NATIONAL PERINATAL EPIDEMIOLOGY CENTRE

# Perinatal Mortality National Clinical Audit in Ireland

Annual Report 2021

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NATIONAL PERINATAL
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# List of Acronyms and Abbreviations

**BBA** – Born Before Arrival

**BMI** – Body Mass Index

**CCU** – Coronary Care Unit

**CMACE** – Centre for Maternal and Child Enquiries

**CS** – Caesarean Section

**FGR** – Fetal Growth Restriction

**GROW** – Gestation-Related Optimal Weight

**HDU** – High Dependency Unit

**HELLP** – Hemolysis, Elevated Liver enzymes and Low Platelets syndrome

**HIQA** – The Health Information and Quality Authority

**HPO** – Healthcare-Pricing Office

**HSE** – Health Service Executive

**ICSI** – Intracytoplasmic Sperm Injection

**ICU** – Intensive Care Unit

**IOG** – Institute of Obstetricians and Gynaecologists

**IUGR** – Intra-Uterine Growth Restriction

**IUI** – Intrauterine Insemination

**MCA** – Major Congenital Anomaly

**MBRRACE UK** – Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries across the UK

**MECC** – Making Every Contact Count

**NCCA** – National Centre for Clinical Audit

**NOCA** – National Office of Clinical Audit

**NPEC** – National Perinatal Epidemiology Centre

**NWIHP** – National Women and Infants Health Programme

**PMNCA** – Perinatal Mortality National Clinical Audit

**PMR** – Perinatal Mortality Rate

**RR** – Rate Ratio

**SGA** – Small for Gestational Age

**TGCS** – Robson Ten Group Classification System

**TOP** – Termination of Pregnancy

**TOW** – Term Optimal Weight

**TTTS** – Twin to Twin Transfusion Syndrome

# Foreword

Welcome to the 2021 Annual Perinatal Mortality Report from the National Perinatal Epidemiology Centre (NPEC). This is the tenth report of the national clinical audit on perinatal mortality using the NPEC data collection tool and classification system. The NPEC appreciates the provision of data to the audit in the first place; even more so that this was achieved despite the increased workload and uncertainty that arose with the COVID-19 Pandemic starting in March 2020; continuing in 2021 and showing a more significant effect on maternity services with the evolution of Cov-Sars-2 placentitis and increased morbidity in pregnant women as seen in our SMM Audit report. The HSE cyber attack in May 2021 added further to the difficulties of data collection.

In addition to the data, we also greatly value the feedback and discussion with colleagues and patients across our maternity services; it all goes to enhance the system learning and understand how this data can be used to assess and improve the care we all provide. I sincerely thank all my colleagues in the maternity services in Ireland who continue to engage with the NPEC and produce knowledge of which we are all proud. The NPEC actively encourages the use of data in the units through individual hospital reports and the use of the national data set.

It is disappointing to see that the Perinatal mortality rate has remained static for the last number of years - 2018-2021. Internationally, countries that put a whole system focus on the issue have had success at lowering the rates. While the NWIHP working with the maternity services are progressing a number of the recommendations from previous NPEC reports; a coordinated approach including other agencies such as the Institute of Obstetricians and Gynaecologists and the Healthy Ireland Programme (Department of Health and Well Being in the HSE); would allow a care bundle approach towards initiating further improvement - this has worked in other countries; an example was provided in the 2020 report and is repeated in this report.

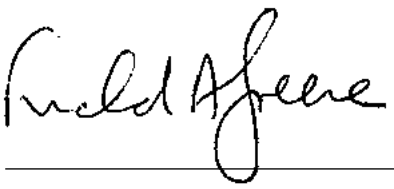
Implementation of the recommendations in this report and perhaps packaging them with those such as CTG interpretation/ risk assessment, as recommended in the Therapeutic Hypothermia Report 2020[1], would I believe assist the maternity services in Ireland to achieve further reduction in the perinatal mortality and morbidity rates.

We can enhance our knowledge by integrating knowledge from beyond our own system, learning from other health colleagues who investigate the death of babies in their care. International comparison of these outcomes can enhance our learning. This comparison is difficult when we are not comparing like with like, where definitions differ. The NPEC is now progressing a discussion with stakeholders around case definitions for perinatal mortality we use in the Republic of Ireland.

As we read through the findings in this audit report, there are clearly areas that warrant research across the spectrum of pregnancy-related health; more research is needed to improve outcomes for women and babies. Research funding organisations and Health Service Funders need to invest in and encourage research around the impact, experience and awareness of perinatal morbidity, perinatal death and the development and implementation of preventative care – i.e., reduction of perinatal loss related to fetal growth problems, enhancing periconceptional health for women.

The NPEC continues to collaborate with the NWIHP and acknowledges the key relationship between the two organisations. We are also grateful to our colleagues in the National Office of Clinical Audit (NOCA) to whose standards our audits are aligned and who provide us with constructive feedback and support.

Lastly, I would like to thank the staff in the NPEC for their ongoing dedication to the mission of the Centre and their continued drive to achieve our audit reports. Thanks to our Perinatal Mortality National Clinical Audit Governance Committee (PMNCAGC) for their guidance and intellectual input. Working with all the stakeholders involved, the NPEC continues its mission to improve the care of mothers and babies in Ireland, again evidenced by this report.



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[1]San Lazaro Campillo I, McGinley J, Corcoran P, Meaney S, McKenna P, Filan P, Greene RA, Murphy J on behalf of Neonatal Therapeutic Hypothermia Steering Group. Neonatal Therapeutic Hypothermia in Ireland, Annual Report 2016-2020.

# Acknowledgements

It is with sincere thanks and appreciation that the NPEC would like to acknowledge the many healthcare professionals who contribute to the NPEC audit on perinatal mortality. In particular, we would like to thank the unit co-ordinators (see Appendix A) who continue to co-ordinate the collection of perinatal mortality data at unit level. This report would not have been possible without their dedicated support and co-operation. Collation of audit data at unit level was particularly challenging during the Pandemic 2021 and the added problems following the HSE Cyber-attack (May 2021) and subsequent impact on IT systems. The on-going support of unit co-ordinators in collating data is highly commendable, particularly as many do so without protected time for clinical audit.

The NPEC would like to acknowledge members of the NPEC Perinatal Mortality National Clinical Audit Governance Committee (PMNCAGC), listed in Appendix B, for their guidance in the continual optimisation of the NPEC national clinical audit of perinatal mortality. We would also like to extend thanks to the NPEC Governance Committee, who represent a diverse range of key stakeholders from maternity centres, universities throughout the country and public patient representatives for their support and guidance as the Centre continues to grow and evolve (Appendix C).

We are grateful for the support of the National Office of Clinical Audit (NOCA), whose endorsement of this report is included in Appendix D.

The NPEC would also like to acknowledge the National Perinatal Reporting System (NPRS) within the Healthcare Pricing Office (HPO) for their continued collaboration in consolidating national data on perinatal deaths thus ensuring that both agencies represent the most accurate and complete record of Irish perinatal mortality data annually as recommended by the Chief Medical Officer.

As with our previous annual reports, expert commentary was invited on a specific topic of perinatal care and services in Ireland. I would like to thank Dr Tamara Escanuela Sanchez, PhD. Post-Doctoral Researcher in the NPEC and the Pregnancy Loss Research Group, Cork University Maternity Hospital, for her invited commentary on “Exploring the complexity of stillbirth prevention: Insights from the RELEVANT Study on risk factors and implications for policy and practice’.

# Introduction

This Perinatal Mortality National Clinical Audit (PMNCA) Report provides information on perinatal deaths arising from births occurring in the Republic of Ireland (ROI) for the reporting year 2021.

Since 2009, the NPEC, in collaboration with the multidisciplinary Perinatal Mortality National Clinical Audit Governance Committee (see Appendix B), has conducted a national clinical audit of Perinatal Mortality annually. The fundamental aim of this clinical audit is to provide a national review of perinatal deaths, to identify quality improvement initiatives and make recommendations for the improvement of care for mother and babies in Ireland. It is acknowledged that ongoing monitoring of quality and safety data is essential to continually drive improvements in the maternity services. The information provided in this report contributes to a body of evidence that will guide future clinical practice; the counselling of bereaved parents, public-health interventions, and inform policy makers within the health services.

A significant recent development is the endorsement of this clinical audit by the National Clinical Effectiveness Committee (NCEC). The NPEC Perinatal Mortality National Clinical Audit (PMNCA) is the second audit to be quality assured by the NCEC and becomes No. 2 in the NCEC suite of National Clinical Audits. The NCEC endorsement mandates that the appropriate services engage with the NPEC National Clinical Audit of Perinatal Mortality, thereby superseding all other national clinical audits on the topic.[2]

This PMNCA 2021 report is divided into seven sections (Figure I) with additional information provided in the Appendices.

**Section 1 contains the main findings including:**

- National and international comparison of Perinatal Mortality Rates (PMR) and the impact of in-utero transfer on individual unit's PMR.
- Distribution of Perinatal Deaths by the Robson Ten Group Classification System.
- Maternal and infant characteristics impacting on adverse perinatal outcomes.
- Management of delivery in women experiencing perinatal loss.
- Infant characteristics impacting on adverse perinatal outcomes.
- Perinatal mortality following termination of pregnancy.
- Investigations to determine the cause of perinatal death.

**Section 2 contains the invited expert commentary:**

- Exploring the complexity of stillbirth prevention: Insights from the RELEVANT Study on risk factors and implications for policy and practice.

**Sections 3, 4, 5 and 6 provide findings specific to (respectively):**

- Stillbirths.
- Early neonatal deaths.
- Perinatal deaths associated with intrapartum events.
- Late neonatal deaths.

**Section 7 presents data on early neonatal deaths with a birthweight <500g and a gestational age at delivery of <24 weeks.**

- These deaths are not included in the PMR.

**Figure I: Outline of the PMNCA Report Sections**

[2]The report from the NCEC was published by Minister Donnelly on April 25th, 2022, and is available at: www.gov.ie/en/publication/032fa-national-clinical-effectiveness-committee-national-clinical-audit-perinatal-mortality

# Executive Summary

This is the tenth report of the national clinical audit on Perinatal Mortality in Ireland, using the NPEC data collection tool and classification system on cause of death. All 19 Irish maternity units reported anonymised data on 357 deaths arising from 60,841 births occurring in 2021, of at least 500g birthweight or at least 24 weeks gestation.

Stillbirths and early neonatal deaths accounted for 238 (66.7%) and 119 (33.3%) of the 357 deaths, respectively. There were a further 40 late neonatal deaths. The Perinatal Mortality Rate (PMR) was 5.87 deaths per 1,000 total births; corrected for Major Congenital Anomaly (MCA), the rate was 3.78 per 1,000 total births; the stillbirth rate was 3.91 per 1,000 total births; the early neonatal death rate was 1.96 per 1,000 live births. The extended PMR including late neonatal deaths was 6.53 per 1,000 live births based on birthweight ≥500g or gestational age ≥24 weeks and it was 6.17 with the criteria of birthweight >500g.

The level of variation in the rate of PMR between maternity units was lower in 2021 compared to 2020. When adjusted for MCA and in-utero transfers, no maternity unit was considered an outlier as defined by NOCA. In 2021, a slight decrease in the PMR is observed, but it is not statistically significant compared to previous years 2020 and 2019. Decreasing rates of perinatal mortality were observed in Ireland in the decade prior to 2012, the PMR levelled off thereafter, with an increase in PMR in 2020 compared to 2018. While reductions in perinatal mortality rates are not easy to achieve, other countries have made significant reductions in PMR, particularly with stillbirth rates in recent years.

Among mothers experiencing perinatal death, the proportion of women attending their first antenatal visit at 20 weeks gestation or later was 6.3%. This was slightly lower compared to 7.2% in 2020, but still higher when compared to 5.5% in 2019.

The care of pregnant mothers with fetus in-utero was transferred to another maternity unit in 12.0% of the perinatal death cases in 2021, most commonly to a tertiary referral maternity unit.

The rate of autopsy uptake in 2021 (44.6%) is lower than the rate of 52.3% reported in 2020, and the rate of 49.2% reported in 2019. Similar to previous years, a post-mortem examination was performed more often in stillbirths (53.8%) than in neonatal deaths (25.0%). In the vast majority of perinatal deaths that did not receive an autopsy, an autopsy was offered, and we understand declined by parents (78.2%).

There continues to be a high rate of placental histology examinations performed following perinatal death (94.5% in stillbirths and in 87.1% of early neonatal deaths).

Specific placental conditions was the primary cause of death in stillbirths in 2021 (32.8%) in contrast with previous years where Major Congenital Anomaly (MCA) was the most common cause of death in stillbirths; MCA was the second most common cause (28.6%). The cause of death was unexplained in almost fifteen percent of stillbirths (14.7%). In sixty percent of these unexplained cases, it was reported that the maternity unit was pending post-mortem results (most commonly coronial autopsy reports).

MCA was the primary cause of death in almost half of the early neonatal deaths in 2020 (49.6%). Respiratory disorder was the second most common cause of death, accounting for more than one in four (26.1%) early neonatal deaths, most commonly associated with severe pulmonary immaturity. Major congenital anomaly was also the most common cause of late neonatal deaths (32.5%).

In 2021, a severe 'third and fourth wave' of the COVID-19 pandemic affected Ireland when the virulent variants of concern (Alpha and Delta) were found to impact on maternal and fetal wellbeing compared to 2020. Among perinatal deaths occurring in 2021 a total of one ENND and nine stillbirths were due to SARS-CoV-2 placentitis.

Low birthweight continues to be associated with perinatal deaths, particularly with stillbirths. Over one third (38.3%) of all stillbirths were classified as severely small for gestational age (<3rd customised birthweight centile). While the level of antenatal diagnosis of fetal growth restriction in severely small for gestational age remains low (33.1%), an improvement was observed compared to corresponding rates in 2020 (24.8%).

An association between maternal age and perinatal mortality was identified. Compared to mothers aged between 30-34 years, women aged greater than 40 years had a 1.8-fold increased rate of perinatal mortality (p value <0.001) in 2021.

An association between increased BMI and perinatal mortality was again identified in 2021. Overweight women (BMI between 25 and less than 30 kg/m2) had a 46% higher risk of perinatal mortality compared to women who gave birth during 2021 with a lean BMI category (BMI<25 kg/m2; p value=0.003). The increased risk for obese women was less evident in 2021 than in recent years.

While the numbers involved were small, ethnic minorities were over-represented (when compared to the overall population) in the mothers who experienced perinatal deaths.

In 2021, the perinatal mortality rate for babies in multiple pregnancies was 4.46 times higher than for singleton babies.

While on-going clinical audit is essential to identify key factors influencing adverse perinatal outcomes, we believe the opportunity to learn from the tragic event of a perinatal death would be greatly enhanced by the establishment of a confidential review into defined cohorts of perinatal deaths.

# Key findings in 2021

### Perinatal Mortality Rate (PMR)

- The perinatal mortality rate (PMR) was 5.87 per 1,000 total births in 2021. While a slight decrease in the PMR was observed in 2021, it is not statistically significant compared to previous years 2020 and 2019. Corrected for Major Congenital Anomaly (MCA), the PMR was 3.78 per 1,000 total births.
- The stillbirth rate associated was 3.91 per 1,000 total births and the early neonatal death rate was 1.96 per 1,000 live births.
- The level of variation in the rate of PMR between maternity units was lower in 2021 compared to 2020. When adjusted for MCA and in-utero transfers, no maternity unit was considered an outlier as defined by NOCA policy.

### Maternal characteristics

- Maternal age (greater than 40 years) and overweight were associated with an increased risk of perinatal mortality.
- While the numbers involved were small, Irish Traveller, Asian and Black ethnicities were overrepresented in the mothers who experienced perinatal deaths in 2021.
- Twenty percent (20.1%) of mothers experiencing perinatal loss booked into hospital for antenatal care before 12 weeks gestation, and more than seventy percent (70.8%) attended between 12- and 19-weeks gestation.

### Infant characteristics

- As in previous reports, low birthweight centiles were associated with perinatal deaths in 2021, particularly stillbirths.
- An increased risk of perinatal mortality with multiple births compared to single pregnancy was again identified in 2021. Perinatal death from multiple births accounted for 13.7% of all perinatal deaths.
- The rate of autopsy uptake continues to be higher in stillbirths compared to neonatal deaths.

### Stillbirths

- Stillbirths accounted for 66.7% of perinatal deaths in 2021.
- In contrast to previous years, specific placental conditions was the most common cause of death in stillbirths (32.8%) followed by major congenital anomaly (28.6%).
- Intrapartum deaths accounted for 5.9% of stillbirths. This rate is similar to previous years.

### Early neonatal deaths

- Early neonatal deaths accounted for 33.3% of perinatal deaths in 2021.
- Major congenital anomaly was the most common cause of early neonatal death (49.6%) followed by Respiratory disorders (26.1%), primarily due to severe pulmonary immaturity.
- More than half (53.4%) of early neonatal deaths occurred within 24 hours of delivery.

### Late Neonatal deaths

- There were 40 late neonatal deaths reported to the NPEC in 2021
- Major congenital anomaly was the most cause of late neonatal death (32.5%) followed by Respiratory disorders (17.5%)
- In contrast to previous reports, the proportion of late neonatal deaths was found to increase across the second and third weeks of life in 2021 (i.e., 42.5% in week two and 57.5% in week three).

### Early neonatal deaths with a birthweight <500g and a gestational age at delivery <24 weeks

- There were 47 early neonatal deaths with a birthweight < 500g and a gestational age at delivery < 24 weeks in 2021.
- The majority (63.8%) of these babies delivered between 20 and 22 weeks gestation and one quarter (25.5%) delivered at less than 20 weeks gestation.
- The assigned neonatal cause of death was pre-viable for the majority of cases (72.3%) followed by severe pulmonary immaturity (14.9%).

# Recommendations

**Based on the findings of this and previous reports, the NPEC Perinatal Mortality National Clinical Audit Governance Committee makes the following recommendations:**

- Robust clinical audit of perinatal outcomes in all maternity units in Ireland is vital for quality patient care. Funding should be provided to ensure protected time for clinical audit and implementation of its findings. This funding might be best channeled through midwifery and obstetric management posts where clinical audit is embedded within job descriptions. Owner; the Quality and Patient Directorate in the HSE.

- National data on social factors impacting on perinatal loss, e.g. smoking and alcohol abuse, remain difficult to collate. Consideration should be given to methodologies to capture this information consistently. Owner; the NPEC and the NWIHP.

- A communication policy should be developed regarding neonatal outcomes in babies whose care has been transferred post-delivery. This should ensure the flow of vital information between tertiary maternity units/ paediatric centres and the referring maternity unit that is essential to inform appropriate follow up care, including counselling of women experiencing perinatal loss. It is also necessary to inform clinical audit in the referring maternity unit. Owner: National Clinical Lead for Neonatology and NWIHP.

- The establishment of a confidential review for stillbirth and neonatal deaths should be considered in order to enhance the learning to assist better care. This could take the format of a standardized review of specific cohorts, such as:

  – unexpected intrapartum related deaths
  – multiple pregnancies
  – Stillbirths (normally formed babies)

These cohorts could be reviewed on a rolling basis. Owner; the National Women and Infants Health Programme (NWIHP) and the Institute of Obstetricians and Gynaecologists (IOG).

- All healthcare professionals (obstetricians, GPs and midwives) should see every interaction with a woman as an opportunity to address weight, nutrition and lifestyle to optimize her health. This also supports the HSE Programme 'Making Every Contact Count' (MECC).[3] Owner; All Healthcare staff.

- Standardised approach to improved antenatal detection of fetal growth restriction (FGR) with timely delivery is a potential preventative strategy to reduce perinatal mortality.[4]

A multidisciplinary working group should be developed to address a national standardised approach to the detection of FGR. A national approach should include a standardised training program for all staff involved in antenatal care and also evaluate the use of a standard growth curve and management options across the Irish maternity service. Owner; the NWIHP and the IOG.

**Progress:** A working group has been established to address this, and a guideline is in development. The NWIHP, through work stream 5 of the National Neonatal Encephalopathy Action Group (NNEAG), will engage with the guideline development team around national rollout and implementation.

- The NPEC advocates the introduction and use of a **'Care Bundle'** approach in an attempt to lower perinatal mortality; similar approaches in other countries have achieved a reduction. An example of a 'Care Bundle' is outlined below.

[3] www.hse.ie/eng/about/who/healthwellbeing/making-every-contact-count/

[4] Clinical Practice Guideline No 29 (2014). Fetal Growth Restriction Guideline - 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. (please note guidance update is outstanding)

**Example of a care bundle for the Irish context might include:**

- Public health programmes which focus on:
  - reducing smoking in pregnancy,
  - weight management to lower BMI and prepare women for a healthier entry to pregnancy,
  - raising awareness of stillbirth and reduced fetal movements.
- Healthcare staff education on modifiable health risk factors for perinatal mortality and using the MECC programme.
- Develop a care pathway including staff education around risk assessment and surveillance for fetal growth restriction using a standard national approach.
- Effective fetal monitoring during labour with potential cross over effects for a reduction in Neonatal Brain injury and intrapartum related death.
- Integrate best practice research for a reduction of preterm labour.
- Develop a standard approach to assessment of all Perinatal Deaths including/consulting with parents for reviews of their care. The learning points from these reviews should be communicated to all staff.
- Establish a Confidential Review for stillbirth and neonatal deaths, which should be considered in order to enhance the lessons which may improve care.

# Recommendation from previous reports being progressed by relevant stakeholders in the maternity services

- There are multiple demands for data in the maternity services and indeed some duplication; there needs to be a review of the data requirements and a streamlining in keeping with good data governance and indeed the HIQA data quality framework.[5] Owner: the NPEC and the NWIHP.

**Progress:** The NPEC with the NWIHP have undertaken work to align definitions with the Irish Maternity Indicator System and work is progressing with the Maternity Safety Statement.

- Consideration should be given to the establishment of a national working group to include Obstetricians, Neonatologists, Midwives and Allied Health Professionals whose remit is to look at the problem of preterm birth (PTB) in Ireland at a national level and how it is best addressed. Owner; the NWIHP.

**Progress:** Terms of Reference are currently being drafted and a meeting of the established working group is due to convene in Quarter four 2023. The national working group will include representation across disciplines at both hospital and national level.

- Defining and auditing perinatal loss.

(a) To allow for international comparison of stillbirths, a move towards collecting data on fetal deaths >22 weeks and < 24 weeks should be considered in the audit of perinatal mortality in Ireland.[6]

[5]Health Information and Quality Authority. (HIQA) Guidance on a data quality framework for health and social care. Health Information and Quality.2018. Available from: https://www.hiqa.ie/sites/default/files/2018-10/Guidance-for-a-data-quality-framework.pdf

[6]Kelly K et al. A review of stillbirth definitions: A rationale for change. European Journal of Obstetrics & Gynaecology and Reproductive Health. 256 (2021) 235-245

(b) A national working group should be convened to review the definition of perinatal mortality in the Republic of Ireland (ROI). This working group should include the NWIHP, NPEC, the General Registers Office (GRO), the Healthcare Pricing Office (HPO), the Institute of Obstetrics and Gynaecology, the National Clinical Programme for Paediatrics and Neonatology and the Department of Health. Owner; the NPEC.

**Progress:** A national working group, including the relevant stakeholders and patient representation, has been established to address this with an initial meeting due to convene in October 2023.

- Engagement with the Coroner Society of Ireland to explore the timeliness of autopsy reports provided to maternity units is warranted.

**Progress:** In October 2021, a Submission document to the Department of Justice, via the Department of Health, regarding the Coroner's (Amendment) Act 2019 was made on behalf of the NPEC, NWIHP, NOCA and the PMNCAGC. At time of writing this report, the NPEC and afore mentioned agencies await progression of this recommendation by the Department of Justice.

## Other valuable resources and learning.

- National Standards for Bereavement Care Following Pregnancy Loss and Perinatal Death 2022. Available at: **www.hse.ie/eng/about/who/acute-hospitals-division/woman-infants/bereavement-care/**

- HIQA National Maternity Bereavement Experience Survey 2022.

- The HSE response to the findings of the National Maternity Bereavement Experience Survey 2022. Available at: **www.hse.ie/eng/services/news/media/pressrel/findings-of-the-national-maternity-bereavement-experience-survey-2022.html**

## Implications for research identified in the findings of this report.

As we read through the findings in this audit report, there are clearly areas that warrant research across the spectrum of pregnancy-related health; there is increasing evidence that more research is needed to improve outcomes for women and babies.

Research Organisations and Health Service Funders should invest in and encourage research team collaboration to undertake multi-disciplinary research on the impact, experience and awareness of perinatal morbidity and perinatal death, including the role of bereavement care and pre-conception health awareness. From this audit examples for research include:

- the implementation of prevention systems – i.e. reduction of perinatal loss related to fetal growth problems.

- the exploration of new methodologies that address supporting facilitators and reducing barriers around risk reduction/positive self-care behaviours e.g. substance misuse, weight management, care attendance including social inclusion, etc.; covering the pre-conception and pregnancy periods.[7]

- Further research exploring factors impacting on autopsy rates, particularly in the case of neonatal deaths.

- Methodologies and approaches to assessment of care when perinatal loss occurs.

- Bereavement related research.

[7]Facilitators and barriers to substance-free pregnancies in high-income countries: A meta-synthesis of qualitative research. Tamara Escañuela Sáncheza, Karen Matvienko-Sikarc, Laura Linehan, Keelin O'Donoghue, Molly Byrned and Sarah Meaney. Women and Birth 2022; 35 (2); e99-110

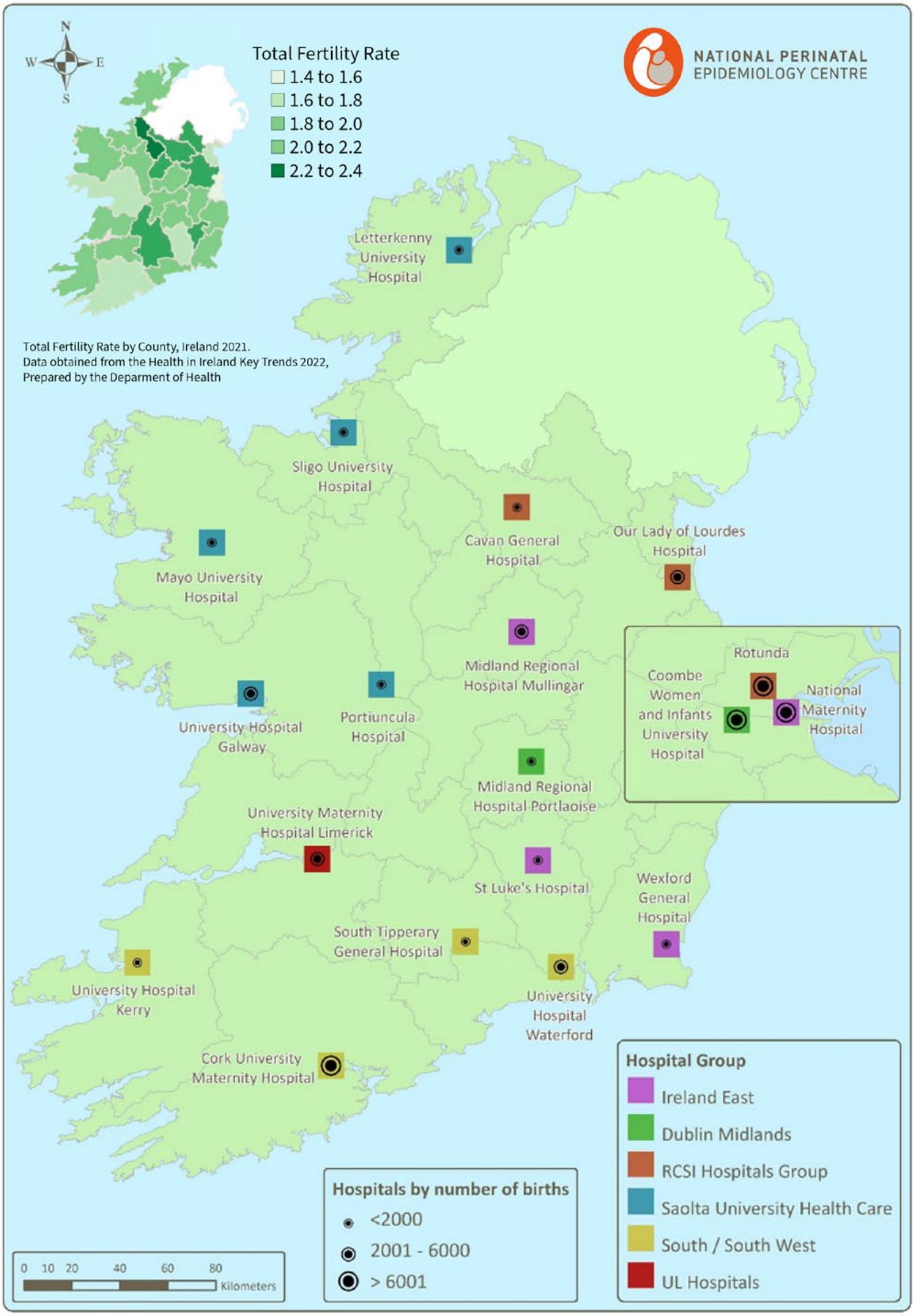


**Figure II: Map of maternity units and hospital groups in the Republic of Ireland**

# Methods

## Data collection and management

In 2021, there were 19 maternity units in Ireland. Within each maternity, unit coordinators with the responsibility of submitting perinatal mortality data to the NPEC have been identified. Pseudonymised data on perinatal deaths from births that occurred between January 1st and December 31st, 2021, were submitted to the NPEC by all 19 units using a standardised notification dataset either electronically, via the secure online NPEC database, or alternatively by paper format. The Perinatal Mortality (PM) notification form is available on the NPEC website at: **www.ucc.ie/en/npec/npec-clinical-audits/perinatalmortality/perinatalmortalityreportsandforms/** (QR code available in footnote). This PM notification dataset is completed using data on fetal and maternal characteristics recorded in the clinical records. Implemented nationally in 2011, the NPEC notification dataset was based on the validated Centre for Maternal and Child Enquiries (CMACE) Perinatal Death Notification Form[8] and has been endorsed by the Clinical Advisory Group at the Institute of Obstetrics and Gynaecology, the Faculty of Paediatrics and the HSE National Obstetric Programme Working Group.

Figure III illustrates the NPEC data collection and management processes. There has been a steady improvement in the overall quality of data reported by all maternity units since the implementation of the NPEC perinatal mortality notification dataset in 2011. To ensure completeness and accuracy of information, all data is validated directly with the respective maternity units. The NPEC also undertakes extensive reconciliation of its annual perinatal mortality dataset with that of the National Perinatal Reporting System (NPRS). This consolidation with the NPRS is in response to recommendations by the Chief Medical Officer[9] and ensures that both agencies datasets represent the most accurate record of perinatal mortality annually.

As previously acknowledged, this report comes from the efforts of many people and among the most important are the coordinators at the maternity hospitals. At unit level, there is an enormous amount of work done by these individuals, some working alone, some with colleagues. When we get data in the NPEC, we often must verify facts about the cases and follow up on outstanding data points and irregularities, etc. We are aware from these interactions that many coordinators are doing this work in their own time and often after hours. Audit is a very important component of health services, it is our way of checking what we are doing, can we improve, where is there variance. It is an area that is recognized as being very important in all strategic documents, but it is rarely supported with specified resources. There are multiple demands for data in the maternity services and some duplication; there needs to be a review of the data requirements and a streamlining in keeping with good data governance and indeed the Health Information and Quality Authority (HIQA) data quality framework.[10] It is difficult to fund resources for audit when the frontline is under pressure for resources, however its value is not less important, and it needs support. As in previous reports we again make a recommendation in this area.

- **Recommendation:** Robust clinical audit of perinatal outcomes in all maternity units in Ireland is vital for quality patient care. Funding should be provided to ensure protected time for clinical audit and implementation of its findings. This funding might be best channeled through midwifery and obstetric management posts where clinical audit is embedded within job descriptions. Owner; the Quality and Patient Directorate in the HSE.

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

[9] Holohan, T. (2014) HSE Midland Regional Hospital, Portlaoise Perinatal Deaths (2006-date). Dublin: Department of Health. Available at: www.lenus.ie/hse/bitstream/10147/313524/1/portlaoiseperinataldeaths.pdf

[10] Health Information and Quality Authority.(HIQA) Guidance on a data quality framework for health and social care. Health Information and Quality.2018. Available from: https://www.hiqa.ie/sites/default/files/2018-10/Guidance-for-a-data-quality-framework.pdf

## NPEC data collection and management processes

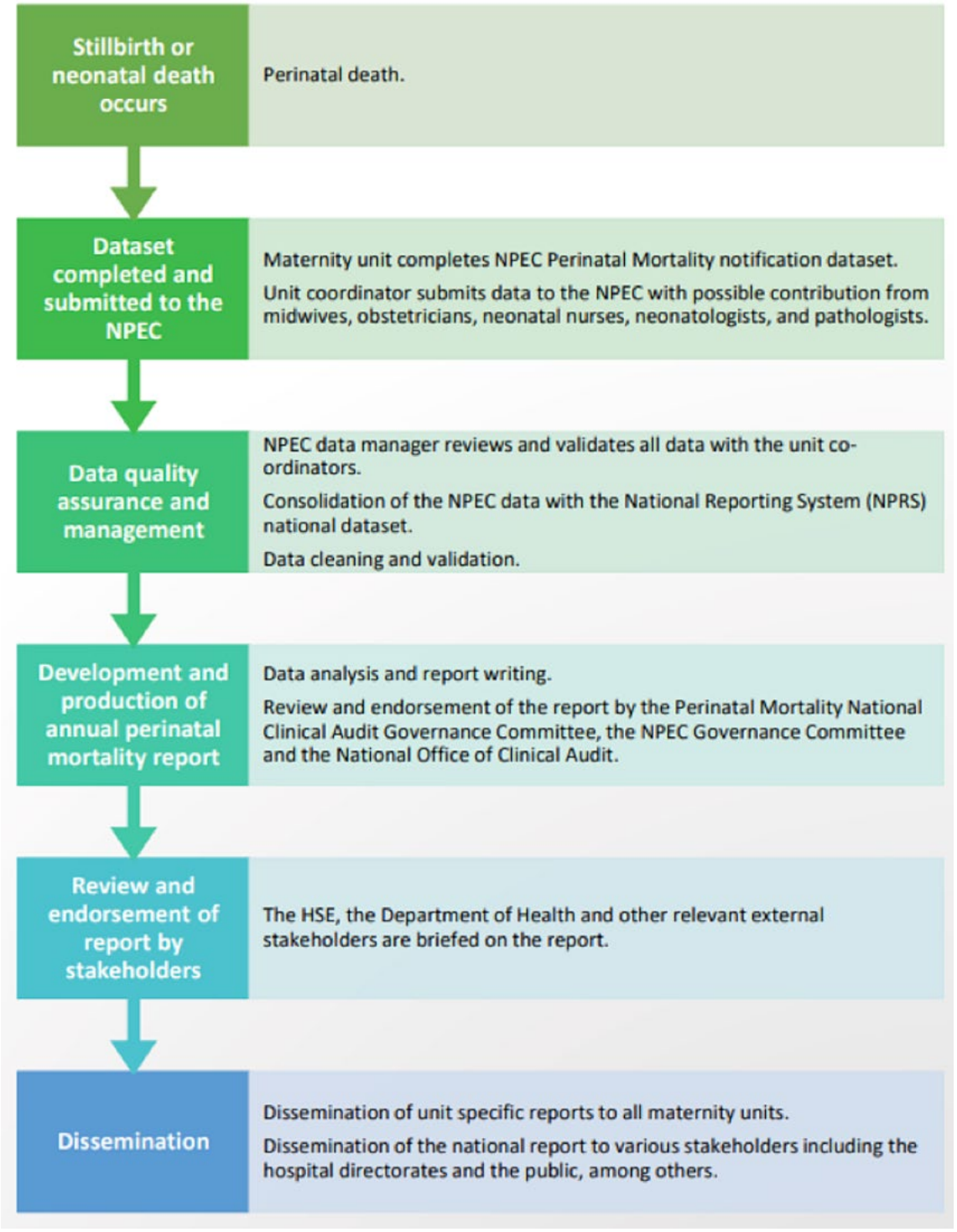


**Figure III: NPEC data collection and management processes**

## The 2021 birth cohort

This report describes the perinatal deaths that occurred among infants born from 1 January to 31 December 2021. Thus, neonatal deaths in January 2021 of infants born in December 2020 are not included while neonatal deaths in January 2022 of infants born in December 2021 are included. The NPEC have been reporting on the perinatal mortality for a birth cohort since the 2015 perinatal mortality report. This method of reporting perinatal mortality for a birth cohort allows more accurate estimates of mortality rates to be produced as appropriate denominators are available. The MBRRACE-UK Perinatal Mortality Surveillance Reports are also based on perinatal mortality for a birth cohort.[11] The NPEC Perinatal Mortality Reports for the years 2011-2014 were based on deaths in a calendar year; therefore, they were revised and adjusted to meet the birth cohort definition.

## Rate calculations

To assess perinatal mortality, overall and unit-specific perinatal mortality rates (PMRs) per 1,000 total births and corresponding 95% confidence intervals were derived. For incidence rates, 95% confidence intervals were calculated using exact Poisson confidence limits unless stated otherwise. Stillbirth, neonatal and corrected PMRs, which exclude deaths due to a major congenital anomaly, were also calculated. In 2021, an "Extended PMR" was also calculated, which includes stillbirths, early neonatal deaths and late neonatal deaths.

Total births was the denominator used for all the PMRs, except for early neonatal deaths which use total live births (i.e., total births minus stillbirths). Denominator data were provided directly by the Irish HPO[12] and the Hospital Inpatient Enquiry (HIPE). Data on BMI were collated for 33,221 maternities in 2021 from seven maternity units. This is 56.4% of the 58,953 women who gave birth in hospital in Ireland in 2021, according to HIPE data. We multiplied the BMI data on 33,221 women by 1.77 (i.e., 100%/56.4%) in order to estimate the national number of maternities by BMI category. This will be accurate if the BMI data from the seven hospitals are representative of all maternities.

Perinatal deaths are included in a maternity unit's rate if the baby was delivered in the maternity unit or if the unit was the intended place of delivery, but the baby was born before arrival. In the event of a neonatal death, the perinatal death is assigned to the maternity unit where the baby was delivered regardless of where the baby died (includes post-natal transfers to tertiary maternity units/ paediatric centres).

## Rate ratios

Further analysis was conducted to assess variation in incidence rates between years, maternal age groups, body mass index categories and nulliparous and multiparous women. This analysis involved using Poisson regression which calculates a rate ratio (for example, the rate in one year divided by the rate in the previous year). Rate ratios have the advantage of being easy to interpret. They are interpreted against the rate to which they are being compared (the reference group/reference rate). A rate ratio is greater than one if a rate is greater than the rate to which it is being compared. For example, a rate ratio of 1.25 indicates the rate being examined is 25% higher than (or 1.25 times) the rate to which it is being compared. Conversely, a rate ratio will be less than one if a rate is less than the rate to which it is being compared. For example, a rate ratio of 0.80 indicates that the rate being examined is equivalent to 80% of the rate to which it is being compared, i.e. it is 20% lower. The Poisson regression analysis provides a 95% confidence interval for the rate ratio and the associated p-value, both of which indicate whether the rate difference is in line with what might be expected due to chance. A rate difference is considered to be beyond what might be expected by chance, i.e. statistically significant, if the 95% confidence interval for the rate ratio does not include the value one. This is equivalent to the p-value derived from the analysis being less than 0.05. If the p-value is less than 0.001 then the rate difference may be considered highly statistically significant.

## Funnel plots

Variations in PMRs between maternity units could potentially be due to random chance or reflect differences in baseline characteristics of the child-

[11] Draper ES, Gallimore ID, Kurinczuk JJ, Smith PW, Boby T, Smith LK, Manktelow BN, on behalf of the MBRRACE-UK Collaboration. MBRRACE-UK Perinatal Mortality Surveillance Report, UK Perinatal Deaths for Births from January to December 2020. Leicester: The Infant Mortality and Morbidity Studies, Department of Health Sciences, University of Leicester. 2022

[12] Healthcare Pricing Office. Perinatal Statistics Report 2021. Dublin: Health Service Executive. [in press]

bearing population. For this reason, funnel plots were used to assess performance outcomes for individual units in comparison to the overall average. In brief, the plot is a scatter diagram of individual maternity unit mortality rates against the number of births within that unit. The national rate is indicated by the solid straight line. The 95% confidence interval is indicated by the curved dashed line. The dashed lines represent the limits within which 95% of units are expected to lie (i.e. within two exact binomial standard errors). The 99.8% confidence interval for the national rate is plotted using solid lines. These solid lines represent the limits within which 99.8% of units are expected to lie (i.e. within three exact binomial standard errors).

The width of the confidence interval is adjusted to allow for meaningful comparison between unit-specific rates and the national rate. The confidence interval is wider for smaller units reflecting the lack of precision in rates calculated based on small numbers. The confidence interval narrows for larger maternity units, giving the diagram a 'funnel' shape. Maternity unit rates outside the 95% and 99.8% confidence interval are statistically significantly different from the national rate. In general, one in 20 units would be expected to lie outside the 95% confidence limits by chance alone whereas an observation outside the 99.8% confidence limits is especially rare, i.e. there is a 0.2% chance of this happening (Figure IV).

In the funnel plots unit specific rates have been identified by a letter and the letter corresponding to each unit is listed in the adjacent legend. Of note, as funnel plots are based on a hierarchy of total births or live births per each unit. As such, pending on the perinatal loss evaluated (stillbirth versus early neonatal deaths) **the letter identifying units will differ between funnel plots and between reporting years. Red markers indicate changes associated with corrections for in-utero transfers**.

