CORA Cork Open Research Archive
Cartlann Taighde Oscailte Chorcaí

| | |
|---|---|
| Title | Perinatal Mortality in Ireland Annual Report 2012 |
| Authors | Manning, Edel;Corcoran, Paul;Meaney, Sarah;Greene, Richard A. |
| Publication date | 2014 |
| Type of publication | Report |
| Link to publisher's version | https://www.ucc.ie/en/npec/, https://www.ucc.ie/en/npec/npec-clinical-audits/perinatalmortality/perinatalmortalityreportsandforms/ |
| Rights | © National Perinatal Epidemiology Centre, 2014 |
| Download date | 2026-11-06 15:28:26 |
| Item downloaded from | https://hdl.handle.net/10468/11508 |



UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

# Perinatal Mortality in Ireland

NATIONAL PERINATAL
EPIDEMIOLOGY CENTRE

ANNUAL REPORT 2012

# Perinatal Mortality in Ireland

NATIONAL PERINATAL EPIDEMIOLOGY CENTRE

ANNUAL REPORT 2012

Design/Artwork by Duggan 083 0071000

**Citation for this report:**
Manning E, Corcoran P, Meaney S, Greene RA, on behalf of the Perinatal Mortality Group. Perinatal Mortality in Ireland Annual Report 2012. Cork: National Perinatal Epidemiology Centre, 2014.

Copyright © National Perinatal Epidemiology Centre, 2014

Funded by the Irish Health Service Executive

Printed by Hackett Reprographics, 5 Copley St., Cork

ISSN 2009-678X (Online) ISSN 2009-6771 (Print)

Contact:
National Perinatal Epidemiology Centre,
Department of Obstetrics and Gynaecology, UCC,
5th Floor, Cork University Maternity Hospital,
Wilton, Cork, Ireland
+353 21 4205017,
npec@ucc.ie
www.ucc.ie/en/npec/

UCC
Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

# Contents

List of figures ..... 4
List of tables ..... 5
Acknowledgements ..... 6
Executive summary ..... 8
Recommendations ..... 11
Methods ..... 13
1. Main findings ..... 16
2. Invited commentary: Fetal growth restriction and the risk of perinatal mortality ..... 37
3. Stillbirths: Specific findings ..... 41
4. Early neonatal deaths: Specific findings ..... 46
5. Perinatal deaths associated with intrapartum events ..... 52
6. Late neonatal deaths: Specific findings ..... 53
Appendix A: Perinatal Mortality Group members ..... 56
Appendix B: Hospital co-ordinators and contributors 2012 ..... 57
Appendix C: Perinatal Death Notification Form 2012 ..... 58
Appendix D: Cause of death guidance and definitions ..... 67

# List of figures


Figure 1: Flow of information in the NPEC data collection process ..... 13
Figure 1.1: Funnel plot of corrected perinatal mortality rate for Irish maternity units, 2012 ..... 18
Figure 1.2: Funnel plot of stillbirth rate for Irish maternity units, 2012 ..... 18
Figure 1.3: Funnel plot of early neonatal mortality rate for Irish maternity units, 2012 ..... 19
Figure 1.4: Distribution of gestational age at delivery in stillbirths and neonatal deaths, 2012 ..... 28
Figure 1.5: Distribution of birthweight in stillbirths and neonatal deaths, 2012 ..... 28
Figure 1.6: Optimal birthweight and normal range compared to actual birthweights of stillbirths, 2012 ..... 29
Figure 1.7: Optimal birthweight and normal range compared to actual birthweights in cases of early neonatal death, 2012 ..... 30
Figure 1.8: Distribution of customised birthweight centiles for stillbirths, 2012 ..... 30
Figure 1.9: Distribution of customised birthweight centiles for early neonatal deaths, 2012 ..... 31
Figure 1.10: Autopsy uptake rate, 2008-2012 ..... 33
Figure 1.11: Autopsy uptake in the 20 Irish maternity units in 2012 ..... 34
Figure 1.12: Flowchart describing autopsy-related steps taken after 454 perinatal deaths in 2012 ..... 34
Figure 2.1: Stillbirth rates for pregnancies overall and for pregnancies with detected and undetected FGR (from Gardosi J) ..... 38
Figure 2.2: Algorithm for management of fetal growth restriction ..... 39
Figure 3.1: Primary cause of death in stillbirths and detailed cause in cases of major congenital anomaly ..... 41
Figure 3.2: Time from confirmation of fetal demise to stillbirth delivery for women with induced and spontaneous labour ..... 42
Figure 4.1: Primary cause of early neonatal death and detailed cause in cases of respiratory disorder and cases of major congenital anomaly ..... 46
Figure 4.2: Place of neonatal death 0-6 complete days after birth ..... 49

# List of tables


Table 1.1: Frequency and rate of perinatal mortality outcomes, 2012 ..... 16
Table 1.2: Comparison of perinatal statistics, 2008-2012 ..... 16
Table 1.3: Perinatal mortality rates across 20 Irish maternity units in 2011 and 2012 ..... 17
Table 1.4: Age distribution of mothers experiencing perinatal loss in 2011 and 2012 ..... 20
Table 1.5: Ethnicity of mothers experiencing perinatal loss in 2011 and 2012 ..... 20
Table 1.6: Occupation at booking of mothers experiencing perinatal loss, 2012 ..... 21
Table 1.7: Weeks gestation at date of first hospital booking in 2011 and 2012 ..... 22
Table 1.8: Body mass index of mothers who experienced perinatal loss in 2011 and 2012 ..... 22
Table 1.9: Distribution of parity, 2011 and 2012 ..... 23
Table 1.10: Gravida/parity of mothers prior to experiencing perinatal loss in 2012 ..... 24
Table 1.11: Previous pregnancy-related problems in 2011 and 2012 ..... 25
Table 1.12: Pre-existing medical problems in mothers who experienced perinatal loss in 2011 and 2012 ..... 25
Table 1.13: Mode of delivery in mothers who experienced perinatal loss in 2012 ..... 26
Table 1.14: Post-delivery outcome for mothers who experienced perinatal loss in 2011 and 2012 ..... 27
Table 1.15: Sex of baby in stillbirths and neonatal deaths, 2012 ..... 27
Table 1.16: Distribution of customised birthweight centiles, 2012 ..... 31
Table 1.17: Distribution of customised birthweight centiles of perinatal deaths due and not due to major congenital anomaly, 2012 ..... 32
Table 1.18: Diagnosis of intra-uterine growth restriction, 2012 ..... 32
Table 1.19: Uptake and offer of autopsy of perinatal deaths due and not due to major congenital anomaly, 2012 ..... 35
Table 1.20: Specific placental conditions for stillbirths and neonates, 2012 ..... 35
Table 1.21: Other examinations performed in investigating perinatal deaths in 2012 ..... 36
Table 3.1: Indication for caesarean section in women experiencing antenatal stillbirth in 2012 ..... 43
Table 3.2: Life status of baby at the onset of care in labour for stillbirths in 2012 ..... 43
Table 3.3: Stillbirth main cause of death in 2011 and 2012, NPEC Classification System ..... 44
Table 4.1: Gestational age distribution in neonatal deaths by broad main cause of death in 2012 ..... 47
Table 4.2: Details of early neonatal deaths due to neurological disorders in 2012 ..... 48
Table 4.3: Management of neonate at birth in babies who died within the first week of life ..... 48
Table 4.4: Age of neonate at death ..... 49
Table 4.5: Location of neonatal death ..... 49
Table 4.6: Early neonatal main cause of death in 2011 and 2012, NPEC Classification System ..... 51
Table 5.1: Details of perinatal deaths in 2012 associated with intrapartum events ..... 52
Table 6.1: Characteristics of late neonatal deaths, 2012 ..... 54
Table 6.2: Late neonatal main cause of death in 2011 and 2012, NPEC Classification System ..... 55

# Acknowledgements

Welcome to the 2012 Perinatal Mortality Report from the National Perinatal Epidemiology Centre (NPEC). The Report adds to the series of outputs from the NPEC multidisciplinary specialist Perinatal Mortality Group addressing the investigation of perinatal mortality in Ireland from a clinical perspective. The members of the Group are listed in Appendix A. In collaboration with the Perinatal Mortality Group, the NPEC has collected and analysed anonymised perinatal mortality data from Irish maternity units since 2008. Results of these clinical audits have been reported in successive annual NPEC reports since the centre's inception.

An important advancement within the NPEC has been the development and implementation nationally in 2011 of a new comprehensive data collection tool and classification system for perinatal deaths. This detailed notification form was based on the validated Centre for Maternal and Child Enquiries (CMACE) Perinatal Death Notification Form[1] and has been endorsed by the Clinical Advisory Group at the Institute of Obstetrics and Gynaecology, the Faculty of Paediatrics and the Health Service Executive (HSE) National Obstetric Programme Working Group. Strengths of the data collection tool include the ability to elucidate maternal and fetal risk factors associated with the perinatal death, management of the mother experiencing perinatal loss and factors influencing investigative procedures into the cause of death. I would like to acknowledge with thanks the intellectual input of the Perinatal Mortality Group in guiding this exciting programme.

It gives me great pleasure to present the second NPEC Perinatal Mortality Report on data collated using this new system on perinatal deaths occurring in Ireland in the year 2012. As with our previous report, expert commentary was invited on a specific topic of perinatal care and services in Ireland. I would like to thank Dr Julia Unterscheider, Maternal Fetal Medicine Fellow at the Royal College of Surgeons in Ireland, for her invited commentary on fetal growth restriction and the risk of perinatal mortality in this report.

Measurement of the outcome of care is central to the development of safe and high quality health care services. Support from all Irish maternity units is instrumental in the success of this important national programme. On behalf of the NPEC, I extend my sincere thanks and appreciation to the many midwives, obstetricians, paediatricians, pathologists and administration staff who have supported and contributed data to this audit. In particular, we at the NPEC gratefully acknowledge the commitment of designated unit co-ordinators (see Appendix B) who co-ordinate the collection of perinatal mortality

1 Centre for Maternal and Child Enquiries (CMACE) (2010) Perinatal Mortality 2008: United Kingdom. London: CMACE

at unit level. This national audit on perinatal mortality would not be possible without their dedicated support and co-operation.

I would also like to acknowledge the NPEC Advisory Group for their intellectual input as the Centre continues to grow and evolve. Advisory Group members represent a diverse range of key stakeholders from maternity units and universities throughout the country, and their support is instrumental to the success of the Centre. With the support of this group, we have developed the NPEC Data Access Policy for researchers wishing to access anonymised data currently maintained in the NPEC.

Lastly, I would like to thank the staff of the NPEC for their hard work and dedication to the mission of the Centre. Assessing the outcomes of maternity care provided, learning from the data and working together, we continue the journey to improving the care of mothers and babies in Ireland. On behalf of all the staff at the NPEC, we look forward to a challenging and fruitful future.



**Richard A Greene,**
**Director,**
**National Perinatal Epidemiology Centre,**
5th Floor, Cork University Maternity Hospital,
Wilton, Cork, Ireland
Email: npec@ucc.ie
Tel: +353 (21) 420 5017
Fax: +353 (21) 420 5025

# Executive summary

This is the second national clinical audit on perinatal mortality in Ireland using the NPEC data collection tool and classification system. Anonymised data were reported by the 20 Irish maternity units on a total of 485 perinatal deaths occurring in 2012 and arising from 71,755 births of at least 24 weeks gestation or at least 500g birthweight. Stillbirths, early neonatal and late neonatal deaths accounted for 304 (62.7%), 141 (29.1%) and 40 (8.2%) of the 485 deaths, respectively.

The perinatal mortality rate was 6.2 per 1,000 births in 2012; corrected for congenital malformation, the rate was 4.1 per 1,000 births; the stillbirth rate was 4.2 per 1,000 births; and, the early neonatal death rate was 2.0 per 1,000 live births. International comparisons are hampered by variation in definitions, availability of screening programmes for congenital anomalies and national legislation on abortion. Nevertheless, the Irish perinatal mortality rates compare favourably with those of countries in the UK and Europe. The year 2012 is the fifth year the NPEC has reported national perinatal mortality rates and while this period is too short to establish trends, it is promising that the observed rates have decreased by approximately 10%.

There was approximately a threefold variation in perinatal mortality rates across the 20 Irish maternity units. This level of variation is in line with statistical expectations, when looking at one year. However, further investigation is required to establish the extent to which it reflects differences in the risk profiles of mothers delivering at the maternity units. Consideration is also given in this year's report to the influence of in utero transfer cases on unit-specific perinatal mortality rates.

Of the 445 perinatal deaths in 2012, there were 26 cases (5.8%) where the care of the mother was transferred in utero, all but one to a tertiary maternity hospital. Twenty-four of the 26 in utero transfer cases were delivered in one of the country's four large maternity hospitals, accounting for 10.5% of the 229 perinatal deaths for these hospitals in 2012. This proportion ranged from 4.4% for one hospital to 14.8% for another. This is the reduction that would be observed in the perinatal mortality rate for these hospitals if perinatal deaths following in utero transfer were excluded.

Major congenital anomaly was the main cause of perinatal death, accounting for 26% of stillbirths, 48% of early neonatal deaths and 38% of late neonatal deaths. These proportions are higher than reported in most European countries where about 15-20% of stillbirths and one-quarter of early neonatal deaths are due to congenital anomalies.[2] A chromosomal disorder was most often implicated in cases of stillbirth (48%) and early neonatal death (25%) when a major congenital anomaly was present. The proportion of stillbirths due to major congenital anomaly has increased in Ireland from 19% in 2008 to 26% in 2012.

Specific placental conditions (24%) were the other major cause of stillbirth; mechanical factors, antepartum or intrapartum haemorrhage and infection were the main cause of 8%, 7% and 5% of stillbirths, respectively. The NPEC Classification System limited the proportion of unexplained stillbirths to 23% compared to approximately 50% previously reported using the Wigglesworth Classification System. This has positive implications for the identification of modifiable factors that may prevent stillbirth.

2 EURO-PERISTAT Project with SCPE and EUROCAT. European Perinatal Health Report. The health and care of pregnant women and babies in Europe in 2010. May 2013. Available

After major congenital anomaly, respiratory disorders were the other main cause of early (31%) and late (23%) neonatal deaths. The vast majority of these deaths were classified as due to severe pulmonary immaturity.

The rate of autopsy following perinatal death in 2012 was 45%. This is slightly higher than in 2011 (41%) but lower than in 2010 (48%). The rate of autopsy in stillbirths has shown a gradual decline since 2008 but is always higher than the rate for early neonatal deaths. In 2012, an autopsy was undertaken following 48% of stillbirths and 39% of early neonatal deaths. When we assessed the perinatal deaths that did not receive an autopsy, an offer of an autopsy was made in 78% of cases.

The importance of placental histology in evaluating causes of stillbirths has been well documented. In this regard, it is a positive finding that a placental histology examination was conducted in almost all stillbirths (96%) and for 80% of early neonatal deaths in 2012. This is higher than in 2011 when placental histology was performed in 93% of stillbirths and 69% of neonatal deaths.

The age profile of mothers who experienced perinatal loss in 2012 was similar to that of all mothers who gave birth in the country that year although there was an overrepresentation of mothers aged at least 40 years, as there was in 2011. In terms of ethnicity and occupation, while the numbers involved were small, ethnic minorities and the unemployed were overrepresented in the mothers who experienced perinatal deaths. Monitoring the socio-economic status of the pregnant population in Ireland is challenging as these data are not routinely captured in Irish maternity records but further efforts must be made if we are to better understand how social disadvantage impacts on perinatal outcomes.

Recording the smoking status of pregnant women also presents challenges. In this report, 17% of the mothers were smokers at the time of their first antenatal booking visit and the data suggested that 10% subsequently stopped smoking. This would put the proportion who smoked throughout their pregnancy in line with that reported for pregnant populations in UK countries (12-19%). Smoking cessation requires priority; given that it is one of the most effective health interventions for improving perinatal outcomes.

Body mass index (BMI) was reported for 78% of the mothers who experienced a stillbirth or early neonatal death in 2012, up from a reporting rate of 67% in 2011. Just over half of these women were either overweight (33%) or obese (20%) which is in line with the findings for women from an earlier general population study though marginally higher than the prevalence of maternal obesity reported by two Irish studies of mothers at first antenatal booking visit.[3,4] Efforts will be made to further improve the completeness of data on BMI with regard to this clinical audit but national data on the BMI status of all pregnant women at first antenatal booking visit and during pregnancy is required in order to establish its association with perinatal mortality and morbidity in Ireland.

Comparing the mothers who experienced a perinatal death to the mothers of all births in 2012 in terms of parity, there was a slight overrepresentation of women who were nulliparous (42% versus 39%) or Para 3+ (13% versus 9%) as was the case in 2011. Of the women with previous pregnancies, 19% had a previous caesarean delivery and 6% had had pre-eclampsia.

One in nine perinatal deaths (11%) arose from multiple birth deliveries which is three times the proportion of multiples among all births in 2012 (4%); this is similar to the findings for 2011.

Twenty-nine mothers (7%) were admitted to the high dependency unit (HDU) following the delivery. Seven mothers (2%) were admitted to the intensive care unit.

3 Fattah C, Farah N, Barry S, O'Connor N, Stuart B, Turner MJ. Maternal weight and body composition in the first trimester of pregnancy. Acta Obstet Gynecol Scand 2010;89:952-5.
4 Lynch CM, Sexton DJ, Hession M, Morrison JJ. Obesity and mode of delivery in primigravid and multigravid women. Am J Perinatol 2008;25:163-7.

The relevance of birthweight in perinatal mortality is highlighted again in this year's report. As well as findings from the clinical audit itself, the invited commentary contributed to this year's report by Dr Julia Unterscheider, Maternal Fetal Medicine Fellow at the Royal College of Surgeons in Ireland, is on the topic of fetal growth restriction and the risk of perinatal mortality.

This year's report includes a section on perinatal deaths associated with intrapartum events in order to raise awareness of the occurrence of unexpected stillbirths and early neonatal deaths of normal birthweight babies with a term or near full term gestational age. There were 24 such deaths in 2011 (n=11) and 2012 (n=13), suggesting a rate of 0.16 per 1,000 births or one in 6,084 births in Ireland. While the 13 deaths in 2012 accounted for just 2.9% of the 445 perinatal deaths reported to this audit for the year, they accounted for one in eight (12.3%) of the 106 cases of perinatal death with normal birthweight and gestation of at least 37 weeks. A high proportion of the deaths was associated with hypoxic ischaemic encephalopathy and had no reported antecedents or associated obstetric factors. This suggests the need for further investigation of unexpected perinatal deaths of intrapartum origin. A retrospective indepth review of a case series may be the most informative approach, in particular with regard to quality of care.

There were 40 late neonatal deaths in 2012 reported to the NPEC, a number that is consistent with the annual number of late neonatal deaths reported by the Central Statistics Office in recent years. Currently in Ireland, there is no formal system by which maternity units are notified of the outcomes for infants referred to paediatric units, which could result in underreporting of late neonatal deaths to the NPEC. We are working with colleagues in the relevant hospitals (maternity and paediatric) to address this issue.

In summary, the findings of this national clinical audit of perinatal mortality highlight the clear and inherent need for on-going audit in order to identify key factors impacting on adverse perinatal outcomes. The methodology for data collection and classification, adapted by the NPEC, with the kind permission of the Centre for Maternal and Child Enquiries in the UK[5] not only facilitated the collection of multiple clinical and demographic factors, but it also identified current clinical practices in the management of women experiencing perinatal loss in Ireland. The use of the NPEC Classification System substantially reduced the proportion of unexplained stillbirths by identifying clinical and pathological factors impacting on such deaths that previously have been labelled as 'unexplained'. This will enhance clinical interpretation of perinatal deaths occurring in Ireland which will further assist in informing clinical practice, public health interventions and counselling of prospective parents. Furthermore, the wide breath of data collected by the NPEC will facilitate future comparisons with other developing classification systems internationally.

5 Centre for Maternal and Child Enquiries (CMACE) Perinatal Mortality 2008: United Kingdom. CMACE: London, 2010

# Recommendations

**Based on the findings of this report, the NPEC makes the following recommendations. Some recommendations from the last report are restated, as improvements remain to be seen particularly in the collation of data on Ireland's pregnant population:**

- Improved antenatal detection and increased surveillance of fetal growth restriction (FGR) with timely delivery is a preventative strategy to reduce perinatal morbidity and mortality. A standardized definition and diagnosis of FGR with an appropriate care model recommended by national clinical guidelines should be referred to. The use of customized centile growth charts should be considered.
- All pregnant women should have an accurate weight, height and BMI measured and documented in the maternity records both at their first antenatal visit and during the last trimester in order to ascertain the impact of maternal weight on perinatal mortality in Ireland.
- Health-care providers should increase their efforts to assess and record the smoking status of all pregnant women in Ireland both at the antenatal booking visit and during the third trimester. The availability of smoking cessation programmes during pregnancy needs to be intensified.
- Consideration should be given to the national collection of a broader range of data points in the maternity records to better understand the impact of socio-economic factors on perinatal heath in Ireland. Additional data points, including the expectant mother's ethnicity, level of education and the economic status of both mother and partner, should be recorded in accordance with the Central Statistics Office coding frames.
- A retrospective indepth review of a case series of unexpected perinatal deaths of intrapartum origin may be warranted to provide additional information with regard to quality of care.
- The maternity hospital of delivery should be notified of any neonatal or infant death occurring in a paediatric centre/unit.
- A multidisciplinary approach, including perinatal pathology, is recommended in the audit of perinatal deaths at unit level.
- Further research exploring factors impacting on declining autopsy rates, particularly in the case of neonatal deaths, is warranted.
- All maternity units should continue to collect and submit anonymised data on perinatal mortality to inform this national clinical audit. This should include all neonatal deaths regardless of gestational age or weight at birth. In the case of stillbirths, all babies from 24 weeks gestation or with a birthweight of ≥500g should be reported.


N
W
E
S
Total Fertility Rate
Births per woman over childbearing years
<2.0
2.0 - 2.1
2.1 - 2.2
>2.2
NATIONAL PERINATAL EPIDEMIOLOGY CENTRE
Data Source - Central Statistics Office 2011
Letterkenny General
Sligo General
Cavan General
Mayo General
Our Lady of Lourdes
Midland Regional Hospital
Rotunda
Coombe Women and Infants University Hospital
National Maternity Hospital
Portiuncula
University Hospital Galway
Mount Carmel
Midland Regional Portlaoise
St Luke's Kilkenny
Mid-Western Regional Limerick
Wexford General
Kerry General
South Tipperary General
Waterford Regional
Cork University Maternity Hospital
HSE Regions
West
South
Mid-Leinster
North-East
Hospitals According to Number of Annual Births
small <2,000
medium 2,000 - 5,999
large >6,000
0 12.5 25 50 75 100
Kilometers

# Methods

## Data recording

In 2012, there were 20 maternity units in Ireland. Anonymised data on the perinatal deaths that occurred between January 1 and December 31 2012 were collected from all 20 units using a standardised notification form (see Appendix C). Figure 1 illustrates the flow of information involved. To ensure accuracy of information, missing or incomplete data were sought from respective maternity units.

## Definitions and terminology

While individual units define perinatal cases similarly, there is some variation. To allow for comparison across all units the NPEC used the following definitions for the current report:

Stillbirth: Baby delivered without signs of life from 24 weeks gestation or with a birthweight ≥500g.[6]

Early neonatal death: Death of a live born baby occurring within 7 completed days of birth.

Late neonatal death: Death of a live born baby occurring after the 7th day and within 28 completed days of birth.

Live birth: Live birth refers to the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of the pregnancy, which, after such separation, breathes or shows any other evidence of life - e.g. beating of the heart, pulsation of the umbilical cord or definite movement of voluntary muscles - whether or not the umbilical cord has been cut or the placenta is attached. Each product of such a birth is considered live born.[7]

Total births: For the purpose of calculating perinatal mortality rates, the denominator used was the number of births (live birth and stillbirths) from 24 weeks gestation or birthweight ≥500g.

Stillbirth rate: Number of stillbirths per 1,000 births (live births and stillbirths from 24 weeks gestation or weighing ≥500g).

