
Wellington Women's Hospital	3,379	31
NZ Level II units		
Gisborne Hospital	731	6
Hastings Hospital	1,999	15
Hutt Hospital	1,841	8
Nelson Hospital	852	10
Palmerston North Hospital	1,788	18
Rotorua Hospital	1,501	10
Southland Hospital	1,142	6
Taranaki Hospital	1,306	8
Tauranga Hospital	1,736	10
Timaru Hospital	595	4
Wanganui Hospital	784	4
Whakatane Hospital	782	3
Whangarei Hospital	1,979	8



Hospitals participating in the Australian and New Zealand Neonatal Network

Appendix 3

Publications by staff of the Neonatal Intensive Care Units in Australia and New Zealand

3.1 Journal Articles

Ahluwalia J, White D & Morley, C. *Infant Flow Driver or single nasal prong continuous positive airway pressure: short term physiological effects.* Acta Paediatr 87: 325-327, 1998.

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Appendix 4
Clinical trials underway in 1998

4.1 Studies where the treatment occurs before birth

ACTOMgSO4 - Australasian collaborative trial of magnesium sulphate for the prevention of mortality and cerebral palsy in infants born very preterm.

ACTORDS - Austalasian collaborative trial of repeated prenatal steroids to women at risk of preterm birth to reduce neonatal morbidity

ORACLE - Medical Research Council's preterm antibiotic uncertainty study.

RNOTT - Randomised nitric oxide as a tocolytic trial.

TermBreech - the Term Breech trial

4.2 Studies where the treatment occurs after birth

BOOST - Benefits of oxygen saturation targeting - a randomised controlled trial assessing the effects of two different oxygen saturation targeting ranges on the long term growth and development of preterm infants.

Caffeine in apnoea: a randomised controlled trial of dose response and population modelling in extremely preterm infants.

Click Study - a randomised controlled trial of rapid diagnosis of respiratory distress syndrome using the click test.

CPAP (continuous positive airways pressure) trial.

High frequency ventilation trial.

Kanmed baby warmer trial : an evaluation of thermal responses, weight gain and maternal perceptions.

Nasal CPAP - optimising delivery.

Pre-discharge oxygen saturation studies to understand morbidity.

Randomised controlled trial of early vs late feeding in preterm infants

Randomised controlled trial of higher or lower vitamin C supplementation in preterm infants.

Randomised controlled trial of normal saline vs heparinised saline for intravenous infusion locks

Role of neonatal post extubation active chest physiotherapy - a randomised controlled trial.

TIPP - Trial of prophylactic indomethacin in preterms.

Appendix 5
Aims, objectives and guidelines

5.1 Aim

The aim of the Australian & New Zealand Neonatal Network (ANZNN) is 'to improve the care of high-risk newborn infants and their families in Australia and New Zealand through collaborative audit and research'. *As revised at the ANZNN Advisory Committee Meeting, Auckland, NZ, 2 April 1995.*

5.2 Objectives

The objectives of the Australian & New Zealand Neonatal Network (ANZNN) are

1. To provide a core data set that will:
   i Identify trends and variations in morbidity or mortality warranting further study.
   ii Enhance the ability to carry out multicentre studies and randomised controlled trials.
   iii Provide information on neonatal outcomes adjusted for case mix and disease severity to participating neonatal units to assist with quality improvement.
2. Monitor the use of new technologies eg surfactant usage by patient type and outcome.
3. Develop and evaluate a clinical risk score for babies in Australian and New Zealand neonatal units (mortality and morbidity).
4. Develop and assess clinical indicators for perinatal care through neonatal outcomes.

As revised at the ANZNN Advisory Committee Meeting, Auckland, NZ, 2 April 1995.

5.3 Confidentiality guidelines

Confidentiality guidelines were devised and agreed to by the Advisory Committee to provide an unambiguous framework for the handing of data that met the strict criteria of governing bodies. These guidelines are set out in full below.

Confidentiality guidelines for the collection, processing, and analysis of data from the national minimum data set of the Australian & New Zealand Neonatal Network.

As revised at the ANZNN Advisory Committee Meeting, Auckland, NZ, 2 April 1995.