## Corrected stillbirths and early neonatal death rates for the combined four years (2018-2021).

In 2021, two new funnel plots are added to the report including corrected stillbirth and early neonatal death rates. The corrected rate for stillbirths and early neonatal deaths, i.e. the rate adjusted to exclude deaths due to major congenital anomaly, have been calculated for the combined years 2018-2021 (Figure 1.7 and Figure 1.8). This allows for a more meaningful comparison of rates across smaller units where, due to small numbers, fluctuation of rates may occur between years.

## Birthweight centile

As with previous reports, we have produced charts 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 2021. To do so, we used the Gestation Related Optimal Weight

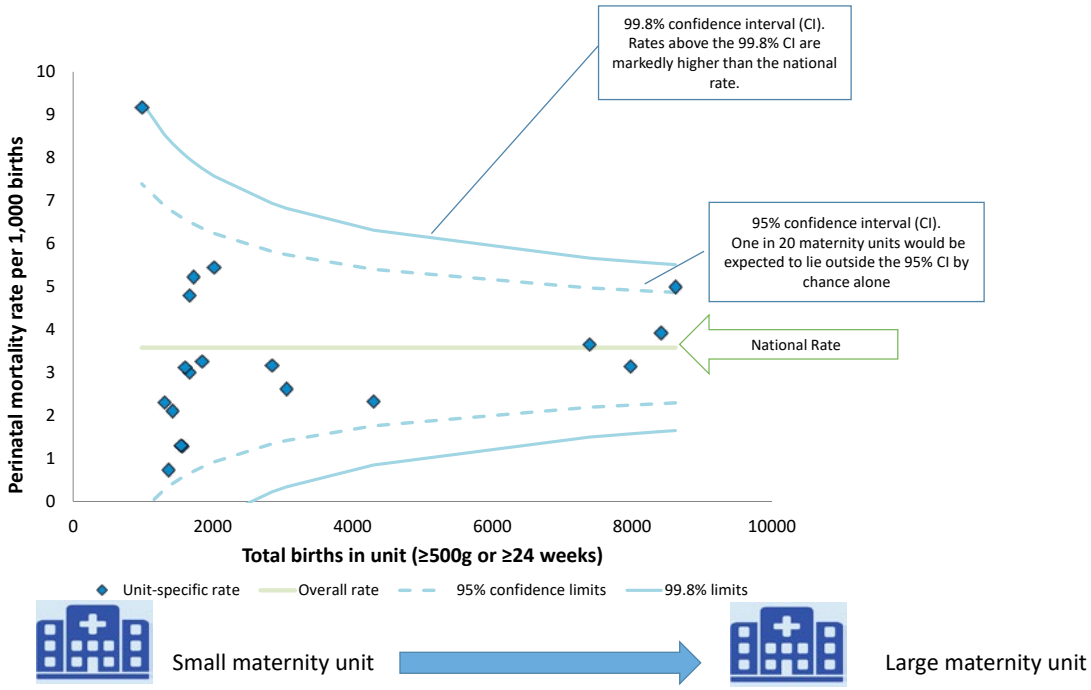


**Figure IV: Diagram outlining the interpretation of a funnel plot**

(GROW) software[13] 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.[14]

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 2021). These steps are described in detail in the GROW documentation.

Customised birthweight centiles were also derived using the GROW software. There was missing data for maternal height (n=71, 19. 9%) and weight (n=68, 19.0%). For these cases, we used the median height and weight of the mothers with complete data. The GROW software also provides estimated customised cases with missing data. Ultimately, customised birthweight centiles were calculated for 352 of the 357 perinatal deaths in 2021.

## Classification of abnormal placental histology

Abnormal placental findings have been classified and presented under the following broad categories: maternal vascular malperfusion, fetal vascular malperfusion, cord pathology, cord pathology with distal disease, delayed villous maturation defect, chorioamnionitis, villitis and 'other placental condition' (Appendix E). This is in keeping with recommendations in a publication from an international consensus meeting of pathology, often referred to as the 'Amsterdam convention'.[15] It is envisaged that this will optimise classification of placental conditions causing or contributing to perinatal loss.

## 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. Unit contributors are 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 F. Briefly described; categories include both pathophysiological entities and clinical conditions present at time of death including congenital fetal anomaly, placental pathology and Intra-Uterine Growth Restriction (IUGR). Classification of stillbirths were 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 neonatal cause of death and the NPEC maternal and fetal classification system was used to identify the underlying obstetric condition/sentinel event associated with the death.

## Robson Ten Group Classification System

In 2021, data from units that participated in the PMNCA also provided data on all women who gave birth classified according to the Robson Ten Group Classification System (TGCS) (Appendix G). For three units, data was used from their 2020 data submission to calculate the total number of maternities. Data on 58,248 maternities were examined and classified by the Robson TGCS. For the first time in 2020, all 19 units that participated in the perinatal mortality audit also provided data on all deliveries classified according to the Ten Group Classification System. For the reporting years 2018 and 2019, and 2020 16 and 17 and all 19 of the 19 Irish maternity units respectively collated data on all births using the TGCS. This facilitated perinatal deaths corrected for major congenital anomalies to be classified according to the Ten Groups at national level. The NPEC and the Irish Maternity Indicator System (IMIS) continue to work together to consolidate the data collection of the Robson TGCS.

## 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:

[13] Gardosi J, Francis A. Customised Weight Centile Calculator. GROW version 8.0.6.1(IE), 2021 Gestation Network, www.gestation.net

[14] 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

[15] Khong TY, Mooney EE et al (2016). Sampling and definition of placental lesions. Arch Pathol Lab Med 2016 Jul;140 (7):698-713

**Stillbirth:** The NPEC seeks to apply a definition of stillbirth in accordance with the Irish Stillbirths Registration Act, which specifies stillbirth as a child born weighing 500 grammes or more or having a gestational age of 24 weeks or more who shows no sign of life.[16] In previous reports, we considered delivery ≥24 gestational weeks to be coterminous with having a gestational age of 24 weeks or more. However, cases of fetus papyraceous, where one of the twin fetuses died early in development, were not included as stillbirths. From 2016, cases of intrauterine death diagnosed before 24 gestational weeks with a birthweight <500g are not considered to have reached a gestational age of 24 weeks or more and thus are not included as stillbirths in this audit.

**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.[17]

**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 total births (live births and stillbirths from 24 weeks gestation or weighing >500g). The reporting guideline used by the Irish Healthcare Pricing Office perinatal statistics report on stillbirths uses the criterion of birthweight >500g.[18] For consistency, we also report the stillbirth rate using the criterion of birthweight >500g.

**Neonatal death rate:** Number of early neonatal deaths per 1,000 live births (from 24 weeks gestation or weighing >500g). The Irish Healthcare Pricing Office perinatal statistics report on early neonatal deaths with a birthweight >500g. For consistency, we also report the early neonatal death rate using the criterion of birthweight >500g.

**Overall perinatal mortality rate (PMR):** Number of stillbirths and early neonatal deaths per 1,000 total births (live births and stillbirths from 24 weeks gestation or weighing >500g). Again, for consistency with the Irish Healthcare Pricing Office reporting of perinatal statistics, we also report the neonatal death rate using the criterion of birthweight >500g. Late neonatal deaths are not included in the PMR.

**Corrected PMR:** Perinatal mortality rate excluding perinatal deaths associated with or due to a major congenital anomaly.

**Extended PMR:** Number of stillbirths, early neonatal deaths and late neonatal deaths per 1,000 total births (live births and stillbirths from 24 weeks gestation or weighing ≥500g).

**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:** From January 2016, the NPEC Perinatal Death Notification Form contains a specific question on whether the obstetric care of the mother was transferred to another maternity unit with the fetus in-utero. The identity of the transferring unit and gestational age at time of in-utero transfer are also captured.

**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 2021.

**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 2021.

[16] Stillbirth Registration Act, 1994. Available at: http://www.irishstatutebook.ie/eli/1994/act/1/enacted/en/print

[17] World Health Organisation. Available at: http://www.who.int/healthinfo/statistics/indmaternalmortality/en/

[18] Healthcare Pricing Office. Perinatal Statistics Report 2020. Dublin: Health Service Executive. [in press]

**Termination of pregnancy (TOP):** Following the Repeal of the Eighth amendment and the subsequent Health (Regulation of Termination of Pregnancy) Act 2018; termination of pregnancy became legal in the Republic of Ireland (ROI) in January 2019.

The NPEC Perinatal Death Notification Form contains a specific question on whether the perinatal loss occurred following Termination of Pregnancy (TOP). TOP refers to all cases where the pregnancy is medically ended, with the expected outcome of fetal or early neonatal death, in either of the following events: when there is a risk to the life, or of serious harm to the health, of the pregnant woman and for a condition likely to lead to death of fetus either before or within 28 days of birth. Since January 2019, limited data on perinatal deaths, as defined in this audit, following TOP are detailed in the NPEC Perinatal Mortality Audit Reports.

## Data Quality Statement

In the National Perinatal Epidemiology Centre the maintenance of data at high quality standards is a priority. The purpose of this data quality statement is to support the interpretation and quality of the information contained in this report.

This quality statement, presented in Appendix H, has been developed in line with the Health Information and Quality Authority (HIQA) guidance on data quality framework for health and social care.[19] The statement describes the quality of the data according to five data quality dimensions as defined by HIQA:

1. Relevance
2. Accuracy and reliability
3. Timeliness and punctuality
4. Coherence and comparability
5. Accessibility and clarity

The Perinatal Mortality National Clinical Audit adheres to following national and international legislation and standards:

- The European Union General Data Protection Regulation 2016
- The Data Protection Act 1988 and the
- Data Protection (Amendment) Act 2003
- Data Protection Act 2018 (Section 36(2)) (Health Research) Regulations 2018
- Information Management Standards for National Health and Social Care Data (2017)
- National Office of Clinical Audit Standards for National Clinical Audit
- National Standards for Safer Better Healthcare (2012)
- FAIR (Findable, Accessible, Interoperable, and Re-usable) Data Principles

[19] Health Information and Quality Authority. Guidance on a data quality framework for health and social care 2018. : HIQA; 2018 [cited 2019]. Available from: https://www.hiqa.ie/sites/default/files/2018-10/Guidance-for-a-data-quality-framework.pdf

# 1. Main findings

## Perinatal mortality rate

## Key findings

1. The perinatal mortality rate (PMR) was 5.87 per 1,000 total births in 2021. While a slight decrease in the PMR was observed in 2021, it is not statistically significant compared to previous years 2020 and 2019. Corrected for Major Congenital Anomaly (MCA), the PMR was 3.78 per 1,000 total births.
2. The stillbirth rate associated was 3.91 per 1,000 total births and the early neonatal death rate was 1.96 per 1,000 live births.
3. The level of variation in the rate of PMR between maternity units was lower in 2021 compared to 2020. When adjusted for MCA and in-utero transfers, no maternity unit was considered an outlier as defined by NOCA policy.

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 2021, the 19 Irish maternity units reported 60,841 births with a birthweight >500g or gestational age of ≥ 24 weeks. Of these 60,841 births, 357 met the criteria and were classified as perinatal deaths. Stillbirths and early neonatal deaths accounted for 238 (66.7%) and 119 (33.3%) of the 357 deaths, respectively. There were a further 40 late neonatal deaths in 2021.

The reporting guideline used by the Irish Healthcare Pricing Office (HPO) in their publication of national perinatal statistics, uses the criterion of birthweight >500g. In 2021, there were 60,804 babies born weighing >500g. Of these 60,804 babies, 335 met the criteria and were classified as perinatal deaths. Stillbirths and early neonatal deaths accounted for 218 (65.1%) and 117 (34.9%) of the 335 deaths, respectively. A further 40 babies met the criteria and were classified as late neonatal deaths in 2021.

As detailed in Table 1.1, the stillbirth rate associated with the criteria of birthweight >500g or gestational age >24 weeks was 3.91 per 1,000 total births and the early neonatal death rate using the same criteria was 1.96 per 1,000 live births compared respectively to 3.59 and 1.93 per 1,000 live births based on birthweight >500g. The overall PMR was 5.87 deaths per 1,000 total births and when corrected for major congenital anomaly was reduced to 3.78 whereas the respective rates based on birthweight >500g were 5.51 and 3.50 per 1,000 total births. For the first time in this audit, the 'Extended' PMR, which includes late neonatal deaths, has been calculated. The extended PMR was 6.53 per 1,000 live births based on birthweight >500g or gestational age >24 weeks. The extended PMR based on a birthweight > 500g are shown for comparison in Table 1.1.

**Table 1.1: Frequency and rate of perinatal mortality outcomes, 2021**

| | BWT ≥500g or gestational age ≥24 weeks | | BWT ≥500g | |
|---|---|---|---|---|
| | Number | Rate (95% CI) | Number | Rate (95% CI) |
| **Total births** | 60,841 | | 60,804 | |
| **Stillbirths** | 238 | 3.91(3.43-4.44) | 218 | 3.59(3.13-4.09) |
| **Early neonatal deaths** | 119 | 1.96(1.63-2.35) | 117 | 1.93(1.6-2.31) |
| **Perinatal deaths** | 357 | 5.87(5.28-6.51) | 335 | 5.51(4.94-6.13) |
| **Corrected perinatal deaths** | 230 | 3.78(3.31-4.3) | 213 | 3.50(3.05-4.01) |
| **Late neonatal deaths** | 40 | 0.66(0.47-0.9) | 40 | 0.66(0.47-0.9) |
| **Extended perinatal deaths** | 397 | 6.53(5.9-7.2) | 375 | 6.17(5.56-6.82) |

Note: BWT=Birthweight; Rate per 1,000 births; 95% CI=95% Poisson confidence interval; Corrected perinatal deaths exclude deaths due to a major congenital anomaly; Extended perinatal deaths include late neonatal deaths, early neonatal deaths and stillbirths.

## European comparison of the rate of stillbirth

In 2022, a published article entitled, the *Clarity and consistency in stillbirth reporting in Europe: why is it so hard to get this right?*[20] compared routine stillbirth statistics in Europe reported by Eurostat with data from the Euro-Peristat research network for stillbirths ≥500 grammes (g) and ≥1000g in 2015. Based on the former criteria, Figure 1.1 illustrates the 2015 Irish total stillbirth rate in comparison to the reported stillbirth rate for the other countries in Europe using the Euro-Peristat available date for 2015.

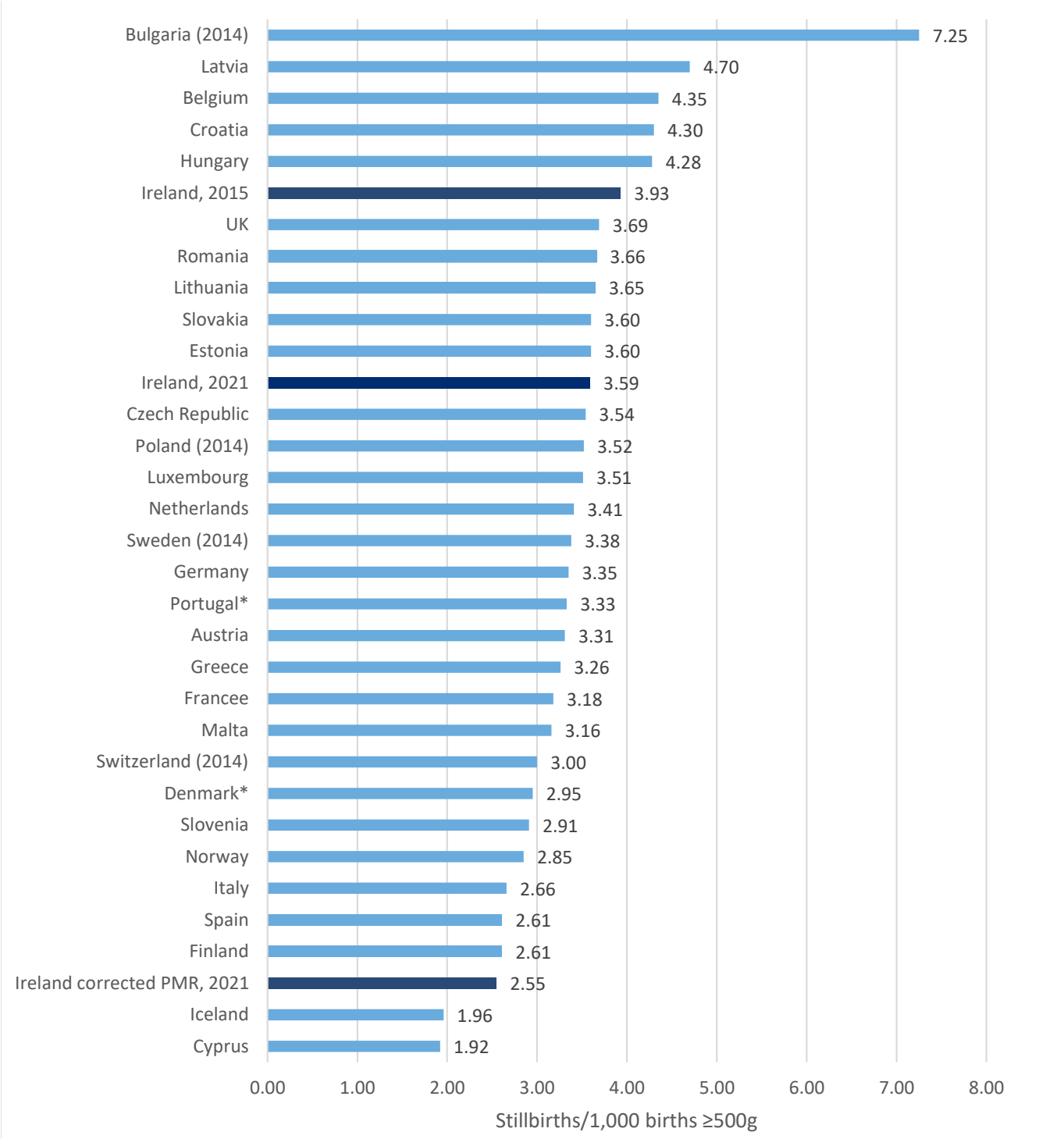


**Figure 1.1: Irish stillbirth rate in 2015 compared to the stillbirth rate in other countries in Europe in 2015.**
Note: Rates based on stillbirths among births with ≥500 grammes.

[20] Gissler M, Durox M, Smith L, Blondel B, Broeders L, Hindori-Mohangoo A, Kearns K, Kolarova R, Loghi M, Rodin U, Szamotulska K. Clarity and consistency in stillbirth reporting in Europe: why is it so hard to get this right?. European journal of public health. 2022 Apr;32(2):200-6. June 2022. Available: https://academic.oup.com/eurpub/article/32/2/200/6528409?login=true

## Comparison of perinatal mortality, 2012-2021

Table 1.2 compares the perinatal mortality outcomes for 2021, based on the criteria of birthweight ≥500g or gestational age ≥24 weeks at delivery, with those of the previous nine years. There was no change in rates of perinatal mortality compared to 2020 or 2019.

**Table 1.2: Comparison of perinatal statistics, 2012-2021**

| | Total births | Stillbirths | | Early neonatal deaths | | Perinatal deaths | | Corrected perinatal deaths | |
|---|---|---|---|---|---|---|---|---|---|
| | N | n | rate | n | rate | n | rate | n | rate |
| **2012** | 71,755 | 299 | 4.17 | 141 | 1.97 | 440 | 6.13 | 292 | 4.07 |
| **2013** | 69,146 | 294 | 4.25 | 162 | 2.34 | 456 | 6.59 | 296 | 4.28 |
| **2014** | 67,663 | 324 | 4.79 | 142 | 2.10 | 466 | 6.89 | 315 | 4.66 |
| **2015** | 65,904 | 287 | 4.35 | 166 | 2.50 | 453 | 6.87 | 279 | 4.23 |
| **2016** | 64,133 | 250 | 3.90 | 124 | 1.90 | 374 | 5.83 | 228 | 3.56 |
| **2017** | 62,076 | 235 | 3.79 | 111 | 1.80 | 346 | 5.57 | 220 | 3.54 |
| **2018** | 61,298 | 217 | 3.54 | 108 | 1.77 | 325 | 5.30 | 196 | 3.20 |
| **2019** | 59,574 | 242 | 4.06 | 118 | 1.99 | 360 | 6.04 | 222 | 3.73 |
| **2020** | 57,114 | 240 | 4.20 | 117 | 2.06 | 357 | 6.25 | 210 | 3.68 |
| **2021** | 60,841 | 238 | 3.91 | 119 | 1.96 | 357 | 5.87 | 230 | 3.78 |
| **RR comparing 2021 to 2020 (95% CI)** | | 0.93 (0.78-1.11) | | 0.95 (0.74-1.23) | | 0.94 (0.81-1.09) | | 0.95 (0.79-1.15) | |
| **RR comparing 2021 to 2019 (95% CI)** | | 0.96 (0.81-1.15) | | 0.99 (0.77-1.27) | | 0.97 (0.84-1.12) | | 0.94 (0.78-1.13) | |

Note: Rates are per 1,000 total births; RR=Rate ratio; 95% CI=Exact Poisson 95% confidence intervals; Corrected perinatal deaths exclude deaths due to a major congenital anomaly.

Decreasing rates of perinatal mortality were observed in the decade prior to 2012.[21] Then the rates levelled off, as illustrated in Figure 1.2, with an increase in perinatal mortality rate noted in 2020 compared to 2018 (rate ratio, RR=1.18, 95%CI=1.01-1.37, p-value=0.032). In 2021, a slight decrease in the PMR is observed, but it is not statistically significant compared to previous years 2020 and 2019 (Table 1.2).

[21] Healthcare Pricing Office. (2016) Perinatal Statistics Report 2014. Dublin:

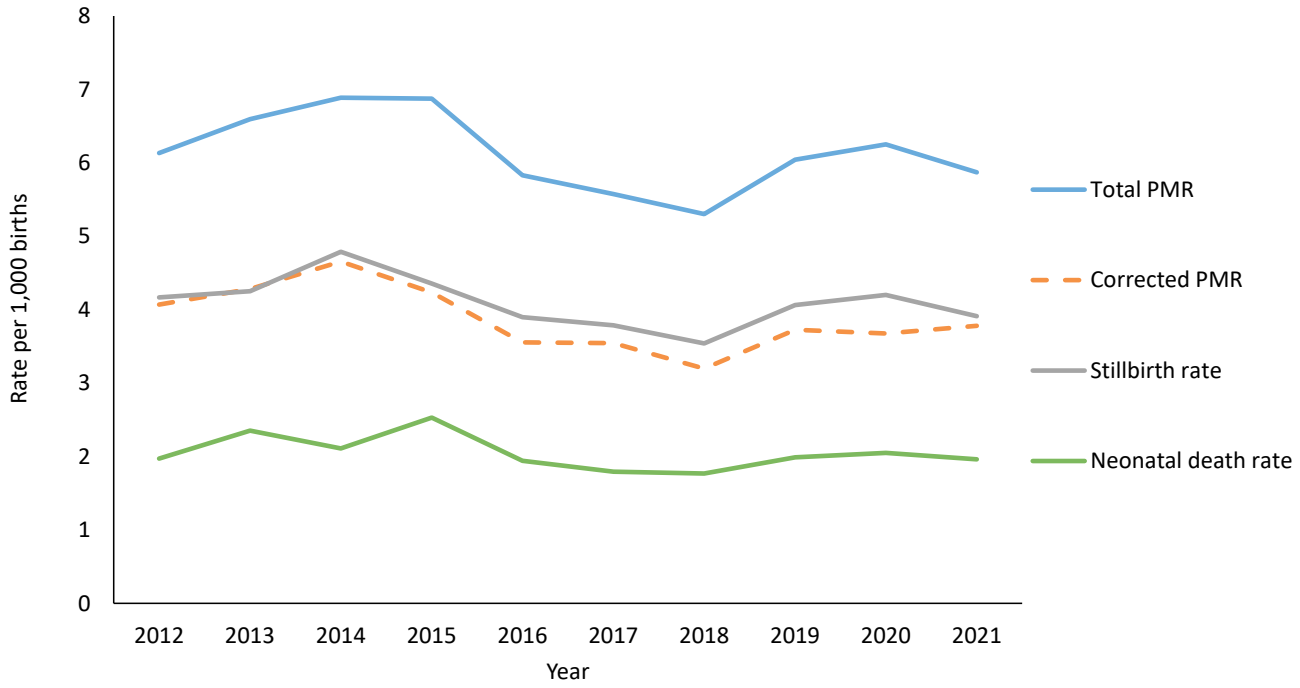


**Figure 1.2: Trend in perinatal mortality rates in Ireland, 2012-2021**

Note: Rates per 1,000 births; PMR = perinatal mortality rate; Corrected PMR excludes deaths due to a major congenital anomaly.

While reductions in perinatal mortality are not easy to achieve, other countries have made significant reductions in recent years. In England, a 20% reduction in stillbirths and a 5.1% reduction in neonatal deaths was achieved.[22] A similar approach in New Zealand has led to an 11% reduction in stillbirths.[23] The Netherlands have shown the highest rate of decrease in stillbirths of 48 countries, at 6.2% per year from 2000 to 2015, while Ireland had a reduction of 3.5% per year.[24] The reductions in the different countries have been achieved through the use of various care bundles, with the greatest reductions been found in stillbirths. NHS England has the 'Saving Babies Lives Care Bundle' which focuses on reducing smoking in pregnancy, risk assessment and surveillance for fetal growth restriction, raising awareness of reduced fetal movement, effective fetal monitoring during labour and the reduction of preterm birth.[25] Similar approaches are undertaken in New Zealand, for example, the National Maternity Monitoring Group (NMMG) was established in 2012 as part of the Maternity Programme to oversee and review national maternity standards and highlight areas in need of improvement. The Netherlands have prioritised the implementation of learning points from audits, and a programme has been developed to help local teams with the implementation process.[26]

In the Irish context, the introduction of a care bundle approach as outlined on page 12 by the relevant agencies (the NWIHP, the IOG and the Department of Health and Well Being in the HSE), may assist the maternity services in Ireland to achieve a reduction in the perinatal mortality and morbidity rates.

The value of a care bundle would be a service wide approach to more effective care using the learning from this audit, international success and research and learning around the topic of Perinatal Mortality and potential cross over effects to reduce neonatal morbidity.

[22] NHS England. Better Births Four Years On: A Review of Progress.; 2020 https://www.england.nhs.uk/wp content/uploads/2020/03/better-births-four-years-on-progress-report.pdf

[23] PMMRC. Twelfth Annual Report of the Perinatal and Maternal Mortality Review Committee Reporting Mortality 2016.; 2018

[24] Flenady V, Wojcieszek AM, Middleton P, et al. Stillbirths: Recall to action in high-income countries. Lancet. 2016;387(10019):691-702

[25] Saving-Babies-Lives-Care-Bundle-Version-Two-Updated-Final-Version.pdf (england.nhs.uk)

[26] www.actiontoolkit.nl

## Variation by maternity unit

Based on the criteria of a birthweight ≥500g and/or a gestational age of ≥ 24 weeks at delivery, in 2021, the uncorrected PMR across the Irish maternity units ranged from 2.74 to 8.15 per 1,000 total births and the corrected PMR ranged from 0.69 to 5.47 per 1,000 total births (Table 1.3). This level of variation across units is lower in 2021 compared to 2020. There was a moderate correlation between the unit specific corrected PMR in 2021 and 2020.

It must be noted that year-to-year changes at the level of individual units are volatile due to the smaller numbers involved. Moreover, 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.

**Table 1.3: Perinatal mortality rates across Irish maternity units, 2021**

| Unit | Uncorrected PMR (95% CI) | | Corrected PMR (95% CI) | |
|---|---|---|---|---|
| | 2020 | 2021 | 2020 | 2021 |
| Cavan (CGH) | 1.46(0.18-5.25) | 3.62(1.18-8.43) | 1.46(0.18-5.25) | 1.45(0.18-5.22) |
| Coombe (CH) | 5.68(4.11-7.64) | 6.08(4.47-8.08) | 3.17(2.03-4.71) | 3.62(2.41-5.23) |
| Cork (CUMH) | 6.67(4.91-8.86) | 5.89(4.28-7.9) | 3.41(2.18-5.07) | 3.75(2.49-5.41) |
| Drogheda (OLOL) | 7.04(4.31-10.86) | 4.96(2.78-8.16) | 5.99(3.49-9.57) | 4.29(2.29-7.33) |
| Galway (UHG) | 10.7(7.12-15.43) | 6.22(3.69-9.82) | 6.5(3.79-10.38) | 3.11(1.42-5.9) |
| Kerry (UHK) | 1.73(0.21-6.24) | 5.45(2.19-11.2) | 0.87(0.02-4.81) | 3.12(0.85-7.96) |
| Kilkenny (SLHK) | 5.56(2.4-10.92) | 3.99(1.47-8.66) | 2.78(0.76-7.10) | 3.32(1.08-7.74) |
| Letterkenny (LUH) | 3.87(1.42-8.41) | 3.15(1.02-7.34) | 1.94(0.4-5.65) | 1.89(0.39-5.52) |
| Limerick (UMHL) | 6.04(3.91-8.90) | 7.67(5.29-10.76) | 2.66(1.33-4.75) | 4.65(2.84-7.17) |
| Mayo (MUH) | 2.83(0.77-7.23) | 4.56(1.84-9.37) | 1.41(0.17-5.1) | 2.61(0.71-6.66) |
| Mullingar (RHM) | 4.88(2.23-9.24) | 5.54(2.77-9.89) | 4.88(2.23-9.24) | 4.03(1.74-7.92) |
| National Maternity (NMH) | 8.24(6.31-10.58) | 8.15(6.28-10.39) | 5.41(3.86-7.35) | 5.47(3.96-7.37) |
| Portiuncula (PUH) | 6.43(2.94-12.17) | 2.74(0.75-7.00) | 3.57(1.16-8.31) | 0.69(0.02-3.81) |
| Portlaoise (MRHP) | 5.67(2.45-11.15) | 4.53(1.82-9.31) | 4.96(2.00-10.2) | 4.53(1.82-9.31) |
| Rotunda (RH) | 6.60(4.98-8.59) | 6.11(4.62-7.93) | 3.00(1.94-4.43) | 3.82(2.66-5.31) |
| Sligo (SUH) | 6.02(2.6-11.84) | 3.57(1.16-8.31) | 3.77(1.22-8.76) | 2.14(0.44-6.25) |
| Tipperary (Tipp UH) | 5.12(1.4-13.04) | 4.22(1.15-10.78) | 2.56(0.31-9.21) | 4.22(1.15-10.78) |
| Waterford (UHW) | 5.51(2.52-10.43) | 5.67(2.72-10.39) | 4.28(1.72-8.81) | 5.1(2.33-9.66) |
| Wexford (WGH) | 5.03(2.17-9.89) | 5.25(2.4-9.94) | 2.52(0.69-6.43) | 2.33(0.64-5.96) |
| National | 6.25(5.62-6.93) | 5.87(5.28-6.51) | 3.68(3.2-4.21) | 3.78(3.31-4.3) |

Note: Rates per 1,000 total births based on birthweights ≥500g or gestational age ≥24 weeks; PMR=perinatal mortality rate; 95% CI= 95% Poisson confidence interval; Corrected PMR excludes deaths due to a major congenital anomaly.

## 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 and high-level neonatal intensive care. These transfers are undertaken in the best interest of the mother and their baby/babies to allow appropriate care for preterm deliveries, complex congenital fetal anomalies and maternal complications.

Of the 357 perinatal deaths in 2021, there were 43 cases (12.0%) where the care of the pregnant woman was transferred in-utero. These 43 in-utero transfers resulted in 17 stillbirths (39.5%) and 26 early neonatal deaths (60.5%). All but nine of the 43 in-utero transfer cases in 2021 were transferred to one of the country's four large maternity hospitals (i.e., the National Maternity Hospital, the

Rotunda Hospital, the Coombe Hospital, and the Cork University Maternity Hospital).

The solid horizontal line in Figure 1.3 represents the national PMR in 2021 (5.87 deaths per 1,000 total births) and the lettered square markers represent each unit's PMR. The dashed curves represent the 95% confidence limits around the national rate and the full curves represent the 99.8% confidence limits. For maternity units with a PMR equivalent to the national rate, there is a 5% chance that a unit's observed PMR will be outside the 95% confidence limits and a one-in-500 or 0.2% chance that a unit's observed PMR will be outside the 99.8% confidence limits.

In Figure 1.3, the red square markers represent each unit's PMR in 2021 if the 43 in-utero transfers had not happened, i.e., if all mothers who experienced perinatal loss after their care was transferred in-utero had instead experienced perinatal loss in the care of the maternity unit where they intended to deliver at the time of their first antenatal visit.

As we can see in Figure 1.3, without these in-utero transfer cases, almost all of the country's small maternity units would have had a higher PMR while the PMR for the four large maternity hospitals, considered together, would have been 13.7% lower. This impact varied across the four large maternity hospitals, as illustrated in Figure 1.3. The PMR would have been 8.5-10.7% lower in the Rotunda Hospital (S), Coombe Hospital (Q) and Cork University Maternity Hospital (P). The PMR rate for the National Maternity Hospital (R) would have been 23.4% lower in 2021. One large Dublin Maternity Unit (R) had an uncorrected PMR above the national rate and between the upper 95% confidence limit and the upper 99.8% confidence limit. However, the rate for this unit was almost identical to the national rate after adjusting for in-utero transfers. None of the smaller units had a PMR outside of the 95% confidence limits.

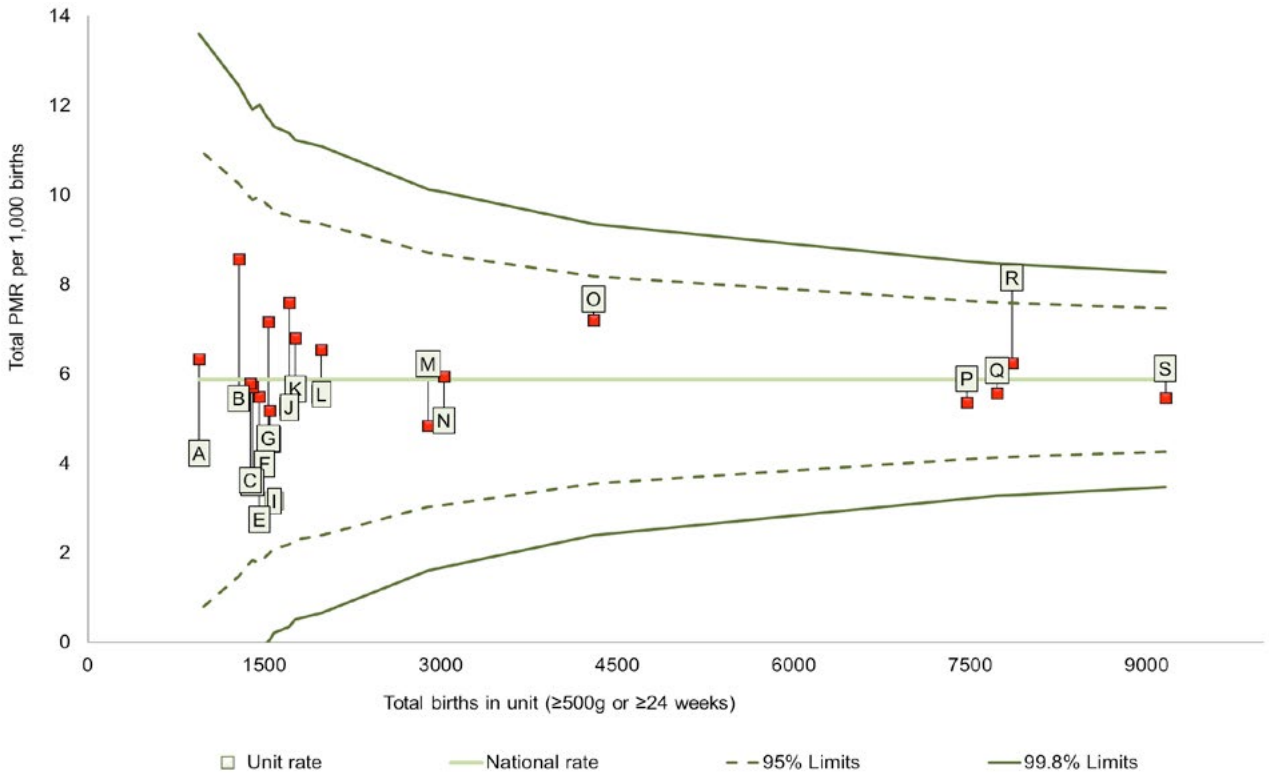


**Figure 1.3: Funnel plot of the perinatal mortality rate (PMR) for Irish maternity units, 2021**

Note: Two units (C=3.62 & D=3.57) have similar unit rates as do two other units (G=4.56 & H=4.53), represented by the overlapping lettered square markers. The letter identifying units will differ between funnel plots and between reporting years. Red markers indicate changes associated with corrections for in-utero transfers.

A - Tipperary (Tipp UH)
B - Kerry (UHK)
C - Cavan (CGH)
D - Sligo (SUH)
E - Portiuncula (PUH)
F - Kilkenny (SLHK)
G - Mayo (MUH)
H - Portlaoise (MRHP)
I - Letterkenny (LUH)
J - Wexford (WGH)
K - Waterford (UHW)
L - Mullingar (RHM)
M - Galway (UHG)
N - Drogheda (OLOL)
O - Limerick (UMHL)
P - Cork (CUMH)
Q - Coombe (CH)
R - National Maternity (NMH)
S - Rotunda (RH)

## Corrected perinatal mortality rate

The solid horizontal line in Figure 1.4 represents the national corrected PMR in 2021 (3.78 deaths per 1,000 total births) based on the 230 perinatal deaths not due to major congenital anomaly.

Twenty-two (9.6%) of the 230 perinatal deaths were associated with cases where the care of the pregnant woman was transferred with the fetus in-utero. None of the smaller units had a PMR outside of the 95% confidence limits. One large Dublin maternity hospital (R) had a corrected PMR (5.47 per 1,000 total births) higher than the national rate and above the upper 95% confidence limit. There were 11 perinatal deaths after in-utero transfer to this maternity hospital. Without these cases, the corrected PMR would have been 4.07 per 1,000 total births and thus under the upper 95% confidence limit.

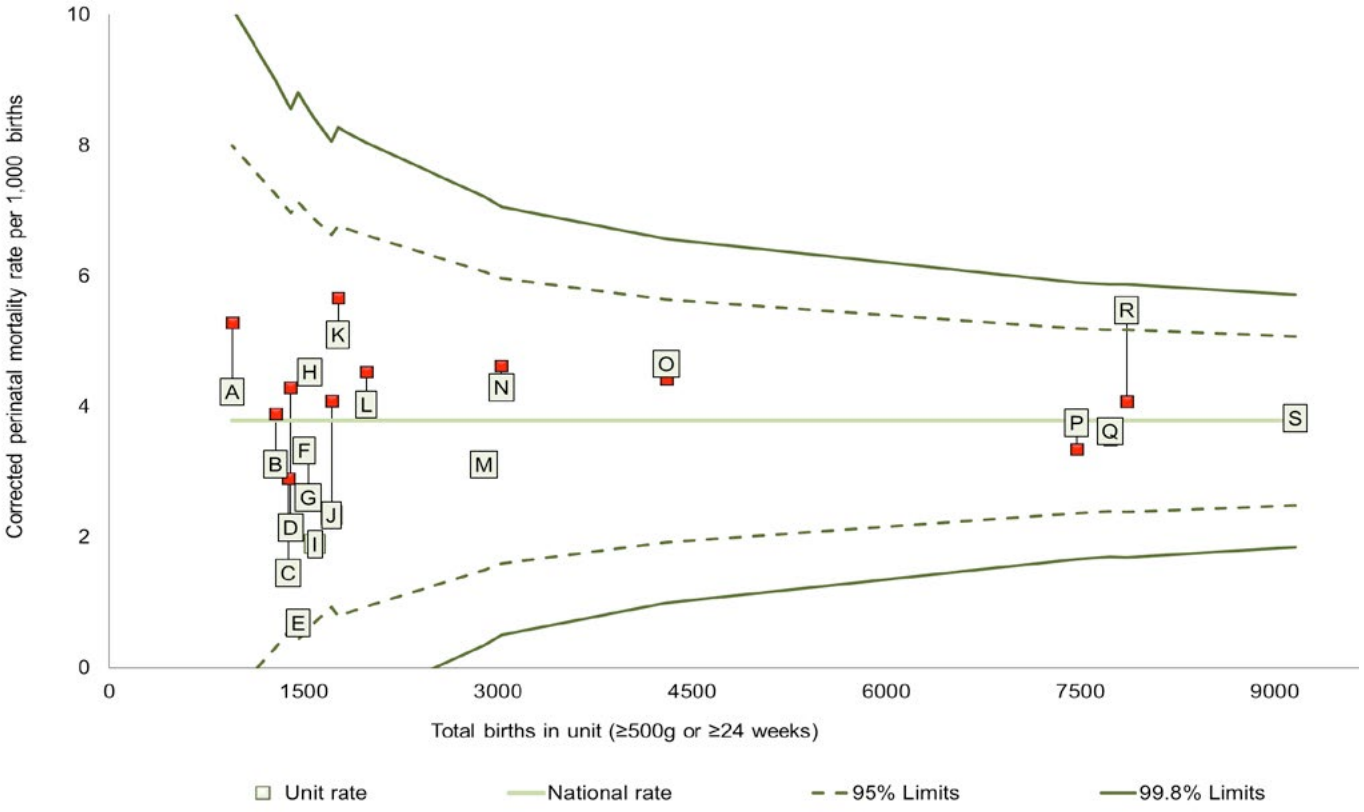


**Figure 1.4: Funnel plot of the corrected perinatal mortality rate – excluding for major congenital anomalies - for Irish maternity units, 2021.**

Note: The letter identifying units will differ between funnel plots and between reporting years. Red markers indicate changes associated with corrections for in-utero transfers.