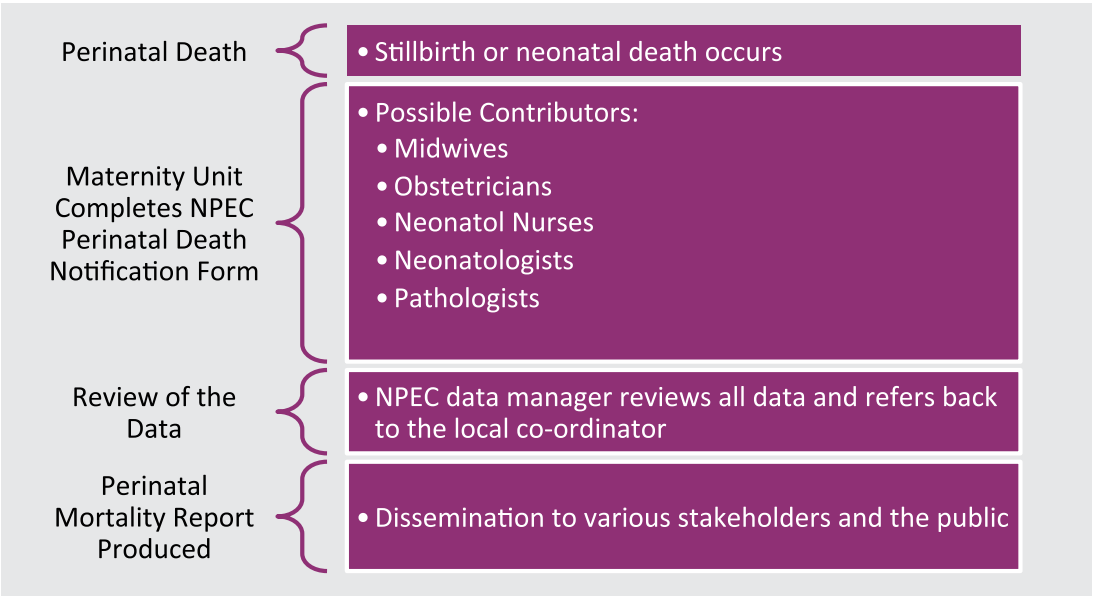



Figure 1: Flow of information in the NPEC data collection process.

6 Stillbirths Registration Act, 1994.
7 World Health Organisation. Available at: http://www.who.int/healthinfo/statistics/indmaternalmortality/en/

Neonatal death rate: Number of neonatal deaths per 1,000 live births (from 24 weeks gestation or weighing ≥500g).

Overall perinatal mortality rate (PMR): Number of stillbirths and neonatal deaths per 1,000 births (live births and stillbirths from 24 weeks gestation or weighing ≥500g).

Adjusted PMR: Perinatal mortality rate excluding perinatal deaths associated with or due to a congenital malformation.

Booking: Some data sought by the NPEC Perinatal Death Notification Form relate to the time of booking. Booking in this regard relates to the mother's first antenatal visit at the maternity unit.

In utero transfer: The NPEC Perinatal Death Notification Form records the intended place of delivery at the time of the mother's first antenatal visit and the place where the baby was ultimately delivered. For cases where the intended place of delivery at booking differed from the actual place of delivery it is presumed that the care of the mother was transferred in utero, i.e. the mother was transferred to the care of another maternity unit where her baby was delivered.

Parity: The number of completed pregnancies, whether live birth or stillbirth, of at least 24 weeks gestation or with a birthweight ≥500g. We refer to parity prior to the pregnancy that resulted in a perinatal loss in 2012.

Gravida: The number of times the mother has been pregnant, irrespective of duration. We refer to gravida prior to the pregnancy that resulted in a perinatal loss in 2012.

## Classification of death

The NPEC data collection form requests contributors to identify maternal, fetal and neonatal conditions, using specific categories, which caused or were associated with the death. The unit contributor is also requested to assign the principal cause of death with reference to the post mortem and placental pathology if performed. Guidance and definitions for completing specific categories are described in Appendix D. Briefly described; categories include both pathophysiological entities and clinical conditions present at time of death including placental pathology and Intra-Uterine Growth Retardation (IUGR). Classification of stillbirths was made using the NPEC maternal and fetal classification system. In the case of neonatal deaths, the NPEC neonatal classification system was used to attribute the main cause of death and the NPEC maternal and fetal classification system was used to identify the main obstetric condition or sentinel event associated with the death. A notable difference in the NPEC neonatal classification system is that neonatal deaths occurring after 22 weeks gestation, previously attributed to prematurity, would most often be captured under the subcategory of 'severe pulmonary immaturity'.

## Rate calculations

To assess perinatal mortality, overall and unit-specific perinatal mortality rates (PMRs) per 1,000 births and corresponding 95% confidence intervals based on the Normal approximation of the Poisson distribution were derived. Stillbirth, neonatal and corrected PMRs, which exclude deaths associated with or due to a congenital malformation, were also calculated. Denominator data on the number of live births and stillbirths were provided directly by individual maternity units. Perinatal deaths are included in a maternity unit's rate if: (i) the baby was delivered in the maternity unit; (ii) the unit was the intended place of delivery but the baby was born before arrival; (iii) the mother had not booked to deliver in a maternity unit but presented to the unit after unattended delivery in the community.

## Funnel plots

Variations in PMRs between maternity units could potentially be due to random chance or reflect differences in baseline characteristics of the childbearing population. For this reason, funnel plots were used to assess performance outcomes for individual units in comparison to the overall average.[8] In brief, the plot is a scatter diagram of individual maternity unit mortality rates against the number of births within that unit. The overall mortality rate is indicated by the solid straight line and the corresponding 95% confidence interval is indicated by the curved dashed line. The confidence interval is wider for smaller units, which are more prone to variable estimates and gradually narrows as the unit size increases, hence, giving the diagram a 'funnel' shape. Maternity units with mortality rates lying outside the 95% confidence interval are statistically significantly different from the overall average. In general, one of 20 units would be expected to lie outside the 95% confidence interval by chance alone.

## Birthweight centile

We have produced charts in this year's report to highlight the issue of failure of fetal growth in utero in relation to the stillbirths and early neonatal deaths that occurred in Ireland in 2012. To do so, we used the Gestation Related Optimal Weight (GROW)[9] software and coefficients derived from the multiple regression analysis of data on 11,072 births in six maternity units in Dublin, Galway, Limerick and Belfast in 2008-2009.[10]

The regression analysis determined the Term (i.e. 40 weeks) Optimal Weight (TOW) in Ireland to be 3,490.7g. The normal range (i.e. the range from the 10th centile weight to the 90th centile weight) around the TOW was then calculated and the recommended proportionality growth function was applied to the TOW, the 10th centile term weight and the 90th centile term weight in order to determine the optimal weight and normal range at all gestations (21-44 weeks for the stillbirths and early neonatal deaths in Ireland in 2012). These steps are described in detail in the GROW documentation.

Customised birthweight centiles were also derived using the GROW software. There was a high level of missing data for maternal height and weight with one or both unknown for 143 (32.1%) mothers. For these cases, we used the median height and weight of the mothers with complete data. As a result, it was possible to calculate customised birthweight centiles for 438 of the 445 mothers (98.4%).

8 Spiegelhalter D. (2002) Funnel plots for institutional comparison. Quality and Safety in Health Care; 11(4):390-91.
9 Gardosi J, Francis A. Customised Weight Centile Calculator. GROW version 6.6, 2013 Gestation Network, www.gestation.net
10 Unterscheider J, Geary MP, Daly S, McAuliffe FM, Kennelly MM, Dornan J, Morrison JJ, Burke G, Francis A, Gardosi J, Malone FD. The customized fetal growth potential: a standard for Ireland. Eur J Obstet Gynecol Reprod Biol 2013; 166(1):14-7

# 1. Main findings

## Perinatal mortality rate

This section of the report provides details of the perinatal mortality rate (PMR), maternal and infant characteristics and autopsy uptake. In line with previous reports, the findings provided in this section relate to stillbirths and early neonatal deaths only. Separate sections are then provided for stillbirths, early neonatal deaths and late neonatal deaths describing clinical management and the main cause of death based on the NPEC Classification System.

In 2012, the 20 Irish maternity units reported 71,755 births weighing ≥500g or ≥24 weeks gestation, of which 485 were subsequently classified as perinatal deaths. Stillbirths, early neonatal and late neonatal deaths accounted for 304 (62.7%), 141 (29.1%) and 40 (8.2%) of the 485 deaths, respectively.

The stillbirth rate was 4.2 per 1,000 births and the early neonatal death rate was 2.0 per 1,000 live births (Table 1.1). The overall PMR was 6.2 deaths per 1,000 births. When corrected for congenital malformation, the PMR was reduced to 4.1 deaths per 1,000 births.

Table 1.1: Frequency and rate of perinatal mortality outcomes, 2012

| | Number | Rate per 1,000 (95% CI) |
|---|---|---|
| Total births (≥500g/≥24 weeks) | 71,755 | |
| Stillbirths | 304 | 4.2 (3.8-4.7) |
| Early neonatal deaths | 141 | 2.0 (1.6-2.3) |
| Perinatal deaths | 445 | 6.2 (5.6-6.8) |
| Corrected perinatal deaths | 297 | 4.1 (3.7-4.6) |

Note: Corrected perinatal deaths exclude deaths associated with or due to a congenital malformation. Abbreviation: 95% CI, 95% confidence interval

## Comparison of perinatal mortality, 2008-2012

Table 1.2 compares perinatal statistics across the five-year period 2008-2012. There are some issues relevant to the comparability of the data. Data were based on 19 maternity units for 2009 and 2010 but were based on all 20 maternity units for other years. Also for 2008-2010, the data for stillbirths were based on birthweights ≥500g whereas for 2011 and 2012 the data for stillbirths were based on birthweights ≥500g or ≥24 weeks gestation. Nevertheless, the reported figures show some evidence of a trend of decreasing perinatal mortality rates though the 2011 and 2012 rates are almost identical.

Table 1.2: Comparison of perinatal statistics, 2008-2012

| | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|
| Total births (N) | 75,421 | 70,250 | 70,182 | 74,265 | 71,755 |
| Total perinatal deaths (N) | 512 | 477 | 463 | 456 | 445 |
| Stillbirth rate | 4.7 | 4.8 | 4.6 | 4.3 | 4.2 |
| Neonatal death rate | 2.1 | 2.0 | 2.0 | 1.9 | 2.0 |
| Uncorrected PMR (95% CI) | 6.8 (6.2-7.4) | 6.8 (6.2-7.4) | 6.6 (6.0-7.2) | 6.1 (5.6-6.7) | 6.2 (5.6-6.8) |
| Corrected PMR (95% CI) | 4.9 (4.4-5.4) | 4.8 (4.3-5.3) | 4.5 (4.0-5.0) | 4.1 (3.6-4.5) | 4.1 (3.7-4.6) |

Note: 2009-2010 data are based on 19 maternity units whereas others years' data are based on 20 maternity units. Rates are per 1,000 births. Abbreviation: PMR, perinatal mortality rate; 95% CI, 95% confidence interval

## Variation by maternity unit

The uncorrected PMR across the 20 Irish maternity units ranged from 3.4 to 8.9 per 1,000 births (Table 1.3); the corrected PMR ranged from 2.4 to 7.0 per 1,000 births. Thus, there was approximately a threefold difference between the lowest and highest PMRs. This level of variation is to be expected when examining rates based on relatively small numbers in a single year.

While there was no change in the corrected PMR between 2011 and 2012 at the national level, there were of course fluctuations at the level of the individual maternity units. There was little correlation between the unit-specific corrected PMR in 2011 and 2012. Indeed, the rate for five units in 2012 was approximately twice or half the rate for the same unit in 2011. Again, such variation in rates is to be expected given the numbers upon which the rates are based.

Table 1.3: Perinatal mortality rates across 20 Irish maternity units in 2011 and 2012

| Unit | Uncorrected PMR (95% CI) | Corrected PMR (95% CI) | |
|---|---|---|---|
| | 2012 | 2012 | 2011 |
| 1 | 8.9 (4.3-13.6) | 5.4 (1.8-8.9) | 2.3 (0.0-4.6) |
| 2 | 8.3 (6.4-10.2) | 5.5 (4.0-7.1) | 4.6 (3.2-6.0) |
| 3 | 8.1 (3.6-12.6) | 4.4 (1.1-7.6) | 4.4 (1.1-7.8) |
| 4 | 7.8 (3.8-11.8) | 6.2 (2.6-9.8) | 5.4 (2.1-8.6) |
| 5 | 7.6 (3.4-11.8) | 7.0 (3.0-11.1) | 5.4 (2.0-8.8) |
| 6 | 6.9 (2.3-11.5) | 3.1 (0.0-6.2) | 2.6 (0.0-5.6) |
| 7 | 6.4 (4.7-8.1) | 4.0 (2.6-5.3) | 3.7 (2.4-5.0) |
| 8 | 6.3 (3.7-8.9) | 4.9 (2.6-7.2) | 4.7 (2.5-6.9) |
| 9 | 6.2 (3.5-8.9) | 3.3 (1.3-5.2) | 3.5 (1.5-5.5) |
| 10 | 5.9 (4.3-7.5) | 3.8 (2.5-5.1) | 4.1 (2.8-5.4) |
| 11 | 5.9 (2.9-8.8) | 5.2 (2.4-7.9) | 3.6 (1.3-5.9) |
| 12 | 5.9 (3.7-8.1) | 4.3 (2.4-6.1) | 4.4 (2.6-6.3) |
| 13 | 5.5 (2.3-8.7) | 3.7 (1.1-6.3) | 2.7 (0.5-4.9) |
| 14 | 5.3 (2.3-8.4) | 3.1 (0.8-5.5) | 5.8 (2.7-8.9) |
| 15 | 5.3 (3.7-6.8) | 3.3 (2.0-4.5) | 3.8 (2.4-5.1) |
| 16 | 4.8 (1.6-8.0) | 2.7 (0.3-5.0) | 6.0 (2.5-9.4) |
| 17 | 4.7 (1.6-7.8) | 3.1 (0.6-5.7) | 1.5 (0.0-3.1) |
| 18 | 3.9 (1.1-6.6) | 2.4 (0.3-4.6) | 5.1 (2.0-8.2) |
| 19 | 3.4 (0.0-6.8) | 2.6 (0.0-5.5) | 2.4 (0.0-5.2) |
| 20 | 3.4 (0.8-6.0) | 2.4 (0.3-4.6) | 3.1 (0.8-5.4) |
| **All** | **6.2 (5.6-6.8)** | **4.1 (3.7-4.6)** | **4.1 (3.6-4.5)** |

Note: Rates per 1,000 births. Corrected PMR excludes deaths associated with or due to a congenital malformation.
Abbreviation: PMR, perinatal mortality rate; 95% CI, 95% confidence interval

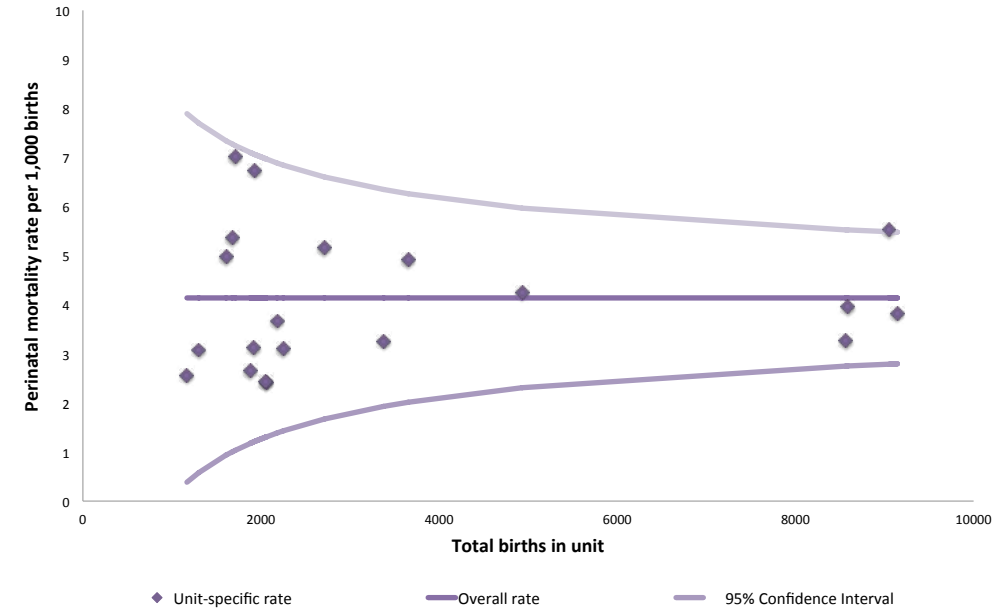



Figure 1.1: Funnel plot of corrected perinatal mortality rate for Irish maternity units, 2012

While differences in corrected PMRs were identified between units, there were no statistically significant outliers. The solid straight line in Figure 1.1 represents the overall corrected PMR (4.1 deaths per 1,000 births) and the curved dashed lines represent the 95% confidence interval around the overall rate adjusted for the number of births at the individual unit. In 2012, all unit-specific corrected PMRs fell within the 95% confidence interval.

In Figure 1.2, the solid straight line represents the overall stillbirth mortality rate of 4.2 per 1,000. For all 20 maternity units the stillbirth rate was within the limits of the 95% confidence interval.

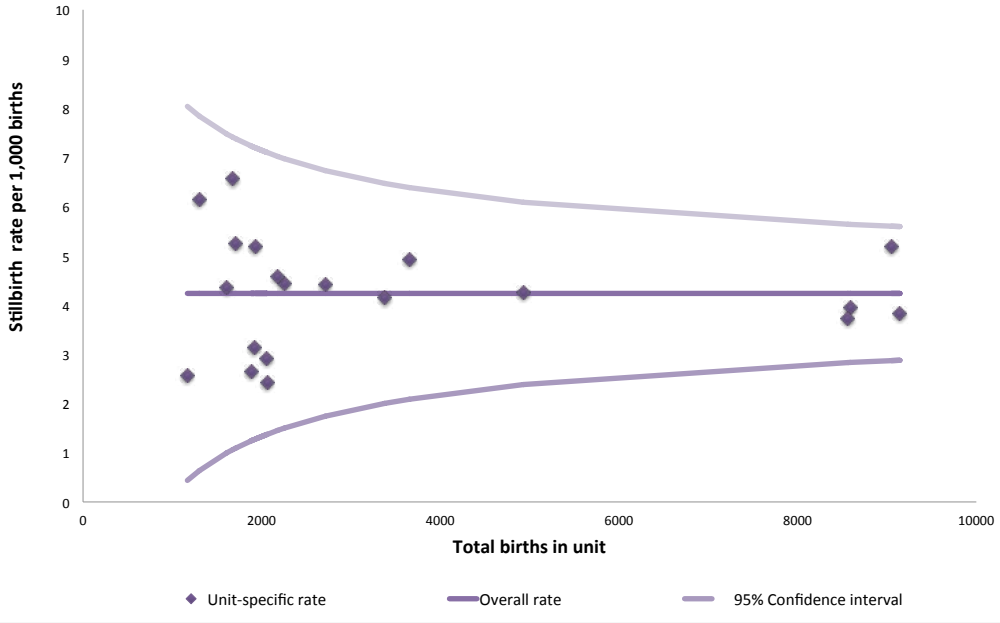



Figure 1.2: Funnel plot of stillbirth rate for Irish maternity units, 2012

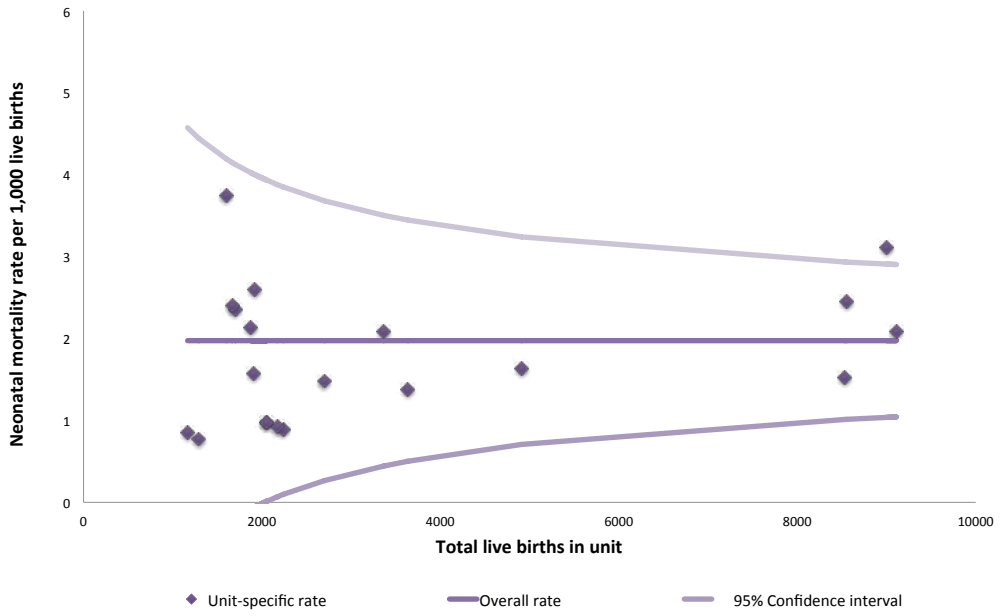



Figure 1.3: Funnel plot of early neonatal mortality rate for Irish maternity units, 2012

The solid straight line in Figure 1.3 represents the overall neonatal mortality rate of 2.0 per 1,000 live births. The neonatal mortality rate from one of the individual units was outside the upper limit of the confidence interval indicating that it was statistically significantly higher than the overall rate. A similar observation was made for 2011 whereby a different unit had a neonatal mortality rate above the upper limit. Statistically it can be expected for one in 20 observations to be outside the 95% confidence range. No unit has been outside the range in successive years. The profile of mothers delivered may differ across Irish maternity units and this may explain variation in perinatal mortality rates. However, to establish this requires more detailed information on all mothers delivered at Irish maternity units than is currently available.

## In utero transfer

In Ireland, women with high risk pregnancies may be transferred to the care of tertiary maternity units with facilities for specialist fetal medicine. Of the 445 perinatal deaths in 2012, there were 26 cases (5.8%) where the care of the pregnant woman was transferred in utero. The 26 in utero transfer cases resulted in nine stillbirths (34.6%) and 17 early neonatal deaths (65.4%). Major congenital anomaly was the cause of two of the stillbirths and nine of the early neonatal deaths. For all but one case the mother was referred before the onset of labour and to a tertiary maternity unit. Twenty-four of the 26 in utero transfer cases were delivered in one of the country's four large maternity hospitals. For these hospitals in 2012, 10.5% of their 229 perinatal deaths arose from in utero transfer cases. This proportion ranged from 4.4% for one hospital to 14.8% for another. This shows the reduction that would be observed in the perinatal mortality rate for these hospitals if perinatal deaths following in utero transfer were excluded.

## Maternal characteristics

### Age

The mothers who experienced perinatal loss in 2012 ranged in age from early teenage years through to the mid-forties. Their age distribution broadly reflected that of the population of mothers who gave birth in Ireland (Table 1.4). Mothers aged at least 40 years made up 5.5% of the population who gave birth in 2012 but 10% of the mothers who experienced perinatal loss. There was a somewhat older age profile among mothers who experienced a stillbirth. Forty percent were over 35 years of age compared to 30% of those who experienced a neonatal death.

Table 1.4: Age distribution of mothers experiencing perinatal loss in 2011 and 2012

| Age group | Perinatal deaths (N=454) 2011 | Perinatal deaths (N=440*) 2012 | All births[11] 2012 | Stillbirths (N=300) 2012 | Neonatal deaths (N=140) 2012 |
|---|---|---|---|---|---|
| <20yrs | 12(2.6) | 14(3.2) | 2.3% | 6(2.0) | 8(5.7) |
| 20-24yrs | 61(13.4) | 44(10.0) | 9.7% | 27(9.0) | 17(12.1) |
| 25-29yrs | 96(21.1) | 78(17.7) | 21.5% | 51(17.0) | 27(19.3) |
| 30-34yrs | 137(30.2) | 141(32.0) | 36.2% | 95(31.7) | 46(32.9) |
| 35-39yrs | 104(22.9) | 118(26.8) | 24.8% | 89(29.7) | 29(20.7) |
| ≥40yrs | 44(9.7) | 45(10.2) | 5.5% | 32(10.7) | 13(9.3) |

Note: Values are shown as n(%) unless otherwise stated. *Maternal age unknown for five mothers.

### Ethnicity

Three-quarters of the mothers who experienced perinatal loss were of white Irish ethnicity. This is essentially the proportion of white Irish women in the female population aged 15-49 years enumerated by the National Census 2011. While the numbers involved were small, Irish Traveller, Asian and Black ethnicities were overrepresented in the mothers who experienced perinatal deaths, together accounting for 10% of these mothers compared to 5% of the female 15-49 year-old population. Ethnicity was not recorded for 5.9% of cases in 2011 but only 0.7% in 2012.

Table 1.5: Ethnicity of mothers experiencing perinatal loss in 2011 and 2012

| Ethnicity | Perinatal deaths 2011 | Perinatal deaths 2012 | 15-49 year-old female population, 2011 |
|---|---|---|---|
| White Irish | 331(72.6) | 343(77.1) | 80.4% |
| Irish Traveller | 6(1.3) | 16(3.6) | 0.7% |
| Other white background | 48(10.5) | 49(11.0) | 12.5% |
| Asian/Asian Irish | 10(2.2) | 16(3.6) | 2.4% |
| Black/Black Irish | 17(3.7) | 12(2.7) | 1.6% |
| Other/mixed | 17(3.7) | 6(1.3) | 1.0% |
| Not recorded | 27(5.9) | 3(0.7) | 1.4% |

Note: Values are shown as n(%) unless otherwise stated. Population data from the National Census 2011

11 Central Statistics Office. (2013) *Vital Statistics Fourth Quarter and Yearly Summary 2012*. Cork: CSO.

## Occupation

Lower socio-economic status has been shown to be associated with poor pregnancy outcomes.[12] In the NPEC national clinical audit, data on the mother's and father's occupation at booking was sought. No data were recorded for 77 (17.3%) of the 445 women who experienced perinatal loss. There were 181 (40.7%) cases with no data relating to the father's occupation. Table 1.6 provides a high-level overview of the data that were provided on mother's occupation alongside data available for the most comparable categories for mothers of all births from the Perinatal Statistics Report 2012[13] and for the 15-44 year-old female population from the National Census 2011.