The purpose of these guidelines is to set out the principles under which the National Minimum Data set (NMD) for Neonatal Intensive Care Units is formulated and the conditions that apply to the use of these data and release to parties internal and external to the Australian & New Zealand Neonatal Network (ANZNN). As the ANZNN is part of the AIHW National Perinatal Statistics Unit, it is bound by Australian Institute of Health and Welfare Act, and thus confidentiality of any information covering another person must be upheld. The Act also allows for the data provider to place conditions on the use, release and publication of information.

The essential purpose of the NMD is to provide national unit record data on babies meeting specified criteria who have been admitted to Neonatal Intensive Care Units (NICU), or affiliated nurseries, in Australia and New Zealand. In general, this will be achieved through distribution of an annual report containing summary tables without identifying characteristics, either of a personal, institutional or State / Territory / national nature. In certain other instances, data may be provided internally in the following manner:

- as de-identified summary tables not provided in the annual report, but available upon request;
- as de-identified unit record data for analytical purposes as approved by the ANZNN; and
- as identifiable summary and / or unit record data for clinical audit purposes by the respective NICU providing the data.

These guidelines will cover the collection and provision of the data retrospectively from 1 January 1994.

A Principles of ownership and maintenance of the data

1. The ANZNN will be responsible for collection and maintenance of the data set and decision-making with respect to its use, under the auspices of the AIHW National Perinatal Statistics Unit.
2. The Custodians of the data will be the ANZNN Coordinators, David Henderson-Smart at King George V Hospital, Sydney, Paul Lancaster at the AIHW National Perinatal Statistics Unit, University of New South Wales, and Brian Darlow at the Christchurch School of Medicine, Christchurch, New Zealand. All queries related to the NMD should be referred to a Custodian, who will address them personally or refer them to the appropriate source person.

B Conditions for collection of the data

It is expected that all participating NICUs will collect an agreed-upon minimum set of data in a standardised format. Data entry on to hard-copy data forms or into an electronic data form will be performed at the respective NICU. The Clinical Reporting System (CRS) data management system is being used for data processing and all data sent to the coordinating centre will be in the form of CRS data files, as ASCII data, or on appropriate forms.

C Conditions for use and release of the data

1. Use of the data would entail agreement by the Advisory Committee (Directors, or their nominee, of each contributing NICU) and the Coordinators (David Henderson-Smart, Paul Lancaster and Brian Darlow).
2. Data will not be published or supplied with any patient identifying information.
3. Data will not be published or supplied with any NICU or State / Territory / nation identifying information without the written approval of all the NICU Directors of the State / Territory or nation concerned.
4. External requests for a hard copy of patient de-identified data will be made in writing to the data custodians. Any requests for data that could potentially identify a unit or State / Territory / nation will be referred to the Advisory Committee.

   External requests for patient de-identified data on computer disk will be made in writing to the data custodians, and then referred to the Advisory Committee.

   Requests in writing must be in the form of a one page research proposal. A confidentiality agreement must be signed by the person(s) requesting data prior to the release of the data.
5. Publication of data in any form must be endorsed in writing by seventy-five percent (75%) of the Advisory Committee prior to the material being submitted for publication. The mechanism for this will be by prior notification and then endorsement at an Advisory Committee meeting, or by faxing each committee member.

   All published data must acknowledge the ANZNN Advisory Committee and Coordinators.
6. Data will be released annually in a report provided free to each participating Director. This report will summarise the pooled, de-identified data. This report will be distributed widely after the majority of the Advisory Committee agree on content and form.

   Data will also be released to each Director in electronic form with their own unit data identified, and the rest of the data completely de-identified.

D Conditions for security of the data

Patient-identifiable data should not leave the site of the ANZNN. The electronic version of this data will be maintained on a single central computer protected by password. All hard copy patient identifiable data and electronic backup files will be kept in locked cabinets. Master lists of code material will be kept in a separate locked area. All rooms and offices used by ANZNN are locked when not in use. Filing cabinets containing data are locked when not in use. Computerised data are protected by passwords known only to each person who has access to computerised data. Security disposal of data is available through use of designated bags or a shredding machine.