A - Tipperary (Tipp UH)
B - Kerry (UHK)
C - Cavan (CGH)
D - Sligo (SUH)
E - Portiuncula (PUH)
F - Kilkenny (SLHK)
G - Mayo (MUH)
H - Portlaoise (MRHP)
I - Letterkenny (LUH)
J - Wexford (WGH)
K - Waterford (UHW)
L - Mullingar (RHM)
M - Galway (UHG)
N - Drogheda (OLOL)
O - Limerick (UMHL)
P - Cork (CUMH)
Q - Coombe (CH)
R - National Maternity (NMH)
S - Rotunda (RH)

## Stillbirth and early neonatal death rate

In Figure 1.5, the solid horizontal line represents the annual national stillbirth rate of 3.91 per 1,000 total births based on cases reported for 2021. All the units were within 95% confidence limits.

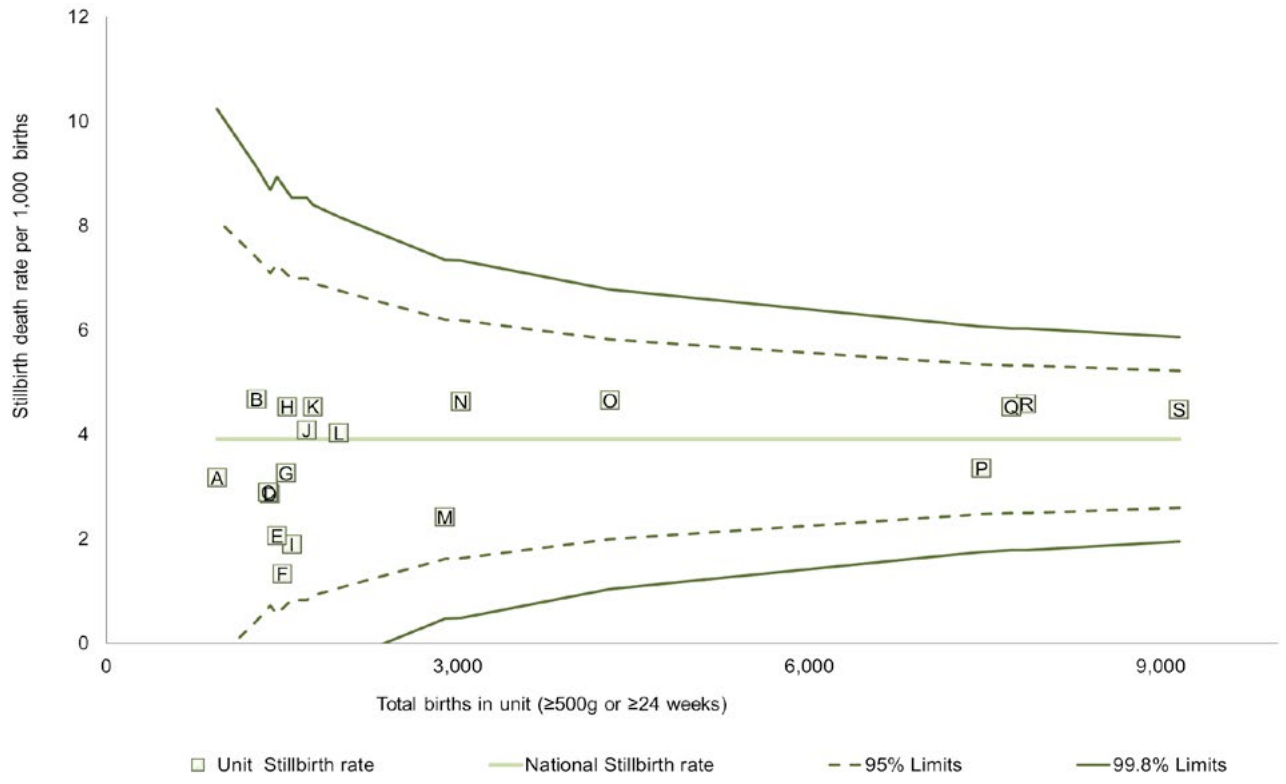


**Figure 1.5: Funnel plot of the stillbirth rate for Irish maternity units, 2021**

Note: Two units (C=2.90 & D=2.86) have similar unit rates, represented by the overlapping lettered square markers. The letter identifying units will differ between funnel plots and between reporting years.

A - Tipperary (Tipp UH)
B - Kerry (UHK)
C - Cavan (CGH)
D - Sligo (SUH)
E - Portiuncula (PUH)
F - Kilkenny (SLHK)
G - Mayo (MUH)
H - Portlaoise (MRHP)
I - Letterkenny (LUH)
J - Wexford (WGH)
K - Waterford (UHW)
L - Mullingar (RHM)
M - Galway (UHG)
N - Drogheda (OLOL)
O - Limerick (UMHL)
P - Cork (CUMH)
Q - Coombe (CH)
R - National Maternity (NMH)
S - Rotunda (RH)

The solid horizontal line in Figure 1.6 represents the annual national early neonatal death rate of 1.96 per 1,000 live births based on cases reported for 2021. One large Dublin maternity hospital (R) had a rate higher than the national rate just above the upper 99.8% confidence limit. As shown in earlier funnel plots, deaths due to major congenital anomaly or following in-utero transfer were associated with elevating the rate of perinatal deaths in the large tertiary maternity hospitals, especially in the case for the maternity hospital (R).

A small unit (M) had a rate higher than the national rate and above the upper 95% confident limit, and another unit (N) had a rate lower than the national rate and within the lower 95% confident limit.

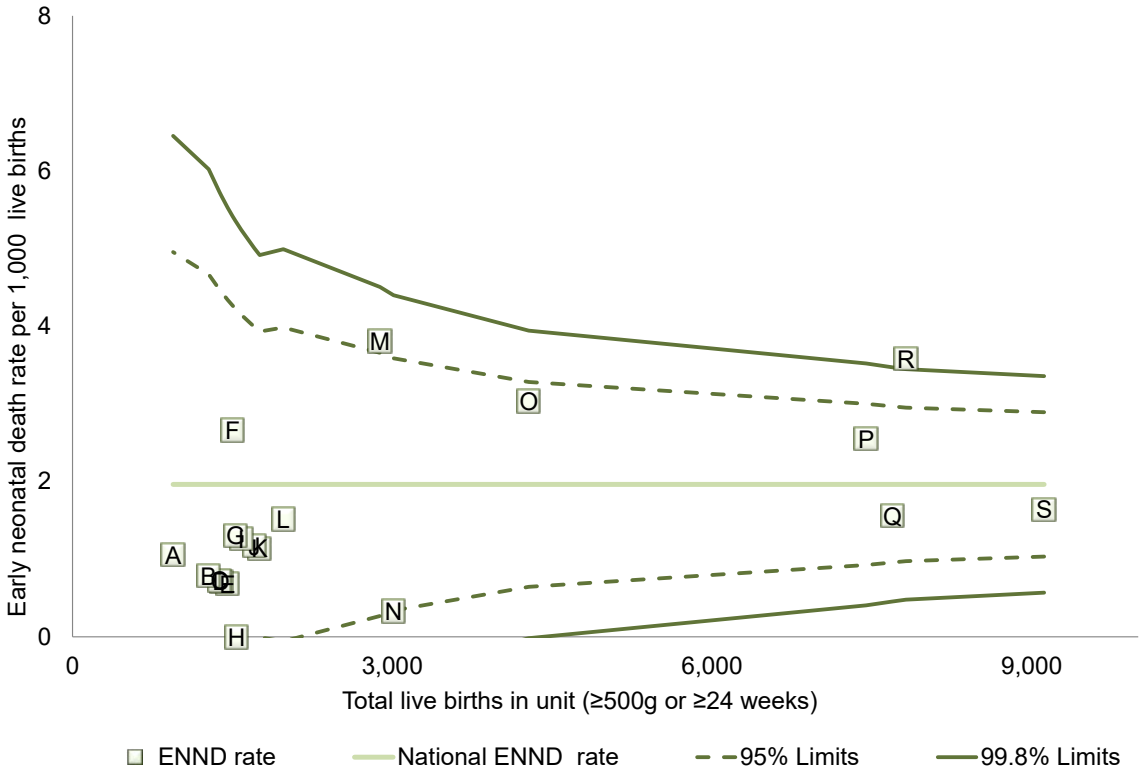


**Figure 1.6: Funnel plot of the early neonatal death rate for Irish maternity units, 2021**

Note: Three units (C=0.73, D=0.72 and E=0.69) have similar unit rates as do four other units (G=1.31 & I=1.26; J=1.17 & K=1.14), represented by the overlapping lettered square markers. The letter identifying units will differ between funnel plots and between reporting years.

A - Tipperary (Tipp UH)
B - Kerry (UHK)
C - Cavan (CGH)
D - Sligo (SUH)
E - Portiuncula (PUH)
F - Kilkenny (SLHK)
G - Mayo (MUH)
H - Portlaoise (MRHP)
I - Letterkenny (LUH)
J - Wexford (WGH)
K - Waterford (UHW)
L - Mullingar (RHM)
M - Galway (UHG)
N - Drogheda (OLOL)
O - Limerick (UMHL)
P - Cork (CUMH)
Q - Coombe (CH)
R - National Maternity (NMH)
S - Rotunda (RH)

## Corrected stillbirths and early neonatal death rates for the combined four years (2018-2021).

The corrected rate for stillbirths and early neonatal deaths, i.e. the rate adjusted to exclude deaths due to major congenital anomaly, have been calculated for the combined years 2018-2021 (Figure 1.7 and Figure 1.8). This allows for a more meaningful comparison of rates across smaller units where, due to small numbers, fluctuation of rates may occur between years.

The solid horizontal line in Figure 1.7 represents the national corrected rate for stillbirths for the combined years 2018-2021 (2.73 deaths per 1,000 total births) based on the 649 stillbirths not due to major congenital anomaly.

Thirty-six (5.5%) of the 649 stillbirths were associated with cases where the care of the pregnant woman was transferred in-utero. As indicated by the red markers in Figure 1.7, the corrected stillbirth rate of most small maternity units would have been higher if these in-utero transfers did not occur and the corrected rate of three of the four large maternity hospitals would have been lower.

One large Dublin maternity hospital (Q) had a corrected stillbirth rate (3.59 per 1,000 total births) higher than the national rate and above the upper 95% confidence limit and just below the upper 99.8% confidence limit. There were 14 stillbirths in babies following in-utero transfer of mothers to this maternity hospital. Without these cases, the corrected stillbirth rate would have been 3.11 per 1,000 total births and thus comparable with the national rate.

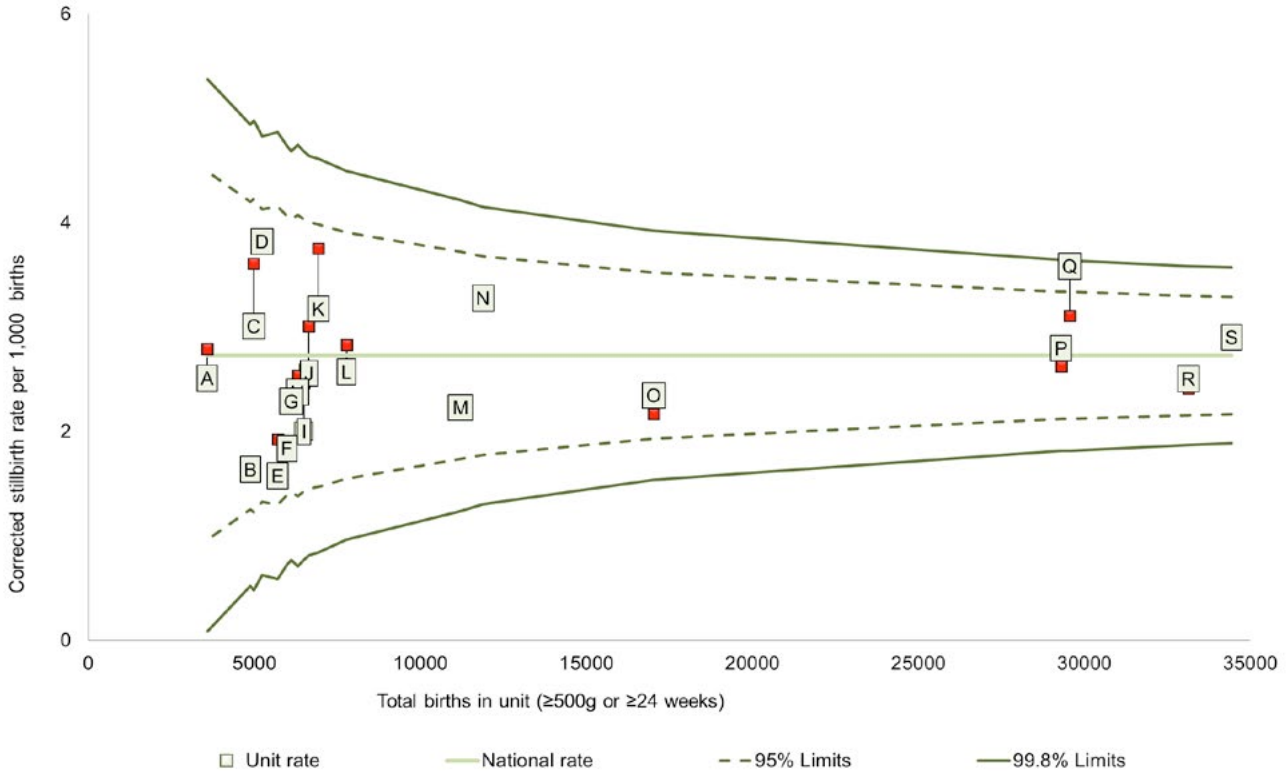


**Figure 1.7: Funnel plot of the corrected stillbirth rate for Irish maternity units, 2018-2021**

Note: Two units (H=2.38 & G=2.29) have similar unit rates represented by the overlapping lettered square markers. Excludes one stillbirth delivered at home not under the care of any 19 maternity units in Ireland. The letter identifying units will differ between funnel plots and between reporting years. Red markers indicate changes associated with corrections for in-utero transfers.

A - Tipperary (Tipp UH)
B - Kerry (UHK)
C - Sligo (SUH)
D - Portlaoise (MRHP)
E - Cavan (CGH)
F - Kilkenny (SLHK)
G - Mayo (MUH)
H - Portiuncula (PUH)
I - Letterkenny (LUH)
J - Wexford (WGH)
K - Waterford (UHW)
L - Mullingar (RHM)
M - Galway (UHG)
N - Drogheda (OLOL)
O - Limerick (UMHL)
P - Cork (CUMH)
Q - National Maternity (NMH)
R - Coombe (CH)
S - Rotunda (RH)

The solid horizontal line in Figure 1.8 represents the national corrected rate for early neonatal deaths for combined years 2018-2021 (0.88 deaths per 1,000 live births) based on the 209 early neonatal deaths not due to major congenital anomaly.

Forty-four (21.1%) of the 209 early neonatal deaths were associated with cases where the care of the pregnant woman was transferred in-utero. As indicated by the red markers in Figure 1.8, the neonatal death rate adjusted for in-utero transfers was higher for most small maternity units and was lower for three of the four large maternity hospitals.

One large maternity hospital (Q) had a corrected neonatal death rate (1.66 per 1,000 live births) higher than the national rate and the upper 99.8% confidence limit. There were 17 early neonatal deaths in babies following in-utero transfer of mothers to this maternity hospital. Without these cases, the corrected neonatal death rate would have been 1.09 per 1,000 live births and thus under the upper 95% confidence limit. The rate of all smaller units were within the 95% confidence limits.

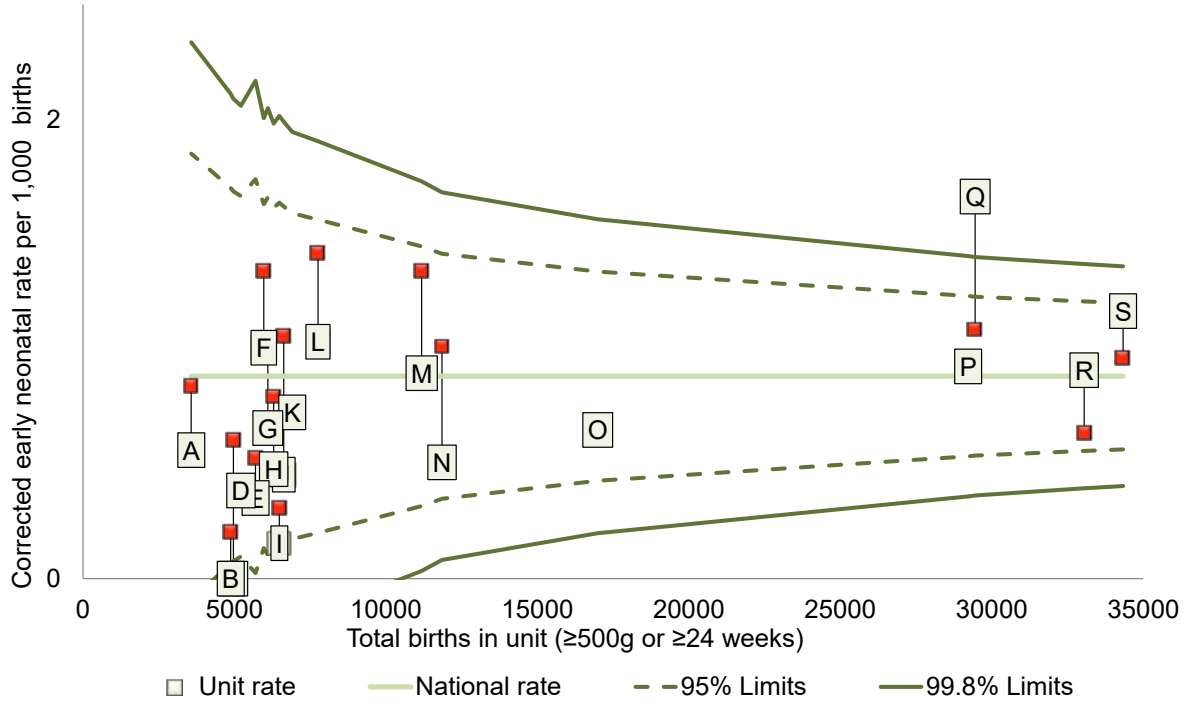


**Figure 1.8: Funnel plot of the corrected early neonatal death rate for Irish maternity units, 2018-2021**

Note: Two units (B=0.00 & C=0.00) have similar unit rates as do two other units (H=0.48 & J=0.45), represented by the overlapping lettered square markers. The letter identifying units will differ between funnel plots and between reporting years. Red markers indicate changes associated with corrections for in-utero transfers.

A - Tipperary (Tipp UH)
B - Kerry (UHK)
C - Sligo (SUH)
D - Portlaoise (MRHP)
E - Cavan (CGH)
F - Kilkenny (SLHK)
G - Mayo (MUH)
H - Portiuncula (PUH)
I - Letterkenny (LUH)
J - Wexford (WGH)
K - Waterford (UHW)
L - Mullingar (RHM)
M - Galway (UHG)
N - Drogheda (OLOL)
O - Limerick (UMHL)
P - Cork (CUMH)
Q - National Maternity (NMH)
R - Coombe (CH)
S - Rotunda (RH)

## Distribution of Perinatal Deaths by Robson Ten Group Classification System

The Robson Classification, also referred to as the Ten Group Classification System (TGCS), is a classification system providing a common starting point for further detailed analysis within which all perinatal outcomes can be measured and compared.[27] The system classifies all pregnant women into one of 10 categories that are mutually exclusive and, as a set, totally comprehensive.[28] The categories are based on five basic obstetric characteristics that are routinely collected for all maternities: parity, gestational age, onset of labour, fetal presentation, and number of fetuses.

In cases of antepartum stillbirth, the baby is usually delivered following induction of labour or by pre-labour caesarean section. This places most women who experience antepartum stillbirth into Group 2 or Group 4, depending on parity. It thereby causes these groups to have relatively high perinatal mortality rates compared to groups 1 and 3, which is a consequence of care after the perinatal loss event rather than reflecting valid differences in risk. To address this issue, we report perinatal mortality data for Groups 1 and 2 combined and Group 3 and 4 combined. The TGCS allows for further investigation of Perinatal Mortality by group.

[27] Robson MS (2001). Classification of caesarean sections. Fetal and Maternal Medicine Review, 12, pp 23-39 doi:10.1017/S0965539501000122

[28] Robson M et al. The 10-Group Classification System (Robson classification), induction of labor, and cesarean delivery. International Journal of Gynecology and Obstetrics 131 (2015) S23–S27

Treating Groups 1 & 2 and Groups 3 & 4 as single cohorts allows focus on the principal groups of nulliparous and multiparous women, irrespective of mode of delivery.[29]

Table 1.4 below outlines the number of deliveries reported to the NPEC for the TGCS for the years 2018, 2019, 2020 and 2021 (n=222,496). All 19 units that participated in the PMNCA also provided data on all deliveries classified according to the TGCS. This facilitated the perinatal deaths corrected for major congenital anomalies to be classified according to the Ten Groups at national level. Group One through Five accounted for 87.7% of the deliveries (n= 195,351) but represented 25.1% of the perinatal deaths (n= 213). Higher perinatal mortality rates are expected in Groups 8 and Group 10 considering the range of complications associated with both multiple pregnancy and prematurity. Prematurity is strongly associated with perinatal mortality. This is made especially clear by the TGCS. Group Ten contains all single cephalic pregnancies delivered preterm. This group contained 4.1% of the deliveries, it had the highest PMR and contributed 1.63 per 1,000 babies delivered to the overall PMR of 3.82 per 1,000 babies delivered. The incidence of perinatal mortality varies across the groups. The Robson TGCS highlights the reasons that contribute to the overall corrected PMR and allows more focused interventions to improve clinical care. The TGCS reinforces the need for close monitoring of multiple pregnancy and other pregnancies at risk of premature birth.

**Table 1.4: Incidence of corrected perinatal deaths for major congenital anomaly by Robson TGCS in Irish maternity units 2018 – 2021**

| Group | Group description | Number of babies delivered | Perinatal deaths (n) | Rate per 1,000 | Group contribution to rate |
|---|---|---|---|---|---|
| All* | | 222,496 | 850 | 3.82 | – |
| 1 | Nulliparous, singleton, cephalic, ≥37 spontaneous labour | 75413 | 98 | 1.30 | 0.44 |
| 2 | Nulliparous, singleton, cephalic, ≥37 induced or elective CS | | | | |
| 3 | Multiparous (excluding previous CS), singleton, cephalic, ≥37 spontaneous labour | 84990 | 97 | 1.14 | 0.44 |
| 4 | Multiparous (excluding previous CS), singleton, cephalic, ≥37 induced or elective CS | | | | |
| 5 | Previous CS, singleton, cephalic, ≥37 induced or elective CS | 34948 | 18 | 0.52 | 0.08 |
| 6 | All nulliparous women with a single breech pregnancy | 9,880 | 140 | 14.17 | 0.63 |
| 7 | All multiparous breech (including previous CS) | | | | |
| 9 | All women with a single pregnancy with a transverse or oblique lie, including women with previous uterine scars | | | | |
| 8 | All multiple pregnancies (including previous CS) | 7956 | 134 | 16.84 | 0.60 |
| 10 | All singleton, cephalic, <37 (including previous CS) | 9309 | 363 | 38.99 | 1.63 |

[29] O'Farrell IB, Manning E, P Corcoran, Greene RA, on behalf of the Perinatal Mortality Group. Perinatal Mortality in Ireland Annual Report 2017. Cork: National Perinatal Epidemiology Centre, 2019

## Maternal characteristics

The findings presented in this section relate to characteristics of mothers of stillbirths and early neonatal deaths born with a birthweight ≥500g or having achieved a gestational age ≥24 weeks.

## Key findings

1. Maternal age (greater than 40 years) and overweight were associated with an increased risk of perinatal mortality.
2. While the numbers involved were small, Irish Traveller, Asian and Black ethnicities were overrepresented in the mothers who experienced perinatal deaths in 2021.
3. Twenty percent (20.1%) of mothers experiencing perinatal loss booked into hospital for antenatal care before 12 weeks gestation, and more than seventy percent (70.8%) attended between 12- and 19-weeks gestation.

### Age

The age of mothers experiencing perinatal loss was known for all but one of the perinatal deaths in 2021, (99.7%; Table 1.5). The mothers who experienced perinatal loss in 2021 ranged in age from teenage years (the youngest 16 years of age) through to mid-forties (45 years of age). Their age distribution broadly reflected that of the population of mothers who gave birth in Ireland in 2021 (Table 1.5). Over half of the population (51.0%) who gave birth in 2021 were aged 25-34 years, whereas a slightly lower proportion of mothers who experienced perinatal loss were in this age group (45.1%). The age profile of mothers who experienced a stillbirth was similar to that of mothers who experienced early neonatal death. Mothers experiencing early neonatal deaths were slightly more likely to be aged 40 or more.

**Table 1.5: Age distribution of mothers experiencing perinatal loss, 2021**

| Age group | All births[30] 2021 N=60,841 N(%) | Perinatal deaths (N=357) N(%) | Stillbirths (N=238) N(%) | Early Neonatal deaths (N=119) N(%) |
|---|---|---|---|---|
| <25yrs | 5,005(8.2) | 32(9.0) | 19(8.0) | 13(10.9) |
| 25-29yrs | 98,48(16.2) | 42(11.8) | 26(10.9) | 16(13.4) |
| 30-34yrs | 21,160(34.8) | 119(33.3) | 82(34.5) | 37(31.1) |
| 35-39yrs | 19,691(32.4) | 110(30.8) | 81(34.0) | 29(24.4) |
| >40yrs | 5,135(8.4) | 53(14.8) | 30(12.6) | 23(19.3) |
| Not stated | 2(0) | 1(0.3) | 0(0) | 1(0.8) |

Note: Values are shown as N(%) unless otherwise stated. Maternal age unknown for one ENND.

In line with findings published in previous perinatal mortality reports, an association between maternal age and perinatal mortality was found. Compared to mothers aged between 30-34 years, women aged 40 or more had a 1.8 fold increase in the rate of perinatal mortality ($p<0.001$) in 2021 (Table 1.6).

[30] Healthcare Pricing Office. Perinatal Statistics Report 2021. Dublin: Health Service Executive. [in press]

**Table 1.6: Comparing the rate ratio of perinatal mortality by age group among mothers, 2021**

| Age group | Rate per 1,000 births (95% CI) | Rate Ratio 95% CI | P-Value |
|---|---|---|---|
| <25yrs | 6.39(4.38-9.01) | 1.14(0.77-1.68) | 0.52 |
| 25-29yrs | 4.26(3.08-5.76) | 0.76(0.53-1.08) | 0.12 |
| 30-34yrs | 5.62(4.66-6.73) | 1.00 (reference) | |
| 35-39yrs | 5.59(4.59-6.73) | 0.99(0.77-1.29) | 0.96 |
| >40yrs | 10.32(7.74-13.48) | 1.84(1.33-2.54) | <0.001 |

Note: Maternal age unknown for one ENND. 95% CI=Exact Poisson 95% confidence intervals.

## Ethnicity

Assessment of risk of perinatal loss associated with ethnic group is impeded by the absence of national data on ethnicity for the pregnant population in Ireland. In 2021, the majority of mothers who experienced perinatal loss were of white Irish ethnicity (n=250 of 357, 70.0%, data missing for three cases; Table 1.7). This is close to the proportion of white Irish women in the female population aged 15-49 years enumerated by the National Census 2016. While the numbers involved were small, Irish Traveller, Asian and Black ethnicities were overrepresented in the mothers who experienced perinatal deaths in 2021 (12.1%) compared to their reported presence 5.0% of the female 15-49-year-old population.

**Table 1.7: Ethnicity of mothers experiencing perinatal loss, 2021**

| Ethnicity | Perinatal deaths N=357 N(%) | 15-49 year-old female population, 2016[31] (%) |
|---|---|---|
| White Irish | 250(70.0) | 77.1 |
| Irish Traveller | 15(4.2) | 0.7 |
| Other white background | 51(14.3) | 13.3 |
| Asian/Asian Irish | 20(5.6) | 1.6 |
| Black/Black Irish | 8(2.2) | 2.7 |
| Other/mixed | 10(2.8) | 1.8 |
| Not recorded/Missing | 3(0.8) | 2.7 |

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

## Employment Status

Lower socio-economic status has been shown to be associated with poor pregnancy outcomes.[32] In the NPEC national clinical audit, data on the mother's employment status at booking was sought. Data was not recorded for 16 (4.5%) of the 357 women who experienced perinatal loss, this was slightly lower than the proportion of unrecorded employment status in 2020 (5.3%). Table 1.8 provides a high-level overview of the data that were provided on mother's occupation alongside data available for the most comparable occupation categories for mothers of all births in Ireland (from the Perinatal Statistics Report 2021),[33] and for the 15–44-year-old female population from the National Census 2016.[34]

Employment status was specified for 95.5% of the mothers for whom data were recorded (Table 1.8). It can be seen that unemployment status was recorded for 9.7% of the mothers experiencing perinatal loss compared to 5.2% of all births in 2021, and 8.2% of the female population aged 15-44 years in 2016. The proportion of mothers engaged in home duties who experienced perinatal loss (16.7%) was slightly higher than the percentage of all women engaged in home duties who gave birth (14.1%) in 2021, as in previous reports.

[31] Population data from the National Census 2016

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

[33] Healthcare Pricing Office. Perinatal Statistics Report 2021. Dublin: Health Service Executive. [in press].

[34] Population data from the National Census 2016

**Table 1.8: Employment status at booking of mothers experiencing perinatal loss, 2021**

| Employment Status | Perinatal deaths N=341 N(%) | All births N=55,745* (%) | 15-44 year-old female population, 2016 (%) |
|---|---|---|---|
| Employed | 243(71.3) | 44,969(80.7) | 57.8 |
| Unemployed | 33(9.7) | 2,895(5.2) | 8.2 |
| Home duties | 57(16.7) | 7,881(14.1) | 10.4 |
| Student | 1(0.3) | n/a | 21.1 |
| Others not in labour force | 7(2.1) | n/a | 2.5 |

Note: Data not known on employment status for 16 mothers who experienced perinatal deaths. *There were an additional 5,096 mothers in the births population whose employment status was not stated or not classifiable in 2021.

## Gestation at booking

Gestation at the time of the mother's first antenatal visit to the maternity hospital was not recorded for 39 cases of perinatal death in 2021 (10.9%). Of the 318 cases with data, approximately three percent were not booked (2.8%), twenty percent (20.1%) booked into hospital before 12 weeks gestation, and more than seventy percent (70.8%) attended for antenatal care between 12- and 19-weeks' gestation (Table 1.9). In 2021, the median gestational age at booking was 13 weeks.

**Table 1.9: Weeks gestation at date of first hospital booking, 2021**

| Gestation at booking | Stillbirths N=227 N(%) | Early Neonatal deaths N=91 N(%) | Perinatal deaths N=318 N(%) |
|---|---|---|---|
| Less than 12 Weeks | 43(18.9) | 21(23.1) | 64(20.1) |
| 12-19 Weeks | 167(73.6) | 58(63.7) | 225(70.8) |
| 20 Weeks or Later | 13(5.7) | 7(7.7) | 20(6.3) |
| Not Booked | 4(1.8) | 5(5.5) | 9(2.8) |

Note: Gestation at booking unknown for 39 cases in 2021.

The proportion of women presenting for first antenatal visit at 20 weeks gestation or later was lower in 2021 (6.3%) compared to 2020 (7.2%), but higher than 2019 (5.5%; Figure 1.9).

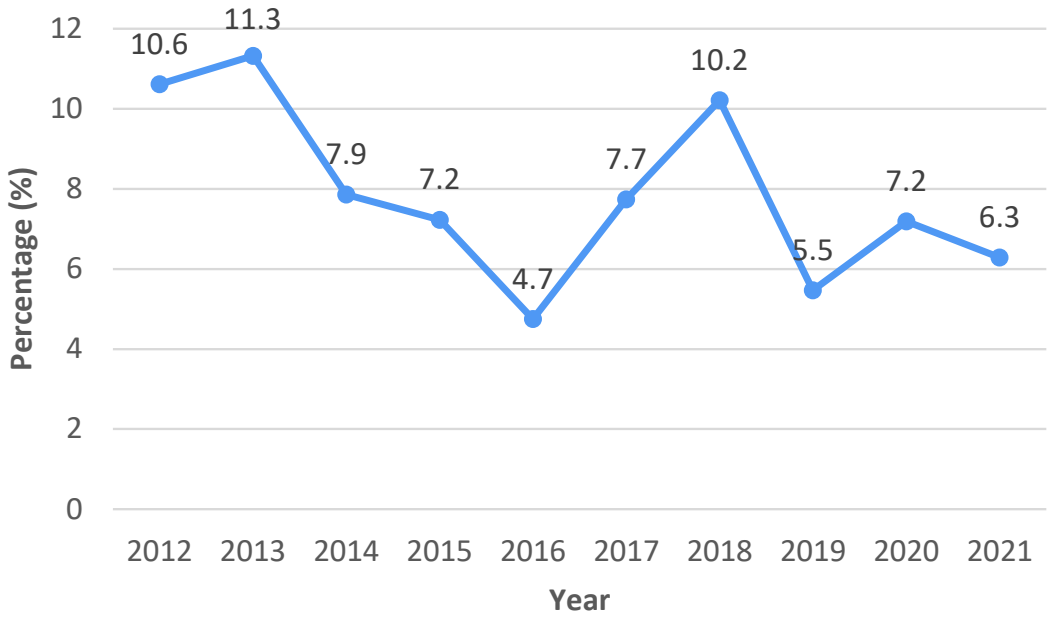


**Figure 1.9: Proportion attending first booking appointment ≥20 weeks gestation among women who experienced perinatal loss in 2012-2021**

## Anatomy scan

Since 2017, the NPEC have collected data on whether a woman underwent an anatomy scan. As recommended by the National Maternity Strategy 2016-2026, access to fetal anomaly ultrasound scanning should be universally available to all pregnant women in Ireland and a national guideline was published in 2023.[35, 36]

Data on whether a woman received an anatomy scan was recorded for 355 of 357 women who experienced perinatal loss in 2021. Of these 355 women, 91.8% (n=326) received an anomaly scan in 2021. All maternity units in 2021 provided an anatomy scan to at least 75% of the women.

## Fertility treatment

Currently in Ireland there is no national data on the number of births as a result of fertility treatment. The NPEC Perinatal Death Notification Form contains a specific question on whether the pregnancy was the result of fertility treatment. In 2021, information was available for 329 of the 357 (92.2%) cases of perinatal death. In 25 of these 329 cases (7.6%) the pregnancy was reported to be the result of fertility treatment (n=17 of 212 stillbirths, 8.0% and n=8 of 117 early neonatal deaths, 6.8%). Almost one quarter (n=6, 24.0%) of these 25 pregnancies were associated with multiple births ending in perinatal loss of one or more infants.

The method of treatment was specified for all but two of the 25 pregnancies resulting from fertility treatment. In order of frequency, the methods were: in vitro fertilisation (including egg donation and Intracytoplasmic Sperm Injection (ICSI); n=21) and ovulation induction therapy (n=2).

## Body mass index

Increased maternal Body Mass Index (BMI) has been associated with an increased risk of major congenital anomaly and stillbirth.[37, 38] However, complete national data on the BMI is not available. Body mass index (BMI) was available for 314 of the 357 (88.0%) women who experienced perinatal loss in 2021 (Table 1.10). Women in the lean BMI category (40.4%) were underrepresented among women who experience perinatal loss compared to the population of women who gave birth in 2021 (48.7%). Overall, the percentage of women in the lean range in 2021 was similar to the percentage of women in this range across the years 2017 to 2021. In 2021, the percentage of women who experienced perinatal loss and who were obese (22.6%) was the lowest since 2016 and was similar to the population of women who gave birth in 2021.

**Table 1.10: Body mass index of mothers who experienced perinatal loss, 2017-2021**

| BMI Category (kg/m²) | 2017 N=312 N(%) | 2018 N=263 N(%) | 2019 N=257 N(%) | 2020 N=324 N(%) | 2021 N=314 N(%) | Maternities 2021 N=58,952 N(%)* |
|---|---|---|---|---|---|---|
| Lean (<25) | 137(43.9) | 110(41.8) | 101(39.3) | 121(37.3) | 127(40.4) | 28,682(48.7) |
| Overweight (25<30) | 103(33) | 77(29.3) | 72(28) | 105(32.4) | 116(36.9) | 17,960(30.5) |
| Obese (30+) | 72(23.1) | 76(28.9) | 84(32.7) | 98(30.2) | 71(22.6) | 12,310(20.9) |

Note: Values are shown as N(%) unless otherwise stated; Percentage refers to the total 314 cases for which BMI was obtained in 2021. The range for not recorded BMI data from 2017 to 2021 varies from 9% to 19%. *Data on BMI were collated for 33,221 maternities in 2021 from seven maternity units. This is 56.4% of the 58,953 women who gave birth in hospital in Ireland in 2021, according to HIPE data. We multiplied the BMI data on 33,221 women by 1.77 (i.e., 100%/56.4%) in order to estimate the national number of maternities by BMI category.

[35] Creating a better future together. National Maternity Strategy 2016-2026. Available at: https://www.gov.ie/en/publication/0ac5a8-national-maternity-strategy-creating-a-better-future-together-2016-2/

[36] The Fetal Anatomy Ultrasound (2023). Available at: https://www.hse.ie/eng/about/who/acute-hospitals-division/woman-infants/clinical-guidelines/#National%20Clinical%20Guidelines%20in%20Obsterics%20and%20Gynaecology

[37] 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

[38] 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.

As shown in Table 1.11, women in the overweight category who experienced perinatal loss were overrepresented relative to the population of women who gave birth in 2021. This was reflected in the perinatal mortality rate of 6.46 per 1,000 for overweight women. Thus, overweight women had a 46% higher risk of perinatal mortality compared to women who gave birth in 2021 with a lean BMI (p-value= 0.003). The increased risk for obese women was less evident in 2021 compared to recent years.

**Table 1.11: Perinatal mortality by body mass index (BMI) among mothers, 2021**

| BMI Category (kg/m²) | Rate per 1,000 (95% CI) | Rate Ratio (RR) 95% CI | P-Value |
|---|---|---|---|
| Lean (<25) | 4.43(3.69-5.27) | 1.00(reference) | - |
| Overweight (25<30) | 6.46(5.34-7.74) | 1.46(1.13-1.88) | 0.003 |
| Obese (30+) | 5.77(4.51-7.27) | 1.3(0.97-1.74) | 0.07 |

Note: 95% CI=Exact Poisson 95% confidence intervals; RR=Rate ratio, comparing the rate for women in each BMI category versus the rate for women in the lean BMI category.

- **Recommendation:** All healthcare professionals (obstetricians, GPs and midwives) should see every interaction with a woman as an opportunity to address weight, nutrition and lifestyle to optimize her health. This also supports the HSE Programme 'Making Every Contact Count' (MECC). Owner; All Healthcare staff.

## Smoking and substance misuse

Smoking status of the mothers at their time of booking was recorded for 335 (93.8%) of the 357 women. Of these, 38 (11.3%) were smokers at the time of booking. Seventeen were smoking between one and nine cigarettes per day (n=17 of 32, 53.1%, missing information for six women), and fifteen were smoking at least up to 10 cigarettes per day (n=15 of 32, 46.9%).

Information on smoking in late pregnancy was available for 28 of the 38 smokers (73.7%) and only three (10.7%) stopped smoking during pregnancy.

National data on the prevalence of smoking during pregnancy or in the last trimester is not known for all Irish pregnancies but rates of 12%, 15%, 16% and 19% have been reported for England, Northern Ireland, Wales and Scotland, respectively.[39]

One woman had a documented history of alcohol misuse prior to pregnancy and four women had a documented history of alcohol misuse during pregnancy. Five women had a documented history of drug misuse prior to pregnancy and three women had a documented history of drug misuse during pregnancy.

- **Recommendation:** National data on social factors impacting on perinatal loss, e.g. smoking and alcohol abuse, remain difficult to collate. Consideration should be given to methodologies to capture this information consistently. Owner; the NPEC and the NWIHP.

[39] 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

## Previous pregnancy

Sixty-eight percent of mothers who experienced perinatal loss in 2021 had at least one previous pregnancy (gravida > 0; 242 of 356, missing information for one woman, 68.0%). Table 1.12 specifies gravida/parity for the 356 women who experienced perinatal loss. Almost one third of women (n=114, 32.0%) had never been pregnant before (gravida = 0). Of the 242 women who had been pregnant (gravida > 0), almost 50% (n=118, 48.8%) had pregnancies delivering from 24 weeks or with a birthweight of ≥ 500g (gravida = parity, indicated by green shading). Over one third of these 242 mothers (n=93, 38.4%) experienced at least one pregnancy exceeding 24 weeks or with a birthweight ≥ 500g and at least one pregnancy less than 24 weeks gestation and under 500g birthweight (gravida > parity > 0, indicated by yellow shading). Additionally, for 12.8% (n=31) of these women their previous pregnancies never exceeded 24 weeks gestation or 500g birthweight (gravida > parity = 0, indicated by orange shading).