An occupation was specified for 71% of the 368 mothers for whom data were recorded (Table 1.6), which is the same as the proportion of all mothers in 2012 with a specified occupation. A limitation of this national audit and ESRI data is that occupation does not assess employment status. It can be seen that unemployed was recorded for 8% of the mothers experiencing perinatal loss compared to 5% of all mothers and 11% of the female population aged 15-44 years. The proportion specified as engaged in home duties was similar for all women who gave birth in 2012 and for those who experienced perinatal loss and was higher than among the general population of women aged 15-44 years.

Table 1.6: Occupation at booking of mothers experiencing perinatal loss, 2012

| Occupation | Perinatal deaths n(%) | ESRI (%) | 15-44 year-old female population |
|---|---|---|---|
| Occupation specified | 260(70.7) | 71.8 | 55.0%* |
| Unemployed | 28(7.6) | 4.5 | 10.5% |
| Home duties | 68(18.5) | 19.2 | 12.1% |
| Student | 12(3.2) | n/a | 19.9% |
| Others not in labour force | 0(0.0) | n/a | 2.5% |

Note: Population data from Census 2011 relates to economic status rather than occupation, hence * represents the proportion at work.

The NPEC Perinatal Death Notification Form records the highest level of education completed by the mother but this was not provided for the vast majority of the 445 women (368, 82.7%). Level of education is not usually captured in maternity records but has been found to be associated with pregnancy outcome.[14]

12 Centre for Maternal and Child Enquiries (CMACE) (2010) Perinatal Mortality 2008: United Kingdom. London: CMACE
13 Economic and Social Research Institute (ESRI). (2013) Perinatal Statistics Report 2012. Dublin: ESRI
14 Savitz, D.A.; Kaufman, J.S.; Dole, N.; Siega-Riz, A.M.; Thorp, J.M., Jr; Kaczor, D.T. Poverty, education, race, and pregnancy outcome. Ethn. Dis. 2004, 14, 322–329.

## Gestation at booking

Gestation at the time of the mother's first antenatal visit to the maternity hospital was unrecorded for 15 stillbirths and 25 neonatal deaths. One in four booked into hospital before 12 weeks gestation, almost two-thirds attended for antenatal care between 12 and 19 weeks gestation and approximately 10% attended at 20 weeks gestation or later (Table 1.7). While most women attend a general practitioner in early pregnancy prior to their first visit at a maternity unit it can be seen that the proportion who booked into hospital after 20 weeks gestation halved from 25% in 2011 to 12% in 2012.

Table 1.7: Weeks gestation at date of first hospital booking in 2011 and 2012

| Gestation at booking | Perinatal deaths 2011 | Perinatal deaths 2012 | Stillbirths 2012 | Neonatal deaths 2012 |
|---|---|---|---|---|
| Less than 12 Weeks | 76 (18.9) | 104(25.7) | 75(26.0) | 29(25.0) |
| 12-19 Weeks | 225(55.8) | 253(62.5) | 180(62.3) | 73(62.9) |
| 20 Weeks or Later | 81(20.1) | 43(10.6) | 31(10.7) | 12(10.3) |
| Not Booked | 21(5.2) | 5(1.2) | 3(1.0) | 2(1.7) |

Note: Values are shown as n(%) unless otherwise stated.

## Body mass index

Increased maternal BMI has been associated with an increased risk of congenital anomaly and stillbirth.[15,16] The recording of BMI in maternity records is a key recommendation of the Obesity and Pregnancy Clinical Practice Guideline. While this may be common practice, no national data on the BMI of the pregnant population are available.

Body mass index (BMI) was available for 78.2% (n=348) of women who experienced perinatal loss in 2012 which is an improvement on the 66.9% rate of recording for 2011. The BMI of almost half of those mothers (161, 46.3%) was in the healthy range (18.5-24.9kgm$^{-2}$). One in three (33.3%; n=116) were classified as overweight (25.0-29.9kgm$^{-2}$) and 20% (n=69) were obese (30.0-34.9kgm$^{-2}$). The proportion of mothers who were obese was lower in 2012 than in 2011. The pattern of BMI in the mothers who experienced perinatal loss was similar to that in the women from the general population who participated in the 2007 Survey of Lifestyle, Attitudes and Nutrition (SLÁN).[17] There was some difference in the pattern of BMI between mothers who experienced stillbirth and those who experienced early neonatal death. Higher BMI was associated with those who experienced stillbirth (Overweight: 35.2% vs. 28.6%; Obese: 21.6% vs. 15.3%).

Table 1.8: Body mass index of mothers who experienced perinatal loss in 2011 and 2012

| BMI Category (kgm$^{-2}$) | Perinatal deaths 2011 | Perinatal deaths 2012 | SLÁN 2007 |
|---|---|---|---|
| Underweight (<18.5) | 4(1.3) | 2(0.6) | 2% |
| Healthy (18.5-24.9) | 140(45.9) | 161(46.3) | 44% |
| Overweight (25.0-29.9) | 83(27.2) | 116(33.3) | 31% |
| Obese (>30.0) | 78(25.6) | 69(19.8) | 23% |

Note: Values are shown as n(%) unless otherwise stated; SLÁN, Survey of Lifestyle, Attitudes and Nutrition

15 Rasmussen SA, Chu SY, Kim SY, Schmid CH, Lau J. Maternal obesity and risk of neural tube defects: a metaanalysis. Am J Obstet Gynecol 2008;198:611-9
16 Chu SY, Kim SY, Lau J, Schmid CH, Dietz PM, Callaghan WM, et al. Maternal obesity and risk of stillbirth: a metaanalysis. Am J Obstet Gynecol 2007;197:223-8.
17 Harrington J, Perry IJ, Lutomski J, Morgan K, McGee H, Shelley E, Watson D. (2008) Survey of Lifestyle, Attitudes and Nutrition in Ireland: Dietary Habits of the Irish Population. Dublin: The Stationery Office.

## Smoking and substance abuse

Smoking status of the mothers at their time of booking was recorded for 412 (92.6%) of the 445 women. Of these, 71 (17.2%) were smokers at the time, most (55.9%) smoking at least 10 cigarettes per day. Information on smoking in late pregnancy was available for 48 of these mothers; only 5 (10.4%) stopped smoking during pregnancy.

The prevalence of smoking during pregnancy or in the last trimester is not routinely known for all Irish pregnancies but rates of 12%, 15%, 16% and 19% have been reported for England, Northern Ireland, Wales and Scotland, respectively.[18]

There was one case with a documented history of alcohol abuse and five women had a documented history of drug abuse.

## Previous pregnancy

Two thirds of the mothers had at least one previous pregnancy (301 of 445, 67.6%). In terms of parity, 42% were nulliparous which is marginally higher than for all births in 2012 (Table 1.9). Women who experienced perinatal loss were more likely to be nulliparous or Para 3+ compared to the general population of mothers delivered in 2012.

Table 1.9: Distribution of parity, 2011 and 2012

| Parity | Perinatal deaths 2011 | Perinatal deaths 2012 | All births 2012 |
|---|---|---|---|
| Nulliparous | 205(45.5) | 186(41.8) | 39.1% |
| Para 1 | 122(27.1) | 129(29.0) | 34.7% |
| Para 2 | 71(15.7) | 72(16.2) | 17.2% |
| Para 3+ | 53(11.7) | 58(13.0) | 9.0% |

Note: Values are shown as n(%) unless otherwise stated; Data for all births are from the ESRI's Perinatal Statistics Report 2012[19]

18 EURO-PERISTAT Project with SCPE and EUROCAT. European Perinatal Health Report. The health and care of pregnant women and babies in Europe in 2010. May 2013. Available www.europeristat.com
19 Economic and Social Research Institute (ESRI). (2013) Perinatal Statistics Report 2012. Dublin: ESRI

Table 1.10 specifies gravida/parity for the 445 women who experienced perinatal loss in 2012. One in three (n=144, 32.4%) had never been pregnant before (gravida = 0). Of the 301 women who had been pregnant (gravida > 0), approximately half (n=157, 52.2%) only had pregnancies ≥24 weeks (gravida = parity, indicated by pale green shading); one in three (n=102, 33.9%) experienced pregnancy ≥24 weeks and at least one pregnancy <24 weeks gestation and under 500g birthweight (gravida > parity > 0, indicated by yellow shading); and, for 14% (n=42, 14.0%) their previous pregnancies never exceeded 24 weeks gestation or 500g birthweight (gravida > parity = 0, indicated by orange shading).

Table 1.10: Gravida/parity of mothers prior to experiencing perinatal loss in 2012

| Gravida \ Parity | 0 | 1 | 2 | 3 | 4 | 5 | 6 | Total |
|---|---|---|---|---|---|---|---|---|
| 0 | 144 | | | | | | | 144 |
| 1 | 28 | 86 | | | | | | 114 |
| 2 | 9 | 33 | 42 | | | | | 84 |
| 3 | 2 | 7 | 17 | 16 | | | | 42 |
| 4 | 1 | 3 | 7 | 11 | 10 | | | 32 |
| 5 | 0 | 0 | 3 | 4 | 8 | 1 | | 16 |
| 6 | 1 | 0 | 2 | 1 | 3 | 0 | 2 | 9 |
| 7 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 2 |
| 8 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 9 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Total | 186 | 129 | 72 | 32 | 22 | 2 | 2 | 445 |

Note: We refer to gravida and parity prior to the pregnancy followed by perinatal death in 2012. Pale green represents women with previous pregnancies always ≥24 weeks; yellow represents women who had experienced pregnancy ≥24 weeks and pregnancy <24 weeks gestation and birthweight<500g; and, orange represents women whose previous pregnancies were always <24 weeks gestation and birthweight<500g

Almost half (n=133, 44.2%) of the 301 mothers who had a previous pregnancy had had a pregnancy-related problem (Table 1.11). One in five of the 301 mothers had a previous caesarean delivery, 6% had had pre-eclampsia. Three or more miscarriages, pre-term birth or mid-trimester loss and stillbirth were each experienced by 4% of the 301 mothers who had a previous pregnancy.

Table 1.11: Previous pregnancy-related problems in 2011 and 2012

| | 2011 n(%) | 2012 n(%) |
|---|---|---|
| Previous caesarean delivery | 55(18.9) | 60(19.9) |
| Pre-eclampsia | 18(6.2) | 19(6.3) |
| Three or more miscarriages | 19(6.5) | 13(4.3) |
| Pre-term birth or mid-trimester loss | 11(3.8) | 13(4.3) |
| Stillbirth | 5(1.7) | 11(3.7) |
| Baby with congenital anomaly | 7(2.4) | 9(3.0) |
| Infant requiring intensive care | 8(2.7) | 6(2.0) |
| Post-partum haemorrhage requiring transfusion | 5(1.7) | 6(2.0) |
| Placental abruption | 2(0.7) | 4(1.3) |
| Neonatal death | 7(2.4) | 3(1.0) |
| Placenta praevia | 1(0.3) | 1(0.3) |
| Other | 68(23.4) | 54(17.9) |

Note: Percentage of mothers who had a previous pregnancy

## Pre-existing medical problems

Information about pre-existing medical problems was available for 423 of the 485 mothers who experienced perinatal loss (95.1%). Forty percent of these 423 women had a pre-existing medical problem (169, 40.0%). There were no highly prevalent conditions and no notable changes in the prevalence of specific problems from 2011 to 2012 (Table 1.12). The Other category included a wide range of problems such as asthma, anaemia, infertility and urinary tract infection.

Table 1.12: Pre-existing medical problems in mothers who experienced perinatal loss in 2011 and 2012

| | 2011 n(%) | 2012 n(%) |
|---|---|---|
| Hypertension | 12(3.0) | 22(5.2) |
| Endocrine disorder | 19(4.7) | 21(5.0) |
| Psychiatric disorder | 23(5.7) | 19(4.5) |
| Renal disease | 7(1.7) | 9(2.1) |
| Diabetes | 7(1.7) | 8(1.9) |
| Inflammatory disorder | 7(1.7) | 7(1.7) |
| Cardiac disease | 8(2.0) | 6(1.4) |
| Haematological disorder | 7(1.7) | 6(1.4) |
| Epilepsy | 7(1.7) | 5(1.2) |
| Other | 126(31.3) | 103(24.3) |
| Any pre-existing medical problem | 179(44.5) | 169(40.0) |

## Delivery

Labour was induced in 63.5% of women who experienced a stillbirth and 10.6% of those who experienced a neonatal death. A caesarean section was the planned mode of delivery for 8.9% (n=27) of the women who experienced a stillbirth and 12.9% (n=18) of the women who experienced an early neonatal death.

Almost all of the babies (n=433, 97.5%) were delivered under obstetric-led care which is the predominant model of care in Ireland. One baby (0.2%) was delivered under midwifery-led care and ten babies (2.3%) were born before arrival at the maternity unit (five stillbirths and five early neonatal deaths).

Presentation at delivery, known for 422 of the 445 babies, was vertex presentation for three in four (n=316, 74.9%), almost one in four (n=96, 22.7%) was breech presentation and in ten cases the presentation was either compound (n=6), brow (n=1) or face (n=3).

Spontaneous vertex was the mode of delivery more often in cases of stillbirths (67.4%; Table 1.13) than for all births in 2012. Respectively, 40% and 43% of births with a subsequent early neonatal death were by spontaneous vertex delivery and caesarean section. Among stillbirths delivered by caesarean section, over 40% of the mothers (n=16, 42.1%) had had a previous caesarean delivery. Assisted breech deliveries were relatively common in cases of stillbirth (18.1%) and neonatal death (13.5%) whereas this was very rare for all births in 2012.

Table 1.13: Mode of delivery in mothers who experienced perinatal loss in 2012

| Mode of delivery | Stillbirths (N=304) | Neonatal deaths (N=141) | All births, ESRI % |
|---|---|---|---|
| Spontaneous vertex delivery | 205(67.4) | 57(40.4) | 55.6 |
| Pre-labour caesarean section | 31(10.2) | 33(23.4) | 28.8 |
| Caesarean section after onset of labour | 7(2.3) | 27(19.1) | |
| Lift out forceps | 2(0.7) | 1(0.7) | 3.9 |
| Mid-cavity forceps | 1(0.3) | 1(0.7) | |
| Rotational forceps | 2(0.7) | - | |
| Assisted breech | 55(18.1) | 19(13.5) | 0.4 |
| Ventouse | 1(0.3) | 3(2.1) | 11.2 |

Note: Values are shown in N (%) unless otherwise stated. Data for all births from the ESRI's Perinatal Statistics Report 2012[20]

Most of the 98 deliveries by caesarean section were emergencies (n=57, 58.2%), 16.3% were categorised as urgent (n=16) and one quarter were elective (n=24, 24.5%). The type of caesarean delivery differed by type of perinatal loss; caesarean deliveries with subsequent early neonatal death were more often emergencies (70% vs. 40% of stillbirths delivered by caesarean).

20 Economic and Social Research Institute (ESRI). (2013) Perinatal Statistics Report 2012. Dublin: ESRI

### Level of care for mothers post-delivery

The rate of admission to the high dependency unit (HDU) and the intensive care unit (ICU) was similar in 2011 and 2012 (Table 1.14). In 2012, 29 mothers (6.5%) were admitted to the HDU following the delivery and seven mothers (1.6%) were admitted to the ICU. Admission to the HDU was more common in cases of early neonatal death than stillbirth. Higher rates of admission to both HDU (17.2%) and ICU (4.7%) were more likely following emergency pre-labour caesarean section.

Table 1.14: Post-delivery outcome for mothers who experienced perinatal loss in 2011 and 2012

| | Perinatal deaths 2011 | Perinatal deaths 2012 | Stillbirths 2012 | Neonatal deaths 2012 |
|---|---|---|---|---|
| Admitted to HDU | 27(5.9) | 29(6.5) | 14(4.6) | 15(10.6) |
| Admitted to ICU | 8(1.8) | 7(1.6) | 5(1.6) | 2(1.4) |

Note: Values are n(%) unless otherwise stated.

## Infant characteristics

### Sex

There were three perinatal deaths for which the sex of the baby was indeterminate. Of the 442 other perinatal deaths, just over half were male (n=224, 50.7%). This is in line with the overall population of births in 2012 in which 51.5% were male.[21] Male babies slightly outnumbered female babies among early neonatal deaths but not among stillbirths (Table 1.15).

Table 1.15: Sex of baby in stillbirths and neonatal deaths, 2012

| | Stillbirths n(%) | Early neonatal deaths n(%) |
|---|---|---|
| Male | 148(48.7) | 76(53.4) |
| Female | 153(50.3) | 65(46.1) |
| Indeterminate | 3(1.0) | - |

### Multiple births

There was an association found in this audit between perinatal death and multiple pregnancies. There were 47 perinatal deaths from multiple births, making up 10.5% of all perinatal deaths in 2012. This is three times the proportion of multiples among all births in 2012 (3.5%). Consequently, the perinatal mortality rate of 18.6 per 1,000 multiple births was three times the national rate.[20]

The 47 perinatal deaths from multiple births comprised of 24 stillbirths and 23 early neonatal deaths. Half (n=12, 52.2%) of the 23 early neonatal deaths were due to respiratory disorders, usually severe pulmonary immaturity, generally associated with spontaneous premature labour or ascending infection. The main causes of the 24 stillbirths from multiple births were similar to those of all stillbirths in 2012, most commonly either major congenital anomaly or specific placental conditions. Based on the NPEC Maternal and Fetal Classification System, twin-twin transfusion was the main cause of death in six of the 47 deaths from multiple births (12.8%).

There were 32 cases where one twin died, seven cases where both twins died and one case where a triplet died. Chorionicity was reported for 45 of the 47 perinatal deaths from multiple births. Most were dichorionic diamniotic (n=26, 57.8%) and 42.2% (n=19) were monochorionic diamniotic. The observed proportion of monochorionic diamniotic twins is higher than would be expected based on all twin deliveries in Ireland.

21 Economic and Social Research Institute (ESRI). (2013) Perinatal Statistics Report 2012. Dublin: ESRI

## Gestation

Gestational age at delivery of 22-27 weeks was observed for one in three cases of early neonatal death compared to one in four stillbirths (Figure 1.4). Only 31% of stillbirths and one in four babies who died in their first week were not delivered pre-term.

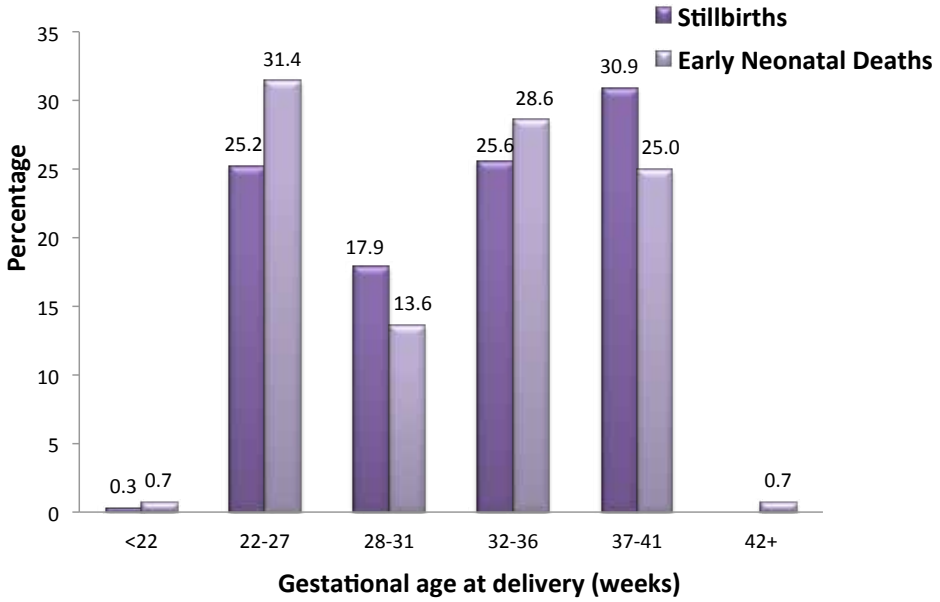



Figure 1.4: Distribution of gestational age at delivery in stillbirths and neonatal deaths, 2012

## Birthweight

The most represented birthweight in cases of perinatal death was in the range 500-999 grams, especially for early neonatal deaths (Figure 1.5). For almost three quarters of perinatal deaths (70.4% of stillbirths and 72.3% of neonatal deaths) the birthweight was less than 2,500 grams.

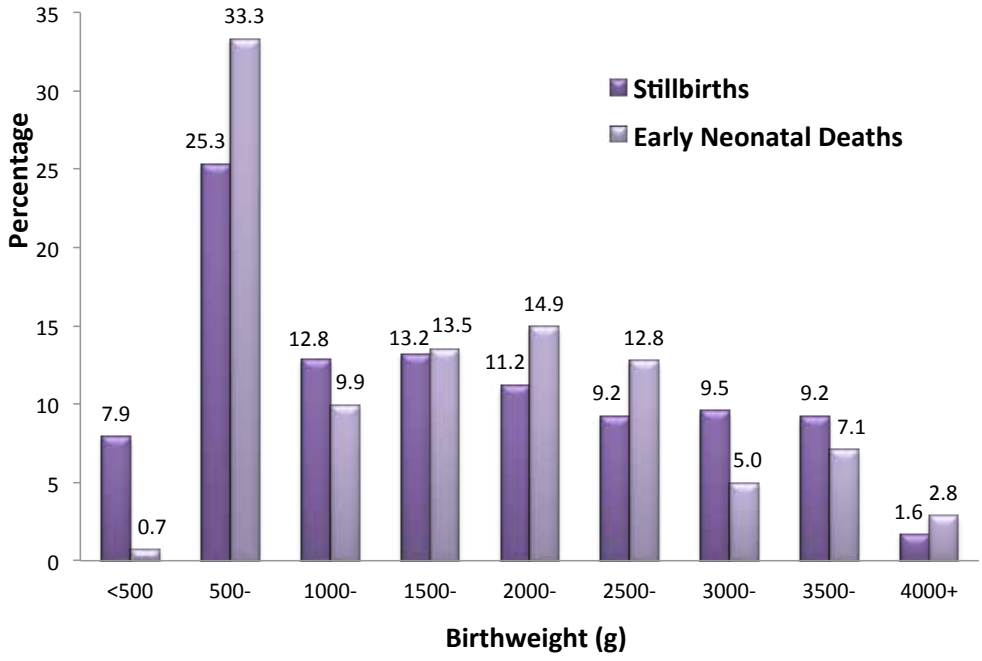



Figure 1.5: Distribution of birthweight in stillbirths and neonatal deaths, 2012

## Birthweight centile

An increased risk of perinatal death has been associated with failure of fetal growth in utero. We have produced two charts to highlight this issue in relation to the stillbirths and early neonatal deaths that occurred in Ireland in 2012. To do so, we used the Gestation Related Optimal Weight (GROW) software[22] and coefficients derived from the multiple regression analysis of data on 11,072 births in six maternity units in Dublin, Galway, Limerick and Belfast in 2008-2009.[23]

The regression analysis determined the Term (i.e. 40 weeks) Optimal Weight (TOW) in Ireland to be 3,490.7g. The normal range (i.e. the range from the 10th centile weight to the 90th centile weight) around the TOW was then calculated and the recommended proportionality growth function was applied to the TOW, the 10th centile term weight and the 90th centile term weight in order to determine the optimal weight and normal range at all gestations (21-44 weeks for the stillbirths and early neonatal deaths in Ireland in 2012). These steps are described in detail in the GROW documentation.

The optimal weight and normal range for all gestations are plotted with the actual birthweights of the stillbirths in Figure 1.6 and with the birthweights for the cases of early neonatal death in Figure 1.7. For the stillbirths, it can be seen that the majority were below the lower limit of the normal range (10th centile). This was particularly associated with stillbirths occurring between 24-37 weeks gestation. In cases of early neonatal death, the birthweight was often below the normal range, particularly for births after 33 weeks gestation. However, this was observed less often than for cases of stillbirth.