**Table 1.12: Gravida/parity of mothers prior to experiencing perinatal loss, 2021**

| GRAVIDA | PARITY | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **10** | **Total** |
| **0** | 114 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 114 |
| **1** | 17 | 67 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 84 |
| **2** | 10 | 26 | 29 | 0 | 0 | 0 | 0 | 0 | 0 | 65 |
| **3** | 3 | 15 | 13 | 11 | 0 | 0 | 0 | 0 | 0 | 42 |
| **4** | 1 | 3 | 10 | 3 | 3 | 0 | 0 | 0 | 0 | 20 |
| **5** | 0 | 1 | 3 | 6 | 3 | 6 | 0 | 0 | 0 | 19 |
| **6** | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 3 |
| **7** | 0 | 1 | 0 | 0 | 1 | 2 | 0 | 2 | 0 | 6 |
| **8** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| **14** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 |
| **Total** | 145 | 114 | 56 | 20 | 7 | 9 | 0 | 4 | 1 | 356 |

Note: We refer to gravida and parity prior to the pregnancy ending in perinatal death in 2021. Green represents women with previous pregnancies that were all ≥24 weeks or ≥500g; yellow represents women who had experienced pregnancy ≥24 weeks or ≥500g and also pregnancy <24 weeks and <500g; and orange represents women whose previous pregnancies were always <24 weeks gestation and <500g birthweight.

Of the 242 women who had a previous pregnancy, 43.0% (n=104) were reported to have had a previous pregnancy-related problem (unknown for four women). Caesarean section delivery was the most common previous pregnancy-related problem with almost twenty percent of mothers (n=47 of 242, 19.4%) having a previous caesarean section delivery (Table 1.13). Experiencing pre-term birth or mid-trimester loss was the second most common previous pregnancy problem (n=19, 7.9%) followed by experiencing three or more miscarriages (n=15, 6.2%).

**Table 1.13: Previous pregnancy-related problems in mothers who experienced perinatal loss in 2016-2021**

| | 2016 N=264 N(%) | 2017 N=230 N(%)* | 2018 N=230 N(%)* | 2019 N=244 N(%)* | 2020 N=252 N(%)* | 2021 N=242 N(%) |
|---|---|---|---|---|---|---|
| Previous caesarean delivery | 69(26.1) | 52(22.6) | 41(16.8) | 41(16.8) | 58(23) | 47(19.4) |
| Pre-term birth or mid-trimester loss | 24(9.1) | 13(5.7) | 18(7.4) | 18(7.4) | 12(4.8) | 19(7.9) |
| Three or more miscarriages | 21(8) | 7(3.0) | 12(4.9) | 12(4.9) | 21(8.3) | 15(6.2) |
| Baby with congenital anomaly | 7(2.7) | 7(3.0) | 5(2.0) | 5(2.0) | 5(2) | 7(2.9) |
| Infant requiring intensive care | 11(4.2) | 6(2.6) | 8(3.3) | 8(3.3) | 7(2.8) | 10(4.1) |
| Stillbirth | 9(3.4) | 5(2.2) | 7(2.9) | 7(2.9) | 4(1.6) | 8(3.3) |
| Neonatal death | 5(1.9) | 5(2.2) | 3(1.2) | 3(1.2) | 6(2.4) | 2(0.8) |
| Pre-eclampsia | 11(4.2) | 5(2.2) | 9(3.7) | 9(3.7) | 8(3.2) | 8(3.3) |
| Placental abruption | 3(1.1) | 2(0.9) | 1(0.4) | 0(0) | 2(0.8) | 3(1.2) |
| Placenta praevia | 2(0.8) | 1(0.4) | 2(0.8) | 2(0.8) | 4(1.6) | 1(0.4) |
| Post-partum haemorrhage requiring transfusion | 5(1.9) | 1(0.4) | 5(2.0) | 5(2) | 4(1.6) | 8(3.3) |
| Other | 43(16.3) | 26(11.3) | 30(12.3) | 30(12.3) | 32(12.7) | 26(10.7) |

Note: Percentage relates to the total number of mothers who had a previous pregnancy (n=242); more than one previous pregnancy related problem may apply per woman.

In terms of parity, women who experienced perinatal loss in 2021 were broadly similar to the population of women who gave birth in 2021 (Table 1.14).

**Table 1.14: Distribution of parity, 2016-2021**

| Parity | 2016 N=373 N(%) | 2017 N=346 N(%) | 2018 N=325 N(%) | 2019 N=359 N(%) | 2020 N=357 N(%) | 2021 N=356 N(%) | All births[40] 2021 N=60,841 (%) |
|---|---|---|---|---|---|---|---|
| Nulliparous | 135(36.2) | 147(42.5) | 123(37.8) | 156(43.5) | 133(37.3) | 145(40.7) | 23,580(38.8) |
| Para 1 | 128(34.3) | 91(26.3) | 88(27.1) | 96(26.7) | 120(33.6) | 114(32) | 21,278(35) |
| Para 2 | 62(16.6) | 69(19.9) | 61(18.8) | 69(19.2) | 63(17.6) | 56(15.7) | 10,773(17.7) |
| Para 3+ | 48(12.9) | 39(11.3) | 53(16.3) | 38(10.6) | 41(11.5) | 41(11.5) | 5,210(8.6) |

In 2021, a parity of 3 or more showed a small increased risk for perinatal mortality (Table 1.15).

**Table 1.15: Comparing the rate ratio of perinatal mortality by parity among mothers, 2021**

| Parity | Rate per 1,000 95% CI | Rate Ratio 95% CI | P-Value |
|---|---|---|---|
| Nulliparous | 6.15(5.19-7.23) | 1.00(reference) | - |
| Para 1 | 5.36(4.42-6.43) | 0.87(0.68-1.11) | 0.27 |
| Para 2 | 5.20(3.93-6.75) | 0.85(0.62-1.15) | 0.29 |
| Para 3+ | 7.87(5.65-10.66) | 1.28(0.9-1.81) | 0.16 |

[40] Healthcare Pricing Office. Perinatal Statistics Report 2021. Dublin: Health Service Executive. [in press].

## Pre-existing medical problems

Information about pre-existing medical conditions was available for 348 of the 357 mothers who experienced perinatal loss in 2021 (97.5%) (Table 1.16). Over thirty-five percent of these 348 women had a pre-existing medical problem (n=123, 35.3%). This was slightly higher than previous years (2020, 2019 and 2018; n=121, 34.0%; n=118, 32.8%; and n=100, 30.8%, respectively).

The most common type of pre-existing medical problems were psychiatric disorders with 10.1% of mothers (n=35 of 348 women) suffering from conditions of this type (Table 1.16). This was followed by endocrine disorders (n=23, 6.6%). Under the 'Other' category a wide range of problems were captured, such as gynaecological issues, asthma, infection and musculoskeletal issues. Given the higher prevalence of the 'Other' category (18.7%), a planned review of the NPEC perinatal death notification form by the PMNCAGC will include review of subcategories of pre-existing medical problems to access more accurately the impact of specific pre-existing maternal morbidities associated with perinatal loss.

**Table 1.16: Pre-existing medical problems in mothers who experienced perinatal loss, 2016-2021**

| Available data per year | 2016 N=347 N(%) | 2017 N=337 N(%) | 2018 N=325 N(%) | 2019 N=360 N(%) | 2020 N=356 N(%) | 2021 N=348 N(%) |
|---|---|---|---|---|---|---|
| Psychiatric disorder | 40(11.5) | 27(8.0) | 17(5.2) | 19(5.3) | 30(8.4) | 35(10.1) |
| Endocrine disorder | 26(7.5) | 22(6.5) | 16(4.9) | 23(6.4) | 17(4.8) | 23(6.6) |
| Diabetes | 8(2.3) | 7(2.1) | 8(2.5) | 13(3.6) | 7(2) | 8(2.3) |
| Cardiac disease | 6(1.7) | 6(1.8) | 6(1.8) | 2(0.6) | 1(0.3) | 3(0.9) |
| Hypertension | 9(2.6) | 6(1.8) | 11(3.4) | 8(2.2) | 12(3.4) | 11(3.2) |
| Renal disease | 3(0.9) | 4(1.2) | 1(0.3) | 2(0.6) | 6(1.7) | 4(1.1) |
| Haematological disorder | 9(2.6) | 4(1.2) | 4(1.2) | 1(0.3) | 5(1.4) | 4(1.1) |
| Inflammatory disorder | 3(0.9) | 2(0.6) | 4(1.2) | 1(0.3) | 9(2.5) | 12(3.4) |
| Epilepsy | 1(0.3) | 0 | 2(0.6) | 4(1.1) | 3(0.8) | 6(1.7) |
| Other | 62(17.9) | 61(18.1) | 54(16.6) | 75(20.8) | 73(20.5) | 65(18.7) |
| *Any pre-existing medical problem | 123(35.4) | 107(31.8) | 100(30.8) | 118(32.8) | 121(34) | 123(35.3) |

Note: Percentage relates to the total number of mothers who had any information available for previous medical problems (n=348); more than one medical problem may apply per woman; *'Any pre-existing medical problem' represents the number of women who had 'any pre-existing medical problem'.

## Delivery

Labour was induced in almost 72% of women who experienced a stillbirth (n=171 of 238, 71.8%) and in almost 11% of those who experienced a neonatal death (n=13 of 119, 10.9%). A caesarean section was the planned mode of birth for 11% of the women who experienced a stillbirth (n=25 of 237, unknown for one woman) and 22.0% of the women who experienced an early neonatal death (n=26 of 118, unknown for one woman).

The type of care received at delivery was known for of all mothers who experienced perinatal loss (n= 357). The vast majority of the babies (n=341 of 357, 95.5%) were delivered under obstetric-led care which is the predominant model of care in Ireland. Thirteen babies (3.6%) were born before arrival at the maternity unit.

Presentation at delivery was known for 98% of all mothers who experienced perinatal loss (n=351 of 357, 98.3%). Over seventy-seven percent of presentations at delivery were vertex presentations (n=271 of 351, 77.2%), one in five were breech presentation (n=75 of 351, 21.4%) and in just three cases, the presentation was compound (n=3 of 351, 0.9%).

The mode of delivery was known for 99.4% of women who experienced perinatal loss (n=355 of 357; Table 1.17). Spontaneous vaginal cephalic delivery was the mode of delivery for approximately seventy percent of stillbirths (n=164 of 237, 69.2%) and for fifty percent of the babies who died in the early neonatal period (n=59 of 118, 50.0%). Approximately eleven percent of stillbirths involved caesarean section (n=26, 10.9%), again predominantly pre-labour (n=21, 8.9%). Among stillbirths delivered by caesarean section, almost thirty percent of the mothers (n=7 of 26, 26.9%) had a previous caesarean delivery.

In comparison to the proportion of all births occurring with assisted breech delivery in 2021 (0.5%), this type of delivery is more common in stillbirths (18.6%) and neonatal deaths (14.4%).

**Table 1.17: Mode of delivery for mothers who experienced perinatal loss, 2021**

| | Stillbirths N=237 N(%) | Neonatal deaths N=118 N(%) | | All births 2021[41] N=60,841 N(%) |
|---|---|---|---|---|
| Spontaneous vaginal cephalic | 164(69.2) | 59(50) | Vaginal birth | 30,289(49.8) |
| Breech; spontaneous and assisted | 44(18.6) | 17(14.4) | Breech; spontaneous and assisted | 299(0.5) |
| Pre-labour caesarean section | 21(8.9) | 31(26.3) | Caesarean section | 22,485(37) |
| Caesarean section after the onset of labour | 5(2.1) | 11(9.3) | – | – |
| Ventouse | 1(0.4) | 0(0) | Ventouse | 5,830(9.6) |
| Forceps | 2(0.8) | 0(0) | Forceps | 1,937(3.2) |

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

The type of caesarean section was known for all stillbirth cases delivered by caesarean section, except one (n=25). Elective caesarean section delivery was the most common type of caesarean section delivery in stillbirths (n=10 of 25, 40.0%), followed by urgent caesarean section (i.e., maternal or fetal compromise which is not immediately life threatening; n=8 of 25, 32.0%) and emergency caesarean section (i.e., maternal or fetal compromise which is an immediate threat to life of women or fetus; n=7 of 25, 28.0%). The type of caesarean section was known for all early neonatal cases delivered by caesarean section (n=42). Urgent caesarean delivery was the most common type of caesarean delivery in neonatal deaths in 2021 (n=16 of 42, 38.1%), followed by emergency caesarean section delivery, maternal or fetal compromise which is not immediately life threatening (n=14, 33.3%). Elective caesarean delivery was carried out in almost 29% of neonatal deaths (n=12, 28.6%). No neonatal deaths or stillbirths had a caesarean section following failed instrumental delivery in 2021.

[41]Healthcare Pricing Office. Perinatal Statistics Report 2021. Dublin: Health Service Executive. [in press]

## Level of care for mothers post-delivery

For women who experienced perinatal loss in 2021, 5.6% (n=20 of 356, missing information for one stillbirth) were admitted to a high dependency unit (HDU). Similar admission rates were reported for 2020 (5.9%). Admission to HDU was slightly higher for the mothers in cases of early neonatal deaths compared to stillbirths in 2021 (7.6% versus 4.6%, respectively). Thirteen cases (n=13 of 356, 3.7%) were admitted to an intensive care unit (ICU), higher percentage than in previous years (Table 1.18).

Deliveries by emergency/urgent caesarean section were associated with high levels of admission to the HDU (n=8 of 44, 18.2%) and ICU (n=10 of 44, 22.7%.

**Table 1.18: Post-delivery outcome for mothers who experienced perinatal loss, 2016-2021**

| Parity | 2016 N=374 N(%) | 2017 N=346 N(%) | 2018 N=325 N(%) | 2019 N=360 N(%) | 2020 N=357 N(%) | 2021 N=356 N(%) | Stillbirths 2021 N=237 N(%) | Neonatal deaths 2021 N=119 N(%) |
|---|---|---|---|---|---|---|---|---|
| Admitted to HDU | 20(5.3) | 13(3.8) | 25(7.7) | 23(6.4) | 21(5.9) | 20(5.6) | 11(4.6) | 9(7.6) |
| Admitted to ICU | 7(1.9) | 1(0.3) | 7(2.2) | 5(1.4) | 1(0.3) | 13(3.7) | 9(3.8) | 4(3.4) |

Note: Values are N(%) unless otherwise stated. Location of post-delivery maternal care in HDU and ICU is presented separately for women experiencing stillbirths and neonatal deaths in 2021. A total of five women were admitted to both HDU and ICU in 2021 (n=5; two stillbirths and three early neonatal deaths).

## Maternal complications associated with HDU and ICU admissions

While the NPEC data collection form does not contain a specific question on the indication for admission to HDU/ICU, maternal complications and obstetric factors which caused or were associated with the perinatal death are identified. As mentioned previously in this section, a review of the NPEC Perinatal Notification Form by the PMNCAGC is planned and indication for HDU/ICU admission will be addressed.

For this section, the five women who were admitted to both HDU and ICU are reported in the higher location of care category (i.e., ICU).

Of the nine women delivering stillbirths who were admitted to HDU, placental abruption was the cause of death in four of the cases. Of the remaining five cases, an associated maternal disorder was reported in three cases: Hemolysis, Elevated Liver enzymes and Low Platelets syndrome (HELLP, n=1), pre-eclampsia (n=1), and coagulopathy requiring treatment (n=1). For two cases a maternal complication was not associated with the cause of stillbirth.

In contrast, of the six women experiencing an early neonatal death (ENND) admitted to a HDU, two cases were associated with chorioamnionitis. For the remaining four ENND, there were no maternal complications associated with the death.

Of the thirteen women experiencing perinatal loss who were admitted to ICU (n=9 stillbirths and n=4 ENND), placental abruption was reported as an associated cause of death in three cases. Of the remaining ten cases, an associated maternal disorder was reported in all but two cases: SARS-CoV-2 placentitis (n=3), diabetes (n=3), cardiac arrest (n=1) and HELLP with liver capsular haematoma (n=1). Of the remaining two cases, information on cause of stillbirth is pending coronial autopsy results in one case and prolonged premature ruptured membranes was associated with an ENND.

## Infant characteristics

The findings presented below are based on stillbirths and early neonatal deaths born with a birthweight ≥500g or having achieved a gestational age ≥24 weeks.

## Key findings

1. As in previous reports, low birthweight centiles were associated with perinatal deaths in 2021, particularly stillbirths.
2. An increased risk of perinatal mortality with multiple births compared to single pregnancy was again identified in 2021. Perinatal death from multiple births accounted for 13.7% of all perinatal deaths.
3. The rate of autopsy uptake continues to be higher in stillbirths compared to neonatal deaths.

### Sex

There were three perinatal deaths among the stillbirth cases for which the sex of the baby was indeterminate (Table 1.19). Of the 357 perinatal deaths, 55.2% were male (n=197). In the overall population of births in 2021, 51.3% were male and 48.7% female. Male babies outnumbered female babies among stillbirths and early neonatal deaths.

**Table 1.19: Sex of baby in stillbirths and neonatal deaths, 2021**

| | Stillbirths N=238 N(%) | Early neonatal deaths N=119 N(%) | All births 2021[42] N=60,841 N(%) |
|---|---|---|---|
| Male | 131(55) | 66(55.5) | 31,197(51.3) |
| Female | 104(43.7) | 53(44.5) | 29,636(48.7) |
| Indeterminate | 3(1.3) | 0(0) | 7(0) |

Note: Values are N(%) unless otherwise stated. Unknown for one perinatal death from the HPO data, 2021.

### Multiple births

An increased risk of perinatal mortality associated with multiple pregnancy compared to singleton pregnancy was again found in 2021. There were 49 perinatal deaths from multiple births, making up 13.7% of all perinatal deaths in 2021 (Table 1.20). This is around four times the proportion of multiples among all births in 2021 (3.4%).

**Table 1.20: Perinatal deaths from singleton and multiple births, 2021**

| | Stillbirths N=238 N(%) | Early neonatal deaths N=119 N(%) | Perinatal deaths N=357 N(%) | | All births 2021[43] (%) |
|---|---|---|---|---|---|
| Singleton | 216(90.8) | 92(77.3) | 308(86.3) | Singleton | 58,744(96.6) |
| Twin | 21(8.8) | 25(21) | 46(12.9) | Multiple | 2,097(3.4) |
| Triplet | 1(0.4) | 2(1.7) | 3(0.8) | | |

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

In 2021, the perinatal mortality rate for babies in multiple pregnancies was 4.46 times higher than singleton births at 23.37 per 1,000 live births ($p<0.001$; Table 1.21).

[42]Healthcare Pricing Office. Perinatal Statistics Report 2021. Dublin: Health Service Executive. [in press].

[43]Healthcare Pricing Office. Perinatal Statistics Report 2021. Dublin: Health Service Executive. [in press].

**Table 1.21: Comparing the rate ratio of perinatal mortality by single and multiple births among mothers, 2021**

| Parity | Rate per 1,000 (95% CI) | Rate Ratio (95% CI) | P-Value |
|---|---|---|---|
| Singleton | 5.24(4.68-5.86) | 1.00 (reference) | – |
| Multiple | 23.37(17.34-30.78) | 4.46(3.3-6.02) | <0.001 |

Note: 95% CI=Exact Poisson 95% confidence intervals.

The 49 perinatal deaths from multiple births comprised of 27 early neonatal deaths and 22 stillbirths. The majority (n=14, 51.9%) of the 27 early neonatal deaths from multiple births were due to respiratory disorders, followed by five deaths due to major congenital anomalies (n=5, 18.5%). The remaining eight causes included neurological disorders (n=2, 7.4%), other specific causes (n=2,7.4%), infection (n=2,7.4%), gastrointestinal disease (n=1,3.7%) and in one case the cause of death was unexplained.

The main cause of death for the 22 stillbirths from multiple births was specific fetal conditions (e.g. includes twin-to-twin transfusion, n=10, 45.5%). Major congenital anomalies (n=5, 22.7%) and specific placental conditions (n=4, 18.2%) were the second and third most common cause of death in this group. Of the remaining causes, associated obstetric factors, mechanical factors and antepartum or intrapartum haemorrhage accounted for one death each (n=1, 4.5%). There were no stillbirth cases from multiple pregnancies where the cause of death was unexplained in 2021.

Chorionicity was reported for all but one of the perinatal deaths from multiple births. The majority were monochorionic diamniotic (n=26, 54.2%) twins. The remaining cases were dichorionic diamniotic (n=21, 43.8%), and monochorionic monoamniotic (n=1, 2.1%).

In 2021, there were 40 cases where one twin died, three pairs of twins where both twins died (n=6), and one set of triples where three triplets died (n=3), representing a total of 49 perinatal losses.

## Gestation

The vast majority of perinatal deaths in 2021 were associated with delivery before 37 weeks gestation (n=272 of 354, 76.8%, missing information for three cases; Figure 1.10). This was the case for 75.9% of stillbirths (n=180 of 237, missing information for one case) and 78.6% of early neonatal deaths (n=92 of 117, missing information for two cases). The majority of the perinatal deaths were delivered at 22-27 weeks gestation (i.e. for stillbirths, n=80, 33.8% and for early neonatal deaths, n=51, 43.6%). A slightly higher proportion of extremely preterm delivery (i.e., less than 27 weeks gestation) was more often associated with cases of early neonatal deaths compared to stillbirth (44.4% versus 34.6%, respectively).

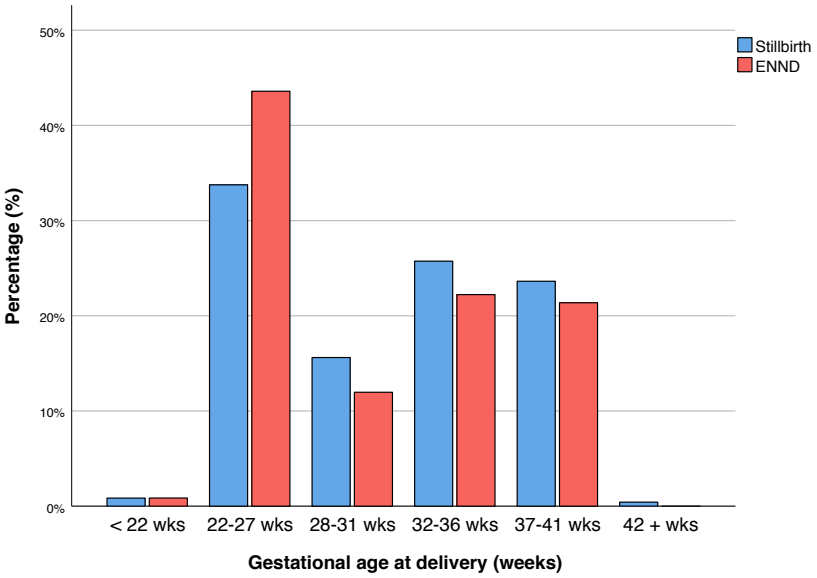


**Figure 1.10: Distribution of gestational age at delivery in stillbirths and neonatal deaths, 2021**

Note: Data on gestational age was unknown for one stillbirth and two early neonatal deaths.

## Birthweight

The most represented birthweight in cases of perinatal death was in the range 500-999 grams (n=130 of 357, 36.4%; Figure 1.11).

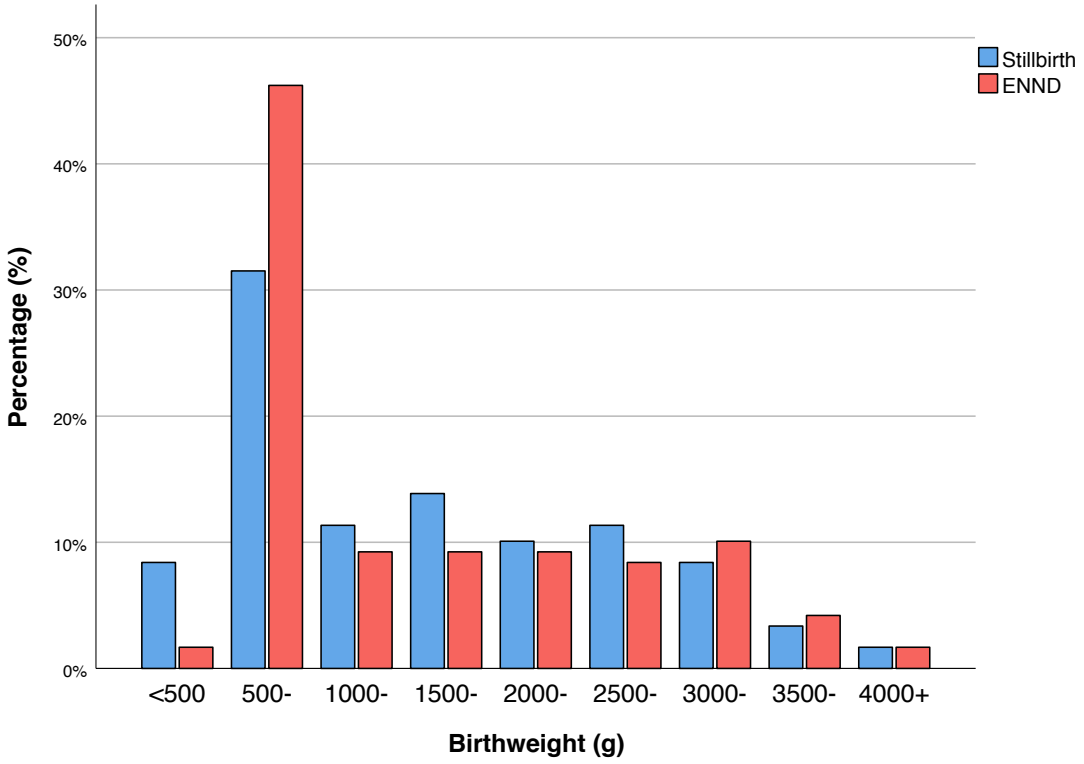


**Figure 1.11: Distribution of birthweight in stillbirths and neonatal deaths, 2021**

In approximately seventy-five percent of perinatal deaths (n=269, 75.4%) the birthweight was less than 2,500 grams (Table 1.22). For stillbirths, 75.2% had a birthweight below 2,500g (n=179 of 238) and 75.6% of neonatal deaths (n=90 of 119) also registered weight below this value. This is in contrast to the overall population of births in 2021, of whom less than 6% had a birthweight below 2,500g (n=3,619 of 60,841, 5.9%). Thus, highlighting the association between perinatal deaths and low birth weight.

**Table 1.22: Distribution of birthweight in stillbirths and neonatal deaths, 2021**

| | Stillbirth N=238 N(%) | Early Neonatal Deaths N=119 N(%) | Perinatal Deaths N=357 N(%) | Total Births N=60,841 N(%) |
|---|---|---|---|---|
| < 500g* | 20(8.4) | 2(1.7) | 22(6.2) | 37(0.1) |
| 500 - 999g | 75(31.5) | 55(46.2) | 130(36.4) | 291(0.5) |
| 1000 - 1499g | 27(11.3) | 11(9.2) | 38(10.6) | 324(0.5) |
| 1500 - 1999g | 33(13.9) | 11(9.2) | 44(12.3) | 697(1.1) |
| 2000 - 2499g | 24(10.1) | 11(9.2) | 35(9.8) | 2270(3.7) |
| 2500 - 2999g | 27(11.3) | 10(8.4) | 37(10.4) | 7407(12.2) |
| 3000 - 3499g | 20(8.4) | 12(10.1) | 32(9.0) | 19987(32.9) |
| 3500 - 3999g | 8(3.4) | 5(4.2) | 13(3.6) | 20867(34.3) |
| 4000 or more g | 4(1.7) | 2(1.7) | 6(1.7) | 8961(14.7) |

Note: *All babies who had a birthweight less than 500g had a gestational age of ≥ 24 weeks.

## Birthweight centiles

An increased risk of perinatal death has been associated with failure of fetal growth in-utero. We have produced charts to highlight this issue in relation to the stillbirths and early neonatal deaths that occurred in Ireland in 2021. To do so, we used the Gestation Related Optimal Weight (GROW) software[44] 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.[45]

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 stillbirths and early neonatal deaths in Ireland in 2021). 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 2021 in Figure 1.12, and with the birthweights for cases of early neonatal death in 2021 in Figure 1.13. For stillbirths across all gestational ages, a high proportion were below the lower limit of the normal range (10th centile). In cases of early neonatal death, the birthweight was often below the normal range for births after 32 weeks gestation. However, low birthweight was observed less often in early neonatal deaths than for cases of stillbirths.

Figures 1.12 and 1.13 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.[46] Small-for-gestational-age (SGA) refers to birthweights below the 10th centile and severely SGA refers to birthweights less than the 3rd centile.[47]

[44] Gardosi J, Francis A. Customised Weight Centile Calculator. GROW version 8.0.6.1(IE), 2021 Gestation Network, www.gestation.net

[45] 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

[46] 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

[47] 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

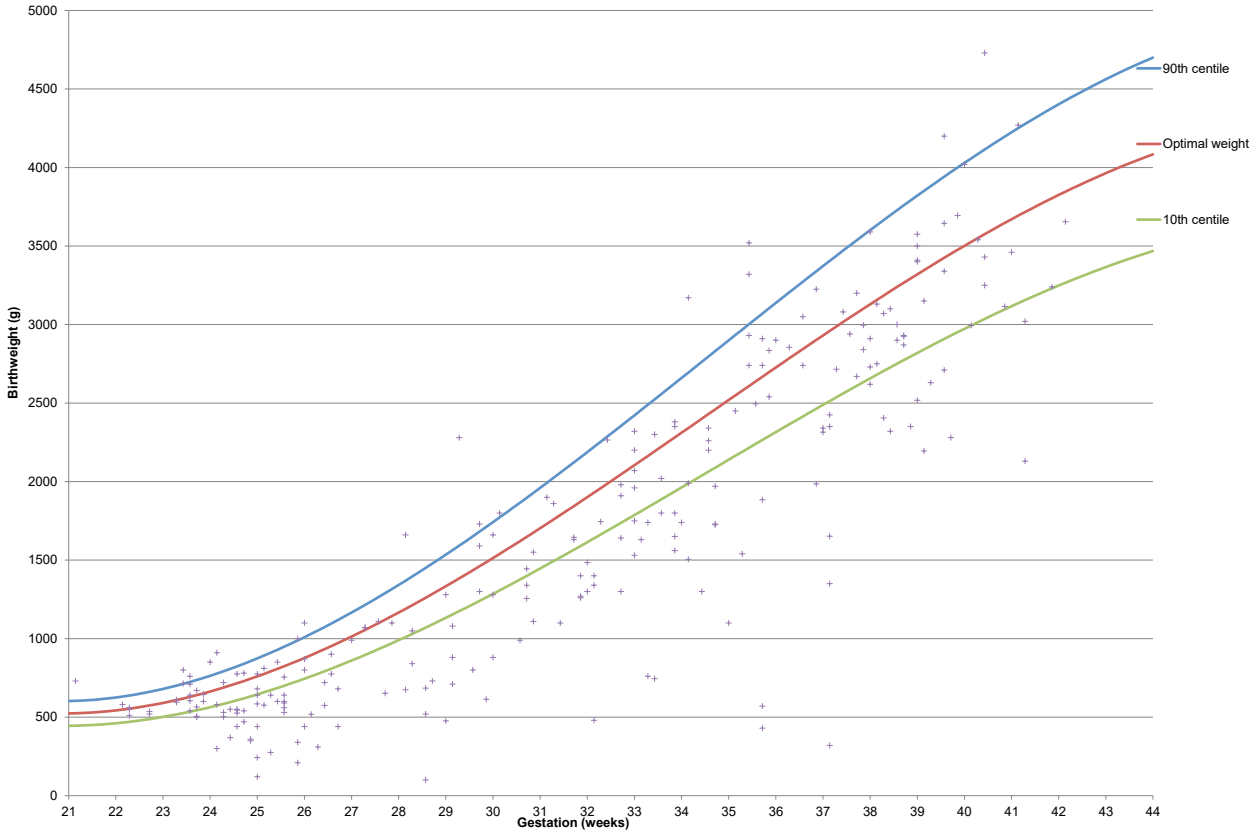


**Figure 1.12: Optimal birthweight and normal range compared to actual birthweights of stillbirths, 2021**

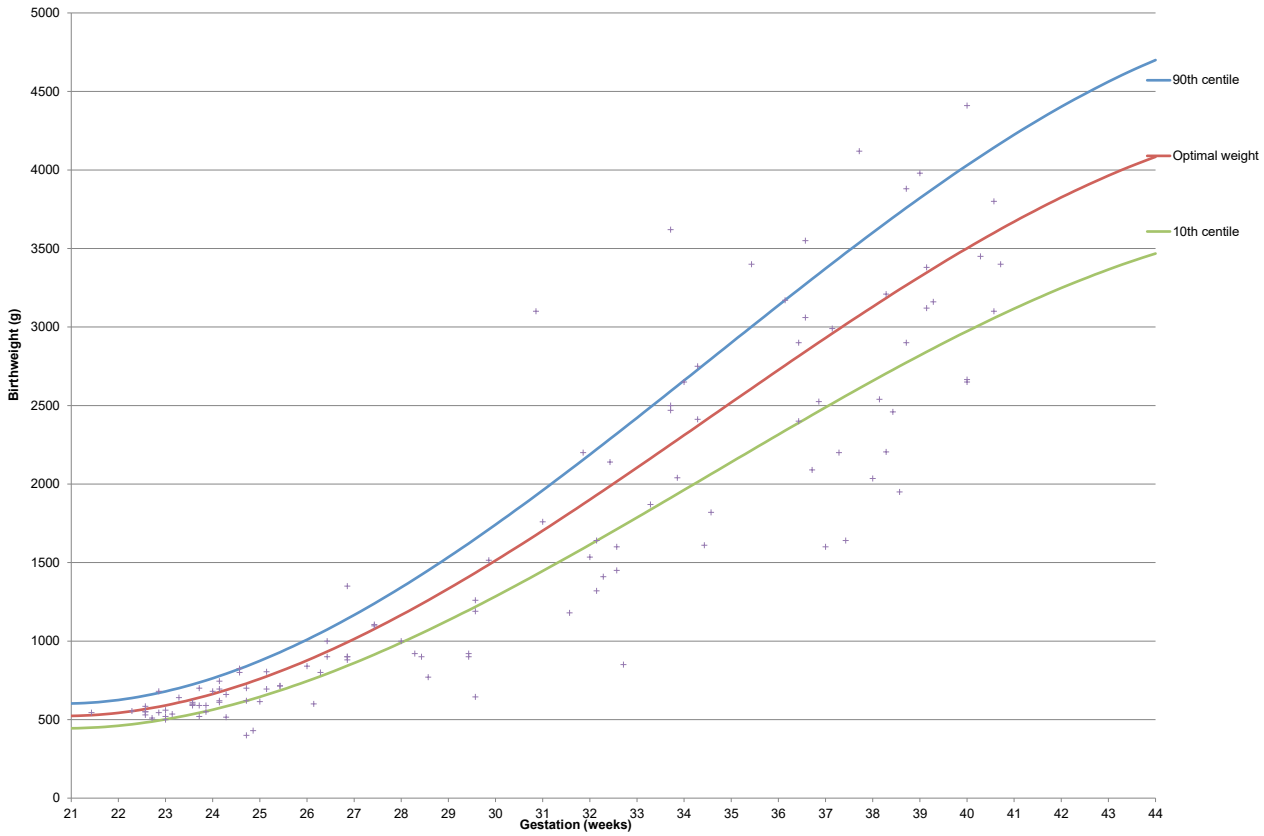


**Figure 1.13: Optimal birthweight and normal range compared to actual birthweights in early neonatal deaths, 2021**

Customised birthweight centiles were derived using the GROW software.[48] There was missing data for maternal height (n=71, 19. 9%) and weight (n=68, 19.0%). For these cases, we used the median height and weight of the mothers with complete data. The GROW software also provides estimated customised birthweight centiles in cases with missing data. Ultimately, customised birthweight centiles were calculated for 352 of the 357 perinatal deaths in 2021.

The distribution of customised birthweight centiles at all gestations is illustrated for stillbirths in Figure 1.14 and for early neonatal deaths in Figure 1.15. At all gestations, there were cases spanning the full range of birthweight centiles (i.e. 0-100th) but there was a concentration of babies at or near centile zero. These babies represent cases of extreme intrauterine growth restriction (IUGR).

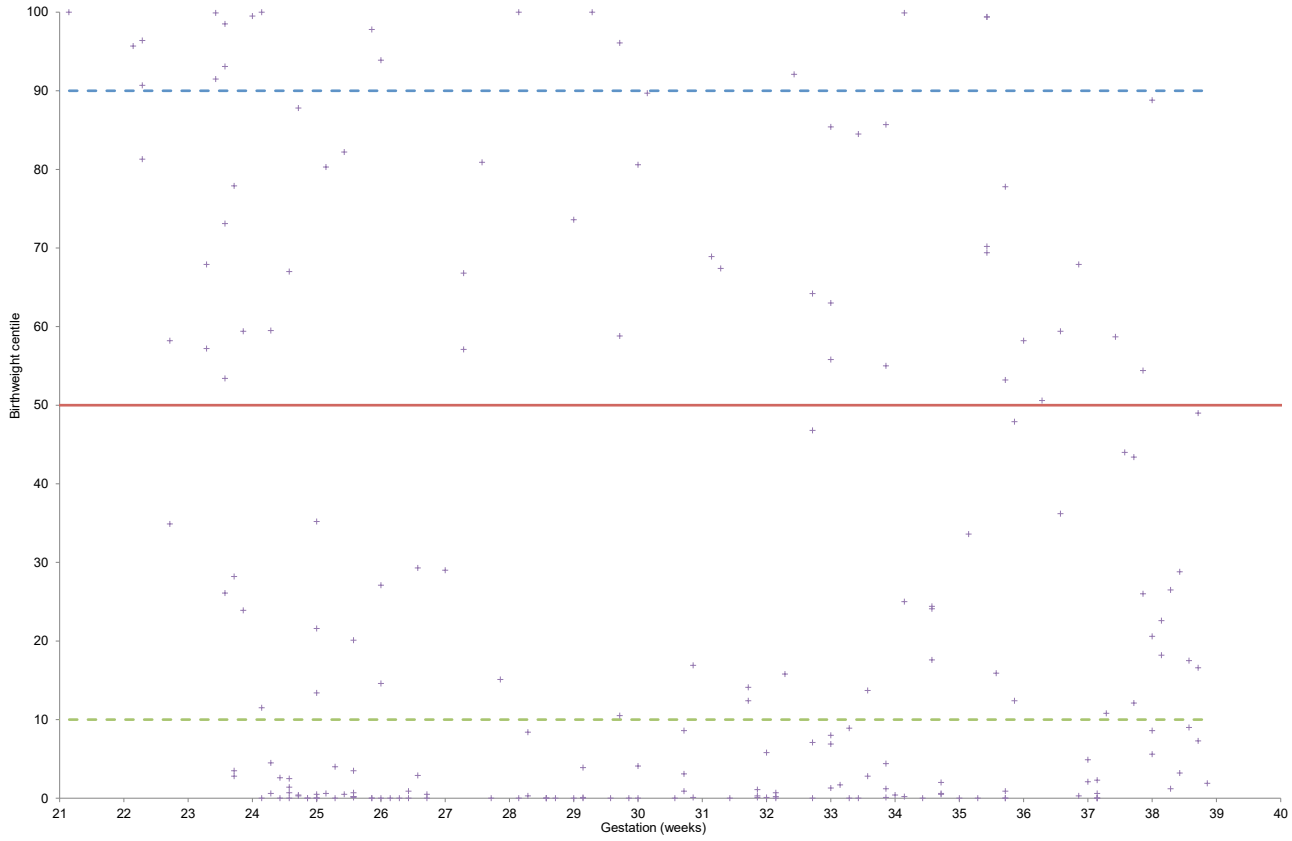


**Figure 1.14: Distribution of customised birthweight centiles for stillbirths, 2021**

[48] Gardosi J, Francis A. Customised Weight Centile Calculator. GROW version 8.0.6.1(IE), 2021 Gestation Network, www.gestation.net

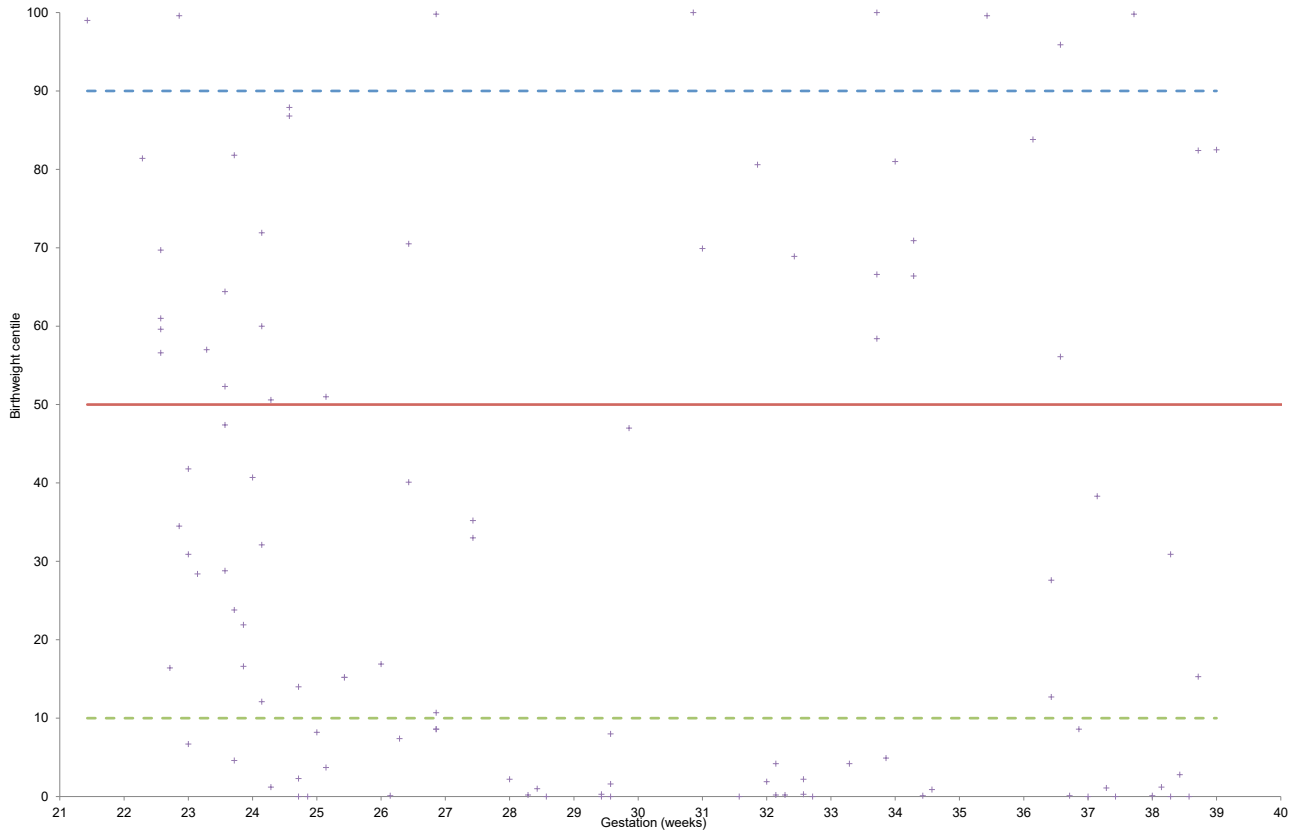


**Figure 1.15: Distribution of customised birthweight centiles for early neonatal deaths, 2021**

Table 1.23 details the numbers and percentages of stillbirths and early neonatal deaths within specific ranges of customised birthweight centiles. Low birthweight centiles were associated with both groups but particularly with stillbirths. Thirty-eight percent (n=90, 38.3%) of all stillbirths were classified as severely SGA (i.e., <3rd customised birthweight centile), and almost 50% (n=112, 47.7%) were SGA (i.e., <10th customised birthweight centile) compared to 29.1% (n=34) and 40.2% (n=47) of the cases of early neonatal death, respectively.

As in previous years, the prevalence of SGA and severe SGA was higher among stillbirths than in early neonatal deaths in 2021 (Table 1.23). 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 stillbirths but there was support for this hypothesis. The customised birthweight centile of the stillborn baby was lower when there was more than one week between confirmation of death and delivery.

**Table 1.23: Distribution of customised birthweight centiles, 2021**

| Centile | Stillbirth N=235 of 238, N% | Neonatal death N=117 of 119, N% |
|---|---|---|
| < 3rd | 90(38.3) | 34(29.1) |
| < 10th* | 112(47.7) | 47(40.2) |
| 10-49th | 52(22.1) | 32(27.4) |
| 50-89th | 48(20.4) | 29(24.8) |
| 90th+ | 23(9.8) | 9(7.7) |

Note: Values are N(%) unless otherwise stated; *Includes cases from the category <3rd Centile. Centiles could not be calculated for three stillbirths, and two neonatal deaths.

Cases of stillbirths and early neonatal deaths were at significantly lower birthweight centiles when the cause of death was attributed to major congenital anomaly (Table 1.24). Over 47% of the 67 stillbirths due to major congenital anomaly (n=32, 47.8%) were severely SGA in comparison to 35% of the stillbirths due to other causes (n=58, 34.5%). Similarly, almost forty-six percent of the 59 early neonatal deaths due to major congenital anomaly (n=27, 45.8%) were severely SGA compared to just twelve percent (n=7, 12.1%) of the 58 early neonatal deaths due to other causes.

**Table 1.24: Distribution of customised birthweight centiles of perinatal deaths with and without major congenital anomaly, 2021**

| Centile | Stillbirth (N=235 of 238) | | Neonatal Death (N=117 of 119) | |
|---|---|---|---|---|
| | Cause of death: major congenital anomaly | | Cause of death: major congenital anomaly | |
| | Yes N=67 N(%) | No N=168 N(%) | Yes N=59 N(%) | No N=58 N(%) |
| < 3rd | 32(47.8) | 58(34.5) | 27(45.8) | 7(12.1) |
| < 10th* | 36(53.7) | 76(45.2) | 32(54.2) | 15(25.9) |
| 10-49th | 12(17.9) | 40(23.8) | 12(20.3) | 20(34.5) |
| 50-89th | 11(16.4) | 37(22) | 11(18.6) | 18(31) |
| 90th+ | 8(11.9) | 15(8.9) | 4(6.8) | 5(8.6) |

Note: Values are N(%) unless otherwise stated; *Includes cases from the category <3rd Centile. Centiles could not be calculated for three stillbirths, and two neonatal deaths.

## Diagnosis of fetal growth restriction (FGR)

Data on diagnosis of fetal growth restriction (FGR) were recorded for 348 of the 357 perinatal deaths (i.e., FGR diagnosis unknown for eight stillbirths, and one neonatal death). A diagnosis of FGR was reported for 72 (20.7%) of the 348 deaths, 54 (23.5%) stillbirths and 18 (15.3%) early neonatal deaths. An antenatal diagnosis of FGR (as opposed to diagnosis based on observation at delivery or post-mortem) was reported for 51 perinatal deaths of the 72 with a diagnosis of FGR (n=51 of 72, 70.8%), 35 stillbirths (n=35 of 54, 64.8%) and 16 early neonatal deaths (n=16 of 18, 88.9%).

For stillbirths and cases of early neonatal deaths that were severely SGA (i.e., <3rd customised birthweight centile based on the birthweight centiles derived using the GROW software), 33.1% (n=41 of 124) had an antenatal diagnosis of FGR (Table 1.25). The level of antenatal diagnosis of FGR was slightly lower for stillbirths and early neonatal deaths that were SGA (stillbirths = 28.6%, neonatal deaths = 29.8%) compared to stillbirths and early neonatal deaths that were severely SGA (stillbirths = 32.2%, neonatal deaths = 35.3%). While detection rates were low, an improvement in the diagnosis of FGR among stillbirths and neonatal deaths that were severely SGA was observed in 2021 compared to corresponding figures in 2020 (stillbirths = 25.3%, neonatal deaths = 23.8%).

**Table 1.25: Antenatal diagnosis of fetal growth restriction (FGR) for small-for-gestational-age (SGA) and severely SGA perinatal deaths, 2021**

| | Stillbirth | | Neonatal death | |
|---|---|---|---|---|
| | Severely SGA (<3rd centile) N=90, N(%) | SGA (<10th centile)* N=112, N(%) | Severely SGA (<3rd centile) N=34, N(%) | SGA (<10th centile)* N=47, N(%) |
| **Antenatal diagnosis of FGRn of N(%)** | 29(32.2) | 32(28.6) | 12(35.3) | 14(29.8) |

Note: SGA cases include severely SGA cases; *Includes cases from the category <3rd Centile. FGR diagnosis unknown for eight stillbirths, and one neonatal death.

- **Recommendation:** Standardised approach to improved antenatal detection of fetal growth restriction (FGR) with timely delivery is a potential preventative strategy to reduce perinatal mortality.

  A multidisciplinary working group should be developed to address a national standardised approach to the detection of FGR. A national approach should include a standardised training program for all staff involved in antenatal care and also evaluate the use of a standard growth curve and management options across the Irish maternity service. Owner; the NWIHP and the IOG.

## Perinatal mortality following termination of pregnancy

Since January 2019, the change in the Irish legislation following the 'Repeal of the Eighth amendment' legalised termination of pregnancy (TOP) in the Republic of Ireland (ROI) in certain circumstances. Abortion in the ROI is regulated by the Health Regulation of Termination of Pregnancy Act 2018. Abortion is permitted in early pregnancy, when there is a risk to the life, or of serious harm to the health, of the pregnant woman and for a condition likely to lead to death of fetus either before or within 28 days of birth.[49]

In 2021, around eight percent (n=30, 8.4%) of all the 357 perinatal deaths with a birthweight ≥500g and/or gestation at delivery ≥24 weeks reported to NPEC resulted from a TOP (stillbirths; n=26 of 238, 10.9% and neonatal deaths; n=4 of 119, 3.4%). This is lower than the rate (11%) of all perinatal deaths in 2020.

Major congenital anomaly was associated with all but one case of stillbirth delivered following TOP (n=25, 96.2%). For the remaining stillbirth, ascending infection was the reported underlying obstetric antecedent complication. The majority of stillbirths delivered following TOP occurred between the gestational ages of 22 to 27 weeks (n=23 of 26, 88.5%). Major congenital anomaly was associated with all cases of neonatal death following TOP (n=4, 100%) and most commonly occurred between the gestational ages of 28 to 31 weeks (n=2 of 4, 50.0%).

While not included in the calculation of the perinatal mortality rates, the NPEC asks for notification of deaths in the early neonatal period of live born babies born before 24 weeks gestation and weighing less than 500g. In 2021, ten such deaths following TOP were reported to the NPEC. Major congenital anomaly was associated with five of the ten cases, chorioamnionitis was reported for four cases, and premature rupture of membranes was the underlying complication for the remaining case.

[49] Health (Regulation of Termination of Pregnancy) Act 2018. Available at: http://www.irishstatutebook.ie/eli/2018/act/31/enacted/en/html

## Investigations to determine the cause of death

### Autopsy

Current practice guidelines recommend that parents should be offered a full post-mortem examination of the stillborn infant to help explain the cause of death. When a cause is found it can crucially influence care in a future pregnancy.[50] In this 2021 audit, data on autopsy uptake was reported for 350 of the 357 perinatal deaths. Autopsy uptake data was missing for seven cases of ENND, six deaths of which occurred in a paediatric hospital. Notably, feedback from maternity units highlighted the lack of formal notification between paediatric hospitals and maternity units in the event of information surrounding neonatal deaths in relation to autopsy uptake and cause of death. Of the 350 cases, 44.6% (n=156) underwent an autopsy. The rate of autopsy uptake in 2021 is lower than the rate of 52.3% reported in 2020, and the rate of 49.2% reported in 2019. In fact, it is one of the lowest since 2018 (41.9%). The trend in the perinatal autopsy rate is illustrated in Figure 1.16. The autopsy uptake rate in stillbirths continues to be higher than in cases of early neonatal death.

In Ireland in 2021, an autopsy was undertaken following 53.8% of stillbirths (n=128 of 238) and 25.0% of early neonatal deaths (n=28 of 112, unknown for seven cases), see Figure 1.16. These figures are similar to rates reported in the United Kingdom in 2020 (i.e. full autopsy for 46.0% of stillbirths and 26.5% of early neonatal deaths).[51]

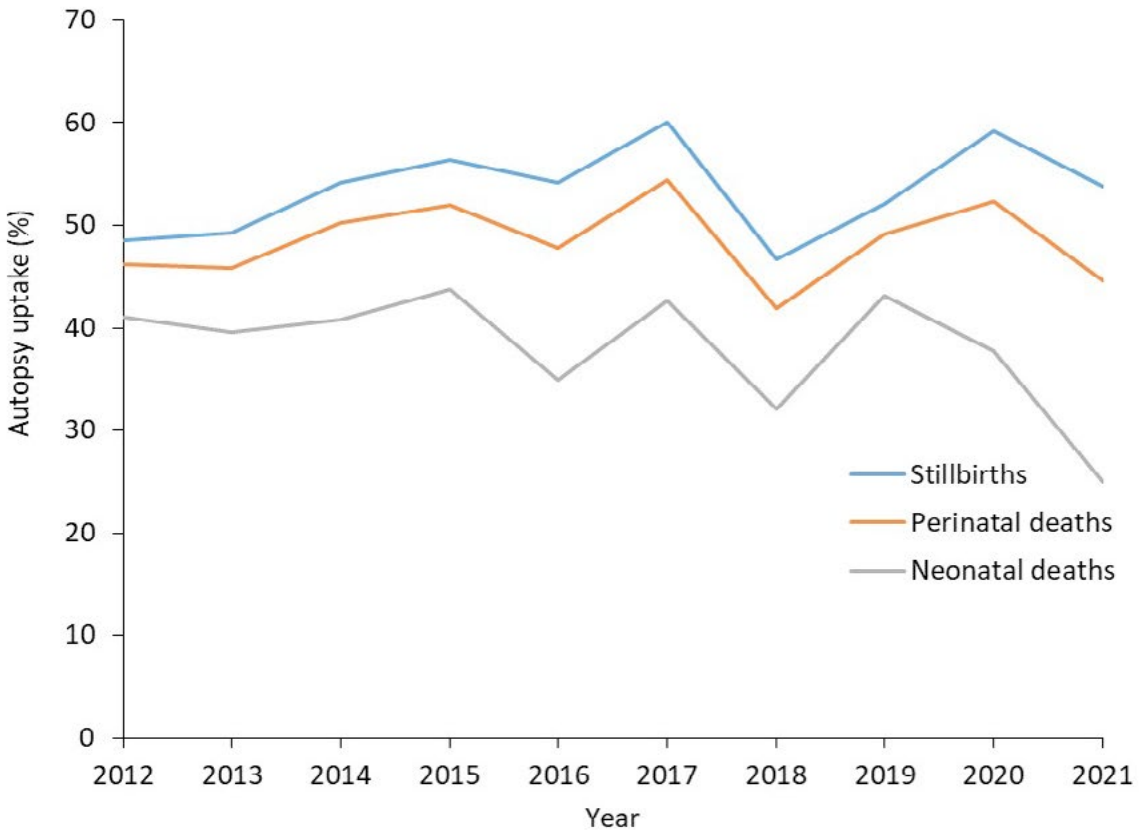


**Figure 1.16: Autopsy uptake percentage, 2012-2021**

[50] 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. 'Due for update in 2022'

[51] Draper ES, Gallimore ID, Smith LK, Matthews RJ, Fenton AC, Kurinczuk JJ, Smith PW, Manktelow BN, on behalf of the MBRRACE-UK Collaboration. MBRRACE-UK Perinatal Mortality Surveillance Report, UK Perinatal Deaths for Births from January to December 2020: Tables and Figures. Leicester: The Infant Mortality and Morbidity Studies, Department of Health Sciences, University of Leicester. 2022

The variation in the rate of autopsy across the 19 maternity units in 2021 is illustrated in Figure 1.17. This may reflect variation in access to dedicated perinatal pathology services across units. There was some variation found across the four large maternity units, with rates of 26.6%, 35.7%, 52.3% and 75.0% for autopsy uptake being found across the four units in 2021. However, as detailed in Figure 1.18 and Table 1.26, in the vast majority (n= 151, 78.2%) of the 193 cases where an autopsy was not performed, an autopsy was offered but we understand declined by the parents. For one stillbirth where an autopsy was not performed, it was unknown if the autopsy was offered or not. As such, variation in autopsy rates across units may likely be influenced by parental consent to the procedure.

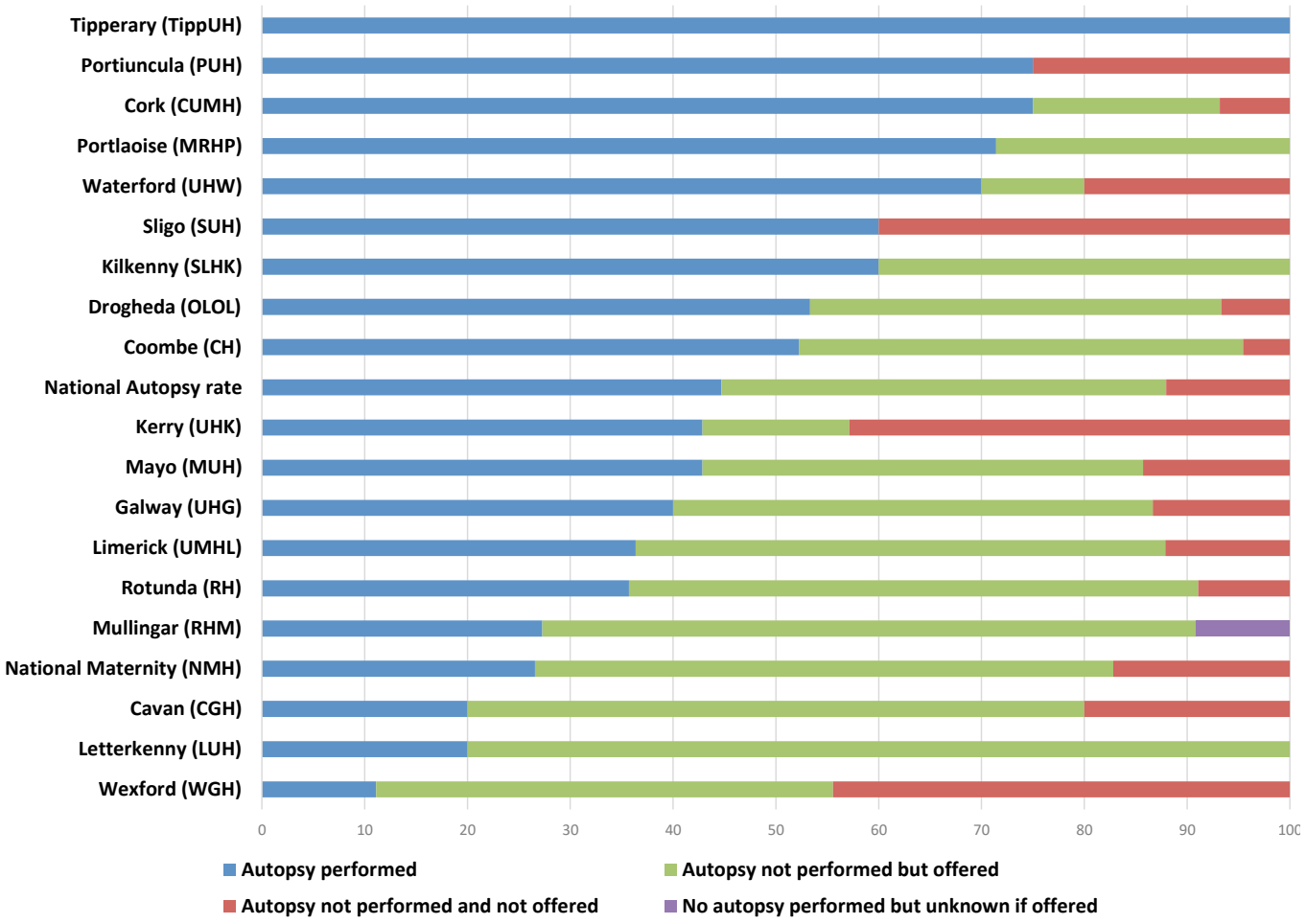


**Figure 1.17: Percentages of autopsy uptake and offer of autopsy in the 19 Irish maternity units, 2021**

An autopsy was declined more frequently in cases of stillbirths (n=91 of 109, 83.5%, unknown for one case) compared to early neonatal deaths (n=60 of 84, 71.4%) in 2021. Consequently, for 2021, of the 193 cases where an autopsy was not performed, there were 42 perinatal deaths for which an autopsy was not offered (n=42 of 193, 21.8%, unknown for one stillbirth). Corresponding figures for the year 2020 was 17.8%, the years 2018-2019 was 19.4% and 2017 was 9.8%.

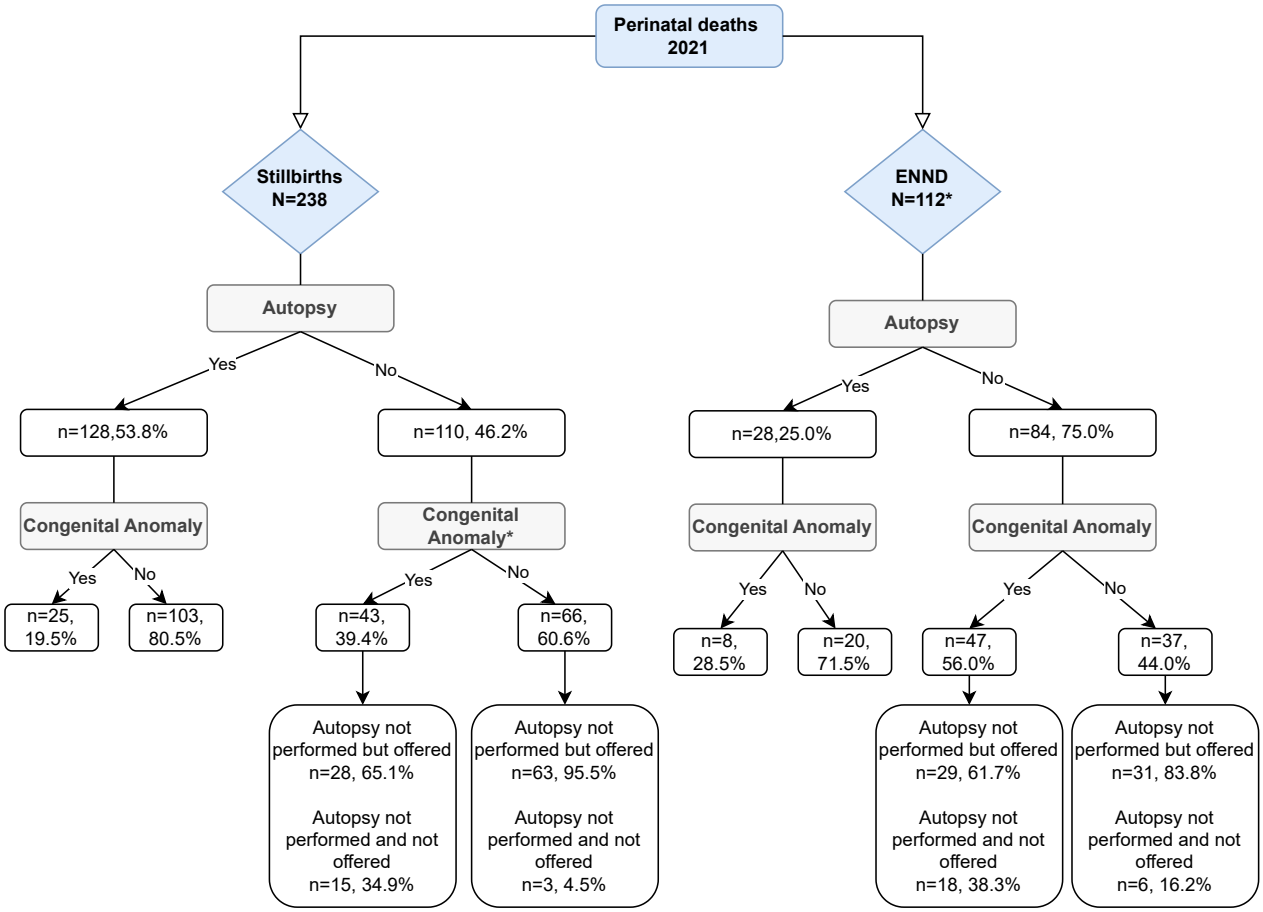


**Figure 1.18: Flowchart outlining autopsy-related steps taken after 349 perinatal deaths, 2021**

Note: Values are N(%) unless otherwise stated. *There was one stillbirth where it was reported that an autopsy was not performed, but it was not known whether an autopsy was offered. Seven early neonatal deaths where it was unknown if an autopsy was carried out. Of this, six deaths occurred in a paediatric hospital.

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 when an autopsy was not offered was higher if the perinatal death was due to a major congenital anomaly than if it the death was due to another cause (Table 1.26). For the reporting year 2021, feedback from units highlighted a delay in returns of coronial autopsy reports, which was exacerbated due to the impact of the COVID-19 pandemic.

As recommended in previous NPEC reports, engagement with the Coroner Society to explore the timeliness of autopsy reports provided to the maternity units (impacting negatively on support of bereaved families and informing clinical audit) has been progressed via the Department of Health. In October 2021, a Submission document to the Department of Health regarding the Coroner's (Amendment) Act 2019 was made on behalf of the NPEC, the NWIHP, the NOCA and the PMN-CAGC. At time of writing this report, the NPEC and afore mentioned agencies await progression of recommendation by the Department of Justice.

**Table 1.26: Uptake and offer of autopsy of perinatal deaths with and without a major congenital anomaly, 2021**

| Autopsy | Stillbirth (N=237 of 238) | | Neonatal Death (N=112 of 119) | |
|---|---|---|---|---|
| | Cause of death: major congenital anomaly | | Cause of death: major congenital anomaly | |
| | Yes N=68 N(%) | No N=169 N(%) | Yes N=55 N(%) | No N=57 N(%) |
| Performed | 25(36.8) | 103(60.9) | 8(14.5) | 20(35.1) |
| Offered | 28(41.2) | 63(37.3) | 29(52.7) | 31(54.4) |
| Not offered | 15(22.1) | 3(1.8) | 18(32.7) | 6(10.5) |

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

## Placental examination

The value of placental examination in determining cause of perinatal death is well documented.[52] In 2021, placental histology examinations were conducted for almost all stillbirths (n=225 of 238, 94.5%) and for 87% of early neonatal deaths (n=101 of 116, 87.1%, unknown for three early neonatal deaths). These figures are slightly lower than those reported for stillbirths (98.3%) and for early neonatal deaths (96.1%) in 2020, and for stillbirths (99.1%) and for early neonatal deaths (97.8%) in 2018/2019. However, the 2021 rate of placental examinations is similar to levels of placental histology examinations reported for stillbirths in the United Kingdom as a whole in 2020 (94.5%).[53]

## Specific placental conditions

Abnormal placental findings have been classified in line with recommendations from the publication from the international consensus meeting of pathology.[54] These are presented under the following broad categories: maternal vascular malperfusion, fetal vascular malperfusion, cord pathology, cord pathology with distal disease, delayed villous maturation, chorioamnionitis, villitis, fetal vasculitis and 'other' placental pathology.

Approximately 64% of all perinatal deaths had an associated placental pathology (n=227 of 357, 63.6%; Table 1.27). Placental conditions were generally more prevalent among stillbirths (n=169 of 238, 71.0%) than among cases of early neonatal death (n=58 of 119, 48.7%; Table 1.27). In the case of stillbirths in 2021, conditions within the fetal vascular malperfusion, maternal vascular malperfusion, and cord pathology categories were most commonly reported. Among early neonatal deaths, maternal vascular malperfusion, chorioamnionitis and fetal vascular malperfusion were the most frequently reported placental conditions in 2021.

**Table 1.27: Placental histology findings for stillbirths and early neonatal deaths, 2021**

| | Stillbirth N=169 N(%) | Neonatal Death N=58 N(%) | Total Perinatal Deaths N=227 N(%) |
|---|---|---|---|
| Fetal vascular malperfusion | 68(40.2) | 15(25.9) | 83(36.6) |
| Maternal vascular malperfusion | 56(33.1) | 23(39.7) | 79(34.8) |
| Cord pathology | 53(31.4) | 12(20.7) | 65(28.6) |
| Delayed villous maturation | 25(14.8) | 3(5.2) | 28(12.3) |
| Chorioamnionitis | 23(13.6) | 21(36.2) | 44(19.4) |
| Cord pathology with distal disease | 13(7.7) | 1(1.7) | 14(6.2) |
| Fetal vasculitis | 11(6.5) | 12(20.7) | 23(10.1) |
| Villitis | 9(5.3) | 4(6.9) | 13(5.7) |
| Other placental condition* | 55(32.5) | 18(31) | 73(32.2) |
| No abnormal placental histology reported | 50(29.6) | 44(75.9) | 94(41.4) |

Note: More than one placental condition was present for some cases. Percentages for "placental condition" are calculated using the total of perinatal deaths in 2021. *Other placental condition includes conditions such as placental disease due to diffuse chorionic hemosiderosis and SARS-CoV-2 placentitis.

[52] 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

[53] Draper ES, Gallimore ID, Smith LK, Matthews RJ, Fenton AC, Kurinczuk JJ, Smith PW, Manktelow BN, on behalf of the MBRRACE-UK Collaboration. MBRRACE-UK Perinatal Mortality Surveillance Report, UK Perinatal Deaths for Births from January to December 2020: Tables and Figures. Leicester: The Infant Mortality and Morbidity Studies, Department of Health Sciences, University of Leicester. 2022

[54] Khong TY, Mooney EE et al (2016). Sampling and definition of placental lesions. Arch Pathol Lab Med 2016 Jul;140 (7):698-713

## Other examinations performed

External examinations were performed for approximately forty percent of the perinatal deaths in 2021 (n=156 of 355, 43.9%, data unknown for two early neonatal deaths). This is similar to previous years (49.0% in 2020 and 42.8% in 2019; Table 1.28). Computerised tomography scans (CT scan) and magnetic resonance imaging (MRI) tests were rarely undertaken. Similar to 2020, X-Ray examinations were carried out more often following cases of stillbirth (n=81, 34.0%) rather than for cases of early neonatal death in 2021 (n=16, 13.7%).

**Table 1.28: Other examinations performed in investigating perinatal deaths, 2020-2021**

| Examination | Perinatal Deaths 2020 N=357 N(%) | Perinatal Deaths 2021 N=355 N(%) | Stillbirths 2021 N=238 N(%) | Neonatal Deaths 2021 N=117* N(%) |
|---|---|---|---|---|
| External | 175(49.0) | 156(43.9) | 106(44.5) | 50(42.7) |
| X-Ray | 112(31.4) | 97(27.3) | 81(34.0) | 16(13.7) |
| CT scan | 10(2.8) | 3(0.8) | 3(1.3) | 0(0) |
| MRI | 1(0.3) | 1(0.3) | 1(0.4) | 0(0) |

Note: Values are N(%) unless otherwise stated. CT=Computerised tomography, MRI=magnetic resonance imaging. Categories are not mutually exclusive. *Data missing for two neonatal deaths.

## Genetic investigation in chromosomal disorders

Cytogenetic analysis is an important investigation in the diagnosis of chromosomal abnormalities. Some abnormalities are potentially recurrent and can be tested for in future pregnancies.[55] In the event of a chromosomal disorder, a specific question on the NPEC Perinatal Death Notification form asks how the diagnosis was made.

In 2021, a chromosomal disorder was the most commonly reported major congenital anomaly causing death (56 perinatal deaths: 33 stillbirths and 23 early neonatal deaths). In more than ninety percent of these cases (n=51 of 56, 91.1%), the diagnosis was made by cytogenetic analysis (n=31 of 33 stillbirths, 94.0%; n=20 of 23 neonatal deaths, 86.9%).

[55] 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: "Exploring the complexity of stillbirth prevention: Insights from the RELEVANT Study on risk factors and implications for policy and practice'.

Tamara Escanuela Sanchez, PhD

## Introduction

Stillbirth is one of the most devastating pregnancy outcomes that parents can face, and unfortunately, it is also one of the most common[1] and it is a global health burden that affects 2 million babies every year.[2] The global data on stillbirth rates show that the disparities between countries are enormous, with the highest national stillbirth rate being 20 times higher than the lowest stillbirth national rate in 2021.[3] The idea that no stillbirth is preventable is a myth;[4–6] since 2000, the rate of stillbirth has declined by a 35%, with the annual number of stillbirths decreasing from 2.9 million to 1.9 million.[3, 6] Although this progress seems promising, it is not sufficient to achieve global goals, and the progress over the last decade has been slower than in the first decade of the 21st century.[3] Ending preventable stillbirths is one of the main goals of the United Nations' Global Strategy for Women's, Children's and Adolescents Health (2016-2030)[7] and the Every Newborn Action Plan.[8]

Previous research has explored the psychological impact of stillbirth on bereaved parents. In a state of acute grief, mothers and fathers report feelings of guilt and blame, regret, stigma, and even suicidal ideation.[9] Stillbirth can be associated with different psychological symptoms such as anxiety, depression, distress and negative well-being, especially during the first few months post-stillbirth.[10] Stillbirth may result in social isolation due to bereaved parents avoiding activities where they might have to confront families with babies or explain their experience.[11] This might be explained by a phenomenon commonly named as disfranchised grief.[12] Parents do not feel allowed or supported to mourn the death of their baby due to stigma and societal taboo and it not being culturally acceptable.[11] This stigma experienced by bereaved parents can lead them to feel more isolated, blamed, silenced and not recognised as parents.[11, 12]

Despite its prevalence and strong impact that stillbirth can have on parents, previous research has shown that the population awareness of stillbirth in Ireland is poor. In a study conducted in 2017, only 17% of respondents correctly identified the incidence of stillbirth rates, and around 56% were unable to identify any risk factor for stillbirth.[13] This lack of population awareness around stillbirth contributes to bereaved parents' feelings of isolation, and it prevents the enhancement of prevention efforts through the early disclosure and identification of risks.

## Issues with definitions, inclusion criteria and establishment of prevalence

In Ireland, stillbirth is defined as a baby born with no signs of life at 24 weeks gestation or later, or with a birthweight of 500 grammes or more.[14] However, stillbirth definitions differ depending on the country.[15, 16] These definitions can use different gestational thresholds and different birthweight thresholds which, in high-income countries, range from ≥22 to 28 weeks of gestation and from ≥500-1000 grammes. On the other hand, there are also differences in the inclusion of stillbirths and neonatal deaths occurring because of a Termination of Pregnancy for Fetal Anomaly (TOPFA) across different countries, which are inconsistently reported, and might result in an increase or decrease of perinatal rates. The inclusion or not of TOPFA in stillbirth rates, especially at early gestation, increases the difficulty to assess the variation of rates and trends of stillbirths across countries.[17, 18] Similarly, some regions exclude cases of stillbirth caused by major congenital anomalies in the reporting of their rates, this can also result in an

inaccurate representation of the rates and mask the need for targeted interventions to reduce stillbirths caused by fetal anomalies as well as public health efforts.[19] In Ireland, the rates of perinatal mortality are calculated including TOPFA with possibility to exclude them and are also reported including major congenital anomalies and corrected to exclude major congenital anomalies.

Using different definitions and inclusion criteria is problematic because it causes discrepancies and inaccuracies in international reporting and comparison, and potentially excludes some cases of stillbirths from the epidemiological data. The World Health Organisation (WHO) proposes different definitions for stillbirth depending on what purpose that definition is going to be used for. For international comparison and reporting, the WHO recommends using a gestational week threshold of ≥28 weeks and a birthweight of ≥1000 grammes.[16] However, the use of the WHO definition leads to an under-reporting of stillbirths that occur at less than 28 weeks, which represent those showing the least improvements in reductions in high-income countries (HIC).[20] Furthermore, the differences in definition also have implications for bereaved families, as their rights differ depending on the gestation of stillbirth. In Ireland, for example, women who have a stillborn child at ≥24 weeks gestation or a birthweight of ≥500 g currently can avail of 26 weeks of paid maternity leave.[21]

The rates of stillbirth globally decreased by over 35% in the last 20 years (21.4 per 1000 births in 2000 to 13.9 in 2019), mostly in east Asia and the Pacific, followed by Eastern Europe and Central Asia.[22] However, this rate reduction is slow when compared with the decreases in mortality rates of children younger than 5 and also compared with progress in reducing neonatal mortality rates.[22] In high-income countries, the rates of stillbirth have remained steady, showing very small reductions in the last decade.[23] The differences in stillbirth rates between different high-income countries and within the same high-income country show that there is a possibility to reduce the rates of stillbirth even further.[23]

## Risk factors for stillbirth

There are multiple types of risk factors associated with an increased risk of stillbirth that have been discussed in the literature. These include sociodemographic factors, medical factors and behavioural and lifestyle factors (Please see Table 2.1).

**Table 2.1: Main risk factors associated with stillbirth**[24]

| Categories | | Main risk factors for stillbirth |
|---|---|---|
| Sociodemographic factors | | Maternal Age<br>Ethnic minorities<br>Socioeconomic status |
| Medical factors | Maternal medical factors | Hypertension<br>Diabetes<br>Thyroid disorders<br>Bacterial and viral infections |
| | Mental health conditions | |
| | Obstetric history | Parity<br>Previous history of pregnancy loss<br>Multiple pregnancies<br>History of Caesarean Section<br>Use of assisted reproductive technologies |
| | Pregnancy complications and fetal factors | Fetal growth restriction<br>Placental insufficiencies<br>Pregnancy length<br>Changes in fetal movements |
| Behavioural and lifestyle factors | | Smoking<br>Alcohol and illicit drug use<br>Use of medical drugs and supplements<br>Maternal weight<br>Sleeping habits<br>Antenatal care attendance |

Extracted from Escañuela Sánchez, T. 2022. Rethinking stillbirth through behaviour change. PhD Thesis, University College Cork.

Behavioural and lifestyle-related risk factors represent factors that have the potential to be modified, and therefore can be addressed to improve pregnancy outcomes and potentially reduce stillbirth rates. Although, behavioural and lifestyle-related factors often co-occur and are associated with other issues such as socioeconomic or sociodemographic factors,[25–28] most of these behaviours or lifestyle factors have been reported as independent risk factors for stillbirth.[29] However, they need to be understood taking into account all the potential interrelated influences over the risk of stillbirth.[30]

## International Efforts to reduce stillbirth rates

Some initiatives have been put into place in various countries with the aim to prevent stillbirths through different approaches. These efforts acknowledge the preventability of a significant number of stillbirths in high-income countries. The two main international approaches are: (1) conducting perinatal mortality audits to identify causes and risk factors, and (2) raising awareness and changing clinical practice through public health initiatives. Currently, only four high-income countries (Ireland, UK, New Zealand, and the Netherlands) conduct national perinatal mortality audits,[31] while a few countries (UK, USA, Australia, New Zealand, and Canada) implement public health approaches.

### Perinatal mortality audits, reviews and confidential enquiries

Using epidemiological data to identify risk factors and sub-optimal care is essential to produce recommendations that might enhance care in the future, hence, perinatal mortality audits, reviews and confidential enquiries are necessary to help preventive efforts.

There are four high-income countries that conduct national perinatal mortality clinical audits at the moment.[31] The Perinatal Mortality National Clinical Audit in Ireland is conducted by the NPEC,[32] the National Perinatal Clinical Audit is conducted in the UK by National Perinatal Epidemiology Unit (NPEU) and Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries across the UK (MBRRACE-UK and University of Lancaster); the New Zealand's National Perinatal Mortality Audit is conducted by the Perinatal & Maternal Mortality Review Committee (PMMRC)[31] and finally, the Netherlands has a system of national audits conducted by Perined, which is a merger organisation of PAN (Perinatal Audit Netherlands) and PRN (Perinatal Registry Netherlands).[33]

Internationally, initiatives like the Euro-PERISTAT Network and reports from UNICEF, WHO, World Bank Group, and the United Nations focus on reducing stillbirth rates through auditing and data analysis.[34, 35]

## Care Bundles and public health approaches internationally

Some countries around the world have implemented care bundles and public health approaches that include components related to awareness about behavioural risk factors or behavioural modification components to reduce stillbirth rates. To date, there has not been any initiative involving behavioural risk awareness and/or modification components carried out in Ireland. The following are examples of initiatives conducted in different high-income countries that could serve as examples to inform the development of an initiative in Ireland.