Figures 1.6 and 1.7 have the limitation of plotting actual birthweights against the optimal weight and normal range adjusted only for gestational age. There is no adjustment for other factors affecting birthweight; namely, maternal height, weight, parity and ethnic group and infant sex. The use of centiles customised for maternal and infant characteristics affecting birthweight identifies small babies at higher risk of mortality better than population centiles.[24] Small-for-gestational-age (SGA) refers to birthweights below the 10th centile and severely SGA refers to birthweights less than the 3rd centile. [25]

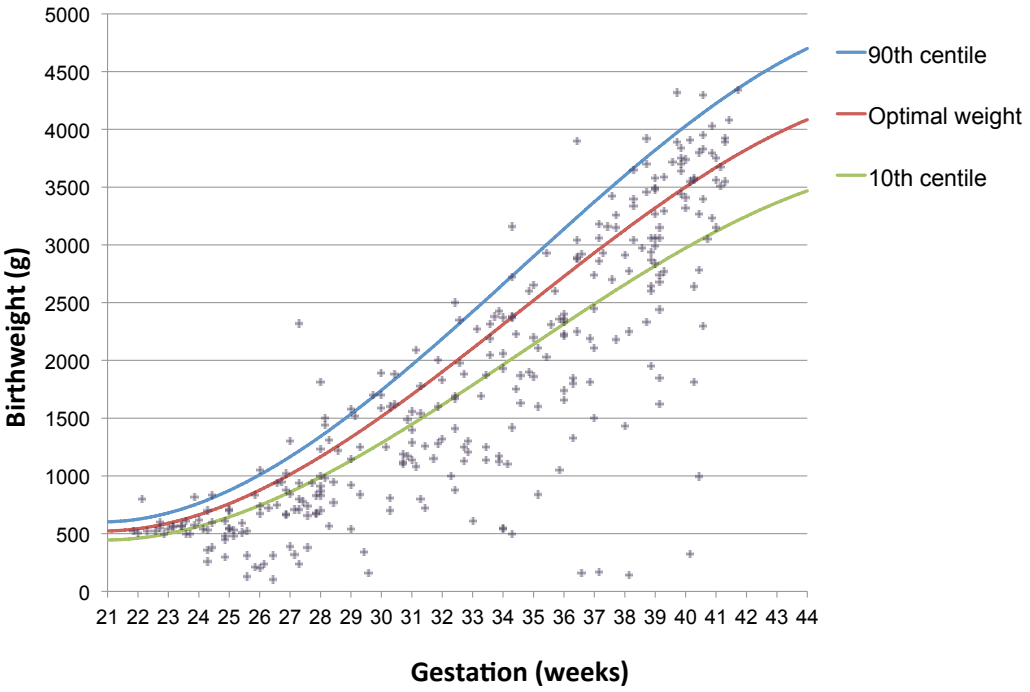



Figure 1.6: Optimal birthweight and normal range compared to actual birthweights of stillbirths, 2012

22 Gardosi J, Francis A. Customised Weight Centile Calculator. GROW version 6.6, 2013 Gestation Network, www.gestation.net
23 Unterscheider J, Geary MP, Daly S, McAuliffe FM, Kennelly MM, Dornan J, Morrison JJ, Burke G, Francis A, Gardosi J, Malone FD. The customized fetal growth potential: a standard for Ireland. Eur J Obstet Gynecol Reprod Biol 2013; 166(1):14-7
24 Clausson B, Gardosi J, Francis A, Cnattingius S. Perinatal outcome in SGA births defined by customised versus population–based birthweight standards. BJOG 2001;108:830–4.
25 Royal College of Obstetrics and Gynaecologists. The investigation and management of the small-for-gestational age fetus. RCOG Green Top Guideline 2013 (NO.31). Available at: www.rcog.org.uk/files/rcog-corp/22.3.13GTG31SGA_ExecSum.pdf

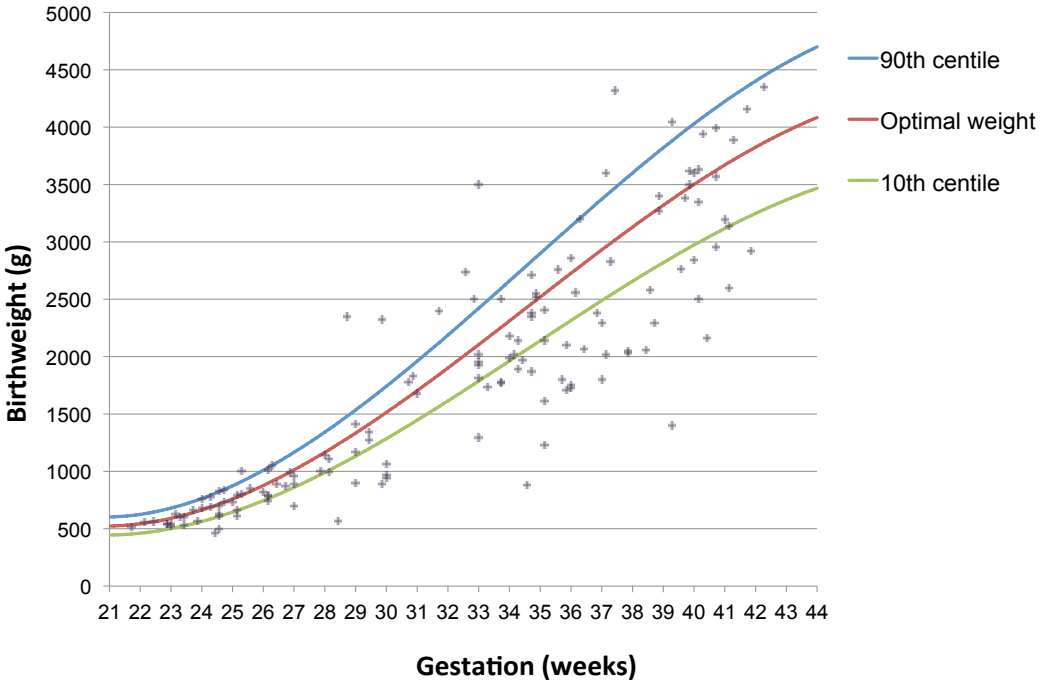



Figure 1.7: Optimal birthweight and normal range compared to actual birthweights in cases of early neonatal death, 2012

Customised birthweight centiles were derived using the GROW software.[26] There was a high level of missing data for maternal height and weight with one or both unknown for over 40% of the mothers (n=195, 42.8%). For these cases, we used the median height and weight of the mothers with complete data. As a result, it was possible to calculate customised birthweight centiles for almost all of the 456 mothers (n=442, 96.9%).

The distribution of customised birthweight centiles at all gestations is illustrated for stillbirths in Figure 1.8 and for cases of early neonatal death in Figure 1.9. At all gestations, there were cases spanning the full range of birthweight centiles (i.e. 0-100th) but there was a clear overrepresentation of cases below the median and far more at or near centile zero than would be expected in the population of all births.

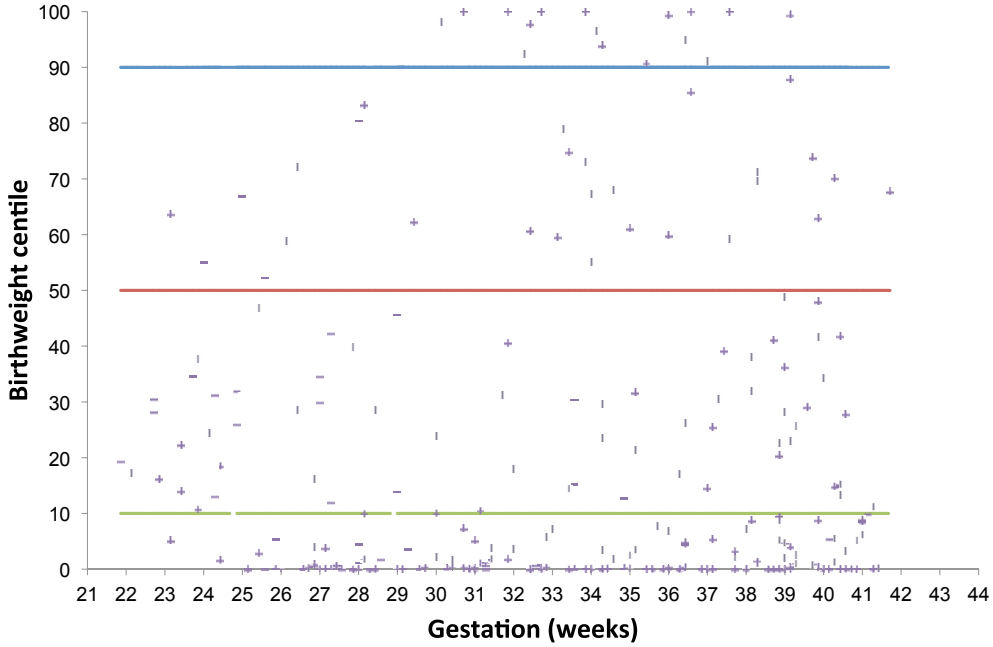



Figure 1.8: Distribution of customised birthweight centiles for stillbirths, 2012

26 Gardosi J, Francis A. Customised Weight Centile Calculator. GROW version 6.6, 2013 Gestation Network, www.gestation.net

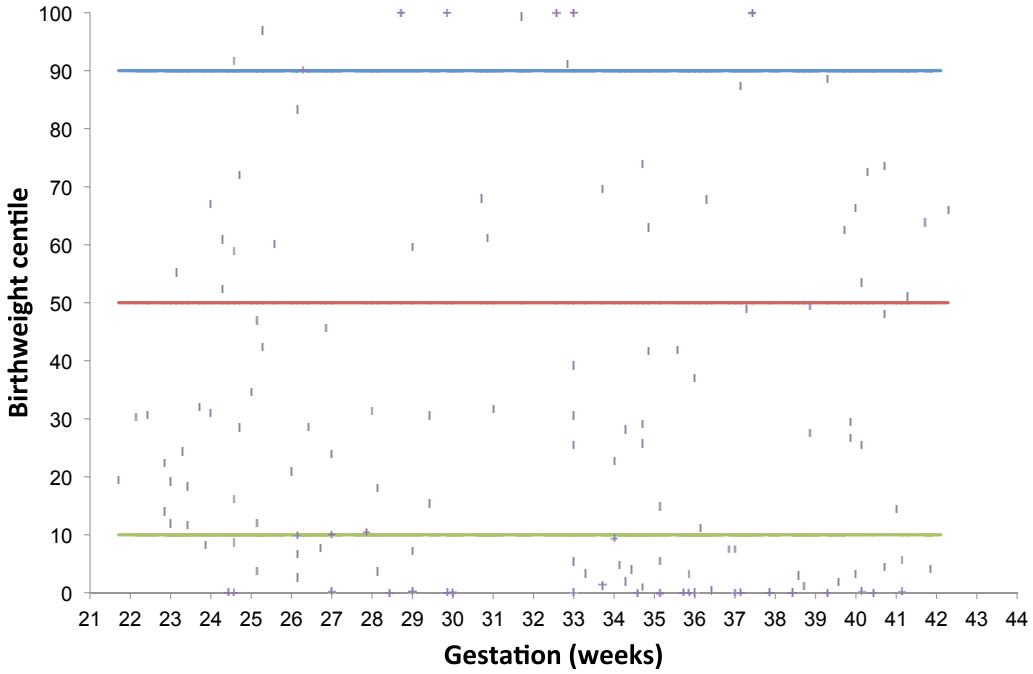



Figure 1.9: Distribution of customised birthweight centiles for early neonatal deaths, 2012

Table 1.16 details the number and percentage of stillbirths and early neonatal deaths within specific ranges of customised birthweight centiles. Low birthweight was associated with both groups but particularly with stillbirths. Almost one in three (30.2%) had a birthweight at centile zero compared to 19.3% of early neonatal death cases. Just over 40% of stillbirths were classified as severely SGA and over half were SGA (54.0%) compared to 24.3% and 40.0% of the cases of early neonatal death, respectively.

SGA may be more prevalent among stillborn babies because they may have died some days or weeks before being delivered. We do not record whether there was evidence of maceration in cases of stillbirth but there was support for this hypothesis. The data showed a correlation whereby the longer the time between confirmation of death and time of delivery, the lower the customised birthweight centile of the stillborn baby.

Table 1.16: Distribution of customised birthweight centiles, 2012

| Centile | Stillbirth n(%) (N=298) | Neonatal death n(%) (N=140) |
|---|---|---|
| Zero | 90(30.2) | 27(19.3) |
| < 3rd | 124(41.6) | 34(24.3) |
| < 10th | 161(54.0) | 56(40.0) |
| 10-49th | 83(27.9) | 49(35.0) |
| 50-89th | 38(12.8) | 25(17.9) |
| 90th+ | 16(5.4) | 10(7.1) |

Note: Centiles could not be calculated for six stillbirths and one early neonatal death

Cases of stillbirth and early neonatal death were at significantly lower birthweight centiles when the cause of death was attributed to major congenital anomaly (Table 1.17). Most of the 78 stillbirths due to congenital anomaly (n=46, 59.0%) were severely SGA (<3rd customised birthweight centile) whereas this was the case for one third of the stillbirths due to other causes (n=78, 35.5%). Similarly, 40% of the 68 early neonatal deaths due to congenital anomaly (n=27, 39.7%) were severely SGA compared to 10% (n=7, 9.7%) of the 72 early neonatal deaths due to other causes.

Table 1.17: Distribution of customised birthweight centiles of perinatal deaths due and not due to major congenital anomaly, 2012

| Centile | Stillbirth (N=298) | | Neonatal death (N=140) | |
|---|---|---|---|---|
| | Cause of death: major congenital anomaly | | Cause of death: major congenital anomaly | |
| | Yes (n=78) | No (n=220) | Yes (n=68) | No (n=72) |
| Zero | 39(50.0%) | 51(23.2%) | 21(30.9%) | 6(8.3%) |
| < 3rd | 46(59.0%) | 78(35.5%) | 27(39.7%) | 7(9.7%) |
| < 10th | 51(65.4%) | 110(50.0%) | 38(55.9%) | 18(25.0%) |
| 10-49th | 14(17.9%) | 69(31.4%) | 17(25.0%) | 32(44.4%) |
| 50-89th | 6(7.7%) | 32(14.5%) | 7(10.3%) | 18(25.0%) |
| 90th+ | 7(9.0%) | 9(4.1%) | 6(8.8%) | 4(5.6%) |

Note: Centiles could not be calculated for six stillbirths and one early neonatal death

## Diagnosis of intra-uterine growth restriction (IUGR)

The NPEC Perinatal Death Notification Form contains a specific question on whether a diagnosis of IUGR was made in perinatal deaths and the timing of diagnosis if applicable. A diagnosis of IUGR was reported for 68 (15.3%) of the 445 perinatal deaths (unknown for two cases) - 17.2% of stillbirths (n=52) and 11.4% of early neonatal deaths (n=16). In most diagnosed cases, IUGR was suspected antenatally (Table 1.18). More than 80% of the cases with a diagnosis of IUGR (n=57 of 68, 83.8%) were severely SGA (<3rd customised birthweight centile). Where a diagnosis of IUGR was made, major congenital anomaly was the main cause of death in half the cases (n=32, 47.1%), placental conditions were the main cause of death in one in four cases (n=16, 23.5%) and IUGR was the main cause of death for seven cases (10.3%).

Table 1.18: Diagnosis of intra-uterine growth restriction, 2012

| | Stillbirth n(%) (N=52) | Neonatal death n(%) (N=16) |
|---|---|---|
| Suspected antenatally | 32(61.5) | 13(81.3) |
| Observed at delivery | 27(51.9) | 7(43.8) |
| Observed at post-mortem | 19(36.5) | 4(25.0) |

Note: Categories are not mutually exclusive and may add up to more than 100%

Among the 410 mothers whose smoking status was known at the time of their hospital booking, there was little difference in the prevalence of diagnosed IUGR in the infants of smokers (n=14 of 70, 20.0%) and non-smokers (n=52 of 340, 15.3%). A diagnosis of IUGR was relatively common among mothers with a pregnancy-related hypertensive disorder (n=10 of 26, 38.5% versus n=58 of 417 mothers without pregnancy-related hypertension, 13.9%).

An invited commentary on fetal growth restriction and the risk of perinatal death follows this section of the Report.

## Investigations to determine the cause of death

### Autopsy

Current practice guidelines[27] recommend that parents should be offered a full post-mortem examination of the stillborn infant to help explain the cause of death. Data on autopsy uptake was reported for 442 of the 445 perinatal deaths of which 45.2% (n=200) underwent an autopsy. This is higher than in 2011 when 40.7% of perinatal deaths had an autopsy performed. Variation in the perinatal autopsy rate from year to year is more pronounced for early neonatal deaths (Figure 1.10). The rate of autopsy in stillbirths has shown a gradual decline since 2008 but is always higher than the rate for early neonatal deaths. In 2012, an autopsy was undertaken following 47.7% of stillbirths and 39.0% of early neonatal deaths. It has been reported that in Scotland in 2012, the autopsy rate was 57.7% for stillbirths and 34.5% for neonatal deaths.[28]

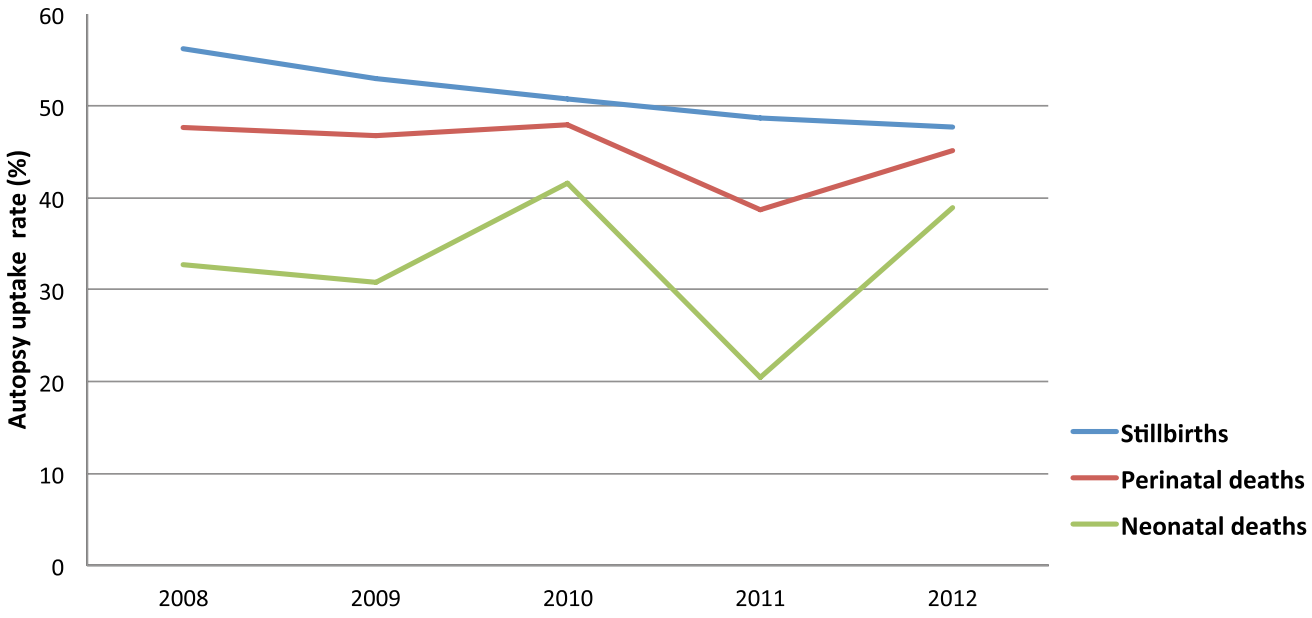



Figure 1.10: Autopsy uptake rate, 2008-2012

There was significant variation in the rate of autopsy across the 20 maternity units in 2012, from 9.1% to 66.7%, as illustrated in Figure 1.11. Most of this variation was observed across the smaller maternity units as the autopsy rate for the four large maternity units was 48.9-61.1%. This may be expected given the smaller numbers involved but it may also reflect variation in access to dedicated perinatal pathology services for smaller units.

27 Clinical Practice Guideline No 4 (2011). Investigation and management of late fetal intrauterine death and stillbirth: Institute of Obstetricians and Gynaecologists, Royal College of Physicians of Ireland and Directorate of Strategy and Clinical Programmes, Health Service Executive.
28 Healthcare Improvement Scotland. (2014) Scottish Perinatal and Infant Mortality and Morbidity Report 2012. Edinburgh: NHS National Services Scotland.

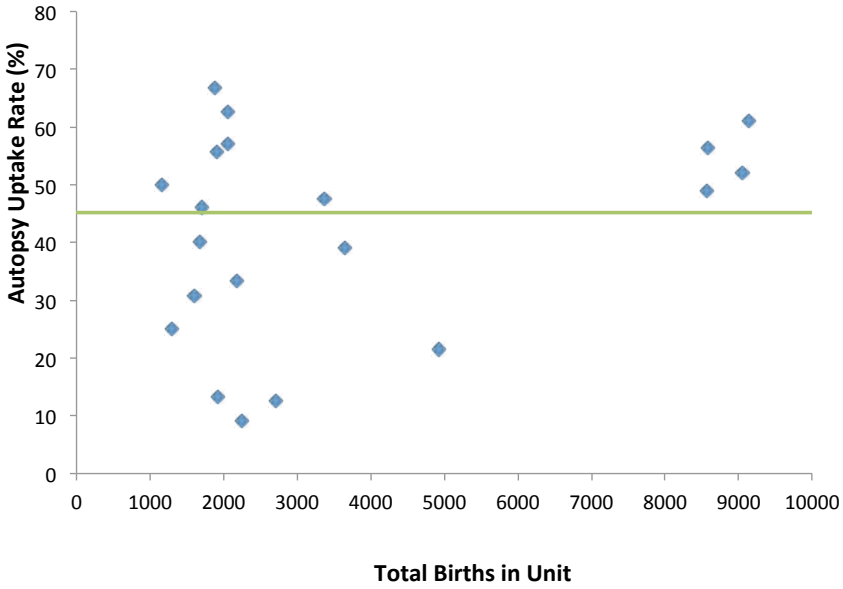



Figure 1.11: Autopsy uptake in the 20 Irish maternity units in 2012

Figure 1.12 details the autopsy-related steps taken following the 445 perinatal deaths in 2012. Thirty-one (7.0%) of the deaths became coroner cases. These cases underwent autopsy and at the time data were reported to the NPEC, the maternity unit had received the autopsy report from the coroner's office in 26 of the 31 cases. There were 169 autopsies undertaken following the 414 deaths that were not coroner cases, an autopsy rate of 40.8% (136, 46.1% for stillbirths and 33, 27.7% for early neonatal deaths).

There were 242 perinatal deaths that did not receive an autopsy. For the majority an autopsy was offered and presumably declined by parents (n=184, 78.0%, unknown for six cases). Such an offer was made more often in cases of stillbirth (128 of 157, 81.5%, unknown for two cases) than for early neonatal deaths (56 of 79, 70.9%, unknown for four cases). Consequently, there were 52 deaths for which an autopsy was not offered, constituting 11.7% of all perinatal deaths.

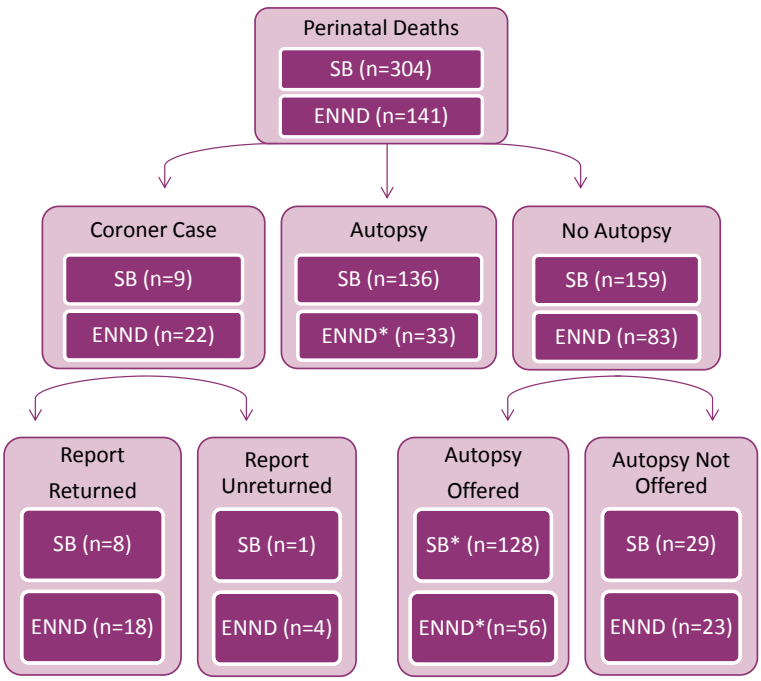



Figure 1.12: Flowchart describing autopsy-related steps taken after 445 perinatal deaths in 2012

Note: Autopsy unknown for three cases of early neonatal death. Autopsy offer unknown for two cases of stillbirth and four cases of early neonatal death.

The decision not to offer to undertake an autopsy may be influenced by the clinical scenario and the antenatal diagnosis. There was evidence to support this in relation to major congenital anomaly. The proportion of cases not offered an autopsy was higher if the perinatal death was due to a major congenital anomaly than if it the death was due to another cause (Table 1.19).