### Scottish Patient and Safety Program (SPSP) Maternity and Children Quality Improvement Collaboration (MCQIC)

The SPSP is a national initiative launched in 2008 with the objective of improving the whole of National Health service (NHS) Scotland. The SPSP MCQIC is currently focusing on reducing stillbirth rates, reducing postpartum haemorrhage rates, reducing neonatal mortality, and highlighting the importance of the essentials of safe care in maternity care.[36]

The stillbirth prevention component of the SPSP MCQIC programme focuses on assessing fetal wellbeing, monitoring fetal movements and fetal monitoring. The programme also aims to offer all women carbon monoxide monitoring when booking their antenatal care appointment,[37] to refer women who are smokers to smoking cessation services and to provide tailored packages of care to all women who continue to smoke. From inception in 2013, the programme has supported a national aggregated reduction in stillbirth rates of 22.5%.[38]

### NHS Saving Babies' Lives Care Bundle (SBLCB), United Kingdom

The NHS Saving Babies' Lives Care Bundle (NHS SBLCB) is a comprehensive approach in the NHS aimed at reducing perinatal mortality. It includes elements such as reducing smoking during pregnancy, monitoring fetal growth, raising awareness of reduced fetal movements, and effective fetal monitoring during labour.[39] A later version

added reducing preterm births.[40] The care bundle includes a public education elements, carbon monoxide testing and training for healthcare professionals.[39]

The evaluation of this care bundle across different participating NHS Trusts concluded that stillbirth rates have declined by 20% over the period in which the SBLCB was implemented,[41] but the authors were not able to determine if the implementation of the SBLCB or any of its components per se was associated with the reduction in rates of stillbirth.[41] Regarding smoking, the authors found that the proportion of women recorded as smoking at delivery declined from 14.3% before SBLCB to 11.8% after SBLCB,[41] however, there was no evidence of an increase in smoking cessation rates.[41] These findings are supported by the latest UK national perinatal mortality report with 2020 data states that rates of stillbirth have reduced by 21% from 4.20 per 1,000 total births in 2013 to 3.33 per 1,000 total births in 2020.[42]

### National Stillbirth Action and Implementation plan and the Safer Baby Bundle, Australia

The National Stillbirth Action and Implementation plan in Australia aims to achieve a sustainable reduction of preventable stillbirths by 20% or more over five years.[43] The plan focuses on five priorities: ensuring high-quality prevention and care, raising awareness and education, improving bereavement care and support, enhancing stillbirth reporting and data collection, and prioritizing research.[43]

Implementation of the Safer Baby Bundle, a key component of priority one focusing on prevention and care, has shown promising results in reducing stillbirth rates and increasing smoking cessation rates among pregnant women.[44] The bundle includes interventions such as smoking cessation support, monitoring fetal growth, promoting awareness of fetal movements, advising on maternal sleep positions, and facilitating shared decision-making on birth timing.[45] Results of the effectiveness of this approach in reducing stillbirth are currently available for the 15 Victorian health services that completed both phases of the Safer Baby collaborative. Results show a decrease in stillbirth rates by 21%, from an average rate of 0.24% to 0.19%. The days between stillbirths increased by 131%, from an average of 3.5 days to 8.1 days, including periods of 42 and 32 days without a stillbirth occurring at any of the reporting sites.[46] The rates of smoking cessation of women during pregnancy increased by 200%, from an average rate of 11% to 33%.[46]

### Public health approaches

Other initiatives implemented in different countries have focused on raising awareness and addressing behavioural risk factors through public health messaging. In Australia, the "Still six lives" campaign focuses on smoking cessation, monitoring fetal movements, and side sleeping after 28 weeks gestation.[47] The "Count the Kicks" campaign in the USA educates mothers about monitoring their babies' movements.[48, 49, 50] The "Sleep on Side" campaign in New Zealand promotes side sleeping during late pregnancy.[50] In Canada, the Canadian Collaborative for stillbirth prevention seeks to adapt the Australian stillbirth prevention plan to their context through a petition to the government.[51]

## Potential for improvement in Ireland

In Ireland, there has been some focus on stillbirth reduction, largely through the establishment of the Perinatal Mortality National Clinical Audit. This Audit was endorsed by the National Clinical Effectiveness Committee (NCEC) in 2022.[52] The NPEC has repeatedly recommended in their reports that "A public health education programme on perinatal deaths and modifiable risk factors should be developed"[53, 54] and advocates for the introduction of a "Care Bundle" approach in an attempt to reduce the perinatal mortality rates in Ireland.[55] Amongst other elements, the care bundle proposed by the NPEC includes a public health awareness programme focusing on reducing smoking in pregnancy, weight management to achieve adequate BMI, raising awareness of stillbirth and reduced fetal movements, and increasing awareness of HCP on modifiable risk factors for PM.[55] The proposed bundle also includes elements of staff training and surveillance for fetal growth restriction using a standard national approach, as well as advocating for effective monitoring of the baby during labour for a reduction in Neonatal Brain Injury and intrapartum deaths.[55] Such a care bundle, together with all of the other efforts made to date, could have the potential to reduce the rates of stillbirth in Ireland.[55]

Recently, a National Clinical Practice Guideline focusing on all aspects relating to stillbirth was developed and published in Ireland.[56] This guideline focuses on risk factors, diagnosis, investigations, management, classification, audit and review, follow-up care, and future research priorities.[56] The

guideline includes a section on the identification of risk factors and proposes best clinical practice and has numerous related recommendations.[56]

Evidence from the evaluation of the care bundles and public health campaigns in other countries has shown that stillbirth rate reductions are possible and can serve as learning points to develop new approaches in countries like Ireland.[40, 45] Although Ireland's stillbirth rates are comparable to other high-income countries, they are rising rather than falling and there is much scope for improvement.[53] To date, no public health campaigns in Ireland exist despite the availability of research showing the lack of awareness about stillbirth of the Irish population.[13] Further, the National Standards for Antenatal Education in Ireland do not include any information regarding communication about the risks of stillbirth nor education on how to support women with behaviour change[57] and the information available on Irish and UK websites around stillbirth and risk factors is very poor.[58] Hence, additional efforts need to be considered.

## The RELEVANT project

The development and implementation of potentially effective and appropriate behaviour change interventions to prevent stillbirth by addressing the behavioural risk factors for stillbirth must be based on a good understanding of the behaviours that need to be addressed, as well as behavioural theory.[59]

The Rethinking Stillbirth through behaviour change (RELEVANT) project aimed to enhance the understanding of modifiable behavioural risk factors for stillbirth and pregnancy and it was funded by Science Foundation Ireland from 2018 to 2022. The project employed both qualitative and quantitative methods to build an evidence base to be used to inform the future development of an intervention to address the behavioural risk factors for stillbirth.

Initially, a narrative review of the literature was conducted to identify key behavioural risk factors[60] associated with stillbirth. To conduct this review, a non-systematic search was performed using different databases such as Pubmed and Google scholar. Relevant articles regarding the different selected risk factors were reviewed and organised using Mendeley, however, the search progressed as the work was being completed. The strongest evidence linked substance use, smoking, heavy drinking, illicit drug use, lack of antenatal care attendance, weight-related risks, and sleep position.[60] These factors were prioritised for the project. A quantitative analysis of UK and Irish websites followed, revealing limited information on stillbirth and behavioural risks,[64] with only one site offering comprehensive information.[58]

To understand the factors influencing behaviour change, three qualitative meta-syntheses were conducted,[61–63] focusing on pregnant women's experiences. Five main concerns emerged: 1) health literacy, awareness of risks and benefits; 2) insufficient and overwhelming sources of information; 3) lack of opportunities and healthcare professionals' attitudes interfering with communication and discussion; 4) social influence of environment; and 5) social judgement, stigmatisation of women, and silence around stillbirth.[61–63] Additionally, a qualitative semi-structured interview study was carried out with postpartum women,[64] revealing ease of behaviour change driven by baby's well-being. Limited awareness of stillbirth and lack of discussion during antenatal care were noted.[64] Yet, women expressed openness to receiving sensible information, valuing knowledge.[64]

Lastly, a systematic review of interventions designed for stillbirth prevention and targeting behavioural risk factors was conducted.[65] Nine relevant interventions were identified. The review focused on identifying the behaviour change techniques (BCTs) employed in these interventions. A BCT is an observable, replicable and irreducible component of an intervention, an "active ingredient", designed to alter or redirect causal processes that regulate behaviour.[66] The most common BCTs used were "information about health consequences" and "adding objects to the environment," as revealed through BCT coding.[65]

The findings from the different studies can be grouped using these four main overarching topics, which move from more person-centred specific aspects to broader societal aspects:

1. Health literacy and sources of information.
2. Relationship with healthcare providers.
3. Healthcare system structural barriers.
4. Interpersonal and social factors: silence around stillbirth and societal stigma.

More detail on the research findings of each study can be found in Table 2.2.

**Table 2.2 Summary of research findings from the RELEVANT Study based on overarching topics**

| Study | Main findings | Overarching topics | | | |
|---|---|---|---|---|---|
| | | **Health literacy and sources of information** | **Relationship with HCPs[56] and communication issues** | **Healthcare service structural barriers** | **Interpersonal and social factors: silence around stillbirth and societal stigma** |
| **Escañuela Sánchez, T., Meaney, S., & O'Donoghue, K. (2019). Modifiable risk factors for stillbirth: a literature review. Midwifery, 79(102539).** | Four main modifiable risk factors with a behavioural component were found to have the strongest evidence:<br>• Substance use (smoking, alcohol, illicit drugs)<br>• Maternal weight<br>• Attendance & compliance with antenatal care.<br>• Sleep position. | • The evidence regarding some of the behavioural modifiable risk factors for stillbirth is conflicting (e.g., small amounts of alcohol, some prescription drugs, herbal and dietary supplements, gestational age at first booking, sleeping less than 6hrs per night). | NA | NA | NA |
| **Escañuela Sánchez, T., Meaney, S., & O'Donoghue, K. (2020). Stillbirth and risk factors : an evaluation of Irish and UK websites. Journal of Communication in Healthcare, 0(0), 1–10.** | • <50% of websites contained information about stillbirth<br>• <30% of websites contained information about risk factors for stillbirth<br>• Only one website contained all the information sought about stillbirth (e.g. definition, prevalence, etc.) & risk factors. | • Online resources have been underused to provide information about stillbirth and risk factors. | NA | • Professional body health services websites are not being used to provide information about stillbirth and risk factors.<br>• Professional body websites and health body websites rely heavily on providing links to clinical guidelines, which are not user friendly. | • The lack of information about stillbirth and behavioural risk factors for stillbirth in general websites directed at the general pregnant population might be a consequence of the stigma and taboo associated with these topics. |
| **Escañuela Sánchez, T., Linehan, L., O'Donoghue, K., Byrne, M., & Meaney, S. (2022). Facilitators and barriers to seeking and engaging with antenatal care in high-income countries: A meta-synthesis of qualitative research. Health & Social Care in the Community, 00(1), 1–19.**<br><br>**Escañuela Sánchez, T., Matvienko-Sikar, K., Linehan, L., Donoghue, K. O., Byrne, M., & Meaney, S. (2021). Facilitators and barriers to substance-free pregnancies in high-income countries: A meta-synthesis of qualitative research. Women and Birth, 35(2), e99–e110.**<br><br>**Escañuela Sánchez, T., Meaney, S., O'Connor, C., Linehan, L., O'Donoghue, K., Byrne, M., & Matvienko-Sikar, K. (2022). Facilitators and barriers influencing weight management behaviours during pregnancy: a meta-synthesis of qualitative research. BMC Pregnancy and Childbirth, 22(682), 1–21.** | Identified areas of concern:<br>• Health literacy, awareness of risks & benefits.<br>• Insufficient & overwhelming sources of information.<br>• Lack of opportunities & HCPs' attitudes interfering with communication & discussion.<br>• Social influence of the environment<br>• Social judgement, stigmatisation of women.<br>*A search to identify facilitators and barriers influencing sleep position was also conducted at two different points in time during this PhD, however, no qualitative research was identified. | • Lack of reproductive knowledge acted as a barrier for care seeking behaviour as it delayed women's recognition of their pregnancies.<br>• The lack of reliable sources of information led some women to rely on anecdotal evidence and creating misconceptions about the risks of their behaviour.<br>• A lack of satisfaction with education and advice received during antenatal care was identified.<br>• Advice during antenatal care was too general and not individualised to specific needs.<br>• Women's levels of health literacy have an influence on their perception of risk and incentives, which will influence their engagement in behaviour change. | • HCPs attitudes (stigmatisation, racism, lack of empathy, insensitivity) had an influence on women's willingness to engage with antenatal care.<br>• Non-judgemental, supporting, and empathetic HCPs were highly valued.<br>• Communication problems with healthcare professional were identified (contradictive messages, having concerns dismissed, feeling uninformed, being confused due to jargon).<br>• Authoritarian or coercive communication styles.<br>• Active listening from HCPs, taking time to address concerns, and empowerment of patients were perceived as positive communication. | • Negative clinical experiences affected women's behaviour negatively.<br>• These might be rushed appointments, administrative delays, problems with referral, lack of flexibility and of continuity of carer, lack of individualised care, complexity of the application process for care.<br>• Cultural inappropriateness and language barriers were identified as barriers to behaviour change.<br>• Limited financial resources of healthcare systems resulting in shortage of staff, closure of clinics and limitations associated with government health programmes and cost of care. | • Social position and lifestyle factors such as homelessness, living in deprived areas, low economic resources were identified as barriers for behaviour change.<br>• Social discrimination of certain collectives (ethnic minorities, socioeconomic status).<br>• Lack of social support influenced women's behaviour.<br>• Social pressure and stigma generated feelings of shame and guilt, that acted as a stressor for women and prevented engagement in behaviour change.<br>• Environmental barriers such as lack of access to sports facilities, or distance to maternity services or clinics. |

Table 2.2 continued on the next page

[56] Healthcare professionals

**Table 2.2 continued**

| Study | Main findings | Overarching topics | | | |
|---|---|---|---|---|---|
| | | **Health literacy and sources of information** | **Relationship with HCPs[56] and communication issues** | **Healthcare service structural barriers** | **Interpersonal and social factors: silence around stillbirth and societal stigma** |
| **Escañuela Sánchez, T., Meaney, S., O'Connor, C., Linehan, L., O'Donoghue, K., Byrne, M., & Matvienko-Sikar, K. (2022). Facilitators and barriers influencing weight management behaviours during pregnancy: a meta-synthesis of qualitative research. BMC Pregnancy and Childbirth, 22(682), 1–21.** | • Behaviour change during pregnancy perceived as easy and natural.<br>• Women had high level of awareness regarding health advice, but very limited regarding stillbirth.<br>• There is a lack of discussion with HCPs about stillbirth & risks, so women rely on their own information-seeking behaviours.<br>• Women had a general positive attitude towards receiving information about stillbirth; knowledge perceived as key. | • Women were aware of what habits are recommended and encouraged during pregnancy for better health.<br>• Awareness about stillbirth and the link of the behavioural risk factors with stillbirth was very limited.<br>• Women reported lack of discussion regarding stillbirth and risk factors during their antenatal care.<br>• Lack of advice regarding health behaviours and behavioural risk factors during antenatal care.<br>• Women were not informed about the reasons why those behaviours were relevant.<br>• Women relied on their own information seeking behaviours to raise their own awareness about health habits during pregnancy.<br>• Most women perceived receiving information about stillbirth as helpful to support prevention efforts. | • The importance of communication with HCPs was highlighted, encouraging the use of sensitive and non-blaming language. | • Women expressed a preference for interventions delivered in group settings, rather than targeted at one-on-one level. | • Stillbirth was perceived as a taboo work for some women, and it was described as a difficult topic to talk about. |
| **Escañuela Sánchez, T., O'Donoghue, K., Byrne, M., Meaney, S., & Matvienko-Sikar, K. (2023). A systematic review of behaviour change techniques in the context of stillbirth prevention. Women and Birth.** | • 9 interventions were included in analysis.<br>• The most common BCT used was "Information about health consequences", followed by "Adding objects to the environment".<br>• The maximum number of BCTs was 11 and the minimum was 2. | • The behaviour change interventions conducted to date in the context of stillbirth prevention have a high focus on information provision. | NA | • The interventions do not take into consideration potential structural barriers, and the ones that have shown effects on stillbirth rates require great investment at system level. | • The very limited number of behaviour change interventions highlights how this is an issue that has been neglected in the research agenda, potentially in part due to the stigma associated with the topic. |

## Implications of the RELEVANT Study findings for policy and practice

The findings from the RELEVANT Study have developed the evidence base necessary to comprehensively understand the modifiable behavioural risk factors associated with an increased risk of stillbirth in pregnancy and has some implications related to policy and practice.

**Implications for policy:**

- Improving education and information sources is crucial. Consistent, reliable, evidence-based information sources are needed for women and healthcare professionals (HCPs) regarding stillbirth risk factors and prevention.
- Pregnancy-specific supports should be enhanced and informed by the current evidence, addressing barriers such as fear, misconceptions, and lack of awareness. Services like smoking cessation, alcohol reduction, drug addiction support, and weight management should be tailored to meet the specific needs of women in antenatal care.
- Pre-conceptual education plays a vital role in promoting healthy maternal and pregnancy outcomes. Early education in schools and universities can improve health literacy and awareness of risks and recommendations.
- Behaviour change is affected by multiple factors from the individual to the societal level. Policymakers should consider addressing behavioural risk factors for stillbirths in terms of health, education, employment, housing and social equality.
- Community services, such as public health nurses, can be utilised to support behaviour change during pregnancy. However, staff shortages and limitations within the services need to be addressed.
- Developing a care bundle to reduce the risk of stillbirth is necessary. The evidence from this project, along with international initiatives, can inform the development of public health approaches and interventions.

**Implications for practice:**

- Antenatal education standards and healthcare professionals' training programmes should provide guidance to support healthcare professionals in promoting health with their patients, and also be able to discuss risk factors for stillbirth or other potential adverse pregnancy outcomes.
- Healthcare professionals require further training to understand the complexities of the behavioural risk factors for stillbirth. Training should include aspects of identification of risks and sensitive communication.
- Health promotion should be prioritised during antenatal care, alongside medical needs. Allocating additional time to discuss health habits and providing training programs for HCPs can enhance care.
- Healthcare professionals should incorporate risk factors, health habits and stillbirth in their routine discussions with women, especially in terms of outcomes for their babies, to motivate women to engage in behaviour change.

The RELEVANT project has contributed to the understanding of the maternal behaviours associated with an increased risk of stillbirth, and it provides a necessary evidence-base to inform future prevention strategies to reduce rates of stillbirth in Ireland and in similar healthcare settings. The identified priorities might also serve to help funders and researchers to design and conduct policy-relevant research.

## The RELEVANT Study – Next Steps

The evidence base developed from this research has the potential to inform the development of a behaviour change intervention to prevent stillbirth.

The future development of behaviour change interventions to tackle the modifiable behavioural risk factors for stillbirth will utilise the Behaviour Change Wheel (BCW). The BCW is a methodology that allows researchers to systematically design behaviour change interventions underpinned by a theoretical model to explain behaviour called the COM-B model (Capability, Opportunity, Motivation-Behaviour).[59]

In Stage 1, the behaviours are analysed in terms of their agents, content, context, temporal aspects, and frequency using the findings of the RELEVANT Study. The research findings are organized and interpreted within the COM-B model.[59] In Stage 2, the focus is on producing strategies to modify these behaviours during pregnancy. The Behaviour Change Wheel (BCW) framework will allow here to systematically select appropriate strategies for behaviour change.[59] The prioritisation of strategies is guided by various criteria, including affordability, practicality, effectiveness, acceptability, safety, and fairness. Throughout the completion of the BCW framework, engagement with diverse stakeholders, including healthcare professionals and pregnant women will be ensured. These stakeholders contribute their perspectives and expertise in shaping the interventions, and their input is vital in prioritising the different intervention options based on their perceived importance. To identify specific techniques for behaviour change, the researchers will utilise the Behaviour Change Technique Taxonomy version 1 (BCTTv1) tool.[66] The selected techniques are subsequently translated into practical applications, incorporating stakeholder input and the prioritisation criteria.

## Conclusion

Strategies have been successfully implemented internationally to reduce stillbirth rates by designing and implementing care bundles that, amongst other elements, take into consideration the modifiable/behavioural risk factors for stillbirth. However, in Ireland, no such initiatives have been developed, although recommendations have been made that support their development. For behaviour change interventions or public health initiatives to have the best possible success in reducing the rates of stillbirth, they need to be designed with a solid evidence base. Hence, the overall objective of the RELEVANT Study was to build the evidence base to enhance the understanding of the modifiable behavioural risk factors for stillbirth.

The RELEVANT Study makes a significant contribution to the knowledge base on the modifiable behavioural risk factors for stillbirth and identified key areas for future work in practice, policy and research. Importantly, the findings provide the groundwork for the future development and/or adaptation of interventions to promote behaviour change during pregnancy to reduce women's individual risk of stillbirth and help national efforts at stillbirth rate reduction.

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# 3. Stillbirths

## Key findings

1. Stillbirths accounted for 66.7% of perinatal deaths in 2021.
2. In contrast to previous years, specific placental conditions was the most common cause of death in stillbirths (32.8%) followed by major congenital anomaly (28.6%).
3. Intrapartum deaths accounted for 5.9% of stillbirths. This rate is similar to previous years.

## Cause of death in stillbirths

The cause of death in stillbirths was classified using the NPEC maternal and fetal classification system. This classification system is detailed in the methods section of this report **(click here)**. Cause of death are divided into the following categories: Major congenital anomaly, Placental disease, Antepartum or intrapartum haemorrhage, Mechanical, Infection, Specific fetal conditions, Associated obstetric factors, IUGR, Maternal factors and Unexplained cause of death.

Specific placental conditions were the most common cause of death in stillbirths in 2021 (n=78 of 238, 32.8%) (Figure 3.1 and Figure 3.2). This is in contrast to previous years when major congenital anomaly was the most common cause of death. The last time specific placental conditions were the most prevalent cause of death in stillbirths was in 2017 (Table 3.1). The most commonly occurring placental condition was fetal vascular malperfusion (n=18 of 78, 23.1%), followed by maternal vascular malperfusion and cord pathology with distal disease accounting 16 deaths each (n=16 of 78, 20.5%). Delayed villous maturation (n=8, 10.3%) and cord pathology (n=7, 9.0%) were the next most common causes among specific placental conditions. Of significance in 2021, deaths due to SARS-CoV-2 placentitis (n=9) were categorised under 'other placental conditions.' These cases are discussed in more detail later on in this section. Table 3.1 shows further detail of the cause of death for stillbirths.

Major congenital anomaly was the second most common cause of death in stillbirths in 2021 (n=68 of 238, 28.6%). There was a chromosomal disorder in almost 49% of the stillbirths in 2021 due to major congenital anomaly (n=33 of 68, 48.5%), as shown in Figure 3.3. In the cases with a chromosomal disorder, the diagnosis was made using several methodologies; cytogenetic analysis in almost 94% of cases (n=31 of 33, 93.9%), ultrasound in 76% of cases (n=25, 75.8%) and it was reported that just over half (n=17, 51.5%) of the cases had a clinical diagnosis (i.e. more than one methodology may apply). Of all the stillbirths due to major congenital anomalies, more than 90.0% (n=61 of 66, 92.4% unknown for two cases) had an antenatal diagnosis made by a consultant fetal medicine specialist either in the unit of reference (n=45) or in another unit (n=16). Multiple anomalies (n=10), anomalies of the cardiovascular system (n=10), central nervous system (n=5), musculo-skeletal (n=4), gastro-intestinal (n=3) systems, urinary tract (n=2) and metabolic disorders (n=1) led to 35 (51.5% of 68) stillbirths. No cases were identified for anomalies in the 'other' major congenital anomalies category in 2021. Anomalies of the respiratory system were in association with multiple anomalies or a chromosomal disorder.

In 2021, a specific mechanical cause of death, most commonly due to the umbilical cord around the baby's neck or another entanglement or knot in the umbilical cord, and antepartum or intrapartum haemorrhage, most commonly involving placental abruption, were the next most common cause of stillbirth (n=14 of 238 each, 5.9%). Infection was the main cause of death in 4.2% of stillbirths in 2021, similar to the rate in 2020 (4.2%), but lower than the rate of 6.6% reported in 2019, and almost double the percentage reported in 2018 (2.8%).

In 2021, in almost fifteen percent of stillbirths (n=35 of 238, 14.7%), the cause of death was unexplained. This is higher than the proportion in 2020 (n=26, 10.8%) and 2019 (n=23, 9.5%), but lower than 2018 (n=45, 20.7%). Similar rates were reported in 2016 (Table 3.1). As detailed in Table 3.1, in 2021, for sixty

percent of the stillbirths with an unexplained cause of death, it was reported that the maternity unit was pending post-mortem results or other investigations for these cases (n=21 of 35, 60.0%). As such, a cause of death may be identified when the post-mortem reports are available.

In the majority of these cases where the unit was pending post-mortem results or other investigations, almost all were Coronial cases (n=20 of 21, 95.3%). In over ninety percent of the unexplained cases, it was reported that there were no antecedent or associated obstetric factors (n=26 of 28, 92.9%, unknown for seven cases). For the vast majority of these unexplained stillbirths, an autopsy was performed (n=30 of 35, 85.7%). For the remaining unexplained stillbirths an autopsy was offered and presumably declined (n=5 of 35, 14.3%).

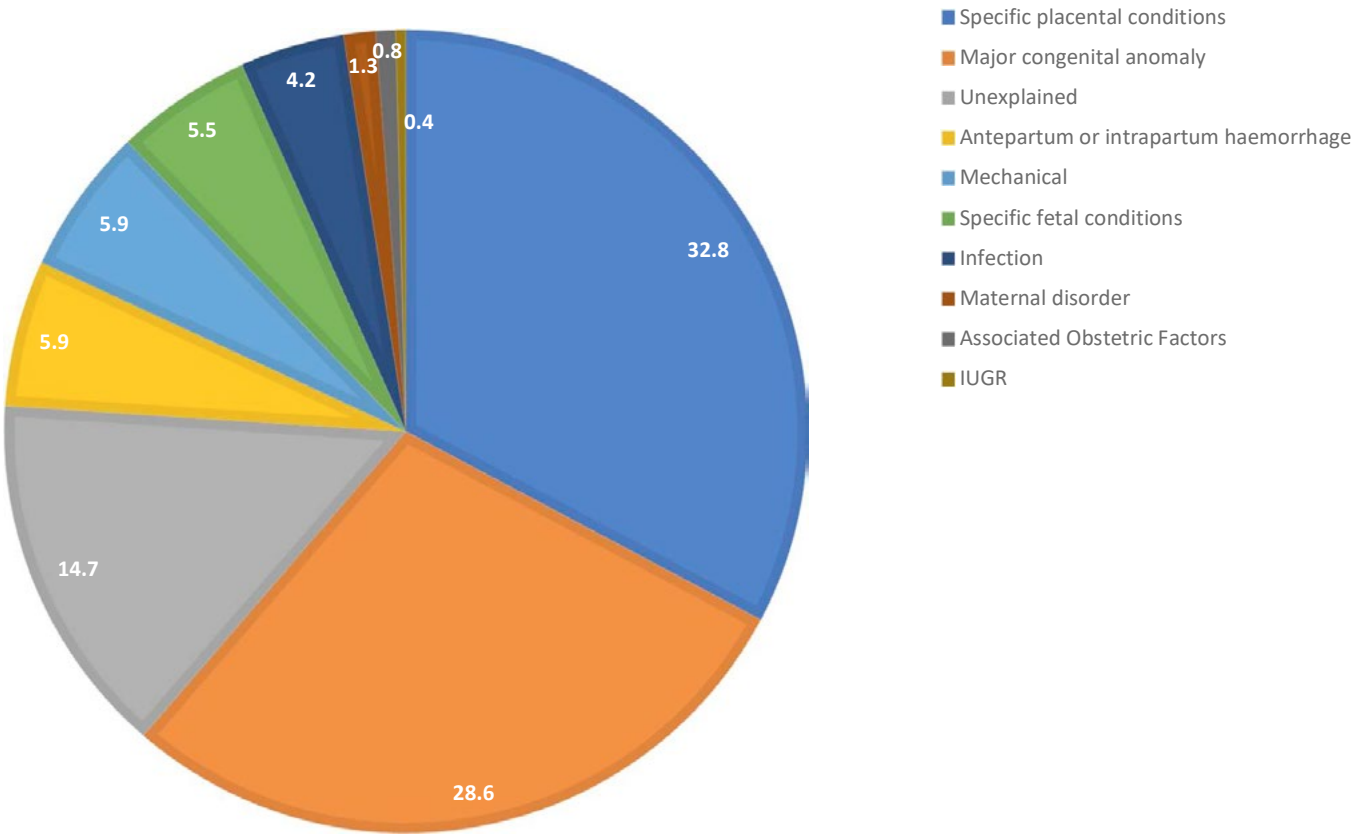


**Figure 3.1: Main cause of death in stillbirths, 2021**

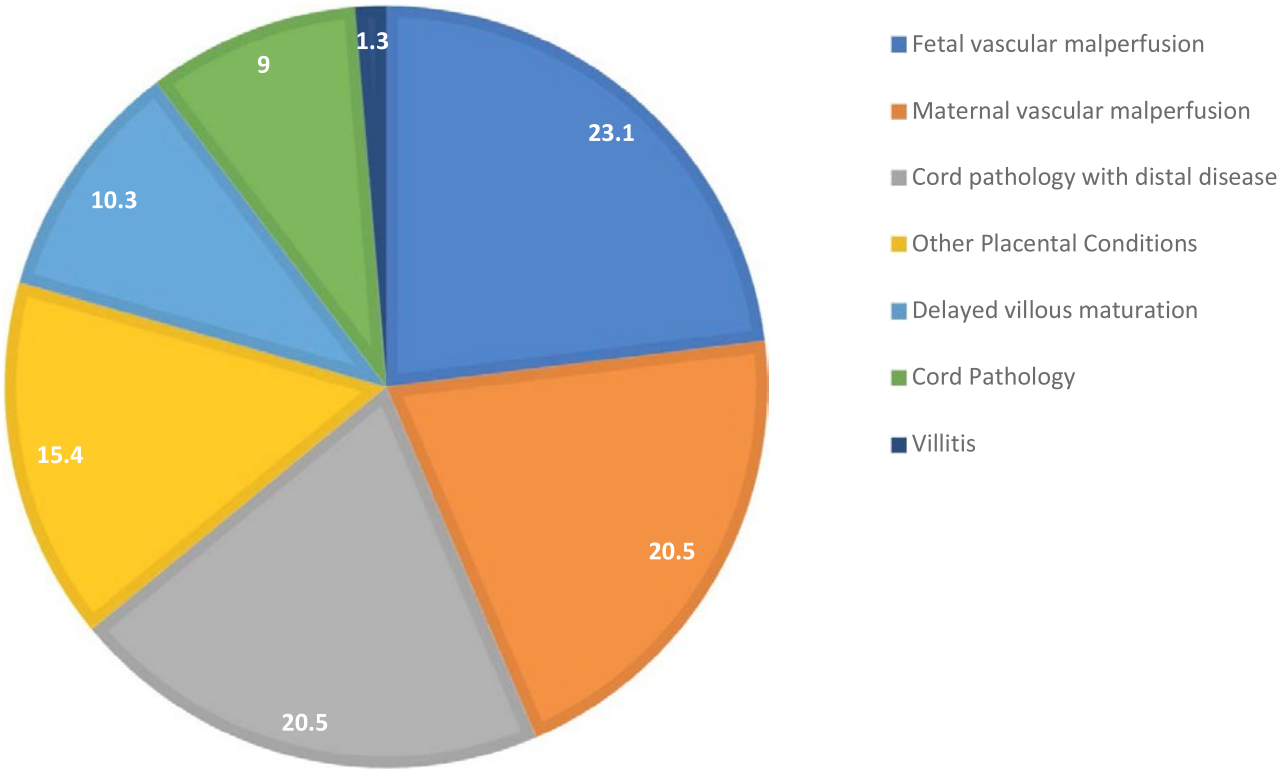


**Figure 3.2: Detailed cause of death in cases of specific placental conditions in stillbirths, 2021**

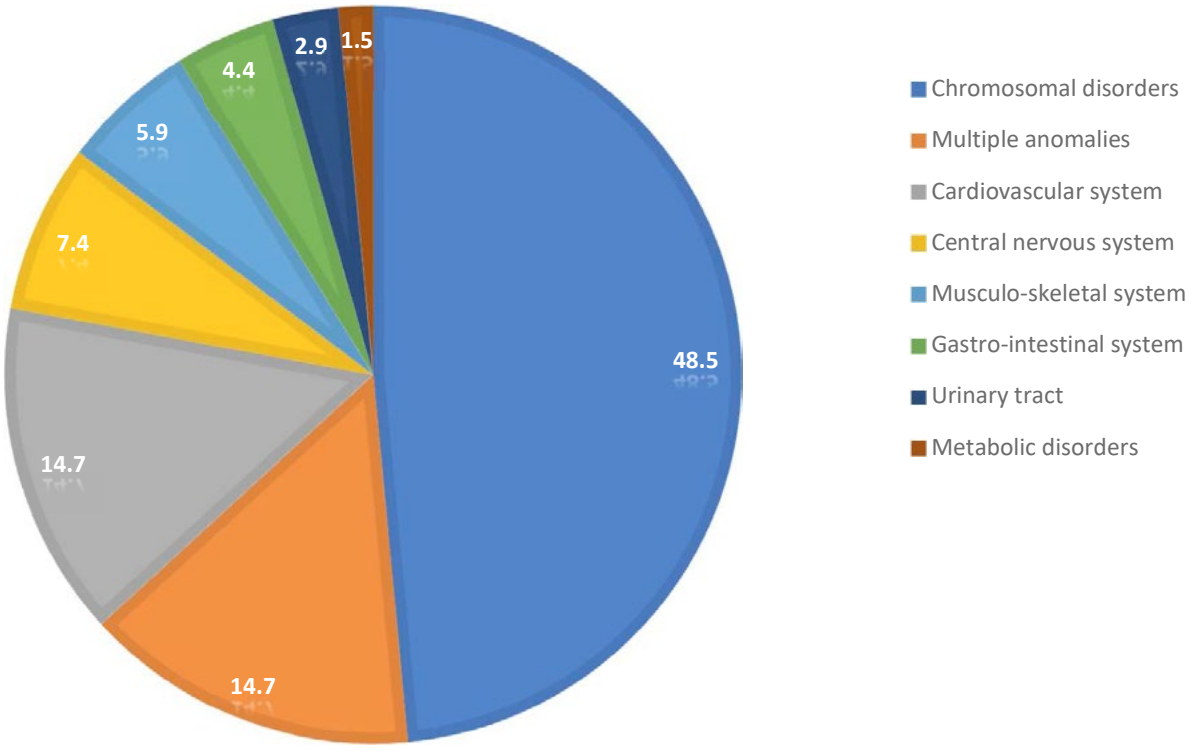


**Figure 3.3: Detailed cause of death in cases of major congenital anomalies in stillbirths, 2021**

**Table 3.1: Stillbirth main cause of death in 2016-2021, NPEC Classification System**

| | 2016 N=250 | 2017 N=235 | 2018 N=217 | 2019 N=242 | 2020 N=240 | 2021 N=238 |
|---|---|---|---|---|---|---|
| **Major congenital anomaly** | **78 (31.2%)** | **64 (27.2%)** | **67 (30.9%)** | **74 (30.6%)** | **79 (32.9%)** | **68 (28.6%)** |
| Chromosomal disorders | 50 | 38 | 37 | 40 | 40 | 33 |
| Central nervous system | 5 | 3 | 9 | 4 | 6 | 5 |
| Cardiovascular system | 3 | 5 | 5 | 11 | 7 | 10 |
| Urinary tract | 3 | 5 | 1 | 2 | 1 | 2 |
| Multiple anomalies | 6 | 6 | 7 | 8 | 12 | 10 |
| Gastro-intestinal system | 3 | 2 | 0 | 1 | 4 | 3 |
| Musculo-skeletal system | 3 | 1 | 2 | 2 | 4 | 4 |
| Respiratory system | 1 | 0 | 2 | 3 | 1 | 0 |
| Metabolic disorders | 0 | 1 | 0 | 0 | 0 | 1 |
| Other major congenital anomaly | 4 | 3 | 4 | 3 | 4 | 0 |
| **Specific placental conditions**[1] | **70 (28.0%)** | **76 (32.3%)** | **57 (26.3%)** | **73 (30.2%)** | **73 (30.4%)** | **78 (32.8%)** |
| Maternal vascular malperfusion | 24 | 28 | 16 | 25 | 19 | 16 |
| Fetal vascular malperfusion | 15 | 17 | 13 | 12 | 14 | 18 |
| Cord pathology | 15 | 15 | 10 | 11 | 12 | 7 |
| Cord pathology with distal disease | 9 | 0 | 7 | 14 | 17 | 16 |
| Delayed villous maturation[2] | 2 | 5 | 6 | 3 | 8 | 8 |
| Chorioamnionitis | 0 | 0 | 0 | 0 | 0 | 0 |
| Villitis | 0 | 1 | 4 | 2 | 2 | 1 |
| Other placental condition | 5 | 10 | 1 | 6 | 1 | 12* |
| **Mechanical** | **20 (8.0%)** | **12 (5.1%)** | **9 (4.1%)** | **18 (7.4%)** | **19 (7.9%)** | **14 (5.9%)** |
| Prolapse cord | 2 | 0 | 1 | 0 | 1 | 1 |
| Cord around neck | 10 | 8 | 4 | 11 | 10 | 5 |
| Uterine rupture before labour | 1 | 0 | 3 | 0 | 1 | 1 |
| Mal-presentation | 0 | 0 | 0 | 0 | 0 | 0 |
| Shoulder dystocia | 0 | 0 | 0 | 1 | 0 | 0 |
| Other cord entanglement or knot | 7 | 4 | 1 | 6 | 7 | 7 |
| **Antepartum or intrapartum haemorrhage** | **18 (7.2%)** | **21 (8.9%)** | **12 (5.5%)** | **22 (9.1%)** | **13 (5.4%)** | **14 (5.9%)** |
| Praevia | 0 | 0 | 1 | 0 | 0 | 1 |
| Abruption | 18 | 21 | 10 | 21 | 13 | 13 |
| Uncertain haemorrhage | 0 | 0 | 0 | 1 | 0 | 0 |
| Cause of haemorrhage other | | | 1 | 0 | 0 | 0 |
| **Infection** | **9 (3.6%)** | **6 (2.6%)** | **6 (2.8%)** | **16 (6.6%)** | **10 (4.2%)** | **10 (4.2%)** |
| Bacterial | 1 | 0 | 0 | 1 | 1 | 0 |
| Syphilis | 0 | 0 | 0 | 0 | 1 | 0 |
| Viral diseases | 1 | 0 | 0 | 0 | 0 | 1 |
| Group B Streptococcus | 1 | 0 | 0 | 1 | 0 | 1 |
| Other maternal infection | 0 | 0 | 0 | 1 | 0 | 0 |
| Chorioamnionitis | 4 | 5 | 5 | 13 | 8 | 8 |
| Other ascending infection | 2 | 1 | 1 | 0 | 0 | 0 |

Note:

[1]The main placental pathology associated with perinatal death is reported.

[2]The term 'Delayed villous maturation' (DVM) has replaced conditions previously reported as 'Placental maturation defect'. DVM includes distal villous immaturity and delayed villous maturation. Includes nine deaths due to SARS-CoV-2 placentitis.

**Table 3.1 continued**

| | 2016 N=250 | 2017 N=235 | 2018 N=217 | 2019 N=242 | 2020 N=240 | 2021 N=238 |
|---|---|---|---|---|---|---|
| **Specific fetal conditions** | **9 (3.6%)** | **18 (7.7%)** | **8 (3.7%)** | **11 (4.5%)** | **13 (5.4%)** | **13 (5.5%)** |
| Twin-twin transfusion | 1 | 5 | 2 | 2 | 7 | 9 |
| Feto-maternal haemorrhage | 3 | 8 | 3 | 7 | 5 | 2 |
| Non immune hydrops | 3 | 4 | 1 | 1 | 1 | 0 |
| Iso-immunisation | 0 | 0 | 0 | 0 | 0 | 0 |
| Other fetal condition | 2 | 1 | 2 | 1 | 0 | 2 |
| **Intra-uterine growth restriction** | **4 (1.6%)** | **1 (0.4%)** | **5 (2.3%)** | **3 (1.2%)** | **0 (0%)** | **1 (0.4%)** |
| IUGR-Suspected antenatally | 4 | 1 | 3 | 3 | 0 | 1 |
| IUGR-Observed at delivery | 0 | 0 | 0 | 0 | 0 | 0 |
| IUGR-Observed at post-mortem | 0 | 0 | 2 | 0 | 0 | 0 |
| **Associated obstetric factors** | **2 (0.8%)** | **6 (2.6%)** | **4 (1.8%)** | **1 (0.4%)** | **6 (2.5%)** | **2 (0.8%)** |
| Premature rupture of membranes | 0 | 1 | 1 | 1 | 1 | 0 |
| Prolonged rupture of membranes >24 hrs | 0 | 1 | 1 | 0 | 1 | 1 |
| Intrapartum asphyxia | 2 | 3 | 1 | 0 | 0 | 0 |
| Intracranial haemorrhage | 0 | 0 | 0 | 0 | 0 | 0 |
| Birth injury to scalp | 0 | 0 | 0 | 0 | 0 | 0 |
| Fracture | 0 | 0 | 0 | 0 | 0 | 0 |
| Other birth trauma | 0 | 0 | 0 | 0 | 1 | 0 |
| Polyhydramnios | 0 | 0 | 0 | 0 | 0 | 0 |
| Oligohydramnios | 0 | 0 | 0 | 0 | 0 | 0 |
| Spontaneous premature labour | 0 | 1 | 0 | 0 | 1 | 1 |
| Other obstetric factors | 0 | 0 | 1 | 0 | 2 | 0 |
| **Maternal disorder** | **0 (0%)** | **3 (1.3%)** | **0 (0%)** | **0 (0%)** | **1 (0.4%)** | **3 (1.3%)** |
| Pre-existing hypertensive disease | 0 | 0 | 0 | 0 | 0 | 0 |
| Diabetes | 0 | 2 | 1 | 0 | 1 | 0 |
| Thrombophilias | 0 | 0 | 0 | 0 | 0 | 0 |
| Uterine anomalies | 0 | 0 | 1 | 0 | 0 | 0 |
| Other maternal disorder | 0 | 1 | 1 | 1 | 0 | 3 |
| Other endocrine conditions | 0 | 0 | 0 | 0 | 0 | 0 |
| Obstetric cholestasis | 0 | 0 | 1 | 0 | 0 | 0 |
| Drug misuse | 0 | 0 | 0 | 0 | 0 | 0 |
| **Hypertensive disorders of pregnancy** | **2 (0.8%)** | **2 (0.9%)** | **0 (0%)** | **0 (0%)** | **0 (0%)** | **0 (0%)** |
| Pregnancy induced hypertension | 1 | 0 | 0 | 0 | 0 | 0 |
| Pre-eclampsia toxaemia | 1 | 2 | 0 | 0 | 0 | 0 |
| HELLP syndrome | 0 | 0 | 0 | 0 | 0 | 0 |
| Eclampsia | 0 | 0 | 0 | 0 | 0 | 0 |
| **Unexplained** | **38 (15.2%)** | **26 (11.1%)** | **45 (20.7%)** | **23 (9.5%)** | **26 (10.8%)** | **35 (14.7%)** |
| No antecedents or associated obstetric factors | 17 | 10 | 17 | 8 | 6 | 6 |
| Antecedents or associated obstetric factors present | 15 | 15 | 21 | 10 | 5 | 8 |
| Pending post-mortem or other investigation | 5 | 1 | 7 | 5 | 15 | 21 |
| Very limited information available | 1 | 0 | 0 | 0 | 0 | 0 |

## COVID-19 pandemic and perinatal mortality 2021

The COVID-19 pandemic reached Ireland on the 29th of February 2020 and within three weeks, cases had been reported across the Island of Ireland. While no perinatal deaths due to SARS-CoV-2 placentitis were reported in the 2020 NPEC PMNCA, this was in stark contrast to findings in this 2021 audit.