Table 1.19: Uptake and offer of autopsy of perinatal deaths due and not due to major congenital anomaly, 2012

| Autopsy | Stillbirth (N=302) | | Neonatal death (N=134) | |
|---|---|---|---|---|
| | Cause of death: major congenital anomaly | | Cause of death: major congenital anomaly | |
| | Yes (n=79)* | No (n=223) | Yes (n=63)* | No (n=71) |
| Performed | 34(43.0%) | 111(49.8%) | 24(38.1%) | 31(43.7%) |
| Offered | 30(38.0%) | 98(43.9%) | 24(38.1%) | 32(45.1%) |
| Not offered | 15(19.0%) | 14(6.3%) | 15(23.8%) | 8(11.3%) |

*Note: Autopsy unknown for three cases of early neonatal death. Autopsy offer unknown for two cases of stillbirth and four cases of early neonatal death.

## Placental examination

The value of placental examination in determining cause of perinatal death is well documented.[29] In 2012, placental histology examinations were conducted for almost all stillbirths (n=293, 96.4%) and for 80.1% of early neonatal deaths (n=113). This is higher than in 2011 when placental histology was performed in 93% of stillbirths and 69% of neonatal deaths.

## Specific placental conditions

Specific placental conditions were diagnosed in 282 (62.9%) of the 448 perinatal deaths (unknown for one neonatal death). A specific placental condition was reported in almost two thirds of stillbirths (n=198, 65.1%) and neonatal deaths (n=84, 60.0%). Specific placental conditions were more frequent for stillbirths than for neonatal deaths with the exception of chorioamnionitis which was reported in 14.3% of early neonatal deaths compared to 8.9% of stillbirths. Severity of chorioamnionitis was reported for 41 of the 47 cases. The vast majority were either moderate (n=15, 36.6%) or severe (n=18, 43.9%). Placental infarction was the most frequently reported placental condition for stillbirths (10.5%) and was considerably more common than in early neonatal deaths (0.7%). Almost half of stillbirths (42.8%) and almost one third (29.3%) of early neonatal deaths reported other placental conditions.

Table 1.20: Specific placental conditions for stillbirths and neonates, 2012

| | Stillbirth n(%) (N=304) | Neonatal death n(%) (N=140) |
|---|---|---|
| Vasa praevia | 2(0.7) | 0(0) |
| Velamentous insertion | 9(3.0) | 0(0) |
| Massive perivillous fibrin deposition | 2(0.7) | 0(0) |
| Placental infarction | 32(10.5) | 1(0.7) |
| Chorioamnionitis | 27(8.9) | 20(14.3) |
| Fetal vasculitis | 9(3.0) | 3(2.1) |
| Retroplacental haemorrhage | 28(9.2) | 5(3.6) |
| Thrombosis in fetal circulation | 23(7.6) | 2(1.4) |
| Villitis | 8(2.6) | 4(2.9) |
| Other | 130(42.8) | 41(29.3) |
| Any placental condition | 198(65.1%) | 84(60.0%) |

Note: Data were unknown for one neonatal death

29 Korteweg FJ, Erwich JJ, Timmer A, van der Meer J, Ravise JM, Veeger NJ, Holm JP. Evaluation of 1025 fetal deaths: proposed diagnostic workup. Am J Obstet Gynecol 2012 206:53.e1-53.e12

The prevalence rates reported for some specific placental conditions in Table 1.20 are lower than those reported in previous studies.[30,31] Whether this reflects varying degrees of detection, reporting or interpretation of placental histology reports warrants further investigation.

### Other examinations performed

External examination was made for almost 40% of all cases of perinatal death (Table 1.21). X-Ray was performed for 15.1% of stillbirths and 12.8% of neonatal deaths.

Table 1.21: Other examinations performed in investigating perinatal deaths in 2012

| Procedure | Stillbirth n(%) (N=304) | Neonatal death n(%) (N=141) |
|---|---|---|
| External examination | 114(37.5) | 56(39.7) |
| X-Ray | 45(15.1) | 18(12.8) |
| CT scan | 1(0.3) | 1(1.4) |
| MRI | 2(0.7) | 2(1.4) |

### Cytogenetic investigation in chromosomal disorders

Cytogenetic analysis is an important investigation in the diagnosis of chromosomal abnormalities.[32] Some abnormalities are potentially recurrent and can be tested for in future pregnancies. In the event of a chromosomal disorder, a specific question on the NPEC Perinatal Death Notification form asks how the diagnosis was made. A major congenital chromosomal disorder was the main cause of 38 stillbirths and 17 early neonatal deaths. For three quarters of these cases, the diagnosis was made by cytogenetic analysis (n=28 of 38 stillbirths, 73.7%; n=13 of 17 neonatal deaths, 76.5%).

30 Beebe LA, Cowan LD, Altshuler G. The epidemiology of placental features: Associations with gestational age and neonatal outcome. Obstetrics & Gynecology. 87(5):771-778, 1996.
31 Mooney EE. Implantation and placenta; and Mooney EE, Doyle EM. Non-neoplastic maternal gestational diseases (2014). In: Mutter GL, Prat J, eds. Pathology of the Female Reproductive Tract. 3rd edition. London: Churchill Livingstone. ISBN 9780702044977
32 Clinical Practice Guideline No 4 (2011). Investigation and management of late fetal intrauterine death and stillbirth: Institute of Obstetricians and Gynaecologists, Royal College of Physicians of Ireland and Directorate of Strategy and Clinical Programmes, Health Service Executive.

# 2. Invited commentary: Fetal growth restriction and the risk of perinatal mortality

Fetal growth restriction (FGR) is an important and common complication of pregnancy that is associated with increased perinatal morbidity and mortality.[33,34] It is estimated that FGR affects up to 10% of pregnancies. In addition to congenital malformations and infectious causes, FGR has been identified as a major contributor to perinatal mortality.[35,36]

Perinatal deaths commonly occur in women with coexistent maternal co-morbidities or who have a history of adverse pregnancy outcomes, such as recurrent pregnancy loss, stillbirth or neonatal death.[37] In addition, ethnic minorities are an overrepresented group among women who experience perinatal deaths.[38,39] The perinatal outcome of FGR fetuses is largely dependent on the severity of growth restriction with those below the 3rd centile and/ or with abnormal umbilical artery (UA) Doppler measurements at greatest risk of adverse outcome.[40,41] Other important prenatal determinants of perinatal outcome are gestational age at delivery and birthweight.[42]

## Definition, Diagnosis and Management of FGR

There is no international consensus as to which clinical and sonographic parameters are the most appropriate to define intrauterine growth failure. The traditional cut-off used to define FGR, a term often interchangeably used with small-for-gestational age (SGA) or intrauterine growth restriction (IUGR), is an abdominal circumference (AC) or estimated fetal weight (EFW) below the 10th centile plotted against population[43] or customised[44] growth standards. The 10th centile has been suggested as a cut-off, given that at this level the risk of perinatal morbidity and mortality increases. At this arbitrary cut-off however the distinction between normal and pathologic growth often cannot reliably be made in the antenatal setting, and approximately 50-70% will be constitutionally healthy small infants not at risk of adverse perinatal outcome.[45,46] In contrast, some infants born above the 10th centile, who might have been destined, for example, to be on the 80th centile, will be growth restricted.

Unsurprisingly, the inconsistencies in FGR definition and diagnosis lead to further uncertainties regarding the optimal antenatal surveillance and management of affected pregnancies. Unfortunately, there is very little evidence from randomised controlled trials to inform best practice for antenatal surveillance regimens in FGR. In order to improve and standardise the care of pregnancies affected by FGR, a clinical practice guideline applicable for the Irish maternity setting was recently published.[47]

33 Bernstein IM, Horbar JD, Badger GJ, Ohlsson A, Golan A. Morbidity and mortality among very-low-birth-weight neonates with intrauterine growth restriction. The Vermont Oxford Network. Am J Obstet Gynecol 2000;182(1 Pt 1):198-206.
34 Baschat AA, Cosmi E, Bilardo CM, et al. Predictors of neonatal outcome in early-onset placental dysfunction. Obstet Gynecol 2007;109(2 Pt 1):253-261.
35 Manning E, Corcoran P, Meaney S, Greene RA, on behalf of the Perinatal Mortality Group. Perinatal Mortality in Ireland, Annual Report 2011. Cork: National Perinatal Epidemiology Centre. 2013.
36 Gardosi J, Madurasinghe V, Williams M, Malik A, Francis A. Maternal and fetal risk factors for stillbirth: population based study. BMJ 2013;346:f108.
37 Frias AE, Jr., Luikenaar RA, Sullivan AE, et al. Poor obstetric outcome in subsequent pregnancies in women with prior fetal death. Obstet Gynecol 2004;104(3):521-526.
38 Unterscheider J, O'Donoghue K, Daly S, et al. Fetal growth restriction and the risk of perinatal mortality-case studies from the multicentre PORTO study. BMC Pregnancy Childbirth 2014;14:63.
39 de Graaf JP, Steegers EA, Bonsel GJ. Inequalities in perinatal and maternal health. Curr Opin Obstet Gynecol 2013;25(2):98-108.
40 Lees C, Marlow N, Arabin B, et al. Perinatal morbidity and mortality in early-onset fetal growth restriction: cohort outcomes of the trial of randomized umbilical and fetal flow in Europe (TRUFFLE). Ultrasound Obstet Gynecol 2013;42(4):400-408.
41 Unterscheider J, Daly S, Geary MP, et al. Optimizing the definition of intrauterine growth restriction: the multicenter prospective PORTO Study. Am J Obstet Gynecol 2013;208(4):290 e291-296.
42 Baschat AA, Cosmi E, Bilardo CM, et al. Predictors of neonatal outcome in early-onset placental dysfunction. Obstet Gynecol 2007;109(2 Pt 1):253-261.
43 Hadlock FP, Harrist RB, Sharman RS, Deter RL, Park SK. Estimation of fetal weight with the use of head, body, and femur measurements--a prospective study. Am J Obstet Gynecol 1985;151(3):333-337.
44 Gardosi J, Chang A, Kalyan B, Sahota D, Symonds EM. Customised antenatal growth charts. Lancet 1992;339(8788):283-287.
45 Lees C, Marlow N, Arabin B, et al. Perinatal morbidity and mortality in early-onset fetal growth restriction: cohort outcomes of the trial of randomized umbilical and fetal flow in Europe (TRUFFLE). Ultrasound Obstet Gynecol 2013;42(4):400-408.
46 Unterscheider J, Daly S, Geary MP, et al. Optimizing the definition of intrauterine growth restriction: the multicenter prospective PORTO Study. Am J Obstet Gynecol 2013;208(4):290 e291-296.
47 Clinical Practice Guideline No 29 (2014). Fetal Growth Restriction – Recognition, Diagnosis and Management: Institute of Obstetricians and Gynaecologists, Royal College of Physicians of Ireland and Directorate of Strategy and Clinical Programmes, Health Service Executive.

## FGR and Perinatal Mortality

Advances in obstetrical and critical neonatal care are reflected in a substantial decrease in the overall perinatal mortality rate (PNMR) in high income countries.[48] While this effect is mainly seen in a reduction of early neonatal deaths, stillbirth rates have remained largely unchanged over the past years.[49,50] Stillbirth affects 1 in 200 pregnancies; as outlined in this report there were 71,755 births and 445 perinatal deaths in 2012. Similar to the previous NPEC perinatal mortality report,[51] stillbirths and early neonatal deaths accounted for 68% (n=304) and 32% (n=141) of perinatal deaths respectively, corresponding to a PMR of 6.2/ 1,000 births. Of the 445 perinatal deaths, a third (n=148) were attributed to congenital structural or genetic abnormalities (corrected PMR 4.1/ 1,000). Half of infants affected by perinatal deaths in 2012 were identified as having birthweights below the 10th customised centile.

As outlined in Figure 2.1, whether or not FGR is identified prenatally influences the risk of stillbirth. While the risk of stillbirth (SB) in pregnancies with prenatally identified FGR is 1% (9.7/ 1,000 births), pregnancies with unrecognised FGR carry an over 8-fold increased risk of SB when compared to pregnancies without FGR (19.8 versus 2.4/ 1,000 births).[52] Some studies state that FGR may be overestimated as attributing factor in perinatal mortality cases due to intrauterine retention following intrauterine demise and the effect of maceration.[53]

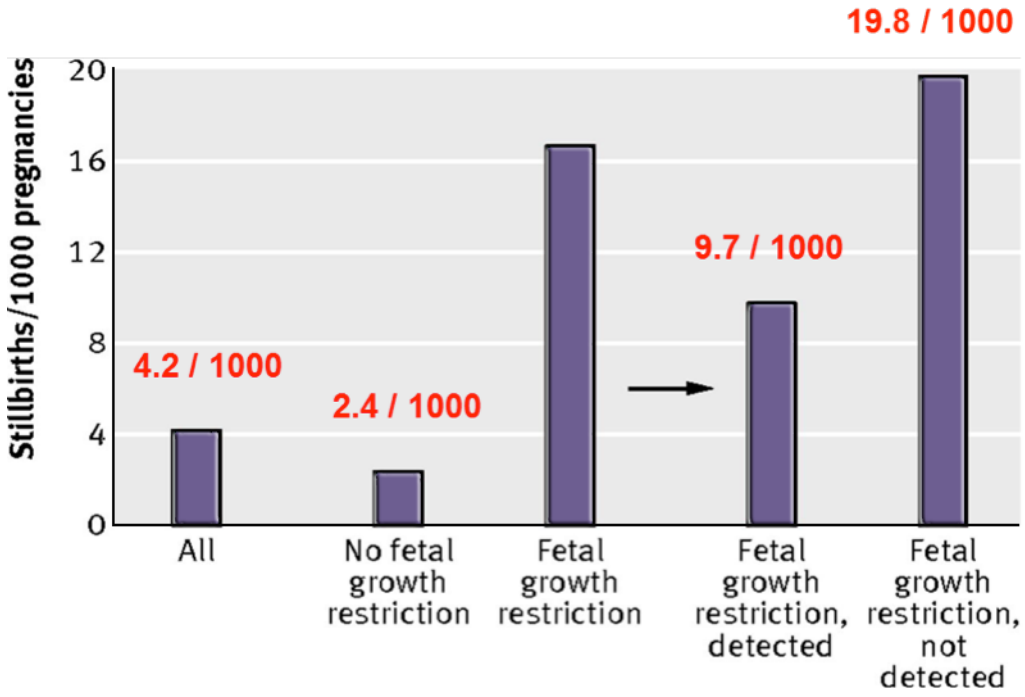
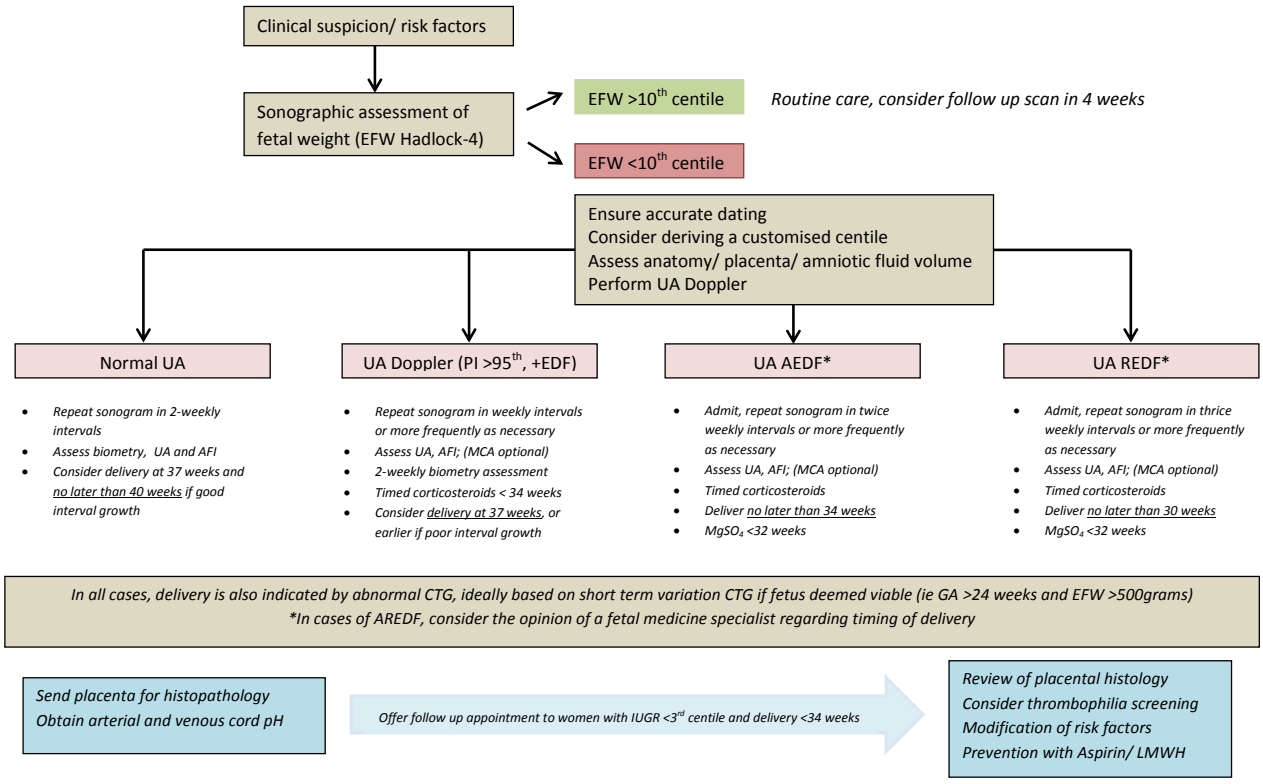



Figure 2.1: Stillbirth rates for pregnancies overall and for pregnancies with detected and undetected FGR (from Gardosi J)[54]

48 Flenady V, Middleton P, Smith GC, et al. Stillbirths: the way forward in high-income countries. Lancet 2011;377(9778):1703-1717.
49 Lawn JE, Blencowe H, Pattinson R, et al. Stillbirths: Where? When? Why? How to make the data count? Lancet 2011;377(9775):1448-1463
50 Cousens S, Blencowe H, Stanton C, et al. National, regional, and worldwide estimates of stillbirth rates in 2009 with trends since 1995: a systematic analysis. Lancet 2011;377(9774):1319-1330.
51 Manning E, Corcoran P, Meaney S, Greene RA, on behalf of the Perinatal Mortality Group. Perinatal Mortality in Ireland, Annual Report 2011. Cork: National Perinatal Epidemiology Centre. 2013.
52 Gardosi J, Madurasinghe V, Williams M, Malik A, Francis A. Maternal and fetal risk factors for stillbirth: population based study. BMJ 2013;346:f108.
53 Maroun LL, Graem N. Autopsy standards of body parameters and fresh organ weights in nonmacerated and macerated human fetuses. Pediatr Dev Pathol 2005;8(2):204-217.
54 Gardosi J, Madurasinghe V, Williams M, Malik A, Francis A. Maternal and fetal risk factors for stillbirth: population based study. BMJ 2013;346:f108.

## Improving the Antenatal Detection of FGR

One of the core problems in FGR is the poor detection rate in pregnancies that are at subsequent risk of adverse outcome, in particular stillbirth. Current antenatal detection rates of FGR are reported to be as low as 25 to 36%.[55,56] Therefore, a preventative strategy to reduce stillbirths is to improve the antenatal detection of fetal growth failure. Whenever FGR is diagnosed prenatally, increased surveillance and timely delivery aims to improve perinatal outcome in FGR, balancing the risk of antepartum stillbirth by remaining in utero and iatrogenic prematurity potentially causing significant morbidity or neonatal death by too early intervention. Figure 2.2 illustrates an algorithm for the management of fetal growth restriction as recommended in the national clinical practice guideline.[57]




**ABBREVIATIONS:** **EFW**, *estimated fetal weight (Hadlock-4)*; **UA**, *umbilical artery*; **EDF**, *end-diastolic flow*; **AEDF**, *absent end-diastolic flow*; **REDF**, *reversed end-diastolic flow*; **AFI**, *amniotic fluid index*; **AREDF**, *absent or reversed end-diastolic flow in UA*; **CTG**, *cardiotocograph*; **MCA**, *middle cerebral artery*; **GA**, *gestational age*, **LMWH**, *low molecular weight heparin.*

Figure 2.2: Algorithm for management of fetal growth restriction

55 McCowan LM, Roberts CT, Dekker GA, et al. Risk factors for small-for-gestational-age infants by customised birthweight centiles: data from an international prospective cohort study. BJOG 2010;117(13):1599-1607.
56 Chauhan SP, Beydoun H, Chang E, et al. Prenatal Detection of Fetal Growth Restriction in Newborns Classified as Small for Gestational Age: Correlates and Risk of Neonatal Morbidity. Am J Perinat 2014;31(3):187-94.
57 Clinical Practice Guideline No 29 (2014). Fetal Growth Restriction – Recognition, Diagnosis and Management: Institute of Obstetricians and Gynaecologists, Royal College of Physicians of Ireland and Directorate of Strategy and Clinical Programmes, Health Service Executive.

Abdominal palpation and fundal height measurement are imprecise in screening for fetal growth aberrations; they are, however, the only physical examination methods available. In current practice a scan for fetal biometry is only performed when clinical concerns over fetal size are raised, and in the presence of significant maternal risk factors or prior pregnancy complications.

In an effort to improve the antenatal detection of FGR in a maternity care system which does not provide serial ultrasound scanning for all pregnancies, Gardosi et al[58] have formulated customised fundal height charts which take into account physiological maternal variables. Another recent study focused on improving the prenatal detection by the provision of routine ultrasound scans at 28 and 36 weeks' gestation; a research group at Cambridge University recently presented level 1 evidence of diagnostic effectiveness that this approach performs well as a screening test to detect FGR in a population of unselected nulliparous women.[59]

A care model whereby every pregnant patient receives an ultrasound scan at least 4 weekly intervals would improve identification of growth failure based on population and customised growth standards. Given that FGR can also occur in infants born with birthweights above the 10th centile cut-off, this approach would also allow us to comment on growth trajectories which have been identified as an important factor in the prediction of morbidity and mortality outcomes.[60] The relevance to clinical practice in reducing perinatal morbidity and mortality could be the subject of future research studies comparing various models of antenatal care. This will impact on resource issues, increase obstetric intervention but no doubt will have an impact on the antenatal detection and reduction in perinatal deaths.

58 Gardosi J, Francis A. Controlled trial of fundal height measurement plotted on customised antenatal growth charts. BJOG 1999;106(4):309-317.
59 Sovia U, Smith G, Dacey A. Level 1 evidence for the diagnostic effectiveness of routine sonography as a screening test for small for gestational age (SGA) infants. Am J Obstet Gynecol 2014;210(1):S408.
60 Barker ED, McAuliffe FM, Alderdice F, et al. The role of growth trajectories in classifying fetal growth restriction. Obstet Gynecol 2013;122(2 Pt 1):248-254.

# 3. Stillbirths: Specific findings

## Cause of death in stillbirths

Major congenital anomaly was the primary cause of death in one quarter (n=80, 26.3%) of the 304 stillbirths occurring in 2012 (Figure 3.1). There was a chromosomal disorder in half of the 80 stillbirths (n=38, 47.5%) due to congenital anomaly. In these cases, the majority were diagnosed by cytogenetic analysis (n=28, 73.7%). Anomalies of the central nervous system and multiple anomalies caused a further 11 (13.8%) and 10 (12.5%) stillbirths, respectively.

Specific placental conditions were diagnosed in two-thirds (65.1%) of stillbirth cases and in one in four stillbirth cases (n=73, 24.0%), the specific placental condition was classified as the main cause of death. Half of these 73 cases were due to either placental insufficiency (n=17), placental infarction (n=12) or fetal thrombotic vasculopathy (n=8). There were 25 stillbirths due to mechanical factors, all but one of which were due to the umbilical cord being around the baby's neck or another entanglement or knot in the umbilical cord. Antepartum or intrapartum haemorrhage was the main cause of death in 21 cases of stillbirth and placental abruption was involved in all of these cases. For the 16 stillbirths with infection as the main cause of death, most involved chorioamnionitis (n=11).

There were 69 stillbirths (22.7%) for which the cause of death was unexplained which is significantly lower than the proportion previously reported as unexplained using the Wigglesworth Classification System. For most of the stillbirths of unexplained cause (n=38, 55.1%), antecedents or associated obstetric factors were present but did not cause the death. In 30 cases (43.4%), it was reported that there were no antecedents or associated obstetric factors. For most of these 30 cases (n=20, 66.7%) an autopsy was offered but not performed. A detailed listing of the main cause of death for the 304 stillbirths is given at the end of this section of the report.