In the reporting year 2021, a severe 'third and fourth wave' of the COVID-19 pandemic affected Ireland when the virulent variants of concern (Alpha- B.1.1.7 and Delta) were found to impact on maternal and fetal wellbeing.[57, 58, 59] In the Irish context, among perinatal deaths occurring in 2021 a total of one ENND and nine stillbirths were due to SARS-CoV-2 placentitis; six of these cases occurred in the third wave and four in the fourth wave. Using the NPEC classification system, stillbirths due to SARS-CoV-2 placentitis were classified as 'other placental condition' (Table 3.1).

The clinical and pathological features of stillbirths due SARS-CoV-2 placentitis during the third wave of COVID-19 pandemic in Ireland is described by Fitzgerald and O'Donoghue et al (2022).[60]

## 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, 62]

In the reporting year 2021, 199 women experienced antepartum stillbirth (83.6% of all the stillbirths; Table 3.3). The management of clinical care (i.e., whether the care involved planned induction of labour or awaiting spontaneous labour, elective delivery by caesarean section) was recorded for all the 199 women who experienced antepartum stillbirth. Labour was induced for almost eighty percent of the women who experienced antepartum stillbirth (n=158, 79.4%) whereas labour was spontaneous for 15.1% (n=30).

As shown in Figure 3.4, the time from diagnosis of fetal demise to delivery was different for women whose labour was induced from the delivery time for women whose labour was spontaneous in 2021. The confirmation of death and delivery took place on the same day for 50.0% (n=15 of 30) of the women whose labour was spontaneous. For women whose labour was induced, it was common for up to three days to pass between diagnosis and delivery (n=108 of 157, 68.8%, unknown for one case). As can be observed from Figure 3.4 a very small number of antepartum stillbirths were delivered more than 10 days after confirmation of fetal demise (n=4), all of them were from multiple births with a liveborn twin.

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[57] Pregnant and Post-Partum women admitted to Intensive Care with confirmed COVID-19 infection - 1st March 2020 to 31st December 2021.HSE. EPI INSIGHT. Vol 24 Issue 2/ February 2023. Available at https://ndsc.newsweaver.ie/4otaa688p3/9cyikgz9vnz?lang=en&a=1&p=61280241&t=3130294

[58] Dwyer, R., et al., NOCA Report on ICU Activity During COVID-19 Pandemic, Ireland, NOCA and ICU-BIS, 2021

[59] Fitzgerald, B. O'Donoghue, K., McEntagart, N., Gillan, J.E., Kelehan, P., et al., Fetal Deaths Due to SARS-CoV-2 Placentitis caused by SARS-CoV-2 Alpha, Arch Pathol Lab Med, Vol 146, May 2022

[60] Fitzgerald, B. O'Donoghue, K., McEntagart, N., Gillan, J.E., Kelehan, P., et al., Fetal Deaths Due to SARS-CoV-2 Placentitis caused by SARS-CoV-2 Alpha, Arch Pathol Lab Med, Vol 146, May 2022

[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

[62] McDonnell A, Butler M, White J, Escañuela Sánchez T, Cullen S, Cotter R, Murphy M, O'Donoghue K. National Clinical Practice Guideline: Stillbirth: Prevention, Investigation, Management and Care. National Women and Infants Health Programme and The Institute of Obstetricians and Gynaecologists. January 2023

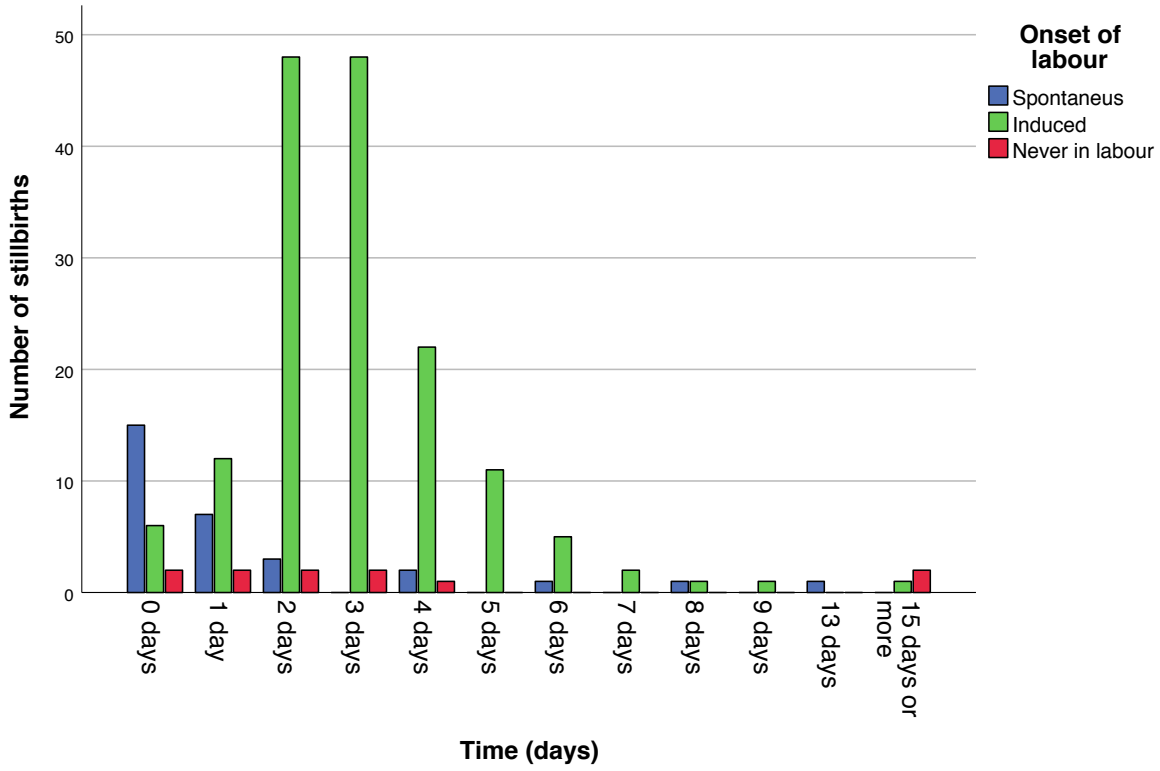



**Figure 3.4: Time from confirmation of fetal demise to delivery for women who experienced antepartum stillbirth, 2021**

Vaginal birth is the recommended mode of delivery for most women experiencing antepartum stillbirth, but caesarean section may be clinically indicated in some cases.[63] Vaginal cephalic delivery was the most common mode of delivery in cases of antepartum stillbirth in 2021 (n=149, 74.9%).

In 18 cases of antepartum stillbirth the intended mode of delivery was a planned caesarean section. Ultimately, caesarean section was the mode of delivery for 11 women of these 18 where a caesarean section was planned (ten pre-labour caesarean sections and one caesarean section performed after onset of labour).

Of the 199 antepartum stillbirths, 15 women delivered by caesarean section (n=11 as pre-labour caesarean section and four as caesarean section performed after onset of labour). Among these cases, the procedure was classified as 'elective' in 46.7% of the cases, 26.7% were 'urgent' and 26.7% were 'emergency' (Table 3.2). Forty percent (n=6, 40.0%) of these 15 women had previously had a caesarean section, and over thirty three percent (n=5, 33.3%) had a multiple delivery, both of these were factors that may have influenced the mode of delivery.

**Table 3.2: Indication for caesarean section in women experiencing antenatal stillbirth, 2021**

| Indication for caesarean section | N=15 N(%) |
|---|---|
| **Elective:** At a time to suit the woman or the maternity team | 7(46.7) |
| **Urgent:** Maternal or fetal compromise which is not immediately life threatening | 4(26.7) |
| **Emergency:** Immediate threat to life of woman or baby | 4(26.7) |

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

[63] 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

## 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.[64] 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. This was not known in 16 cases in 2021 (Table 3.3). Of these 16 cases, five cases were born before arrival at the maternity unit. Among the remaining 11 cases, the majority (n=9) had an antenatal diagnosis of major congenital anomaly which may have influenced monitoring in labour. Of these nine deaths, eight were delivered following TOP.

There were 14 cases of stillbirths where the baby was known to be alive at the onset of care in labour. Thus, intrapartum deaths accounted for 5.9% of stillbirths in the Republic of Ireland in 2021 (Table 3.3). This was similar to the proportion of intrapartum deaths reported in Ireland in 2020 (5.4%) and in the combined years 2018-2019 (5.7%). However, it was lower than the most recently published 2020 figures in the United Kingdom, ranging from 8.2% in Northern Ireland, 7.0% in England to 5.1% in Scotland and Wales (5.0%).[65]

**Table 3.3: Life status of baby at the onset of care in labour for stillbirths, 2021**

| Type of Stillbirth case | Description | N=238 N(%) |
|---|---|---|
| **Antepartum** | Baby not alive at onset of care in labour (Antepartum stillbirth) | 199(83.6) |
| | Never in labour | 9(3.8) |
| **Intrapartum** | Baby alive at onset of care in labour | 14(5.9) |
| **Not known** | | 12(5.0)* |
| **Unattended** | | 4(1.7) |

Note: All the stillbirths who were unattended (n=4) were born before arrival (BBA) at maternity units, of which one was not booked to a maternity unit. *Life status unknown for 12 cases includes eight babies delivered following TOP (all of them with major congenital anomalies); two coroners' cases awaiting Coronial report; and two babies, one with an antenatal diagnosis of major congenital anomaly who presumably were not monitored in labour, and another with chorioamnionitis.

Major congenital anomaly was the main cause of death for fifty percent of the 14 intrapartum deaths (n=7, 50.0%). The next most common cause of death was infection (n=3). Associated obstetrics factors, antepartum or intrapartum haemorrhage, mechanical and specific fetal conditions counted for one each (n=4). There were no unexplained cases among intrapartum stillbirths in 2021. There was no clustering of intrapartum deaths by hospitals due to causes other than major congenital anomaly.

Section 5 of this report provides further details on perinatal deaths associated with intrapartum events in babies with a gestational age of at least 34 weeks gestation and a birthweight of at least 2,500g who were alive at the onset of labour and whose death was not due to major congenital anomaly or infection. However, while the NPEC perinatal mortality audit provides the best national data available on intrapartum deaths and unexpected neonatal deaths, a more formal confidential inquiry-based system is necessary to fully appraise these cases.[66] As in previous reports, we make a recommendation in this area.

[64] 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

[65] Draper ES, Gallimore ID, Smith LK, Matthews RJ, Fenton AC, Kurinczuk JJ, Smith PW, Manktelow BN, on behalf of the MBRRACE-UK Collaboration. MBRRACE-UK Perinatal Mortality Surveillance Report, UK Perinatal Deaths for Births from January to December 2020: Tables and Figures. Leicester: The Infant Mortality and Morbidity Studies, Department of Health Sciences, University of Leicester. 2022

[66] McNamara K, O'Donoghue K, Greene RA. Intrapartum fetal deaths and unexpected neonatal deaths in the Republic of Ireland: 2011 - 2014; a descriptive study. BMC Pregnancy Childbirth. 2018 Jan 4;18(1):9. doi: 10.1186/s12884-017-1636-6. PMID: 29301489; PMCID: PMC5755435.

# 4. Early neonatal deaths

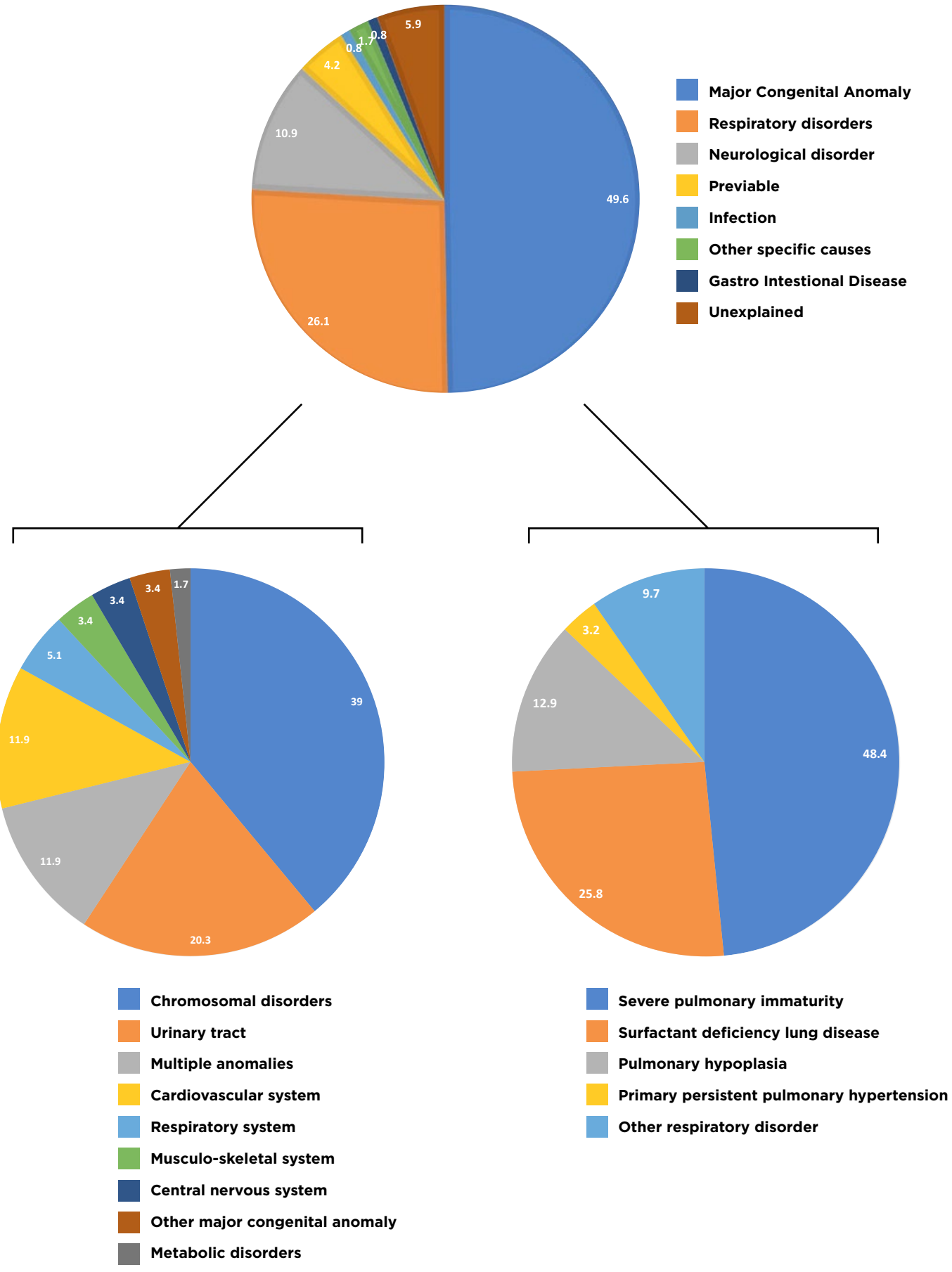
## Key findings

1. Early neonatal deaths accounted for 33.3% of perinatal deaths in 2021.
2. Major congenital anomaly was the most common cause of early neonatal death (49.6%) followed by Respiratory disorders (26.1%), primarily due to severe pulmonary immaturity.
3. More than half (53.4%) of early neonatal deaths occurred within 24 hours of delivery.

## Cause of early neonatal death

The cause of early neonatal deaths in 2021 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. These classification system are detailed in the methods section of this report **(click here)**. Cause of neonatal death are divided into the following categories: major congenital anomaly, respiratory disorders, neurological disorders, previable, infection, other specific causes, gastro intestinal disease and unexplained cause of death.

Major congenital anomaly was the most common cause of early neonatal death in 2021 (n=59 of 119, 49.6%; Figure 4.1) followed by respiratory disorder, accounting for more than one fourth of early neonatal deaths (n=31, 26.1%; Figure 4.1). Neurological disorder was the next most common cause of death (n=13, 10.9%), which was lower than the rate in previous years (14.5% in 2020, 12.7% in 2019 and 12.0% in 2018). Seven deaths (5.9%) were unexplained pending post-mortem or other investigation. Five of them were Coronial cases (71.4%). A detailed listing of the main cause of death for the 119 early neonatal deaths occurring in 2021 is given at the end of this section of the report (Table 4.3).




Upper centre: **Figure 4.1: Main cause of early neonatal death, 2021**

Lower left: **Figure 4.2: Detailed cause of death in cases of major congenital anomaly in neonatal deaths, 2021**

Lower right: **Figure 4.3: Detailed cause of death in cases of respiratory disorder in neonatal deaths, 2021**

## Major congenital anomalies

The types of major congenital anomalies, which caused 59 of the 119 neonatal deaths in 2021, are illustrated in Figure 4.2. Chromosomal disorders were most common type of major congenital anomaly, occurring in almost two fifths of neonatal deaths due to major congenital anomaly (n=23, 39.0%). The second most frequent anomalies were urinary tract disorders occurring in twenty percent of the cases within the major congenital anomaly group (n=12, 20.3%). Multiple anomalies and cardiovascular system disorders each accounted for seven of deaths in this cohort (n=7, 11.9%). Other anomalies included anomalies of the respiratory system (n=3, 5.1%), central nervous system (n=2, 3.4%) and musculo-skeletal system (n=2, 3.4%). Metabolic disorder accounted for one (1.7%) death in this cohort. Two cases were categorised as having 'other' major congenital anomalies (3.4%).

Data on whether the diagnosis of a major congenital anomaly was confirmed/suspected by a consultant fetal medicine specialist was recorded for all the 59 neonatal deaths that occurred in 2021. In the vast majority of these cases a diagnosis was confirmed/suspected by a consultant fetal medicine specialist (n=55 of 59, 93.2%). Among the 23 neonatal deaths attributed to a chromosomal disorder, a number of diagnostic investigations were carried out: cytogenetic analysis in 86.9% (n=20 of 23), clinically in 47.8% (n=11 of 23) and ultrasound in 34.8% (n=8 of 23). Overall, 10 neonatal deaths were diagnosed using one of these diagnostic procedures, five using two, and six neonatal deaths using the three diagnostic procedures (i.e., clinical diagnostic, cytogenetic analysis and ultrasound, unknown for two cases).

## Respiratory disorders

Figure 4.3 details causes of death in cases of respiratory disorders in neonatal deaths in 2021. Of the early neonatal deaths caused by respiratory disorder, the majority (n=15, 48.4%) were due to severe pulmonary immaturity. Surfactant deficiency lung disease occurred in eight cases (25.8%). Pulmonary hypoplasia accounted for four deaths (12.9%), and other respiratory disorders occurred in three early neonatal deaths in 2021 (n=3, 9.7%). For one early neonatal death, the main cause of death was attributed to primary persistent pulmonary hypertension (3.2%).

## Neurological disorders

A neurological disorder was attributed as the main cause of death in 13 (10.9%) early neonatal deaths in 2021. For 10 of these 13 cases, the condition involved was intraventricular/periventricular haemorrhage (IVH/PVH, 76.9%) and for three cases death was due to hypoxic ischaemic encephalopathy (HIE, 23.1%). Table 4.1 details the gestational age, customised birthweight centile and main antecedent or obstetric factor associated with the 13 early neonatal deaths attributed to neurological disorders. All but one case with IVH/PVH occurred in babies with a gestational age of 22-27 weeks. Seven of these 13 early neonatal deaths had an autopsy performed (53.8%) and five of them became Coronial cases (38.5%).

**Table 4.1: Details of early neonatal deaths due to neurological disorders, 2021**

| Neurological disorder | Gestational age (weeks) | Birthweight centile | Main antecedent or obstetric factor associated with the death | Autopsy Performed (Yes/No) | Coroner case (Yes/No) |
|---|---|---|---|---|---|
| IVH/PVH | 26 | 7.4 | Abruption | Autopsy not performed but offered | No |
| IVH/PVH | 28 | 0 | IUGR - Suspected antenatally | Autopsy performed | Yes |
| IVH/PVH | 23 | 6.7 | Spontaneous premature labour | Autopsy not performed and not offered | No |
| IVH/PVH | 23 | 30.9 | Spontaneous premature labour | Autopsy performed | Yes |
| IVH/PVH | 25 | 51 | Spontaneous premature labour | Autopsy performed | Yes |
| IVH/PVH | 27 | 33 | Abruption | Autopsy not performed but offered | No |
| IVH/PVH | 24 | 87.9 | Spontaneous premature labour | Autopsy not performed but offered | No |
| IVH/PVH | 24 | 1.2 | Spontaneous premature labour | Autopsy not performed but offered | No |
| IVH/PVH | 26 | 99.8 | Spontaneous premature labour | Autopsy performed | No |
| IVH/PVH | 23 | 28.4 | Spontaneous premature labour | Autopsy not performed but offered | No |
| HIE | 32 | 68.9 | HELLP syndrome | Autopsy performed | Yes |
| HIE | 36 | 95.9 | Non immune hydrops | Autopsy performed | No |
| HIE | 36 | 27.6 | Fetal vascular malperfusion | Autopsy performed | Yes |

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

Table 4.2 shows the gestational age distribution at delivery in early neonatal deaths in 2021 by main cause of death, missing data for two early neonatal deaths. All but two of the 31 early neonatal deaths attributed to respiratory disorder occurred in babies delivered before 28 weeks gestation. This pattern of gestational age was in marked contrast to the early neonatal deaths due to major congenital anomaly and to those due to all other causes. While early neonatal deaths due to major congenital anomaly occurred in babies delivered from 22 weeks gestation, the majority were delivered between 32- and 41-weeks' gestation (n=43 of 59, 72.9%), of which almost forty-nine percent (n=21, 48.8%) were delivered at term (37-41 weeks gestation).

**Table 4.2: Gestational age distribution in neonatal deaths by main cause of death, 2021**

| | <22 weeks N=1 N(%) | 22-27 weeks N=51 N(%) | 28-31 weeks N=14 N(%) | 32-36 weeks N=26 N(%) | 37-41 weeks N=25 N(%) | ≥42 weeks N=0 N(%) |
|---|---|---|---|---|---|---|
| Respiratory disorder | 0(0) | 29(56.9) | 2(14.3) | 0(0) | 0(0) | 0 |
| Major congenital anomaly | 0(0) | 5(9.8) | 11(78.6) | 22(84.6) | 21(84) | 0 |
| All Other | 1(100) | 17(33.3) | 1(7.1) | 4(15.4) | 4(16) | 0 |

Note: Values are N(%) unless otherwise stated. Data missing for two ENNDs.

Table 4.3 presents a detailed listing of the main cause of death for the 119 early neonatal deaths occurring in 2021.

**Table 4.3: Early neonatal main cause of death in 2016-2021, NPEC Classification System**

| | 2016 N=124 | 2017 N=111 | 2018 N=108 | 2019 N=118 | 2020 N=117 | 2021 N=119 |
|---|---|---|---|---|---|---|
| **Major congenital anomaly** | **68 (54.8%)** | **62 (55.9%)** | **62 (57.4%)** | **64 (54.2%)** | **68 (58.1%)** | **59 (49.6%)** |
| Chromosomal disorders | 18 | 26 | 12 | 15 | 22 | 23 |
| Cardiovascular system | 9 | 10 | 9 | 7 | 8 | 7 |
| Central nervous system | 7 | 7 | 12 | 8 | 7 | 2 |
| Urinary tract | 11 | 4 | 7 | 8 | 8 | 12 |
| Multiple anomalies | 8 | 4 | 14 | 12 | 8 | 7 |
| Musculo-skeletal system | 6 | 3 | 4 | 3 | 1 | 2 |
| Respiratory system | 3 | 2 | 2 | 5 | 9 | 3 |
| Gastro-intestinal system | 0 | 1 | 0 | 0 | 1 | 0 |
| Metabolic disorders | 3 | 0 | 0 | 0 | 2 | 1 |
| Other major congenital anomaly | 3 | 5 | 2 | 6 | 2 | 2 |
| **Pre-viable (<22 weeks)** | **0(0%)** | **2(1.8%)** | **0(0%)** | **0(0%)** | **0(0%)** | **1(0.8%)** |
| **Respiratory disorders** | **36 (29.0%)** | **24 (21.6%)** | **25 (23.1%)** | **28 (23.7%)** | **25 (21.4%)** | **31 (26.1%)** |
| Severe pulmonary immaturity | 25 | 13 | 18 | 20 | 10 | 15 |
| Surfactant deficiency lung disease | 4 | 6 | 3 | 0 | 8 | 8 |
| Pulmonary hypoplasia | 5 | 3 | 2 | 3 | 3 | 4 |
| Primary persistent pulmonary hypertension | 0 | 0 | 1 | 1 | 1 | 1 |
| Meconium aspiration syndrome | 0 | 0 | 0 | 1 | 0 | 0 |
| Chronic lung disease/bronchopulmonary | 0 | 0 | 0 | 0 | 0 | 0 |
| Other respiratory disorder | 2 | 2 | 1 | 3 | 3 | 3 |
| **Gastro-intestinal disease** | **1 (0.8%)** | **4 (3.6%)** | **0 (0%)** | **1 (0.8%)** | **1 (0.9%)** | **1 (0.8%)** |
| Necrotising enterocolitis | 1 | 4 | 0 | 1 | 1 | 1 |
| Other gastro-intestinal disease | 0 | 0 | 0 | 0 | 0 | 0 |
| **Neurological disorder** | **8 (6.5%)** | **9 (8.1%)** | **13 (12%)** | **15 (12.7%)** | **17 (14.5%)** | **13 (10.9%)** |
| Hypoxic ischaemic encephalopathy | 5 | 6 | 7 | 9 | 15 | 3 |
| Intraventricular/periventricular haemorrhage | 3 | 3 | 6 | 6 | 2 | 10 |
| Other neurological disorder | 0 | 0 | 0 | 0 | 0 | 0 |
| **Infection** | **4 (3.2%)** | **1 (0.9%)** | **2 (1.9%)** | **2 (1.7%)** | **2 (1.7%)** | **5 (4.2%)** |
| Sepsis | 4 | 1 | 1 | 1 | 0 | 2 |
| Pneumonia | 0 | 0 | 1 | 0 | 0 | 1 |
| Meningitis | 0 | 0 | 0 | 0 | 0 | 0 |
| Other infection | 0 | 0 | 0 | 1 | 2 | 2 |
| **Other specific causes** | **2 (1.6%)** | **5 (4.5%)** | **1 (0.9%)** | **5 (4.2%)** | **0 (0%)** | **2 (1.7%)** |
| Malignancies/tumours | 0 | 0 | 0 | 0 | 0 | 0 |
| Other specific causes | 2 | 5 | 1 | 5 | 0 | 2 |
| **Sudden unexpected deaths** | **0 (0%)** | **1 (0.9%)** | **1 (0.9%)** | **0 (0%)** | **0 (0%)** | **0 (0%)** |
| Sudden infant death syndrome (SIDS) | 0 | 1 | 1 | 0 | 0 | 0 |
| Infant deaths - Cause unascertained | 0 | 0 | 0 | 0 | 0 | 0 |
| **Unexplained** | **5 (4.0%)** | **3 (2.7%)** | **4 (3.7%)** | **3 (2.5%)** | **4 (3.4%)** | **7 (5.9%)** |
| Pending post-mortem or other investigations | 5 | 2 | 3 | 2 | 4 | 7 |
| Antecedents or associated obstetric factors present | 0 | 1 | 1 | 0 | 0 | 0 |
| No antecedents or associated obstetric factors present | 0 | 0 | 0 | 1 | 0 | 0 |
| Very limited information available | 0 | 0 | 0 | 0 | 0 | 0 |

## 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 early neonatal period. In over forty per cent of these early neonatal deaths that occurred during 2021 (n=50 of 113, 44.2%, unknown for six cases) spontaneous respiratory activity was absent or ineffective at five minutes following delivery and, in a quarter, (n=29 of 115, 25.2%, unknown for four cases) the heart rate was persistently less than 100 beats per minute.

In 2021, active resuscitation was offered in the delivery room in over half of early neonatal deaths (n=68 of 116, 58.6%, unknown for three case). Of the early neonatal deaths not receiving resuscitation (n=48), the majority (n=36, 75.0%) were associated with a major congenital anomaly (Table 4.4). Most (n=10 of 11, 91.0%) early neonatal deaths born without major congenital anomaly and not offered resuscitation were delivered prematurely less than 27 weeks gestation (gestation unknown for one early neonatal death).

**Table 4.4: Early neonatal deaths due to major congenital anomaly not offered resuscitation, 2021**

| Gestation at delivery | Total early neonatal deaths not offered resuscitation N=47* N(%) | Death due to major congenital anomaly not offered resuscitation N=36 N(%) | Death without major congenital anomaly not offered resuscitation N=11 N(%) |
|---|---|---|---|
| < 22 wks | 1(2.1) | 0(0) | 1(9.1) |
| 22-27 wks | 12(25.5) | 3(8.3) | 9(81.8) |
| 28-31 wks | 7(14.9) | 7(19.4) | 0(0) |
| 32-36 wks | 14(29.8) | 14(38.9) | 0(0) |
| 37-41 wks | 13(27.7) | 12(33.3) | 1(9.1) |

Note: Values are N(%) unless otherwise stated. *Gestation at delivery unknown for one ENND.

In 2021, almost sixty percent of babies who died in the early neonatal period were admitted to a neonatal unit (n=70 of 118, 59.3%, unknown for one death) and fifteen percent (n=18 of 119, 15.1%) were transferred to another maternity or paediatric unit. Such admission and transfer depended on whether active resuscitation had been offered in the delivery room. All the neonatal deaths that were transferred to another maternity or paediatric unit were admitted to a neonatal unit (unknown for one case). Over ninety percent of the deaths that were admitted to a neonatal unit had active resuscitation offered in the delivery room (n=64 of 69, 92.8%, missing information for two cases; Table 4.5). Almost seventy percent of early neonatal deaths that were transferred to another maternity or paediatric unit had active resuscitation offered in the delivery room (n=11 of 16, 68.8%, unknown for one case).

**Table 4.5: Management at birth of babies who died within the first week of birth, 2021**

| | | Baby admitted to neonatal unit | | Baby transferred to another maternity or paediatric unit | |
|---|---|---|---|---|---|
| | | No N=47 N(%) | Yes N=69 N(%) | No N=100 N(%) | Yes N=16 N(%) |
| **Resuscitation** | No | 43(91.5) | 5(7.2) | 43(43) | 5(31.3) |
| | Yes | 4(8.5) | 64(92.8) | 57(57) | 11(68.8) |

Note: Values are N (%) unless otherwise stated. Active resuscitation in the delivery room includes BMV, PPV, intubation, cardiac massage. Data on active resuscitation and baby being transferred was unknown for two cases, respectively.

## Age of neonate at death

More than fifty-three percent of the early neonatal deaths occurred within 24 hours of delivery – 1 completed day (n=63, 53.4%, Table 4.6, unknown for one early neonatal death). Within this cohort, major congenital anomaly (n=38 of 63, 60.3%) and respiratory disorders (n=19 of 63, 30.2%), mainly severe pulmonary immaturity (n=12 of 19, 63.2%), were the main cause of death.

**Table 4.6: Age of neonate at death, 2021**

| Completed days | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Number | 63 | 12 | 13 | 8 | 9 | 9 | 4 | 3 |
| % | 53.4 | 10.2 | 11.0 | 6.8 | 7.6 | 7.6 | 3.4 | 2.6 |
| Cumulative % | 53.4 | 63.6 | 74.6 | 81.4 | 89.0 | 96.6 | 100.0 | 100.0 |

Note: Values are N(%) unless otherwise stated. Age of neonate at death was unknown for one case.

## Location of neonatal death

The vast majority of early neonatal deaths in 2021 occurred either in the neonatal unit, the labour ward, or in another maternity unit ward (Table 4.7). A very small proportion of deaths occurred in a paediatric centre or theatres.

**Table 4.7: Location of neonatal death, 2021**

| Place of death | N=119 N(%) |
|---|---|
| Neonatal Unit | 60(50.4) |
| Labour Ward | 32(26.9) |
| Ward of the maternity unit | 11(9.2) |
| Theatre | 4(3.4) |
| Paediatric Centre | 11(9.2) |
| At home* | 1(0.8) |

Note: Values are N(%) unless otherwise stated. *The baby who died at home was discharged from the maternity unit with a known major congenital anomaly.

All of the 32 neonatal deaths that occurred in the labour ward occurred within 24 hours of delivery (n=32). These 32 deaths in the labour ward accounted for over half of the neonatal deaths that occurred within the first day (i.e., <24 hours) of the birth (n=32 of 63, 50.8%). In 2021, of the 32 deaths in the labour ward that occurred within the first day, two resulted from a TOP (n=2 of 32, 6.3%).

A further 25.4% (n=16 of 63) of first day neonatal deaths occurred in a neonatal unit. As detailed in Table 4.6, the daily number of neonatal deaths was significantly lower once 24 hours had elapsed after delivery. The majority of the neonatal deaths that occurred between 1-7 completed days happened in a neonatal unit (Figure 4.4).

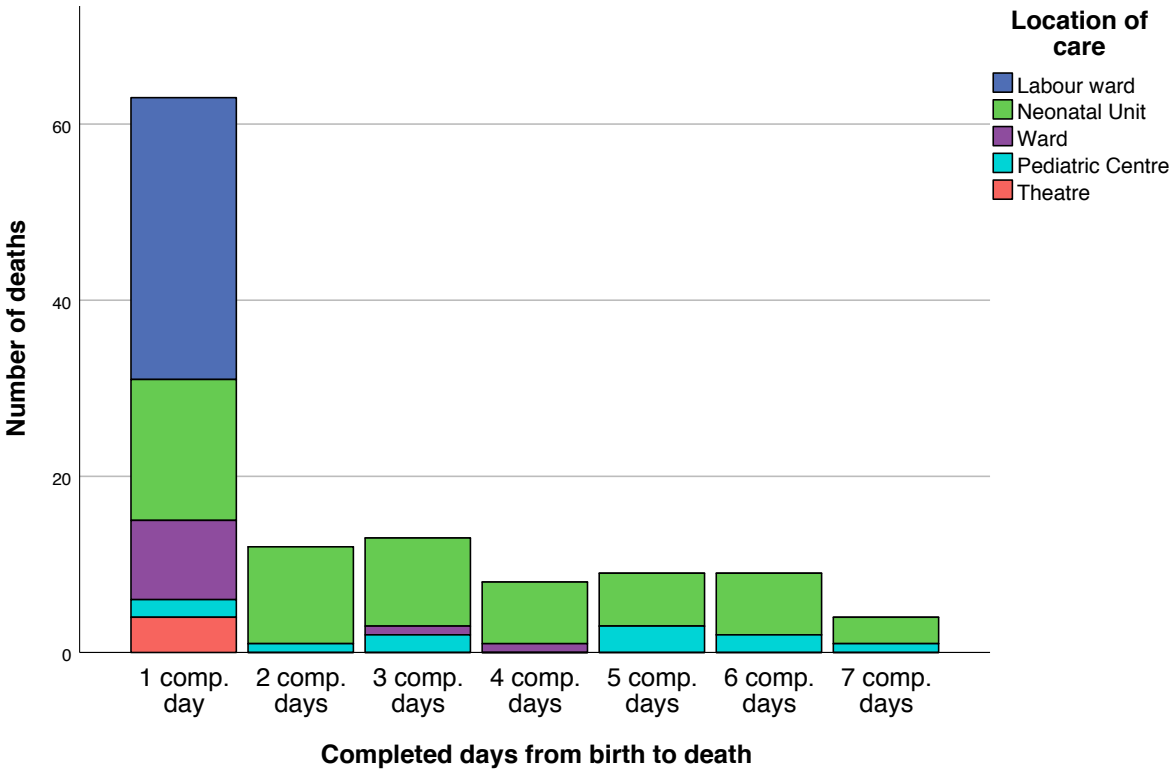



**Figure 4.4: Place of neonatal death 1-7 completed days after birth, 2021**

- **Recommendation:** A communication policy should be developed regarding neonatal outcomes in babies whose care has been transferred pre and post-delivery. This should ensure the flow of vital information between tertiary maternity units/ paediatric centres and the referring maternity unit that is essential to inform appropriate follow up care, including counselling of women experiencing perinatal loss. It is also necessary to inform clinical audit in the referring maternity unit. Owner: National Clinical Lead for Neonatology and NWIHP.

# 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.
As in previous reports, we reviewed perinatal deaths reported in 2021 focusing on cases with a gestational age of at least 34 weeks and a birthweight of at least 2,500g who were alive at the onset of care in labour and whose death was not due to major congenital anomaly or infection. Babies who were delivered by pre-labour caesarean section were not included.

In 2021, there were 17 cases of perinatal death with a gestational age of at least 34 weeks and a birthweight of at least 2,500g who were alive at the onset of care in labour (n=2 stillbirths and n=15 early neonatal deaths). Of the 15 early neonatal death cases, over seventy-three percent were due to due to major congenital anomaly (n=11 of 15, 73.3%). Two further cases of neonatal death were excluded from the cohort as death was due to infection (i.e., congenital pneumonia on a background of chorioamnionitis, n=1 and SARS-CoV-2 placentitis, n=1).

In total, there were four perinatal deaths (two stillbirths and two early neonatal deaths) associated with intrapartum events with a gestational age of at least 34 weeks and a birthweight of at least 2,500g who were alive at the onset of labour and whose death was not due to major congenital anomaly or infection. All of the four deaths were Coronial cases. In order to preserve confidentiality, limited details of the cases are outlined in Table 5.1 below.

**Table 5.1: Details of perinatal deaths in 2021 associated with intrapartum events**

| Type of perinatal death | Gestational age (range in weeks) | Birthweight centile | Main antecedent or obstetric factor associated with the death | Neonatal cause of death | Autopsy Performed |
|---|---|---|---|---|---|
| **SB** | 37-40 | 10th-49th | Uterine rupture during labour | n/a | Yes (Coroner case) |
| **SB** | 37-40 | 90th + | Fetal condition: congenital primary pleural effusions | n/a | Yes (Coroner case) |
| **ENND** | 37-40 | 10th-49th | Pending results from paediatric hospital | Pending reports from paediatric hospital | Unknown |
| **ENND** | 37-40 | 50th-89th | Difficult extraction of fetal head at Delivery<br>Pending post-mortem report | HIE<br>Pending post-mortem report | Yes (Coroner case) |

Note: SB=stillbirth; ENND=early neonatal death; HIE=hypoxic ischaemic encephalopathy.

# 6. Late neonatal deaths

## Key findings

1. There were 40 late neonatal deaths reported to the NPEC in 2021
2. Major congenital anomaly was the most cause of late neonatal death (32.5%) followed by Respiratory disorders (17.5%)
3. In contrast to previous reports, the proportion of late neonatal deaths was found to increase across the second and third weeks of life in 2021 (i.e., 42.5% in week two and 57.5% in week three).

For the purposes of this clinical audit, data were reported to the NPEC relating to 40 late neonatal deaths that occurred among babies born in 2021. This figure is in line with the numbers reported in previous years. On average, 33 late neonatal deaths per year were reported for 2014-2020 and the annual number ranged from 28 to 35. A higher number of late neonatal deaths were reported in 2021 (n=40) compared to previous years. The NPEC figures are similar but not identical to those reported by the Central Statistics Office (CSO). For 2015-2019, an average of 33 late neonatal deaths per year were reported by the CSO and the annual number ranged from 31 to 38. 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 collaborating with the NOCA National Paediatric Mortality Register (NPMR) to address this issue. It is envisaged that this will provide a validated, robust data source to inform the NPEC audit on late neonatal deaths.

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 occurring in 2021, according to the NPEC Neonatal Classification System.

Table 6.1 describes a range of characteristics of the babies who died in the late neonatal period. While values fluctuate from year to year, slightly more babies who died in the late neonatal period were male for the reporting years 2014 to 2018. This was not the case in 2019 and 2020 when slightly more babies who died in the late neonatal period were female (56.3% and 51.4%, respectively). In 2021, half of the babies were female, and half were male.

For the reporting year 2021, almost forty-three percent of the babies, who died in the late neonatal period, were born by vaginal cephalic delivery (n=17, 42.5%) and a similar number by pre-labour caesarean section (n=17, 42.5%). Most of the late neonatal death for 2021 had a gestational age between 22-27 weeks or 37-41 weeks at birth (n=17, 43.6% and n=11, 28.2%, respectively, unknown for one case). Seventy percent of the babies (n=28; 70.0%) had a birthweight less than 2,500 grams. Forty percent of babies were small for gestational age (SGA; <10th centile, n=16, 41.0%, centile unknown for one case).

In contrast to previous reports, the proportion of late neonatal deaths was found to increase across the second and third weeks of life in 2021 (i.e., 42.5% in week two and 57.5% in week three). For the reporting year 2020, half of the late neonatal death occurred in week two (51.4%). For 2019, the majority (75.0%) of late neonatal deaths occurred in week two and a further 12.5% of deaths occurred in both week three and week four.

Almost 53% percent of late neonatal deaths in 2021 occurred in the neonatal unit and almost forty-three percent died in a paediatric centre (n=21, 52.5% and n=17, 42.5%, respectively). This is similar to the late neonatal deaths in 2020, which more than half of them occurred in the neonatal unit, and around thirty percent died in a paediatric centre (n=19, 54.3% and n=12, 34.3%, respectively). The rising number of late neonatal deaths occurring in paediatric centres, coupled with the notification issues of late neonatal deaths to the NPEC perinatal mortality audit as previously discussed, highlight the need for good communication between the referring maternity units and paediatric centres, specifically in relation to cause of late neonatal death and autopsy uptake. Feedback from maternity units have indicated a need for improvement in communications with tertiary obstetric and paediatric units.