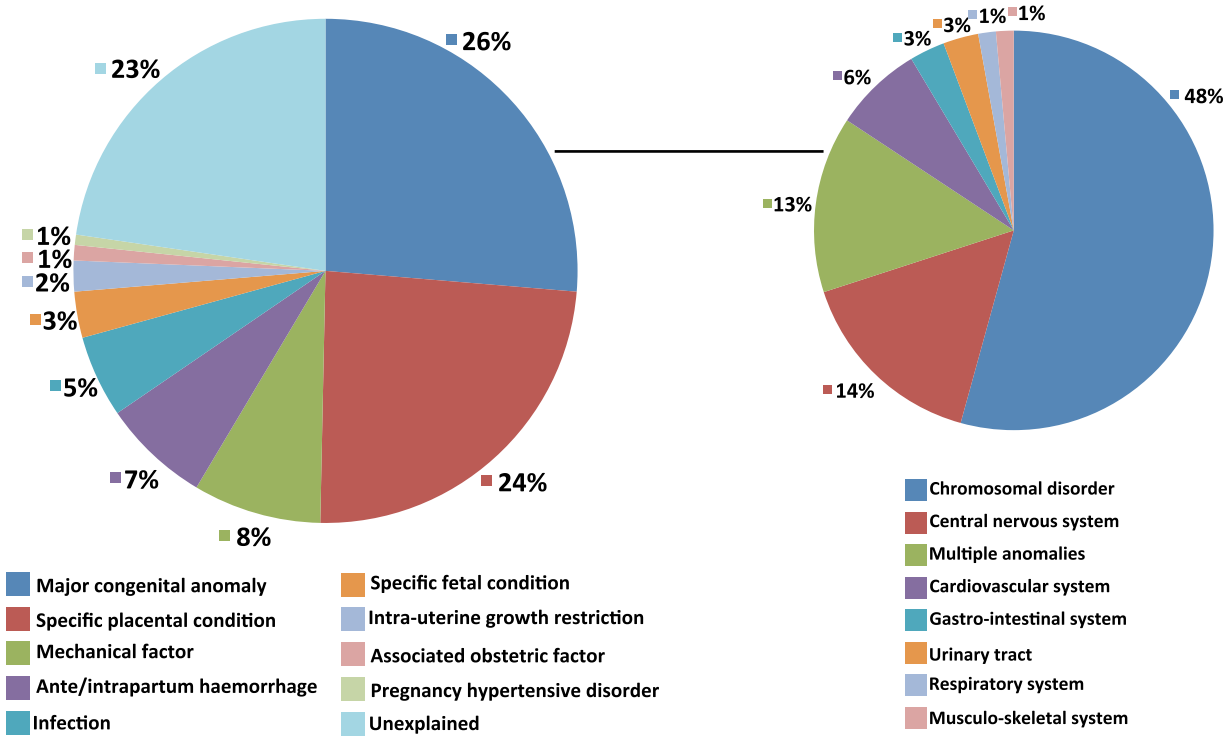



Figure 3.1: Primary cause of death in stillbirths (left-hand chart) and detailed cause in cases of major congenital anomaly (right-hand chart)

## Management of women experiencing antepartum stillbirths

Factors influencing the delivery management of women experiencing antepartum stillbirths include maternal choice, maternal wellbeing, risk of developing severe medical complications and previous obstetric history. Management of clinical care may involve planned induction of labour, awaiting spontaneous labour or in some cases elective delivery by caesarean section.[61]

In 2012, labour was induced for two-thirds of the 278 women experiencing antepartum stillbirth (n=184; 66.2%) whereas labour was spontaneous for 23.0% (n=64). It can be seen from Figure 3.2 that the time from diagnosis of fetal demise to delivery was different for women whose labour was induced than it was for women whose labour was spontaneous. The confirmation of death and delivery took place on the same day for half of the women whose labour was spontaneous. For women whose labour was induced, it was common for one to three days to pass between diagnosis and delivery.

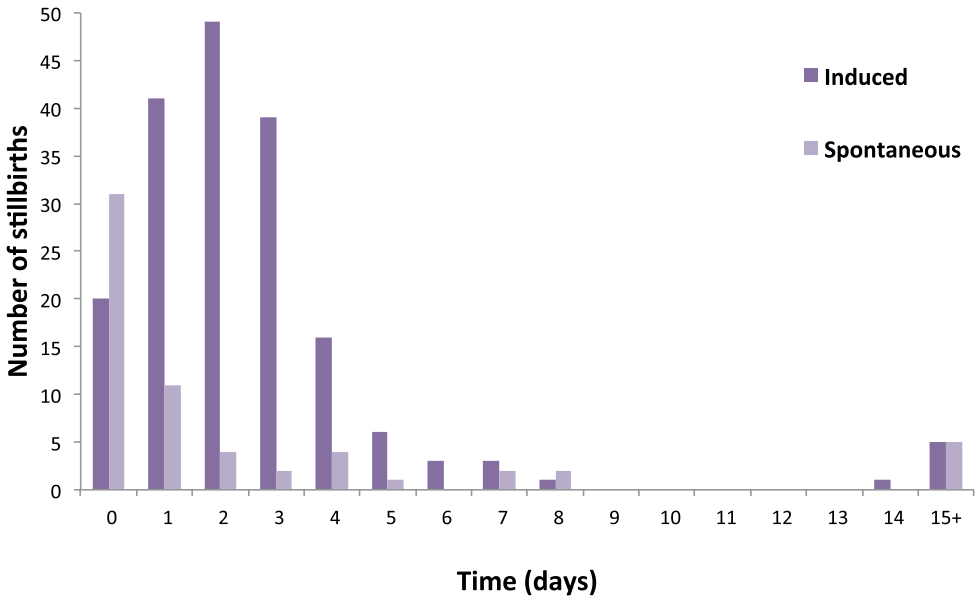



Figure 3.2: Time from confirmation of fetal demise to stillbirth delivery for women with induced and spontaneous labour

Vaginal birth is the recommended mode of delivery for most women experiencing antepartum stillbirth, but caesarean section may be clinically indicated in some cases.[61] Spontaneous vertex delivery was the mode of delivery in more than two-thirds of cases of antepartum stillbirth (69.4%) compared to three of the 15 cases of intrapartum stillbirth (20.0%).

In 27 cases of antepartum stillbirth (9.7%), the intended mode of delivery was a planned caesarean section and ultimately, caesarean section was the mode of delivery for 37 women (including 31 pre-labour caesarean sections and six caesarean sections performed after onset of labour).

Of the 37 women who were delivered by caesarean section, the indication for caesarean section was classified as an 'emergency' in almost 40% of the cases, 13.5% were classified as 'urgent' and almost half were classified as 'elective' (Table 3.1). Fifteen (40.5%) of the 37 women had a caesarean section previously, one in four (n=10, 27.0%) had a multiple delivery and seven (18.9%) had a placental abruption, all factors that may have influenced the mode of delivery.

61 Clinical Practice Guideline No 4 (2011). Investigation and management of late fetal intrauterine death and stillbirth: Institute of Obstetricians and Gynaecologists, Royal College of Physicians of Ireland and Directorate of Strategy and Clinical Programmes, Health Service Executive.

Table 3.1: Indication for caesarean section in women experiencing antenatal stillbirth in 2012

| Indication for caesarean section | n(%) |
|---|---|
| Elective: At a time to suit the woman or the maternity team | 18(48.6) |
| Urgent: Maternal or fetal compromise which is not immediately life threatening | 5(13.5) |
| Emergency: Immediate threat to life of woman or baby | 14(37.8) |

The location of delivery of antepartum stillbirths in all but two cases (n=276, 99.3%) was in obstetric-led maternity units. The two exceptions were born before arrival to hospital.

### Intrapartum stillbirths

It has been suggested that the comparatively low proportion of intrapartum stillbirths in high-income countries indicates that fetal deaths occurring in labour, in non-anomalous babies, are most likely preventable with quality intrapartum care.[62] Intrapartum deaths in this audit were identified by a specific question on the NPEC Perinatal Death Notification Form as to whether the baby was alive at the onset of care in labour. Thus, intrapartum deaths accounted for 4.9% of stillbirths in 2012 (Table 3.2). Comparable data showed that the proportion of stillbirths alive at the onset of care in labour was higher in Scotland at 8.6%.[63] In 11 (3.6%) cases of stillbirth it was not known if the baby was alive at the onset of care in labour and in three (27.3%) of these cases the baby was born before arrival to hospital.

Table 3.2: Life status of baby at the onset of care in labour for stillbirths in 2012

| | n(%) |
|---|---|
| Baby alive at onset of care in labour | 15(4.9%) |
| Baby not alive at onset of care in labour | 266(87.5%) |
| Never in labour | 12(3.9%) |
| Not known | 11(3.6%) |

Of the 15 intrapartum deaths, six (40.0%) were due to major congenital anomaly and six (40.0%) were due to chorioamnionitis or other ascending infection. Intra-uterine growth restriction and associated obstetric factors accounted for a further two cases. In only one case was the cause of death classified as unexplained. There was no clustering by hospital in the intrapartum deaths due to causes other than congenital anomaly. It was reported that a local hospital review was undertaken into half of the intrapartum deaths (7 of 13, 53.8%, unknown in two cases).

62 Darmstadt G, Yakoob M, Haws R, Menezes E, Soomro T and Bhutta Z. Reducing stillbirths: interventions during labour. BMC Pregnancy and Childbirth 2009;9 (Suppl 1):s6
63 Healthcare Improvement Scotland. (2014) Scottish Perinatal and Infant Mortality and Morbidity Report 2012. Edinburgh: NHS National Services Scotland.

Table 3.3: Stillbirth main cause of death in 2011 and 2012, NPEC Classification System

| Stillbirths | 2011 N=318 | 2012 N=304 |
|---|---|---|
| **Major congenital anomaly** | **81(25.5%)** | **80(26.3%)** |
| Central nervous system | 10 | 11 |
| Cardiovascular system | 10 | 5 |
| Respiratory system | - | 1 |
| Gastro-intestinal system | 3 | 2 |
| Musculo-skeletal system | 3 | 1 |
| Multiple anomalies | 10 | 10 |
| Chromosomal disorders | 39 | 38 |
| Metabolic disorders | - | - |
| Urinary tract | 2 | 2 |
| Other major congenital anomaly | 4 | 10 |
| **Infection** | **17(5.3%)** | **16(5.3%)** |
| Maternal | | |
| Bacterial | 1 | - |
| Syphilis | 1 | - |
| Viral diseases | - | 2 |
| Protozoal | - | - |
| Group B Streptococcus | 2 | 1 |
| Other maternal infection | - | - |
| Ascending infection | | |
| Chorioamnionitis | 13 | 11 |
| Other ascending infection | - | 2 |
| **Maternal disorder** | **6(1.9%)** | **0(0.0%)** |
| Pre-existing hypertensive disease | 1 | - |
| Diabetes | 2 | - |
| Other endocrine conditions | - | - |
| Thrombophilias | - | - |
| Obstetric cholestasis | - | - |
| Drug misuse | - | - |
| Uterine anomalies | 1 | - |
| Other maternal disorder | 2 | - |
| **Specific placental conditions** | **52(16.4%)** | **73(24.0%)** |
| Placental insufficiency | 18 | 17 |
| Fetal thrombotic vasculopathy | 7 | 8 |
| Placenta infarction | 6 | 12 |
| Massive perivillous fibrin deposition | - | - |
| Vasa praevia | - | 2 |
| Velementous insertion | 2 | - |
| Retroplacental Haemorrhage | - | 5 |
| Thrombosis in fetal circulation | - | 5 |
| Villitis | - | 4 |
| Other placental condition | 19 | 20 |

Table 3.3: Stillbirth main cause of death in 2011 and 2012, NPEC Classification System (Contd.)

| | 2011 | 2012 |
|---|---|---|
| **Mechanical** | **20(6.3%)** | **25(8.2%)** |
| Prolapse cord | 1 | 1 |
| Cord around neck | 8 | 14 |
| Other cord entanglement or knot | 11 | 10 |
| Uterine rupture before labour | - | - |
| Uterine rupture during labour | - | - |
| Mal-presentation - Breech | - | - |
| Mal-presentation - Face | - | - |
| Mal-presentation - Compound | - | - |
| Mal-presentation - Transverse | - | - |
| Mal-presentation - Other | - | - |
| Shoulder dystocia | - | - |
| **Associated obstetric factors** | **7(2.2%)** | **3(1.0%)** |
| Intracranial haemorrhage | - | - |
| Birth injury to scalp | - | - |
| Fracture | - | - |
| Other birth trauma | - | - |
| Intrapartum asphyxia | 5 | - |
| Polyhydramnios | - | - |
| Oligohydramnios | - | - |
| Premature rupture of membranes | - | - |
| Spontaneous premature labour | - | 2 |
| Other obstetric factors | 2 | 1 |
| **Hypertensive disorders of pregnancy** | **4(1.3%)** | **2(0.7%)** |
| Pregnancy induced hypertension | 1 | - |
| Pre-eclampsia toxaemia | 3 | 2 |
| HELLP syndrome | - | - |
| Eclampsia | - | - |
| **Antepartum or intrapartum haemorrhage** | **35(11.0%)** | **21(6.9%)** |
| Praevia | 2 | - |
| Abruption | 33 | 21 |
| Uncertain haemorrhage | - | - |
| **Specific fetal conditions** | **15(4.7%)** | **9(3.0%)** |
| Twin-twin transfusion | 5 | 4 |
| Feto-maternal haemorrhage | 5 | 2 |
| Non immune hydrops | 3 | - |
| Iso-immunisation | - | - |
| Other fetal condition | 2 | 3 |
| **Intra-uterine growth restriction** | **17(5.3%)** | **6(2.0%)** |
| IUGR - Suspected antenatally | 4 | 4 |
| IUGR - Observed at delivery | 7 | 1 |
| IUGR - Observed at post mortem | 6 | 1 |
| **Unexplained** | **64(20.1%)** | **69(22.7%)** |
| No antecedents or associated obstetric factors | 41 | 30 |
| Antecedents or associated obstetric factors present | 20 | 38 |
| Very limited information available | - | - |
| Pending post mortem or other investigation | 3 | 1 |

# 4. Early neonatal deaths: Specific findings

## Cause of early neonatal death

The cause of early neonatal deaths was classified using both the NPEC Neonatal Classification System and the NPEC Maternal and Fetal Classification System in order to identify both the primary neonatal condition causing the death and the underlying main antecedent or obstetric factor associated with the death.

Major congenital anomaly was the primary cause of death of half (n=68, 48.2%) of the 141 early neonatal deaths (Figure 4.1). Respiratory disorder was the only other common main cause of death, accounting for one in three (n=44, 31.2%) early neonatal deaths. Neurological disorder was the main cause in 9.9% of cases. Two deaths (1.4%) were unexplained. A detailed listing of the main cause of death for the 141 early neonatal deaths is given at the end of this section of the report.

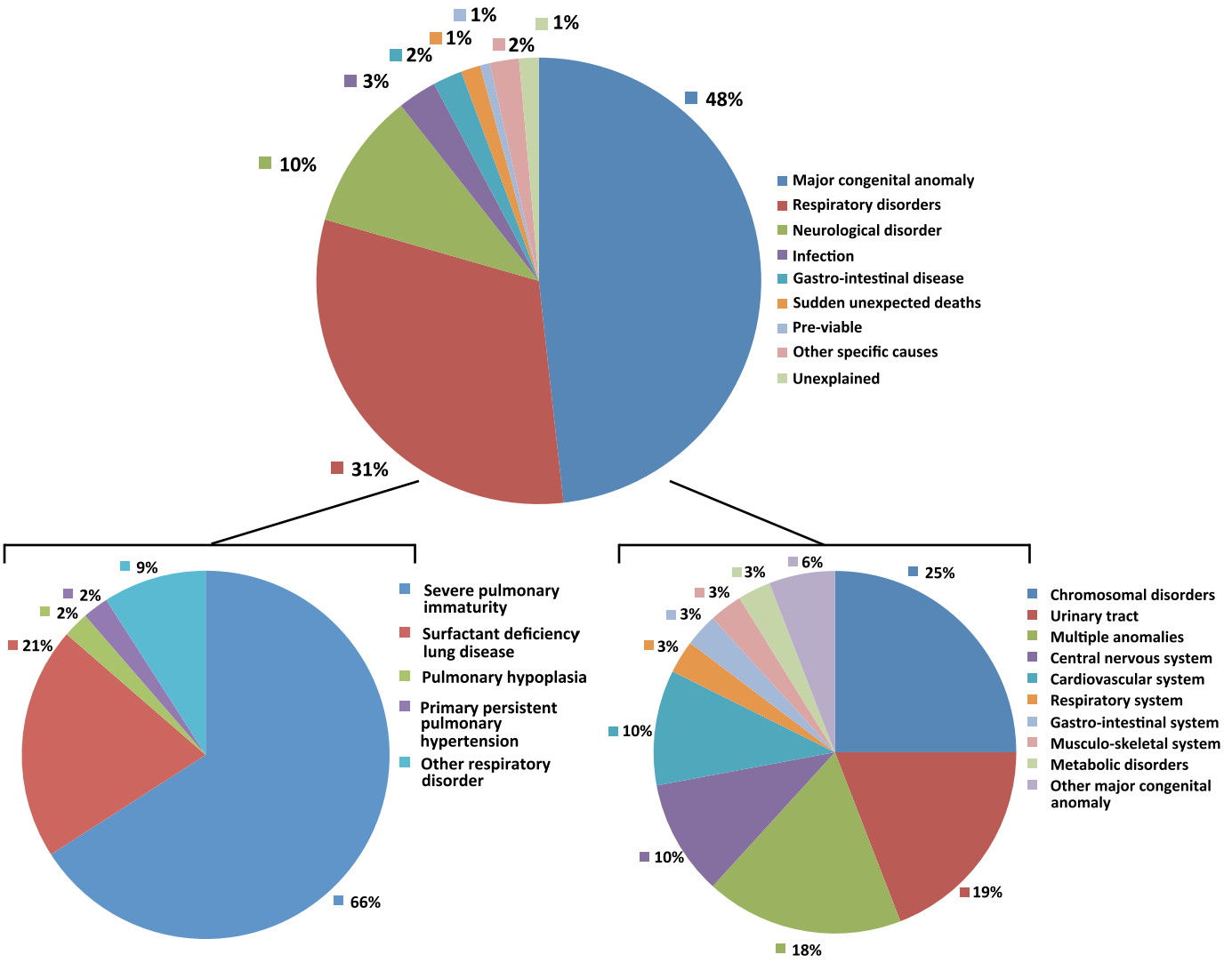



Figure 4.1: Primary cause of early neonatal death (upper chart) and detailed cause in cases of respiratory disorder (lower left-hand chart) and cases of major congenital anomaly (lower right-hand chart)

### Major congenital anomalies

The type of major congenital anomaly that caused 68 of the 141 neonatal deaths is illustrated in Figure 4.1. One in four were due to a chromosomal disorder (n=17, 25.0%), one in five (n=13, 19.1%) were due to anomalies related to the urinary tract and a similar proportion were due to multiple abnormalities. Central nervous system and cardiovascular system anomalies each accounted for a further 10% of these deaths. In neonatal deaths attributed to a chromosomal disorder, the diagnosis was made by cytogenetic analysis in three quarters of cases (n=13 of 17, 76.5%).

### Respiratory disorders

Of the 44 early neonatal deaths caused by respiratory disorder, two-thirds (n=29, 65.9%) were due to severe pulmonary immaturity. Surfactant deficiency lung disease caused nine neonatal deaths (Figure 4.1). All but five of the 44 early neonatal deaths attributed to respiratory disorder occurred in babies delivered between 22 and 27 weeks gestation (Table 4.1). This pattern of gestational age was in marked contrast with the early neonatal deaths due to major congenital anomaly and those due to other causes (Table 4.1).

Table 4.1: Gestational age distribution in neonatal deaths by broad main cause of death in 2012

| Broad main cause of death | <22 weeks | 22-27 weeks | 28-31 weeks | 32-36 weeks | 37-41 weeks | ≥42 weeks |
|---|---|---|---|---|---|---|
| Respiratory disorder | – | 39 | 4 | 1 | – | – |
| | | (88.6%) | (9.1%) | (2.3%) | | |
| Major congenital anomaly | – | 2 | 9 | 35 | 22 | – |
| | | (2.9%) | (13.2%) | (51.5%) | (32.4%) | |
| Other | 1 | 3 | 6 | 4 | 13 | 1 |
| | (3.6%) | (10.7%) | (21.4%) | (14.3%) | (46.4%) | (3.6%) |

### Neurological disorders

A neurological disorder was attributed as the main cause of 14 early neonatal deaths. For ten of these 14 cases, the condition involved was hypoxic ischaemic encephalopathy (HIE). Nine of the ten HIE cases occurred in babies with a gestational age of 37-41 weeks. An autopsy was performed in all but one of these neonatal deaths (n=8; unknown for one case) and seven were coroner cases. Table 4.2 details the gestational age, customised birthweight centile and main antecedent or obstetric factor associated with the 14 early neonatal deaths attributed to neurological disorders.

Table 4.2: Details of early neonatal deaths due to neurological disorders in 2012

| Neurological Disorder | Gestational age | Birthweight centile | Main antecedent or obstetric factor associated with the death |
|---|---|---|---|
| IVH/PVH | 24 | 52nd | Spontaneous premature labour |
| IVH/PVH | 26 | 90th | Spontaneous premature labour |
| HIE | 33 | 25th | Placental abruption |
| HIE | 37 | 8th | Placental disease |
| HIE | 40 | 48th | Placental disease |
| HIE | 40 | 74th | Placental disease |
| HIE | 39 | 89th | Unexplained |
| HIE | 41 | 51st | Unexplained |
| HIE | 41 | 64th | Unexplained |
| HIE | 38 | 49th | Ascending infection- chorioamnionitis |
| HIE | 40 | 66th | Nuchal cord |
| HIE | 38 | 3rd | Other maternal disorder |
| Other | 32 | 91st | Other maternal disorder |
| Other | 41 | 4th | Fracture |

Note: IVH/PVH = Intraventricular/periventricular haemorrhage; HIE = hypoxic ischaemic encephalopathy

## Condition and management at birth

The NPEC Perinatal Death Notification Form records the condition, in terms of respiratory activity and heart rate shortly after delivery, of babies who die in the neonatal period. For half of these babies (n=72, 51.1%), spontaneous respiratory activity was absent or ineffective at five minutes following delivery and for one third (n=49, 35.3%, unknown for two cases) the heart rate was persistently less than 100 beats per minute.

In two-thirds of the cases of early neonatal death, active resuscitation was offered in the delivery room (Table 4.3). In almost three quarters of the cases where active resuscitation was not offered (n=36, 70.6%) major congenital anomaly was the cause of death and a further 17.7% (n=9) were attributed to severe pulmonary immaturity or were pre-viable (<22 weeks gestation).

More than half of the babies were admitted to a neonatal unit in the hospital of delivery (Table 4.3). This varied depending on whether active resuscitation had been offered in the delivery room. Admission to a neonatal unit followed more than three quarters of the cases offered active resuscitation compared to one in four not offered active resuscitation. Twenty-four babies (17.1%) were transferred to another unit.

Table 4.3: Management of neonate at birth in babies who died within the first week of life

| Management | Active resuscitation offered * | | All |
|---|---|---|---|
| | Yes (89, 63.6%) | No (51, 36.4%) | 140 (100%) |
| Baby admitted to neonatal unit | 72 (81.8%) | 13 (25.5%) | 85 (61.2%) |
| Baby transferred to another unit | 15 (16.9%) | 9 (17.6%) | 24 (17.1%) |

*Active resuscitation in the delivery room includes BMV, PPV, intubation, cardiac massage.
Note: Information unknown for two cases.

### Age of neonate at death

Almost two thirds of the early neonatal deaths occurred within 24 hours of delivery (Table 4.4). Major congenital anomaly and severe pulmonary immaturity were the main cause of death in 51.2% (n=44) and 36.0% (n=31) of these cases, respectively.

Table 4.4: Age of neonate at death

| Completed days | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Number | 84 | 20 | 12 | 7 | 11 | 3 | 4 |
| % | 59.6 | 14.2 | 8.5 | 5.0 | 7.8 | 2.1 | 2.8 |
| Cumulative % | 59.6 | 73.8 | 82.3 | 87.2 | 95.0 | 97.2 | 100 |

### Location of neonatal death

The vast majority of early neonatal deaths occurred either in the labour ward or in the neonatal unit (Table 4.5). One in ten deaths occurred in a paediatric centre.

Table 4.5: Location of neonatal death

| Place of death | n(%) |
|---|---|
| Home* | 3(2.1%) |
| Labour ward | 43(30.5%) |
| Neonatal unit | 69(48.9%) |
| Ward of the maternity unit | 11(7.8%) |
| Paediatric centre | 15(10.6%) |

*These babies were delivered in a maternity unit.

All 43 neonatal deaths that occurred in the labour ward occurred within 24 hours of delivery. These 43 deaths in the labour ward accounted for half (51.2%) of the 84 neonatal deaths that occurred in the first day. A further 36.9% (n=31) first day neonatal deaths occurred in a neonatal unit. As detailed in Table 4.4, the daily number of neonatal deaths was significantly lower once 24 hours had elapsed after delivery. Two-thirds of the neonatal deaths after 1-6 completed days happened in a neonatal unit (n=38 of 57, 66.7%) and a further one in five of these deaths (n=12, 21.1%) happening in a paediatric centre (Figure 4.2).

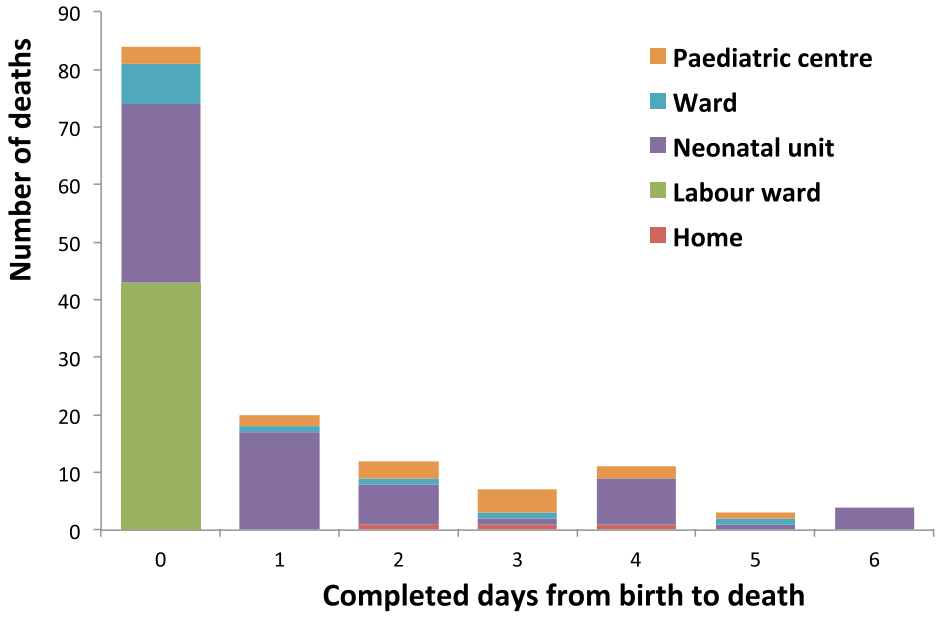



Figure 4.2: Place of neonatal death 0-6 complete days after birth

## Early neonatal deaths <500g birthweight and <24 weeks gestation

While not included in the calculation of perinatal mortality rates, we ask for notification of deaths in the early neonatal period of babies born before 24 weeks gestation and weighing less than 500g. For 2012, 20 such deaths were reported by four maternity units. These maternity units accounted for almost 40% of births in Irish maternity units in 2012. Using this proportion would give a national estimate for 2012 of 50 early neonatal deaths of babies born before 24 weeks gestation with a birthweight less than 500g.

Using the NPEC Neonatal Classification System, the assigned cause of death was pre-viable (<22 weeks) for 12 cases, severe pulmonary immaturity for seven cases and pneumonia for one case. Based on the NPEC Maternal and Fetal Classification System, the antecedent or associated obstetric factors in these 20 early neonatal deaths were ascending infection (n=8), premature rupture of membranes (n=6), spontaneous premature labour (n=3), twin-twin transfusion (n=2) and other placental condition (n=1).

The birthweights of the babies were in the range 240-485g and their gestation at delivery was 19-23 weeks. There was strong evidence of fetal growth restriction based on the customised birthweight centiles calculated for 19 of the 20 babies. All but two (n=17, 89.5%) were small-for-gestational-age (SGA; <10th centile) and 16 (84.2%) were severely SGA (<3rd centile). All died within 24 hours of being delivered and all but one died in the labour ward. For 17 of the 20 babies (85.0%), spontaneous respiratory activity was absent or ineffective at five minutes following delivery and the heart rate was also persistently less than 100 beats per minute. Active resuscitation was not offered in the delivery room and none were admitted to the neonatal unit.

Information about autopsy was reported for 17 of the 20 deaths. An autopsy was performed in four cases, an offer of autopsy was made in another six cases and there were seven cases where an autopsy was not offered. Placental histology examination was conducted for 19 of the 20 deaths (unknown for one case).

Table 4.6: Early neonatal main cause of death in 2011 and 2012, NPEC Classification System

| | 2011 N=138 | 2012 N=141 |
|---|---|---|
| **Major congenital anomaly** | **71(51.4%)** | **68(48.2%)** |
| Central nervous system | 15 | 7 |
| Cardiovascular system | 8 | 7 |
| Respiratory system | 2 | 2 |
| Gastro-intestinal system | 2 | 2 |
| Musculo-skeletal system | 2 | 2 |
| Multiple anomalies | 8 | 12 |
| Chromosomal disorders | 20 | 17 |
| Metabolic disorders (in-born errors of metabolism) | 1 | 2 |
| Urinary tract | 6 | 13 |
| Other major congenital anomaly | 7 | 4 |
| **Pre-viable (<22 weeks)** | **-** | **1(0.7%)** |
| **Respiratory disorders** | **45(32.6%)** | **44(31.2%)** |
| Severe pulmonary immaturity | 39 | 29 |
| Surfactant deficiency lung disease | - | 9 |
| Pulmonary hypoplasia | 3 | 1 |
| Meconium aspiration syndrome | - | - |
| Primary persistent pulmonary hypertension | - | 1 |
| Chronic lung disease/bronchopulmonary dysplasia | - | - |
| Other respiratory disorder | 3 | 4 |
| **Gastro-intestinal disease** | **1(0.7%)** | **3(2.1%)** |
| Necrotising enterocolitis | 1 | 2 |
| Other gastro-intestinal disease | - | 1 |
| **Neurological disorder** | **7(5.1%)** | **14(9.9%)** |
| Hypoxic-ischaemic encephalopathy | 6 | 10 |
| Intraventricular/periventricular haemorrhage | - | 2 |
| Other neurological disorder | 1 | 2 |
| **Infection** | **6(4.3%)** | **4(2.8%)** |
| Sepsis | 4 | 2 |
| Pneumonia | - | 1 |
| Meningitis | - | - |
| Other infection | 2 | 1 |
| **Injury/Trauma** | **-** | **-** |
| **Other specific causes** | **2(1.4%)** | **3(2.1%)** |
| Malignancies/tumours | - | - |
| Other specific cause | 2 | 3 |
| **Sudden unexpected deaths** | **1(0.7%)** | **2(1.4%)** |
| SIDS | 1 | 2 |
| Infant Deaths - Cause Unascertained | - | - |
| **Unexplained** | **5(3.6%)** | **2(1.4%)** |
| No antecedents or associated obstetric factors | - | 1 |
| Antecedents or associated obstetric factors present | - | - |
| Very limited information available | 5 | - |
| Pending post mortem or other investigation | - | 1 |

# 5. Perinatal deaths associated with intrapartum events

The investigation of perinatal deaths due to intrapartum events is valuable in assessing quality of care. These deaths are unexpected and include stillbirths alive at the onset of professional care in labour and neonatal deaths. Traditionally intrapartum deaths referred to babies who were alive at onset of labour but stillborn. The inclusion of neonatal deaths facilitates the assessment of all perinatal deaths that may have an intrapartum origin.

We reviewed perinatal deaths reported for 2011 and 2012 focusing on babies with a gestational age of at least 34 weeks and a normal birthweight (2,500-4,500g) whose death was not due to major congenital anomaly, infection or placental abruption. In total, there were 24 such deaths suggesting a rate of 0.16 per 1,000 births (95% confidence interval: 0.10-0.23 per 1,000) or one in 6,084 births in Ireland. The gestation at delivery was at least 37 weeks for all 24 babies and the deaths occurred in 11 of the 20 maternity units operating in the country in 2011 and 2012. While the numbers are too small to draw conclusions, no maternity unit had an outlying rate.

Eleven deaths occurred in 2011 (six stillbirths and five early neonatal deaths) and 13 in 2012 (two stillbirths and 11 early neonatal deaths). While the 13 deaths accounted for just 2.9% of the 445 perinatal deaths reported to this audit for 2012, they accounted for one in eight (12.3%) of the 106 cases of perinatal death with normal birthweight and gestation of at least 37 weeks. A post mortem was undertaken for all but one of the 13 deaths in 2012 and ten became coroner cases. Details of the 13 deaths in 2012 are provided in Table 5.1.

Table 5.1: Details of perinatal deaths in 2012 associated with intrapartum events

| Type of perinatal death | Gestational age (weeks) | Birthweight centile | Main antecedent or obstetric factor associated with the death | Neonatal cause of death |
|---|---|---|---|---|
| SB | 40 | 24th | Unexplained[1] | Not applicable |
| SB | 41 | 49th | Intrapartum uterine rupture, previous caesarean section | Not applicable |
| ENND | 39 | 89th | Unexplained[1] | HIE |
| ENND | 40 | 48th | Other placental condition | HIE |
| ENND | 41 | 14th | Unexplained[2] | Unexplained[2] |
| ENND | Unknown | Unknown | Unbooked, born at home | Unexplained[3] |
| ENND | 39 | 63rd | Unexplained[1] | SIDS |
| ENND | 41 | 64th | Unexplained[1] | HIE |
| ENND | 41 | 51st | Unexplained[1] | HIE |
| ENND | 41 | 4th | Birth trauma | Intracranial haemorrhage |
| ENND | 38 | 3rd | Non-obstetric maternal haemorrhage | HIE |
| ENND | 40 | 66th | Nuchal cord | HIE |
| ENND | 40 | 74th | Other placental condition | HIE |

Note: SB=Stillbirth; ENND=Early neonatal death; Unexplained1=no antecedents or associated obstetric factors; Unexplained2=pending results of post mortem or further information; Unexplained3=some antecedents or associated obstetric factors; HIE=hypoxic ischaemic encephalopathy; SIDS=Sudden Infant Death Syndrome

# 6. Late neonatal deaths: Specific findings

Data relating to 40 late neonatal deaths occurring in 2012 were reported to the NPEC for the purposes of this clinical audit. At the time of writing finalised figures for late neonatal deaths in 2012 were not yet published by the Central Statistics Office. In the five most recent years for which data are available, 2007-2011, the annual number of late neonatal deaths fluctuated between 29 and 41 with no discernible trend. Thus, the number of late neonatal deaths reported to the NPEC is consistent with the CSO figures for recent years. However, maternity hospitals may not be notified of the late neonatal death of a baby delivered in their unit if the baby was transferred to a paediatric unit or discharged home. The NPEC is working with colleagues in the relevant hospitals (maternity and paediatric) to address this issue.

Given the notification issue and the limited number of late neonatal deaths reported, this section of the report provides a brief summary of the submitted data as well as the detailed listing of the main cause of the 40 deaths according to the NPEC Classification System.

Similar to early neonatal deaths, the most common cause of late neonatal death was major congenital anomaly (n=15, 37.5%) and the next most common cause was respiratory disorder (n=9, 22.5%), specifically severe pulmonary immaturity. For just two (5.0%) of the late neonatal deaths the main cause of death was unexplained.

Table 6.1 describes a range of characteristics of the babies who died in the late neonatal period. There were similar proportions of male (n=18, 45.0%) and female (n=22, 55.0%) babies among those who died in the late neonatal period. This is in contrast with 2011 when three quarters of the babies were male (n=26 of 35, 74.3%).

Most of the babies who died in the late neonatal period in 2012 were born by spontaneous vertex delivery (n=22, 55.0%); 35.0% (n=14) were delivered by caesarean section. Almost half (n=18, 45.0%) had a gestational age of 37 weeks or more at birth but two-thirds (n=27, 67.5%) had a birthweight less than 2,500 grams. More than 40% of the babies were small for gestational age (SGA; <10th centile) and one in three were severely SGA (<3rd centile).

The proportion of late neonatal deaths decreased across the second (57.5%), third (25.0%) and fourth (17.5%) weeks of life. This pattern was also observed in 2011 when 42.9%, 28.6% and 22.9% of late neonatal deaths occurred in weeks two, three and four, respectively.

In 2012, seven of the babies died at home or in transit home (17.5%), almost half (n=18, 45.0%) died in the neonatal unit and one third died in a paediatric centre (n=14, 35.0%). Respectively, 8.6%, 45.7% and 45.7% of late neonatal deaths in 2011 occurred at home, in the neonatal unit and in a paediatric centre.

Table 6.1: Characteristics of late neonatal deaths, 2012

| | N=40 |
|---|---|
| **Infant sex** | |
| Male | 18 (45.0) |
| Female | 22 (55.0) |
| **Mode of delivery** | |
| Spontaneous vertex delivery | 22 (5.0) |
| Pre-labour caesarean section | 10 (25.0) |
| Caesarean section after onset of labour | 4 (10.0) |
| Forceps | 1 (2.5) |
| Assisted breech | 2 (5.0) |
| Ventouse | 1 (2.5) |
| **Gestational age at delivery** | |
| 22-27 weeks | 15 (37.5) |
| 28-31 weeks | 1 (2.5) |
| 32-36 weeks | 6 (15.0) |
| 37-41 weeks | 18 (45.0) |
| **Birthweight** | |
| 500<1000g | 16 (40.0) |
| 1000<1500g | - |
| 1500<2000g | 5 (12.5) |
| 2000<2500g | 6 (15.0) |
| 2500<3000g | 5 (12.5) |
| 3000<3500g | 4 (10.0) |
| 3500<4000g | 1 (2.5) |
| 4000g+ | 3 (7.5) |
| **Customised birthweight centile category** | |
| Zero | 10 (25.0) |
| <3rd | 13 (32.5) |
| <10th | 17 (42.5) |
| 10-49th | 13 (32.5) |
| 50-89th | 6 (15.0) |
| 90th+ | 4 (10.0) |
| **Timing of death** | |
| 2nd week of life | 23 (57.5) |
| 3rd week of life | 10 (25.0) |
| 4th week of life | 7 (17.5) |
| **Location of death** | |
| Home (after delivery in a maternity unit) | 6 (15.0) |
| Ward of the maternity unit | 1 (2.5) |
| Neonatal unit | 18 (45.0) |
| In transit home | 1 (2.5) |
| Paediatric centre | 14 (35.0) |

Table 6.2: Late neonatal main cause of death in 2011 and 2012, NPEC Classification System

| | 2011 N=35 | 2012 N=40 |
|---|---|---|
| **Major congenital anomaly** | **20(57.1%)** | **15(37.5%)** |
| Central nervous system | 2 | 2 |
| Cardiovascular system | 5 | 5 |
| Respiratory system | 1 | 1 |
| Gastro-intestinal system | 1 | - |
| Musculo-skeletal system | 1 | - |
| Multiple anomalies | 1 | 2 |
| Chromosomal disorders | 6 | 4 |
| Metabolic disorders | - | - |
| Urinary tract | - | - |
| Other major congenital anomaly | 3 | 1 |
| **Pre-viable (<22 weeks)** | **-** | **-** |
| **Respiratory disorders** | **5(14.3%)** | **9(22.5%)** |
| Severe pulmonary immaturity | 5 | 5 |
| Surfactant deficiency lung disease | - | 1 |
| Pulmonary hypoplasia | - | - |
| Meconium aspiration syndrome | - | - |
| Primary persistent pulmonary hypertension | - | - |
| Chronic lung disease/bronchopulmonary dysplasia | - | - |
| Other respiratory disorder | - | 3 |
| **Gastro-intestinal disease** | **2(5.7%)** | **6(15.0%)** |
| Necrotising enterocolitis | 2 | 5 |
| Other gastro-intestinal disease | - | 1 |
| **Neurological disorder** | **2(5.7%)** | **1(2.5%)** |
| Hypoxic-ischaemic encephalopathy | 1 | - |
| Intraventricular/periventricular haemorrhage | - | - |
| Other neurological disorder | 1 | 1 |
| **Infection** | **4(11.4%)** | **4(10.0%)** |
| Sepsis | 4 | 3 |
| Pneumonia | - | - |
| Meningitis | - | - |
| Other infection | - | 1 |
| **Injury/Trauma** | **-** | **-** |
| **Other specific causes** | **-** | **-** |
| Malignancies/tumours | - | - |
| Other specific cause | - | - |
| **Sudden unexpected deaths** | **-** | **3(7.5%)** |
| SIDS | - | 3 |
| Infant Deaths - Cause Unascertained | - | - |
| **Unexplained** | **2(5.7%)** | **2(5.0%)** |
| No antecedents or associated obstetric factors | - | - |
| Antecedents or associated obstetric factors present | - | - |
| Very limited information available | 2 | 2 |
| Pending post mortem or other investigation | - | - |

# Appendix A: Perinatal Mortality Group members

**Ms Bridget Boyd,** Assistant Director of Midwifery, Coombe Women & Infants University Hospital
*Nominated by Elizabeth Adams, Deputy Nursing Services Director, HSE*
**Dr David Corcoran,** Consultant Neonatologist, Rotunda Hospital
*Nominated by the Faculty of Paediatrics*
**Dr Patricia Crowley,** Consultant Obstetrician/Gynaecologist, Coombe Women & Infants University Hospital
*Nominated by the Institute of Obstetricians & Gynaecologists, RCPI*
**Dr Elizabeth Dunn,** Consultant Obstetrician/Gynaecologist, Wexford General Hospital
*Nominated by the Institute of Obstetricians & Gynaecologists, RCPI*
**Dr Siobhan Gormally,** Consultant Paediatrician Our Lady of Lourdes Hospital
*Nominated by Martin White of the Faculty of Paediatrics, RCPI*
**Ms Oonagh McDermott,** Assistant Director of Midwifery, Sligo General Hospital
*Nominated by Elizabeth Adams, Deputy Nursing Services Director, HSE*
**Dr Eoghan Mooney,** Consultant Pathologist, National Maternity Hospital
*Nominated by the Faculty of Pathology, RCPI*
**Ms May Quirke,** Assistant Director of Midwifery, Tralee General Hospital
*Nominated by Elizabeth Adams, Deputy Nursing Services Director, HSE*
**Ms Ann Rath,** Clinical Midwife Manager 3, National Maternity Hospital
*Nominated by Elizabeth Adams, Deputy Nursing Services Director, HSE*
**Dr John Slevin,** Consultant Obstetrician/Gynaecologist, Midwestern Regional Maternity Hospital Limerick
*Nominated by the Institute of Obstetricians & Gynaecologists, RCPI*
**Dr Anne Twomey,** Consultant Neonatologist, National Maternity Hospital
*Nominated by the Faculty of Paediatrics, RCPI*
**Ms Patricia Williamson,** Assistant Director of Midwifery, Rotunda Hospital
*Nominated by Elizabeth Adams, Deputy Nursing Services Director, HSE*
**Prof Richard Greene,** Consultant Obstetrician/Gynaecologist, Cork University Maternity Hospital
*Chair, Director of the National Perinatal Epidemiology Centre*
**Ms Edel Manning,** Research Midwife, National Perinatal Epidemiology Centre
*Perinatal Mortality Project Manager*
**Ms Jennifer Lutomski,** Epidemiologist, National Perinatal Epidemiology Centre
*National Perinatal Epidemiology Centre contributor*
**Mr Paul Corcoran PhD,** Senior Lecturer in Perinatal Epidemiology, National Perinatal Epidemiology Centre
*National Perinatal Epidemiology Centre contributor*
**Ms Sarah Meaney,** Health Promotion Research Officer, National Perinatal Epidemiology Centre
*National Perinatal Epidemiology Centre contributor*

# Appendix B: Hospital co-ordinators and contributors

| Hospital | Co-ordinators | Additional contributors |
|---|---|---|
| **Cavan General Hospital** | Dr Rukhsana Majeed, Ms Evelyn McAdam | Dr Salah Aziz,Ms Margaret Mulvany, Ms Joanne McGrath, Ms Karen Malocca |
| **Coombe Women and Infants University Hospital** | Dr Chris Fitzpatrick | |
| **Cork University Maternity Hospital** | Ms Katie Burke, Ms Rhiona Cotter, Ms Siobhan Foley | Dr Keelin O'Donoghue, Dr Brendan Murphy |
| **Kerry General Hospital, Tralee** | Ms Claire Fleming Kelliher, Ms Mary Stack Courtney | |
| **Letterkenny General Hospital** | Ms Raphael Dalton, Ms Mary Doherty, Ms Geraldine Hanley, Ms Mary Lynch | Ms Evelyn Smith |
| **Mayo General Hospital, Castlebar** | Ms Pauline Corcoran, Ms Diane Brady | Dr Hilary Ikele, Dr Meabh Ní Bhuinneain |
| **Midland Regional Hospital, Mullingar** | Ms Marie Corbett | |
| **Midland Regional Hospital, Portlaoise** | Ms Ita Kinsella, Ms Michelle Mahon | |
| **Mid-Western Regional Maternity Hospital, Limerick** | Ms Sandra O'Connor, Ms Margo Dunworth | Ms Margaret Quigley |
| **Mount Carmel Hospital, Dublin** | Ms Catherine Halloran, Ms Felicity Doddy | Dr Valerie Donnelly |
| **National Maternity Hospital, Dublin** | Ms Geraldine Duffy, Ms Fionnuala Byrne | Dr Rhona Mahony Dr Eoghan Mooney |
| **Our Lady of Lourdes Hospital, Drogheda** | Ms Anne Keating | Dr Seosamh Ó Cóigligh |
| **Portiuncula Hospital, Ballinasloe** | Ms Mairead Hynes, Ms Karen Leonard | |
| **Rotunda Hospital, Dublin** | Ms Ruth Ritchie, Ms Aileen Murphy | Dr Sam Coulter Smith |
| **Sligo General Hospital** | Ms Juliana Henry | Dr Heather Langan |
| **South Tipperary General Hospital, Clonmel** | Ms Siobhan Kavanagh | |
| **St Luke's Hospital, Kilkenny** | Ms Connie McDonagh | |
| **University Hospital Galway** | Ms Marie Hession | |
| **Waterford Regional Hospital** | Ms Margaret Coe, Ms Emer Denn Ms Paula Curtin, | |
| **Wexford General Hospital** | Ms Helen McLoughlin | |

# Appendix C: Perinatal Death Notification Form 2011

NATIONAL PERINATAL EPIDEMIOLOGY CENTRE

**For NPEC Office use only:**
**CODE FOR CASE**

**PLACE OF DEATH:**

## PERINATAL DEATH NOTIFICATION FORM

## 2012

**CHOOSE Type of Case** *(TICK)*

☐ **STILLBIRTH:** *A baby delivered without signs of life* from 24 weeks' gestation and/or with a birth weight of ≥ 500g.

*If the birth occurred unattended and there was no lung aeration seen at Post Mortem (PM) and no other circumstantial evidence of life at birth, it should be assumed that the baby was stillborn.

**OR**

☐ **EARLY NEONATAL DEATH:** *Death of a live born baby occurring before 7 completed days after birth.*

**OR**

☐ **LATE NEONATAL DEATH:** *Death of a live born baby occurring from the 7th day and before 28 completed days after birth.*

* For the purpose of reporting, a 'live born' baby is defined as any baby born with evidence of life such as breathing movements, presence of a heart beat, pulsation of the cord or definite movement of voluntary muscles.

**If a baby born at <22 completed weeks is being registered as a neonatal death, please report same to NPEC.**

The National Perinatal Epidemiology Centre is sincerely grateful for your contribution to this audit.

Guidance for completing this form, with specific reference to Sections 11, 12 and 13 on Cause of Death, is outlined in the accompanying reference manual.

The National Perinatal Epidemiology Centre also acknowledges with thanks the Centre for Maternal and Child Enquiry (CMACE) UK for permission to modify and use its Perinatal Mortality Notification Proforma for use in the Irish context.

1

## SECTION 1. WOMANS' DETAILS

**1.1. Mother's age** ☐☐

**1.2. Ethnic group:**

☐ White - Irish ☐ Irish Traveller

☐ Any other White background ☐ Please specify country of origin _____

☐ Asian or Asian Irish ☐ Black or Black Irish

☐ Other including mixed ethnic backgrounds: Please specify _____

☐ Not recorded

**1.3. What was the woman's occupation at booking?**

_____

**1.4. What was the occupation of the woman's partner at booking?**

_____

**1.5. Level of education completed by this woman:**

☐ Primary or less ☐ Secondary ☐ Third Level ☐ Unknown

**1.6. Height at booking (round up to the nearest cm):** ☐☐☐

**1.7. Weight at booking (round up to the nearest kg):** ☐☐☐

If weight is unavailable, was there evidence that the woman was too heavy for hospital scales? ☐ Yes ☐ No

**1.8. Body Mass Index at booking (BMI):** ☐☐.☐

**1.9.a. Did the woman smoke at booking?** ☐ Yes, specify quantity smoked per day_____

☐ No ☐ Unknown

**1.9.b. Did she give up smoking during pregnancy?** ☐ Yes ☐ No ☐ Unknown ☐ N/A

**1.10. Is there documented history of alcohol abuse?**

☐ None recorded ☐ Prior to this pregnancy ☐ During this pregnancy

**1.11. Is there documented history of drug abuse or attendance at a drug rehabilitation unit?**

☐ None recorded ☐ Prior to this pregnancy ☐ During this pregnancy

## SECTION 2. PREVIOUS PREGNANCIES

**2.1. Did the woman have any previous pregnancies?** *If yes, please complete questions 2.2-2.4* ☐ Yes ☐ No

**2.2. No. of completed pregnancies ≥24 weeks and or with a birth weight ≥ 500g (all live and stillbirths):** ☐☐

**2.3. No. of pregnancies <24 weeks and with a birth weight < 500g:** ☐☐

**2.4. Were there any previous pregnancy problems?** *If yes, please tick all that apply below* ☐ Yes ☐ No

☐ Three or more miscarriages ☐ Pre-term birth or mid trimester loss ☐ Stillbirth, *please specify number* ☐

☐ Infant requiring intensive care ☐ Baby with congenital anomaly ☐ Neonatal death, *please specify number* ☐

☐ Previous caesarean section ☐ Placenta praevia ☐ Placental abruption

☐ Pre-eclampsia (hypertension & proteinuria) ☐ Post-partum haemorrhage requiring transfusion

☐ Other, please specify_____ ☐ Unknown

## SECTION 3. PREVIOUS MEDICAL HISTORY

**3.1. Were there any pre-existing medical problems?** *If yes, please tick all that apply below* ☐ Yes ☐ No ☐ Unknown

☐ Cardiac disease (congenital or acquired) ☐ Epilepsy

☐ Endocrine disorders e.g. hypo or hyperthyroidism ☐ Renal disease

☐ Haematological disorders e.g. sickle cell disease ☐ Psychiatric disorders

☐ Inflammatory disorders e.g. inflammatory bowel disease ☐ Hypertension

☐ Diabetes ☐ Other, please specify _____

## SECTION 4. THIS PREGNANCY

**4.1. Final Estimated Date of Delivery (EDD):** ☐☐/☐☐/☐☐ ☐ Unknown

Use best estimate *(ultrasound scan or date of last menstrual period)* based on a 40 week gestation, or the final date agreed in the notes.

**4.2. Was this a multiple pregnancy at the onset of pregnancy?** ☐ Yes ☐ No

**4.3. Date of first booking appointment:** ☐☐/☐☐/☐☐ ☐ Not booked

**4.4. Intended place of delivery at booking:** Name of unit _____

*Please specify the type of unit*

☐ Obstetric Unit ☐ Alongside Midwifery Unit ☐ Home ☐ Unbooked

**4.5. What was the intended type of delivery care at booking?**

☐ Obstetric-Led Care ☐ Midwifery-Led Care ☐ Self-Employed Community Midwife

☐ Home c/o Hospital DOMINO Scheme

## SECTION 5. DELIVERY

**5.1. Onset of labour:**

☐ Spontaneous ☐ Induced ☐ Never in labour

**5.2. Intended place of delivery at onset of labour:** Name of unit _____

*Please specify the type of unit*

☐ Obstetric Unit ☐ Alongside Midwifery Unit ☐ Home

**5.3. What was the intended type of care at onset of labour?**

☐ Obstetric-Led Care ☐ Midwifery-Led Care ☐ Self-Employed Community Midwife

☐ Home c/o Hospital DOMINO Scheme

**5.4. Was the intended mode of delivery a planned caesarean section?** ☐ Yes ☐ No

**5.5. Place of delivery:** Name of unit _____

*Please specify the type of unit*

☐ Obstetric Unit ☐ Alongside Midwifery Unit ☐ Home

**5.6. What was the type of care at delivery?**

☐ Obstetric-Led Care ☐ Midwifery -Led Care ☐ Born Before Arrival (BBA) - Unattended

☐ Self-Employed Community Midwife ☐ Home c/o Hospital DOMINO Scheme

**5.7. Date and time of delivery/birth:** **Date:** ☐☐/☐☐/☐☐ **Time:** ☐☐:☐☐

**5.8. What was the presentation *at full dilation*?**

☐ Vertex ☐ Breech ☐ Compound *(includes transverse and shoulder presentations)* ☐ Brow ☐ Face

**5.9. What was the presentation *at delivery*?**

☐ Vertex ☐ Breech ☐ Compound *(includes transverse and shoulder presentations)* ☐ Brow ☐ Face

**5.10. What was the mode of delivery?** (Please tick all that apply)

☐ Spontaneous Vaginal ☐ Ventouse ☐ Lift-Out Forceps ☐ Mid-Cavity Forceps ☐ Rotational Forceps

☐ Assisted Breech delivery ☐ Pre-Labour Caesarean Section ☐ Caesarean Section After Onset of Labour

**CAESAREAN SECTIONS ONLY**

**5.11. What was the type of *or* indication for Caesarean Section?**

☐ Elective - At a time to suit woman or maternity team ☐ Urgent - Maternal or fetal compromise which is not immediately life threatening

☐ Emergency - Immediate threat to life of woman or fetus ☐ Failed instrumental delivery

## SECTION 6. ALL BABY OUTCOME

**6.1. Sex of fetus/baby:** ☐ Male ☐ Female ☐ Indeterminate

**6.2. Number of fetuses/babies in this delivery:** *(all identifiable including papyraceous)* ☐

**Birth order of this fetus/baby:**

☐ Singleton

☐ Twin 1 ☐ Twin 2

☐ Triplet 1 ☐ Triplet 2 ☐ Triplet 3

☐ Other multiple birth pregnancy, please specify_____ Birth Order ☐

**6.3. If from a multiple delivery, what was the chorionicity?** *Please tick all that apply*

☐ Dichorionic diamniotic ☐ Monochorionic diamniotic ☐ Monochorionic monoamniotic ☐ Trichorionic ☐ Not known

**6.4. Birth weight (kg):** ☐.☐☐☐

**6.5. Gestation at delivery:** ☐☐ weeks + ☐ days ☐ Unknown

**6.6. Was this a termination of pregnancy?** ☐ Yes ☐ No

*Please refer to the reference manual, page 2*

**INTRAPARTUM-RELATED EVENTS ONLY**

**6.7. Was a local hospital review of this case undertaken?** ☐ Yes ☐ No

## SECTION 7. MATERNAL OUTCOME

**7.1. Admission to HDU:** ☐ Yes ☐ No

**7.2. Admission to ICU:** ☐ Yes ☐ No

**7.3. Maternal Death:** ☐ Yes ☐ No

## SECTION 8. STILLBIRTH (If not a stillbirth, please go to Section 9)

**8.1. At what gestation was death confirmed to have occurred?** ☐☐ weeks + ☐ days

If known, what date was death confirmed? ☐☐/☐☐/☐☐

**8.2. Was the baby alive at *onset of care* in labour?**

☐ Yes ☐ No ☐ Never In Labour ☐ Unattended ☐ Unknown

## SECTION 9. NEONATAL DEATH ONLY

**9.1. Was spontaneous respiratory activity absent or ineffective at 5 minutes?** ☐ Yes ☐ No

If a baby is receiving any artificial ventilation at 5 minutes, the assumption is absent/ineffective activity: a 0 Apgar score indicates absent activity.

**9.2. Was the heart rate persistently <100bpm? ( i.e. heart rate never rose above 100bpm before death)**

☐ Persistently <100bpm ☐ Rose above 100bpm

**9.3. Was the baby offered *active resuscitation in the delivery room?** ☐ Yes ☐ No

(*active resuscitation includes BMV, PPV, intubation, cardiac massage)

**9.4. Was the baby admitted to a neonatal unit?** (Includes SCBU and ICU) ☐ Yes ☐ No

**9.5. Was the baby transferred to another unit after birth?** ☐ Yes ☐ No

**9.6. Date and Time of Death:** **Date** ☐☐/☐☐/☐☐ **Time** ☐☐:☐☐

**9.7. Place of Death*:** ☐ Labour Ward ☐ Neonatal Unit ☐ Ward ☐ In Transit ☐ Paediatric Centre ☐ Home

Name of unit:_____

*This question refers to where the baby actually died, e.g. 'ICU, 'at home' or 'in transit'.
Babies are deemed to have died 'at home' if there are no signs of life documented in the home even if resuscitation is attempted.
A baby is deemed to have died 'in transit' if signs of life are documented prior to transfer but the baby was either declared dead on arrival to the hospital or showed no subsequent signs of life in the hospital, despite attempted resuscitation..

## SECTION 10. POST-MORTEM

**10.1. Was this a coroner's case?** *If yes, please complete question 10.2.* ☐ Yes ☐ No

**10.2. Has the post-mortem report been received from the coroner's office?** ☐ Yes ☐ No
*If no, please complete question 10.3.*

**10.3. Please specify which coroner's jurisdiction this case was assigned to:** _____

**10.4. Was a post-mortem performed?** ☐ Yes ☐ No
*If no, please complete question 10.5.*

**10.5. Was a post-mortem offered?** ☐ Yes ☐ No

**10.6. Were any of the following procedures carried out after death?**
*Please tick all that apply*

☐ MRI ☐ X-Ray ☐ CT ☐ External Examination

**10.7. Was the placenta sent for histology?** ☐ Yes ☐ No

## SECTION 11. CAUSE OF DEATH AND ASSOCIATED FACTORS - STILLBIRTH & NEONATAL DEATH

**11. Please TICK ALL the maternal or fetal conditions that were present during pregnancy or were associated with the death.** ***PLEASE REFER TO THE REFERENCE MANUAL.***

### 11.1.1. MAJOR CONGENITAL ANOMALY:

☐ Central nervous system ☐ Cardiovascular system ☐ Respiratory system ☐ Gastro-intestinal system
☐ Musculo-skeletal anomalies ☐ Multiple anomalies ☐ Urinary tract ☐ Metabolic diseases

☐ Other major congenital anomaly, please specify _____

☐ Chromosomal disorder*, please specify _____

*** In the event of a chromosomal disorder how was the diagnosis made?**

☐ Clinically ☐ Cytogenetic analysis * ☐ Ultrasound
**See reference manual, page 2*

### 11.1.2. HYPERTENSIVE DISORDERS OF PREGNANCY:

☐ Pregnancy induced hypertension ☐ Pre-eclampsia ☐ HELLP syndrome ☐ Eclampsia

### 11.1.3. ANTEPARTUM or INTRAPARTUM HAEMORRHAGE:

☐ Praevia ☐ Abruption ☐ Cause uncertain

### 11.1.4. MECHANICAL:

***Cord compression***: ☐ Prolapse cord ☐ Cord around neck ☐ Other cord entanglement or knot
***Uterine rupture***: ☐ Before labour ☐ During labour
***Mal-presentation***: ☐ Breech ☐ Face ☐ Compound
☐ Transverse ☐ Other, please specify _____
***Shoulder dystocia:*** ☐

**11.1.5. MATERNAL DISORDER:**

☐ Pre-existing hypertensive disease ☐ Diabetes ☐ Other endocrine conditions (excluding diabetes)

☐ Thrombophilias ☐ Obstetric cholestasis ☐ Uterine anomalies

☐ Connective tissue disorders, please specify_____

☐ Other, please specify_____

**11.1.6. INFECTION:** (confirmed by microbiology/placental histology)

***Maternal infection:*** ☐ Bacterial ☐ Syphilis ☐ Viral diseases

☐ Protozoal ☐ Group B Streptococcus

☐ Other, please specify organism _____

***Ascending infection:***

☐ Chorioamnionitis ☐ Other, please specify _____

**11.1.7. SPECIFIC FETAL CONDITIONS:**

☐ Twin-twin transfusion ☐ Feto-maternal haemorrhage ☐ Non-immune hydrops ☐ Iso-immunisation

☐ Other, please specify_____

**11.1.8. SPECIFIC PLACENTAL CONDITIONS:**

☐ No abnormal histology reported

☐ Vasa praevia ☐ Velamentous insertion ☐ Massive perivillous fibrin deposition

☐ Placental infarction → Please specify approximate percentage involved _____

☐ Chorioamnionitis → ☐ Mild ☐ Moderate ☐ Severe

☐ Fetal vasculitis → ☐ Arterial ☐ Venous ☐ Both

☐ Retroplacental haemorrhage → Please specify approximate percentage of maternal surface involved _____

☐ Thrombosis in fetal circulation → Please specify if arterial or venous _____

☐ Villitis → ☐ Mild ☐ Moderate ☐ Severe

☐ Other, please specify_____

**11.1.9. INTRA-UTERINE GROWTH RESTRICTION DIAGNOSIS MADE: YES ☐**

What was this based on? *Please tick all that apply*

☐ Suspected antenatally ☐ Observed at delivery ☐ Observed at post-mortem

**11.1.10. ASSOCIATED OBSTETRIC FACTORS:** *Please tick all that apply*

***Birth trauma*** ☐ Intracranial haemorrhage ☐ Subgaleal haematoma

☐ Fracture, please specify_____

☐ Other, please specify_____

***Intrapartum fetal blood sample result < 7.25*** ☐ Yes ☐ No

☐ Polyhydramnios ☐ Oligohydramnios ☐ Premature rupture of membranes

☐ Prolonged rupture of membranes (> 24hours) ☐ Amniocentesis

☐ Spontaneous premature labour ☐ Other, please specify_____

**11.1.11. NO ANTECEDENT OR ASSOCIATED OBSTETRIC FACTORS**: ☐

**11.1.12. UNCLASSIFIED:** *Please use this category as sparingly as possible* ☐

## SECTION 12. MAIN CAUSE OF DEATH: STILL BIRTH & NEONATAL DEATHS

**12.1. Which condition, indicated in Section 11 as being present, was the MAIN condition or sentinel event causing or associated with the death.** *Please refer to the post-mortem report. In the absence of a post-mortem report, please refer to the death certificate.*

*(NB "non-MAIN" conditions are best described as the "Other clinically relevant maternal or fetal conditions/ factors that were associated with but not necessarily causing the death").*

**12.2. Was the cause of death question completed using a placental histology report or a post-mortem report?**

*Please tick all that apply*

☐ Post Mortem ☐ Placental Histology ☐ Both ☐ Neither

## SECTION 13. NEONATAL DEATH ONLY: NEONATAL CONDITIONS ASSOCIATED WITH THE DEATH

**13.1. Please TICK ALL the neonatal conditions causing and associated with the death.**

***PLEASE REFER TO THE REFERENCE MANUAL.***

**13.1.1. MAJOR CONGENITAL ANOMALY:**

☐ Central nervous system ☐ Cardiovascular system ☐ Respiratory system ☐ Gastro-intestinal system

☐ Musculo-skeletal anomalies ☐ Multiple anomalies ☐ Urinary tract ☐ Metabolic diseases

☐ Other major malformation, please specify _____

☐ Chromosomal disorder*, please specify _____

*** In the event of a chromosomal disorder how was the diagnosis made?**

☐ Clinically ☐ Cytogenetic analysis * ☐ Ultrasound

**See reference manual*

**13.1.2. PRE-VIABLE:** (less than 22 weeks) ☐

**13.1.3. RESPIRATORY DISORDERS:**

☐ Severe pulmonary immaturity ☐ Surfactant deficiency lung disease ☐ Pulmonary hypoplasia ☐ Meconium aspiration syndrome

☐ Primary persistent pulm. hypertension ☐ Chronic lung disease / Bronchopulmonary dysplasia (BPD)

☐ Other (includes pulmonary haemorrhage), please specify_____

**13.1.4. GASTRO-INTESTINAL DISEASE:**

☐ Necrotising enterocolitis (NEC) ☐ Other, please specify _____

**13.1.5. NEUROLOGICAL DISORDER:**

☐ Hypoxic-ischaemic encephalopathy (HIE)

☐ * Intraventricular / Periventricular haemorrhage, please specify highest grade (0 – 4) ☐ *

☐ Hydrocephalus*, please tick all that apply:

* ☐ Congenital ☐ Acquired ☐ Communicating ☐ Obstructive ☐ Other_____

☐ Other, please specify_____

**13.1.6. INFECTION:**

☐ Generalised (sepsis) ☐ Pneumonia ☐ Meningitis

☐ Other, specify _____

**13.1.7. INJURY / TRAUMA:** (Postnatal) ☐

Please specify_____

**13.1.8. OTHER SPECIFIC CAUSES:**

☐ Malignancies / Tumours ☐ In-born errors of metabolism, please specify _____

☐ Specific conditions, please specify_____

**13.1.9. SUDDEN UNEXPECTED DEATHS:**

☐ Sudden Infant Death Syndrome (SIDS) ☐ Infant death – Cause unascertained

**13.1.10. UNCLASSIFIED:** (Use this category as sparingly as possible) ☐

**13.2. Which condition, indicated in Section 13.1 as being present, was the MAIN condition causing or associated with the death.** *Please refer to the post-mortem report. In the absence of a post-mortem report, please refer to the death certificate.*

*(NB "non-MAIN" conditions are best described as the "Other clinically relevant maternal or fetal conditions/ factors that were associated with but not necessarily causing the death").*

**13.3. Was the cause of death question completed using a placental histology or a post-mortem report?**

*Please tick all that apply*

☐ Post Mortem ☐ Placental Histology ☐ Both ☐ Neither

# Appendix D: Cause of Death Guidance and Definitions

**Guidance and Definitions for Completion of Section 11**
**CAUSE OF DEATH - STILLBIRTH AND NEONATAL DEATH**

| DEFINITION OF TERMS | Subcategory |
|---|---|
| **1. MAJOR CONGENITAL ANOMALY.** Any genetic or structural defect arising at conception or during embryogenesis incompatible with life or potentially treatable but causing death | Central nervous system<br>Cardiovascular system<br>Respiratory system<br>Gastro-intestinal system<br>Musculo-skeletal anomalies<br>Multiple anomalies<br>Chromosomal disorders<br>Metabolic diseases<br>Urinary tract<br>Other |
| **2. HYPERTENSIVE DISORDERS OF PREGNANCY.** | Pregnancy induced hypertension<br>Pre-eclampsia<br>HELLP syndrome<br>Eclampsia |
| **3. ANTEPARTUM OR INTRAPARTUM HAEMORRHAGE.** After 20 w gestation, whether revealed or not. If associated with PET, APH will be a secondary diagnosis. Ignore minor degrees of haemorrhage (e.g. 'shows', cervical polyps etc). Recurrent bleeding of uncertain origin followed by preterm labour should not be ignored. | Praevia<br>Abruption<br>Uncertain |
| **4. MECHANICAL.** Any death attributed to uterine rupture, deaths from birth trauma or intrapartum asphyxia associated with problems in labour such as cord compression, malpresentation, shoulder dystocia etc.<br>Antepartum deaths associated with cord entanglement in the absence of strong circumstantial evidence that cord compression caused death should be classified as having no associated factor. | **Cord Compression**<br>Prolapse cord<br>Cord around neck<br>Other cord entanglement or knot<br>**Uterine Rupture**<br>Before labour<br>During labour<br>**Mal-presentation**<br>Breech / Transverse<br>Face / Compound<br>Other<br>**Shoulder dystocia** |
| **5. MATERNAL DISORDER.** Specify hypertensive disease present before pregnancy or any other maternal disease or condition sufficient to jeopardise the baby such as diabetes, cardiac disease etc.<br>Infection is classified separately. | Pre-existing hypertensive disease<br>Diabetes<br>Other endocrine conditions<br>Thrombophilias<br>Obstetric cholestasis<br>Drug misuse<br>Uterine anomalies<br>Connective tissue disorders / Other |
| **6. INFECTION**. Confirmed by microbiology / placental histology.<br>Specify maternal infections sufficient to have compromised the baby which may be associated with congenital infection of the baby. Trans-placental transmission may have occurred such as CMV, toxoplasmosis etc.<br>Specify only those ascending infections that are a significant factor in death. Chorioamnionitis sufficient to cause preterm birth may be specified for some neonates but evidence of fetal infection may be required as an explanation of stillbirth. | **Maternal infection**<br>Bacterial / Viral diseases<br>Syphilis /Group B Streptoccus<br>Protozoal<br>Other<br>**Ascending infection**<br>Chorioamnionitis<br>Other |
| **7. SPECIFIC FETAL CONDTIONS.** Document only those specific conditions arising in the fetal period. | Twin-twin transfusion<br>Feto-maternal haemorrhage<br>Non-immune hydrops<br>Iso-immunisation<br>Other |
| **8. SPECIFIC PLACENTAL CONDITIONS.** Specific placental conditions sufficient to cause death or be associated with fetal compromise such as IUGR. These will often be secondary to other maternal conditions e.g. PET.<br>Cord problems associated with compression will normally be classified under 'Mechanical' | Placental infarction<br>Retroplacental haemorrhage<br>Thrombosis in fetal circulation<br>Chorioamnionitis<br>Vilitis<br>Fetal vasculitis<br>Massive perivillous fibrin deposition<br>Vasa praevia / Velementous insertion<br>Other |
| **9. INTRA-UTERINE GROWTH RESTRICTION DIAGNOSIS MADE.** IUGR may be suspected antenatally by abdominal circumference (AC) less than the centile threshold used to define IUGR locally, or decreased AC growth velocity, +/- oligohydramnios. | Suspected antenatally<br>Observed at delivery<br>Observed at post mortem |
| **10. ASSOCIATED OBSTETRIC FACTORS.** Factors recorded as Other Associated Obstetric Factors will be important clinical or pathological features of the pregnancy or baby but will not be an explanation of the death; they will often be secondary to other maternal or fetal conditions. Birth trauma and/or Intrapartum asphyxia should normally be classified primarily by the underlying cause (e.g Mechanical ). Birth Trauma and/or other antenatal/intra-partum factors can be recorded here either as a secondary factor or when there is no underlying explanation. | **Birth Trauma**<br>Intracranial haemorrhage<br>Birth injury to scalp<br>Fracture<br>Other<br>**Intrapartum fetal blood sample <7.25**<br>**Other**<br>Polyhydramnios<br>Oligohydramnios<br>Premature rupture of membranes<br>Spontaneous premature labour<br>Other |
| **11. NO ANTECEDENT OR ASSOCIATED OBSTETRIC FACTORS.** Deaths with no explanation or significant associated factor. | |
| **12. UNCLASSIFIED.** Cases where little or nothing is known about pregnancy or delivery and which cannot be fitted into any of the above categories. Use as sparingly as possible. | |

## Guidance and Definitions for Completion of Section 12:
## CAUSE OF DEATH – NEONATAL DEATH ONLY

The following definitions and associated subcategories will help you choose the relevant neonatal conditions causing and associated with death.

| DEFINITION OF TERMS | Subcategory |
|---|---|
| **MAJOR CONGENITAL ANOMALY.** Any genetic or structural defect arising at conception or during embryogenesis incompatible with life or potentially treatable but causing death. | Central nervous system<br>Cardiovascular system<br>Respiratory system<br>Gastro-intestinal system<br>Musculo-skeletal system<br>Multiple anomalies<br>Chromosomal disorders<br>Metabolic disorders<br>Urinary tract<br>Other |
| **PRE-VIABLE.** Babies (less than 22 weeks) who are non-viable at birth because of gestation but who show signs of life. | |
| **RESPIRATORY DISORDERS.** Severe pulmonary immaturity will encompass those babies where structural lung immaturity is so gross as to mean ventilatory support is unsustainable at the outset, usually babies between 22 – 24w gestation. Surfactant Deficient Lung Disease may include babies with clinical or pathological evidence of hyaline membrane disease. | Severe pulmonary immaturity<br>Surfactant deficiency lung disease<br>Pulmonary hypoplasia<br>Meconium aspiration syndrome<br>Primary persistent pulmonary hypertension<br>Chronic lung disease / BPD<br>Other (includes pulmonary haemorrhage) |
| **GASTRO-INTESTINAL DISEASE.** Many babies with NEC will have associated sepsis which may be given as a secondary cause. | Necrotising enterocolitis (NEC)<br>Other |
| **NEUROLOGICAL DISORDER.** HIE includes those babies with severe hypoxic-ischaemic brain injury before birth. If possible, please specify if HIE was primarily of intrapartum or antepartum origin. Specify periventricular leukomalacia only if this is a significant factor in the infant death. Birth Trauma will usually be classified here. | Hypoxic-ischaemic encephalopathy (HIE)<br>Intraventricular/Periventricular haemorrhage<br>Other |
| **INFECTION.** Where possible specify the location of infection and whether due to bacteria, virus, fungus or other specific organism.<br>If infection was the main cause of death please specify whether infection is congenital (i.e. acquired ante or intrapartum acquired) or neonatal in origin. | Generalised (sepsis)<br>Pneumonia<br>Meningitis<br>Other |
| **INJURY / TRAUMA**. Post natal trauma only including iatrogenic injury. 'Birth Trauma' will usually be classified under neurological disorder e.g. HIE; the obstetric classification identifying the timing of the injury. | |
| **OTHER SPECIFIC CAUSES.** Death due to specific fetal and neonatal conditions such as isoimmunisation or unexplained hydrops. Neonatal conditions will include aspiration, unexplained pulmonary haemorrhage. | Malignancies/Tumours<br>Specific conditions |
| **SUDDEN UNEXPECTED DEATHS.** SIDS should conform to the accepted definition. Unascertained are those unexpected deaths that are not explained despite a full investigation including autopsy, but do not conform to the accepted definition of SIDS. | Sudden Infant Death Syndrome (SIDS)<br>Infant deaths – cause unascertained |
| **UNCLASSIFIED.** Cases where little or nothing is known about the pregnancy or delivery and which cannot be fitted into any of the above categories. Please use this category as sparingly as possible. | |



NATIONAL PERINATAL
EPIDEMIOLOGY CENTRE

National Perinatal Epidemiology Centre,
Department of Obstetrics and Gynaecology, UCC,
5th Floor, Cork University Maternity Hospital, Wilton, Cork, Ireland
T: +353 21 4205017 E: npec@ucc.ie W: www.ucc.ie/en/npec/