**Table 6.1: Characteristics of late neonatal deaths, 2016-2021**

| | 2016 N=33 N(%) | 2017 N=35 N(%) | 2018 N=30 N(%) | 2019 N=32 N(%) | 2020 N=35 N(%) | 2021 N=40 N(%) |
|---|---|---|---|---|---|---|
| **Infant sex** | | | | | | |
| Male | 19(57.6) | 18(51.4) | 18(60) | 14(43.8) | 17(48.6) | 20(50) |
| Female | 14(42.4) | 17(48.6) | 12(40) | 18(56.3) | 18(51.4) | 20(50) |
| **Mode of delivery** | | | | | | |
| Vaginal cephalic delivery | 11(33.3) | 13(37.1) | 12(40) | 10(31.3) | 11(31.4) | 17(42.5) |
| Vaginal breech delivery | 3(9.1) | 3(8.6) | 4(13.3) | 3(9.4) | 0(0) | 0(0) |
| Pre-labour caesarean section | 9(27.3) | 11(31.4) | 9(30) | 13(40.6) | 21(60) | 17(42.5) |
| Caesarean section after onset of labour | 6(18.2) | 6(17.1) | 4(13.3) | 3(9.4) | 3(8.6) | 3(7.5) |
| Forceps | 1(3) | 1(2.9) | 1(3.3) | 0(0) | 0(0) | 1(2.5) |
| Assisted breech | 2(6.1) | 0(0) | 0(0) | 2(6.3) | 0(0) | 0(0) |
| Ventouse | 1(3) | 1(2.9) | 0(0) | 1(3.1) | 0(0) | 2(5.0) |
| **Gestational age at delivery** | | | | | | |
| 22-27 weeks | 12(36.4) | 15(42.9) | 13(43.3) | 13(40.6) | 10(28.6) | 17(43.6) |
| 28-31 weeks | 3(9.1) | 3(8.6) | 5(16.7) | 1(3.1) | 6(17.1) | 5(12.8) |
| 32-36 weeks | 6(18.2) | 4(11.4) | 4(13.3) | 3(9.4) | 5(14.3) | 6(15.4) |
| 37-41 weeks | 12(36.4) | 13(37.1) | 8(26.7) | 15(46.9) | 14(40) | 11(28.2) |
| 42+ weeks | 0(0) | 0(0) | 0(0) | 0(0) | 0(0) | 0(0) |
| **Birthweight** | | | | | | |
| <500g | 1(3) | 0(0) | 2(6.7) | 2(6.3) | 0(0) | 0(0) |
| 500<1000g | 14(42.4) | 15(42.9) | 13(43.3) | 10(31.3) | 8(22.9) | 17(42.5) |
| 1000<1500g | 2(6.1) | 2(5.7) | 3(10) | 2(6.3) | 7(20) | 5(12.5) |
| 1500<2000g | 2(6.1) | 2(5.7) | 4(13.3) | 0(0) | 3(8.6) | 4(10) |
| 2000<2500g | 5(15.2) | 3(8.6) | 1(3.3) | 6(18.8) | 2(5.7) | 2(5) |
| 2500<3000g | 1(3) | 4(11.4) | 2(6.7) | 1(3.1) | 8(22.9) | 6(15) |
| 3000<3500g | 6(18.2) | 4(11.4) | 3(10) | 5(15.6) | 4(11.4) | 4(10) |
| 3500<4000g | 2(6.1) | 4(11.4) | 2(6.7) | 5(15.6) | 3(8.6) | 2(5) |
| 4000g+ | 0(0) | 1(2.9) | 0(0) | 1(3.1) | 0(0) | 0(0) |
| **Customised birthweight centile category** | | | | | | |
| <3rd | 10(30.3) | 7(20.0) | 10(33.3) | 6(18.8) | 12(34.3) | 9(23.1) |
| <10th* | 11(33.3) | 11(31.4) | 12(40) | 10(31.3) | 15(42.9) | 16(41) |
| 10-49th | 15(45.5) | 13(37.1) | 7(23.3) | 9(28.1) | 10(28.6) | 11(28.2) |
| 50-89th | 6(18.2) | 8(22.9) | 7(23.3) | 11(34.4) | 10(28.6) | 11(28.2) |
| 90th+ | 1(3) | 3(8.6) | 4(13.3) | 2(6.3) | 0(0) | 1(2.6) |
| **Timing of death** | | | | | | |
| 2nd week of life | 15(45.5) | 17(48.6) | 17(56.7) | 24(75) | 18(51.4) | 17(42.5) |
| 3rd week of life | 9(27.3) | 11(31.4) | 7(23.3) | 4(12.5) | 11(31.4) | 23(57.5) |
| 4th week of life | 9(27.3) | 7(20.0) | 6(20) | 4(12.5) | 6(17.1) | 0(0) |
| **Location of death** | | | | | | |
| Neonatal unit | 22(66.7) | 21(61.8) | 21(70) | 16(50) | 19(54.3) | 21(52.5) |
| Ward of the maternity unit | 1(3.0) | 0(0) | 0(0) | 1(3.1) | 1(2.9) | (0) |
| Paediatric centre | 7(21.2) | 10(29.4) | 5(16.7) | 13(40.6) | 12(34.3) | 17(42.5) |
| Home | 3(9.1) | 3(8.8) | 4(13.3) | 2(6.3) | 3(8.6) | 2(5) |
| In transit/home | 0(0) | 0(0) | 0(0) | 0(0) | 0(0) | 0(0) |

Note: Data was missing for the following variables: In 2017, place of death not known for one case; in 2021, gestation at delivery and centiles not known for one case each. *Includes cases from the category <3rd centile.

As shown in Table 6.2, major congenital anomaly was the most common cause of death in 2021 (n=13, 32.5%). The next most common causes were respiratory and neurological disorders, each disorder accounting for seven deaths (n=7, 17.5%, respectively). Other causes of death in 2021 included gastro-intestinal disorders (n=4, 10.0%), and infections (n=3, 7.5%). Sudden infant death syndrome accounted for two deaths (n=2, 5.0%). Three further deaths were unexplained pending post-mortem or other investigation (n=3, 7.5%).

**Table 6.2: Late neonatal main cause of death in 2016-2021, NPEC Classification System**

| | 2016 N=33 N(%) | 2017 N=35 N(%) | 2018 N=30 N(%) | 2019 N=32 N(%) | 2020 N=35 N(%) | 2021 N=40 N(%) |
|---|---|---|---|---|---|---|
| **Major congenital anomaly** | **15 (45.5%)** | **13 (37.1%)** | **12 (40.0%)** | **12 (37.5%)** | **18 (51.4%)** | **13 (32.5%)** |
| Central nervous system | 1 | 0 | 0 | 0 | 0 | 0 |
| Cardiovascular system | 2 | 5 | 3 | 5 | 5 | 3 |
| Respiratory system | 0 | 0 | 1 | 0 | 3 | 0 |
| Gastro-intestinal system | 1 | 0 | 0 | 0 | 1 | 0 |
| Musculo-skeletal system | 0 | 0 | 1 | 0 | 0 | 0 |
| Multiple anomalies | 2 | 2 | 0 | 0 | 1 | 4 |
| Chromosomal disorders | 1 | 0 | 6 | 2 | 4 | 4 |
| Metabolic disorders | 6 | 6 | 1 | 0 | 1 | 1 |
| Urinary tract | 1 | 0 | 0 | 1 | 1 | 0 |
| Other major congenital anomaly | 1 | 0 | 0 | 4 | 2 | 1 |
| **Respiratory disorders** | **10 (30.3%)** | **5 (14.3%)** | **3 (10.0%)** | **6 (18.8%)** | **1 (2.9%)** | **7 (17.5%)** |
| Severe pulmonary immaturity | 3 | 3 | 1 | 2 | 0 | 1 |
| Surfactant deficiency lung disease | 6 | 1 | 1 | 2 | 0 | 5 |
| Pulmonary hypoplasia | 0 | 0 | 0 | 0 | 0 | 0 |
| Meconium aspiration syndrome | 0 | 0 | 0 | 0 | 0 | 0 |
| Primary persistent pulmonary hypertension | 0 | 0 | 0 | 0 | 0 | 0 |
| Chronic lung disease/bronchopulmonary dysplasia | 0 | 0 | 0 | 0 | 0 | 0 |
| Other respiratory disorder | 1 | 1 | 1 | 2 | 1 | 1 |
| **Gastro-intestinal disease** | **3 (9.1%)** | **8 (22.9%)** | **5 (16.7%)** | **3 (9.4%)** | **4 (11.4%)** | **4 (10%)** |
| Necrotising enterocolitis | 3 | 7 | 4 | 3 | 4 | 4 |
| Other gastro-intestinal disease | 0 | 1 | 1 | 0 | 0 | 0 |
| **Neurological disorder** | **4 (12.1%)** | **5 (14.3%)** | **4 (13.3%)** | **3 (9.4%)** | **5 (14.3%)** | **7 (17.5%)** |
| Hypoxic-ischaemic encephalopathy | 3 | 5 | 1 | 2 | 4 | 2 |
| Intraventricular/periventricular haemorrhage | 1 | 0 | 3 | 1 | 0 | 5 |
| Other neurological disorder | 0 | 0 | 0 | 0 | 1 | 0 |
| **Infection** | **0 (0%)** | **1 (2.9%)** | **4 (13.3%)** | **3 (9.4%)** | **5 (14.3%)** | **3 (7.5%)** |
| Sepsis | 0 | 1 | 4 | 3 | 0 | 1 |
| Pneumonia | 0 | 0 | 0 | 0 | 0 | 0 |
| Meningitis | 0 | 0 | 0 | 0 | 0 | 0 |
| Other infection | 0 | 0 | 1 | 0 | 0 | 2 |
| **Injury/Trauma** | **0 (0%)** | **0 (0%)** | **0 (0%)** | **0 (0%)** | **0 (0%)** | **0 (0%)** |
| **Other specific causes** | **0 (0%)** | **0 (0%)** | **0 (0%)** | **1 (3.1%)** | **0 (0%)** | **1 (2.5%)** |
| Malignancies/tumours | 0 | 0 | 0 | 0 | 0 | 0 |
| Other specific cause | 0 | 0 | 0 | 1 | 0 | 0 |
| **Sudden unexpected deaths** | **1 (3.0%)** | **1 (2.9%)** | **1 (3.3%)** | **2 (6.3%)** | **1 (2.9%)** | **2 (5%)** |
| Sudden infant death syndrome (SIDS) | 1h | 1 | 1 | 2 | 1 | 2 |
| Infant Deaths - Cause Unascertained | 0 | 0 | 0 | 0 | 0 | 0 |
| **Unexplained** | **0 (0%)** | **2 (5.7%)** | **0 (0%)** | **2 (6.3%)** | **1 (2.9%)** | **3 (7.5%)** |
| No antecedents or associated obstetric factors | 0 | 0 | 0 | 0 | 0 | 0 |
| Antecedents or associated obstetric factors present | 0 | 0 | 0 | 0 | 0 | 0 |
| Very limited information available | 0 | 0 | 0 | 0 | 0 | 0 |
| Pending results of postmortem or other investigations | 0 | 2 | 0 | 2 | 1 | 3 |

# 7. Early neonatal deaths with a birthweight <500g and a gestational age at delivery <24 weeks

## Key findings

1. There were 47 early neonatal deaths with a birthweight < 500g and a gestational age at delivery < 24 weeks in 2021.
2. The majority (63.8%) of these babies delivered between 20 and 22 weeks gestation and one quarter (25.5%) delivered at less than 20 weeks gestation.
3. The assigned neonatal cause of death was pre-viable for the majority of cases (72.3%) followed by severe pulmonary immaturity (14.9%).

While not included in the calculation of perinatal mortality rates in the Republic of Ireland (ROI), we ask for notification of deaths in the early neonatal period of live born babies delivered before 24 weeks gestation and weighing less than 500g. The collation of this data on these perinatal events by the NPEC provides vital information surrounding adverse pregnancy outcomes in all registered live births in the ROI. For 2021, 47 such deaths were reported. Given the limited number of such deaths, a brief summary of the submitted NPEC audit data for 2021 is provided in Table 7.1.

For the reporting year 2021, the majority (n=30, 63.8%) of the 47 deaths occurred in babies delivered between 20- and 22-weeks' gestation, one quarter (n=12, 25.5%) delivered less than 20 weeks gestation, and five deaths occurred in babies after 22-weeks' gestation. The birthweights of babies born in 2021 were in the range of 75g to 485g. Details of the 47 early neonatal deaths born before 24 weeks gestation and weighing less than 500g are provided in Table 7.1.

Similar to previous reports, using the NPEC Neonatal Classification System, the assigned neonatal cause of death was pre-viable (<22 weeks) for the majority of cases in 2021 (n=34, 72.3%). The second most common neonatal cause of death was severe pulmonary immaturity (n=7, 14.9%) of which the majority were attributed to spontaneous premature labour (n=6, 85.7%). Fetal anomaly including central nervous system, urinary tract and chromosomal disorders accounted for five deaths (10.6%).

In 2021, all but two babies died within 24 hours of being delivered (n=45, 95.7%). More than half of the 45 babies who died within 24 hours died in another ward of the maternity unit (n=25, 55.6%) and almost 45% died in the labour ward (n=20 of 45, 44.4%). The location of death in 2021 of babies dying within 24 hours of delivery was very similar to that reported in 2020 (n=24, 53.3% for another ward, and n=20, 44.4% in the labour ward). This is in contrast to that reported in previous years (2013-2019) where the location of death in the vast majority of cases was the labour ward. Among the cases that died after 24 hours in 2021, the two babies died in the neonatal unit.

In 2021, an autopsy was performed in only a small number of cases (n=9, 19.1%). Among the cases where an autopsy was not performed (n=38, 80.9%), an autopsy was offered in almost 58% of the cases (n=22, 57.9%), not offered approximately 20% of them (n=12, 31.6%), and in the remainder four cases it was unknown if the autopsy was offered or not.

A recurrent issue, raised by maternity units, relates to the registration of live babies born before the age of viability. Correspondence from the General Registers Office (GRO) has confirmed the current legislation on registration of such births: if an infant is born with signs of life, regardless of birthweight

or gestational age at delivery, the birth is registered as a live birth and if the subsequent death of the infant occurs during the perinatal period, the death should then also be registered as a neonatal death.[67]

Ongoing communication between the NPEC and maternity units identified a need for clarification on two counts: (1) reportable perinatal deaths to the NPEC audit following termination of pregnancy (TOP), and (2) in light of recent guidelines on the resuscitation of normally formed babies at the cusp of viability, the calculation of perinatal mortality rates at unit level. In response to these queries, the NPEC disseminated a communique to all maternity units following communication with the NWIHP (see Appendix I). Briefly summarised, all perinatal deaths meeting the inclusion criteria for this audit and registerable with the Civil Registration System by law, should be notified to the NPEC perinatal mortality audit.

In the ROI, the legal definition of stillbirths is "a child born weighing 500 grammes or more or having a gestational age of 24 weeks or more who shows no sign of life".[68] This definition is not consistent with international definitions, which generally use the criterion of ≥ 22 weeks gestational age at delivery in the developed world.[69] This not only has economic and psychosocial ramifications but impacts on potential learning for clinicians and hampers robust international comparison.[70] As an initial step, perhaps, there is a need to align data collection on perinatal deaths with international findings. A review of current legal definitions of perinatal deaths in the ROI should also be considered.

According to the criteria used in this report of gestational age ≥24 weeks or birthweight ≥500g, there were 119 early neonatal deaths in 2021. There were nine early neonatal deaths of infants born from 22 weeks and less than 24 weeks gestation with a birthweight less than 500g in 2021. Therefore, applying the criteria of gestational age ≥22 weeks or birthweight ≥500g increases the number of early neonatal deaths by 7.0% (from 119 to 128).

**Recommendation:** Defining and auditing perinatal loss.

(a) To allow for international comparison of stillbirths, a move towards collecting data on fetal deaths >22 weeks and <24 weeks should be considered in the audit of perinatal mortality in Ireland.

(b) A national working group should be convened to review the definition of perinatal mortality in the Republic of Ireland (ROI). This working group should include the NWIHP, NPEC, the General Registers Office (GRO), the Institute of Obstetrics and Gynaecology, the National Clinical Programme for Paediatrics and Neonatology and the Department of Health. Owner; the NPEC.

**Progress:** A national working group, including the relevant stakeholders and patient representation, has been established to address this with an initial meeting due to convene in October 2023.

[65] Smith B, Assistant Registrar General 2016, personal communication, 12th October

[66] Stillbirth Registration Act, 1994. Available at: https://www.irishstatutebook.ie/eli/1994/act/1/enacted/en/print#sec2

[67] Kelly K et al. A review of stillbirth definitions: A rationale for change. European Journal of Obstetrics & Gynaecology and Reproductive Health. 256 (2021) 235-245

[68] LK Smith et al. Producing valid statistics when legislation, culture and medical practices differ for births at or before the threshold of survival: report of a European workshop. BJOG (2019). DOI: 10.1111/1471-0528.15971. Available at: www.bjog.org

**Table 7.1: Early neonatal deaths in 2021 with a birthweight <500g and a gestational age at delivery <24 weeks**

| Gestational age (weeks) | Birth Weight | Location of death | Cause of neonatal death | Autopsy | Coroner Case (Yes/No) |
|---|---|---|---|---|---|
| 16 | 133 | Ward | Pre-viable (<22 weeks) | Autopsy not performed and not offered | No |
| 16 | 75 | Labour ward | Chromosomal disorders | No autopsy performed but unknown if offered | No |
| 17 | 193 | Ward | Pre-viable (<22 weeks) | Autopsy not performed and not offered | No |
| 18 | 160 | Ward | Pre-viable (<22 weeks) | Autopsy performed | No |
| 19 | 280 | Ward | Pre-viable (<22 weeks) | Autopsy not performed but offered | No |
| 19 | 247 | Labour ward | Pre-viable (<22 weeks) | No autopsy performed but unknown if offered | No |
| 19 | 234 | Labour ward | Pre-viable (<22 weeks) | Autopsy not performed but offered | No |
| 19 | 310 | Ward | Pre-viable (<22 weeks) | Autopsy not performed but offered | No |
| 19 | 240 | Ward | Pre-viable (<22 weeks) | Autopsy not performed but offered | No |
| 19 | 280 | Labour ward | Pre-viable (<22 weeks) | Autopsy not performed and not offered | No |
| 19 | 211 | Labour ward | Chromosomal disorders | No autopsy performed but unknown if offered | No |
| 19 | 100 | Ward | Pre-viable (<22 weeks) | No autopsy performed but unknown if offered | No |
| 20 | 280 | Ward | Pre-viable (<22 weeks) | Autopsy not performed and not offered | No |
| 20 | 410 | Labour ward | Pre-viable (<22 weeks) | Autopsy not performed but offered | No |
| 20 | 278 | Ward | Pre-viable (<22 weeks) | Autopsy not performed and not offered | No |
| 20 | 280 | Ward | Pre-viable (<22 weeks) | Autopsy performed | No |
| 20 | 360 | Ward | Urinary tract | Autopsy performed | No |
| 20 | 330 | Ward | Pre-viable (<22 weeks) | Autopsy not performed but offered | No |
| 20 | 420 | Labour ward | Pre-viable (<22 weeks) | Autopsy performed | No |
| 20 | 330 | Labour ward | Pre-viable (<22 weeks) | Autopsy performed | No |
| 21 | 425 | Labour ward | Pre-viable (<22 weeks) | Autopsy not performed but offered | No |
| 21 | 330 | Ward | Pre-viable (<22 weeks) | Autopsy not performed but offered | No |
| 21 | 345 | Labour ward | Pre-viable (<22 weeks) | Autopsy not performed and not offered | No |
| 21 | 450 | Labour ward | Pre-viable (<22 weeks) | Autopsy not performed and not offered | No |
| 21 | 420 | Ward | Pre-viable (<22 weeks) | Autopsy performed | No |
| 21 | 390 | Ward | Pre-viable (<22 weeks) | Autopsy not performed and not offered | No |
| 21 | 350 | Ward | Pre-viable (<22 weeks) | Autopsy not performed and not offered | No |
| 21 | 356 | Ward | Pre-viable (<22 weeks) | Autopsy not performed and not offered | No |
| 21 | 280 | Labour ward | Pre-viable (<22 weeks) | Autopsy not performed and not offered | No |
| 21 | 329 | Ward | Pre-viable (<22 weeks) | Autopsy performed | No |
| 21 | 390 | Labour ward | Pre-viable (<22 weeks) | Autopsy performed | No |
| 21 | 360 | Labour ward | Pre-viable (<22 weeks) | Autopsy not performed but offered | No |
| 21 | 440 | Ward | Severe pulmonary immaturity | Autopsy not performed but offered | No |
| 21 | 350 | Ward | Chromosomal disorders | Autopsy not performed but offered | No |
| 21 | 445 | Labour ward | Pre-viable (<22 weeks) | Autopsy not performed but offered | No |
| 21 | 400 | Labour ward | Pre-viable (<22 weeks) | Autopsy not performed but offered | No |
| 21 | 420 | Ward | Pre-viable (<22 weeks) | Autopsy not performed but offered | No |
| 21 | 417 | Ward | Pre-viable (<22 weeks) | Autopsy not performed but offered | No |
| 22 | 476 | Ward | Pre-viable (<22 weeks) | Autopsy not performed but offered | No |
| 22 | 410 | Labour ward | Severe pulmonary immaturity | Autopsy not performed but offered | No |
| 22 | 480 | Labour ward | Severe pulmonary immaturity | Autopsy not performed but offered | No |
| 22 | 445 | Ward | Severe pulmonary immaturity | Autopsy performed | No |
| 23 | 420 | Labour ward | Severe pulmonary immaturity | Autopsy not performed but offered | No |
| 23 | 480 | Labour ward | Severe pulmonary immaturity | Autopsy not performed but offered | No |
| 23 | 485 | Neonatal Unit | Other respiratory disorder | Autopsy not performed and not offered | No |
| 23 | 310 | Ward | Central nervous system | Autopsy not performed but offered | No |
| 23 | 400 | Neonatal Unit | Severe pulmonary immaturity | Autopsy not performed but offered | No |

# In summary

The PMR was 5.87 per 1,000 total births in 2021.

Corrected for Major Congenital Anomaly (MCA), the PMR was 3.78 per 1,000 live births in 2021. In 2021, a slight decrease in the PMR is observed, but it is not statistically significant compared to previous years 2020 and 2019.

In contrast with previous years, specific placental conditions were the most common cause of death in stillbirths in 2021 followed by MCA. However, MCA was the most common cause of neonatal death followed by severe pulmonary immaturity.

Similar to previous NPEC perinatal mortality reports, small for gestational age (SGA) babies at delivery were associated with perinatal deaths, particularly stillbirths. This highlights the need for a standardised approach to improve antenatal detection of fetal growth restriction (FGR) as recommended in this report.

Recommendations in previous NPEC perinatal mortality reports have been progressed by the NWIHP. This highlights the value of on-going PM audit to identify quality improvement initiatives to improve care of the women and babies in the Irish maternity services.

To allow for international comparison of stillbirths, maternity services should move to collecting data on fetal deaths >22 weeks and <24 weeks for the audit of perinatal mortality in Ireland.

The establishment of a confidential review for stillbirths and neonatal deaths should be considered in order to enhance the learning to assist better care. This could take the format of a standardised review of specific cohorts, such as:

Unexpected intrapartum related deaths

Multiple pregnancies

Term stillbirths (in normally formed babies)

These cohorts could be reviewed on a rolling basis.

# **Appendix A:** Hospital Co-ordinators and Contributors 2021

| Hospital | Co-ordinators | Additional contributors |
|---|---|---|
| **Cavan General Hospital** | Ms Louise Dempsey | Ms Karen Malocca |
| **Coombe Women and Infants University Hospital, Dublin** | Ms Julie Sloan | |
| **Cork University Maternity Hospital** | Ms Claire Everard | Prof Keelin O'Donoghue |
| | | Ms Loritta Munyimani |
| | Prof Gene Dempsey | Neonatology team |
| **University Hospital Kerry** | Ms Mary Stack Courtney | |
| **Letterkenny University Hospital** | Ms Mary Lynch | Ms Evelyn Smith |
| | | Ms Marion Doogan |
| | | Ms Lorna Sweeney |
| **Mayo University Hospital** | Ms Kathy Rava | Dr Hilary Ikele |
| **Regional Hospital Mullingar** | Ms Marie Corbett | |
| | Ms Kathryn Woods | |
| **Midland Regional Hospital Portlaoise** | Ms Emma Mullins | Ms Ita Kinsella |
| **University Maternity Hospital Limerick** | Ms Deirdre O'Connell | Dr Roy Philip |
| | Ms Bernadette Toolan | |
| **National Maternity Hospital, Dublin** | Ms Fionnuala Byrne | Dr Eoghan Mooney |
| | | Dr Lisa McCarthy |
| **Our Lady of Lourdes Hospital, Drogheda** | Ms Aine McArdle | |
| **Portiuncula University Hospital** | Ms Sheila Melvin | |
| **Rotunda Hospital, Dublin** | Ms Ruth Ritchie | |
| **Sligo University Hospital** | Ms Geraldine O'Brien | Ms Juliana Henry |
| **Tipperary University Hospital** | Ms Carol Dunne | |
| **St Luke's Hospital, Kilkenny** | Ms Kayla Thornton | |
| | Ms Margaret Ryan | |
| **University Hospital Galway** | Ms Clare Greaney | |
| **University Hospital Waterford** | Ms Jill Whelan | Ms Paula Curtain |
| **Wexford General Hospital** | Ms Irene Brennan | |

# **Appendix B:** Perinatal Mortality Group Membership


**Perinatal Mortality National Clinical Audit**
**Governance Group**

**Prof Richard Greene**, Consultant Obstetrician & Gynaecologist, Cork University Maternity Hospital
Chair, Director of the National Perinatal Epidemiology Centre

**Paul Corcoran PhD**, Senior Lecturer in Perinatal Epidemiology, National Perinatal Epidemiology Centre
National Perinatal Epidemiology Centre contributor

**Dr Emma Doyle**, Consultant Histopathologist, Rotunda Hospital, Dublin
Nominated by the Faculty of Pathology, RCPI

**Juliana Henry**, Director of Midwifery, Sligo University
Nominated by National Lead Midwife at NWIHP

**Edel Manning**, Research Midwife, National Perinatal Epidemiology Centre
Perinatal Mortality Project Manager

**Ann McIntyre**, Director of Midwifery, Coombe Women and Infant University Hospital
Nominated by National Lead Midwife at NWIHP

**Professor John Morrison**, Consultant Obstetrician & Gynaecologist, University Hospital Galway
Nominated by the Institute of Obstetricians & Gynaecologists, RCPI

**Professor Keelin O'Donoghue**, Consultant Obstetrician & Gynaecologist, Cork University Maternity Hospital Nominated by the Institute of Obstetricians & Gynaecologists, RCPI

**Padraig Ruane,** Advocacy Team Leader, Patient Advocacy Service

**Dr Anne Twomey**, Consultant Neonatologist, National Maternity Hospital
Nominated by the Faculty of Paediatrics, RCPI

**Siobhan Whelan**, Patient Representative

**Awaiting nominations*

*Faculty of Paediatrics, RCPI*

NATIONAL PERINATAL EPIDEMIOLOGY CENTRE

# NPEC Governance Committee Members

**Chair: Dr. Michael Robson**, Consultant Obstetrician and Gynaecologist, National Maternity Hospital

**Dr Linda Biesty,** Senior lecturer in Midwifery at the School of Nursing & Midwifery, **University of Galway**

**Marie Cregan**, Patient Representative, University College Cork

**Georgina Cruise,** Patient Representative, Patient Advocacy Service

**Marina Cronin,** NOCA Head of Quality & Development, National Office of Clinical Audit

**Professor Sean Daly,** Master, The Rotunda Hospital

**Angela Dunne,** National Lead Midwife, National and Infants Health Programme (NWIHP)

**Faye Ferris,** Student Midwifery Representative

**Dr. Geraldine Gaffney**, Senior Lecturer, National University of Ireland, Galway

**Professor Richard Greene**, Consultant Obstetrician & Gynaecologist, Cork University Maternity Hospital, Director of the National Perinatal Epidemiology Centre

**Professor Shane Higgins,** Master, The National Maternity Hospital

**Dr. Heather Langan**, Consultant Obstetrician and Gynaecologist, Sligo General Hospital

**Professor Eleanor Molloy**, Professor of Paediatrics & Child Health, TCD, Faculty of Paediatrics Representative

**Dr Cliona Murphy,** Clinical Director, National and Infants Health Programme (NWIHP)

**Denise Malone/ Ms Jo Delaney co-**chairs of the national Designated Midwifery Officer Group - Home Births

**Lilian Mudoti,** Post Grad Student, Midwifery Representative

**Dr Oladayo Oduola,** JOGS Committee Member

**Dr Michael O'Connell,** Master, Coombe Women & Infants University Hospital

**Dr. Mary O'Mahony**, Specialist in Public Health Medicine, HSE

**Margaret Quigley**, National Lead for Midwifery ONMSD, HSE

# **Appendix D:** National Office of Clinical Audit (NOCA) endorsement of the Perinatal Mortality in Ireland Annual Report 2021

NOCA National Office of Clinical Audit

Prof Richard Greene,
Director,
National Perinatal Epidemiology Centre (NPEC),
5th Floor, Cork University Maternity Hospital,
Wilton,
Cork.

07/11/2023

Dear Prof Greene,

I wish to acknowledge receipt of the Perinatal Mortality National Clinical Audit in Ireland Annual Report 2021. I congratulate all involved in developing this report- teams across the maternity units, the NPEC audit team and the governance committee. This tenth report provides excellent information on perinatal mortality, and a more detailed exploration of stillbirths by means of an invited commentary. Following your presentation to the NOCA Quality Assurance Committee on the 03 November, 2023 we are delighted to endorse this report.

Yours sincerely,

**Dr Brian Creedon**
**Clinical Director**
**National Office of Clinical Audit**

National Office of Clinical Audit
2nd Floor
Ardilaun House, Block B
111 St Stephen's Green
Dublin 2, D02 VN51
Tel: + (353) 1 402 8577
Email: auditinfo@noca.ie

# **Appendix E:** Terminology for placental pathology

| Pathology category | Specific placental findings |
|---|---|
| **Maternal vascular malperfusion** | Refers to the spectrum of findings related to shallow implantation of the placenta, often found in conjunction with PET and IUGR and often called utero placental insufficiency. Placental findings that enable this category to be applied are:<br>**distal villous hypoplasia**<br>**accelerated villous maturation**<br>**ischaemic villous crowding**<br>**placental infarction**<br>**retroplacental haemorrhage**<br>**placental hypoplasia** |
| **Fetal vascular malperfusion** | Refers to thrombosis or decreased flow in the fetal circulation. It may be difficult to distinguish arteries from veins in the placenta and pathology may be present in both. Findings consistent with fetal vascular malperfusion are:<br>**patchy hypoperfusion**<br>**villous stromal-vascular karyorrhexis**<br>**scattered avascular villi**<br>**thrombosis in fetal circulation**<br>**fetal thrombotic vasculopathy / extensive avascular villi** |
| **Cord pathology** | Cord pathology may exist by itself, or may be accompanied by evidence of other disease. The findings of cord pathology include:<br>**hypercoiled cord** (Umbilical coiling index (UCI) of ≥ 0.3)<br>**cord stricture**<br>**hypocoiled cord** (UCI < 0.1)<br>**meconium associated vascular necrosis**<br>**velamentous or marginal (<10mm) cord insertion**<br>**Other** |
| **Delayed villous maturation** | Delayed villous maturation is the recommended term instead of **distal villous immaturity, placental maturation defect or villous maturation defect.** |
| **Chorioamnionitis** | The maternal and fetal inflammatory response should be staged and graded where possible. |
| **Villitis** | The term is used to mean villitis of unknown aetiology and assumes that the reporting pathologist has excluded infection where appropriate. Villitis is graded as either low grade or high grade and can occur with stem vessel obliteration. |
| **Other** | |

Note: More than one placental category may be present.

Khong TY, Mooney EE et al: Sampling and definition of placental lesions. Arch Pathol Lab Med, 2016 Jul;140(7):698-713

# **Appendix F:** Cause of Death Guidance and Definitions

Appendix F

NPEC Maternal and Fetal Classification System: definitions.

**STILLBIRTHS AND NEONATAL DEATHS**

| DEFINITION OF TERMS | Subcategory |
|---|---|
| **MAJOR CONGENITAL ANOMALY**<br>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 |
| **HYPERTENSIVE DISORDERS OF PREGNANCY** | Pregnancy induced hypertension<br>Pre-eclampsia<br>HELLP syndrome<br>Eclampsia |
| **ANTEPARTUM OR INTRAPARTUM HAEMORRHAGE**<br>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 |
| **MECHANICAL.**<br>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>Prolapsecord<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** |
| **MATERNAL DISORDER.**<br>Specify hypertensive disease present before pregnancy or any other maternal disease or condition sufficient to jeopardise the baby such as diabetes, cardiac disease etc. 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 /<br>Other |
| **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 |

1

| | |
|---|---|
| **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 |
| **SPECIFIC PLACENTAL CONDITIONS.** Specific placental conditions sufficient to cause death or be associated with fetal compromise such as IUGR. Cord problems associated with compression will normally be classified under 'Mechanical'**.** | Chorioamnionitis<br>Fetal vasculitis<br>Maternal vascular malperfusion<br>Fetal vascular malperfusion<br>Cord pathology<br>Other |
| **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 |
| **ASSOCIATED OBSTETRIC FACTORS.** Factors recorded as Other Associated Obstetric Factors will be important clinical or pathological features of the pregnancy or baby but may 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 |
| **NO ANTECEDENT OR ASSOCIATED OBSTETRIC FACTORS.** Deaths with no explanation or significant associated factor. | |
| **UNCLASSIFIED.** Cases where little or nothing is known about pregnancy or delivery and which cannot be fitted into any of the above categories**.**<br>**Use as sparingly as possible**. | |

NPEC Neonatal Classification System: definitions.
(**NEONATAL DEATH ONLY**)

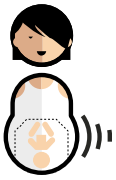
| DEFINITION OF TERMS | Subcategory |
|---|---|
| **MAJOR CONGENITAL ANOMALY**<br>Any genetic or structural defect arising at **conception or during embryogenesis** incompatible with life or potentially treatable but causing death. | Central nervous system<br>Cardiovascular system<br>Respiratory system<br>Gastro-intestinal system<br>Musculo-skeletal system<br>Multiple anomalies<br>Chromosomal disorders<br>Metabolic disorders<br>Urinary tract<br>Other |
| **PRE-VIABLE**<br>Babies (less than 22 weeks) who are non-viable at birth because of gestation but who show signs of life. | |
| **RESPIRATORY DISORDERS**<br>Severe pulmonary immaturity will encompass those babies where structural lung immaturity is so gross as to mean ventilatory support is unsustainable at the outset. Surfactant Deficient Lung Disease may include babies with clinical or pathological evidence of hyaline membrane disease.<br>Please note that neonatal deaths previously attributed to prematurity, would most often be captured under the subcategory of 'severe pulmonary immaturity'. | 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**<br>Many babies with NEC will have associated sepsis which may be given as a secondary cause. | Necrotising enterocolitis (NEC)<br>Other |
| **NEUROLOGICAL DISORDER**<br>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**<br>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**<br>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**<br>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.**<br>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**.**<br><br>**Please use this category as sparingly as possible.** | |

# **Appendix G:** The Robson Ten Group Classification System

## The 10 groups of the Robson Classification [35]

GROUP 1

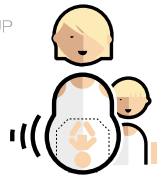


Nulliparous women with a single cephalic pregnancy, ≥37 weeks gestation in spontaneous labour

GROUP 2

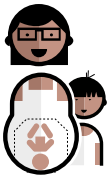
Nulliparous women with a single cephalic pregnancy, ≥37 weeks gestation who either had labour induced or were delivered by caesarean section before labour

GROUP 3



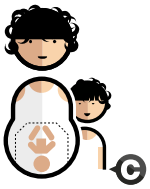
Multiparous women without a previous uterine scar, with a single cephalic pregnancy, ≥37 weeks gestation in spontaneous labour

GROUP 4



Multiparous women without a previous uterine scar, with a single cephalic pregnancy, ≥37 weeks gestation who either had labour induced or were delivered by caesarean section before labour

GROUP 5



All multiparous women with at least one previous uterine scar, with a single cephalic pregnancy, ≥37 weeks gestation

GROUP 6

All nulliparous women with a single breech pregnancy

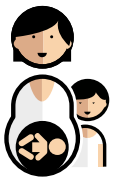
GROUP 7

All multiparous women with a single breech pregnancy, including women with previous uterine scars

GROUP 8

All women with multiple pregnancies, including women with previous uterine scars

GROUP 9



All women with a single pregnancy with a transverse or oblique lie, including women with previous uterine scars

GROUP 10

All women with a single cephalic pregnancy <37weeks gestation, including women with previous scars

35 Robson Classification: Implementation Manual. Geneva: World Health Organization; 2017. Licence: CCBY-NC-SA3.0IGO.

NATIONAL PERINATAL EPIDEMIOLOGY CENTRE

**Data Quality Statement**
**Perinatal Mortality National Clinical Audit**

# Appendix H: Data Quality Statement for the PMNCA

**Reference Number:** NPEC-DQS-NCAoPM-01.18

**Revision Number:** 01

**Author:** National Perinatal Epidemiology Centre

**Approved by:** Richard Greene, Director, National Perinatal Epidemiology Centre

**Effective from:** March 2019

**Review date:** March 2022

**Signatures of all parties responsible**

Richard A Greene, Director,
National Perinatal Epidemiology Centre

NATIONAL PERINATAL EPIDEMIOLOGY CENTRE

# Data Quality Statement
# Perinatal Mortality National Clinical Audit

## 1.0 Introduction

Perinatal mortality is a significant measure of obstetric and neonatal care. Regular audit of perinatal mortality (e.g. stillbirths, neonatal deaths, among other) may identify modifiable risk factors which decrease the risk of perinatal mortality and which inform clinical practise. The NPEC has provided an annual national assessment of perinatal mortality in Ireland from a clinical viewpoint since 2008. It has done so with the guidance and collaboration of the PMNCAGG, a specialist multidisciplinary group, having the aim to develop a comprehensive national clinical audit system of perinatal mortality in Ireland.

## 2.0 Data collection for the Perinatal Mortality National Clinical Audit (PMNCA)

Data on perinatal deaths from births that occurred between January 1 of each year and December 31 of the same year are pseudonymised and submitted to the NPEC by all 19 units using a standardised notification dataset either electronically, via the secure online NPEC database, or alternatively by paper format. The notification dataset is completed using data on fetal and maternal characteristics recorded in the clinical records. Implemented nationally in 2011, the NPEC notification dataset was based on the validated Centre for Maternal and Child Enquiries (CMACE) Perinatal Death Notification Form and has been endorsed by the Clinical Advisory Group at the Institute of Obstetrics and Gynaecology, the Faculty of Paediatrics and the HSE National Obstetric Programme Working Group.

## 3.0 Dimensions of data quality for the Perinatal Mortality National Clinical Audit

The quality of data is defined and assessed here using the internationally accepted dimensions recommended by HIQA:

1. Relevance
2. Accuracy and reliability
3. Timeliness and punctuality
4. Coherence and comparability
5. Accessibility and clarity

## 3.1 Relevance

Processes are in place to regularly monitor the relevance and use of existing data in meeting the needs of data users and other stakeholders. Regular consultation with data users and other stakeholders is undertaken. These are structured consultation activities focussing on the content and the quality of the data collected, the outcomes, continuous operational improvements, future direction, and potential needs.

NATIONAL PERINATAL EPIDEMIOLOGY CENTRE

# Data Quality Statement
# Perinatal Mortality National Clinical Audit

## 3.2 Accuracy and reliability

The population of reference is explicitly stated in all releases. Coverage rates are documented. Internal procedures and guidelines for data quality assessment exist and include data cleaning and validation procedures regarding data submitted through both the online and paper formats. The NPEC online database incorporates a suite of validation checks for accuracy. Data cleaning and correction processes are consistently applied: these include checks on the structure and integrity of the data, checks for missing data, checks that the data conforms to data source specifications and checks for outliers.

## 3.3 Timeliness and punctuality

The NPEC works closely with its data providers to ensure timely submission of data. The NPEC makes data providers aware of submission dates, nevertheless, data collection is done by staff without specific protected time for this purpose. Thus, at times, an extension of the submission dates may be required to allow submission of complete and accurate data.
Planned releases occur within a reasonable period from the end of the reference period. Currently within 18 months of year end of the year under audit, in line with current guidelines.

## 3.4 Coherence and comparability

Assessments of compliance with terminology standards are regularly undertaken to ensure the data collection is compliant with international and national standards, including clinical guidelines and current best practice.

## 3.5 Accessibility and clarity

The Annual Report for the PMNCA, its related lay summary and applied data collection forms are publicly available on the NPEC website:

https://www.ucc.ie/en/npec/npec-clinical-audits/perinatalmortality/

Research output from the audit is catalogued according to individual staff members and publicly available on IRIS, ResearchGate, LinkedIn or other research information systems. Methodologies are outlined in all published outputs.

NATIONAL PERINATAL EPIDEMIOLOGY CENTRE

## Data Quality Statement
## Perinatal Mortality National Clinical Audit

The NPEC operates a Data Access Policy in which clear policies and procedures are outlined for data users in relation to the process of accessing and requesting data.

## 4.0 Further information on the Perinatal Mortality National Clinical Audit

Further information on the NPEC's Perinatal Mortality National Clinical Audit can be found at:

https://www.ucc.ie/en/npec/npec-clinical-audits/perinatalmortality/

Alternatively, please contact us at:

**npec@ucc.ie**

or

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# **Appendix I:** NPEC letter to units

NATIONAL PERINATAL EPIDEMIOLOGY CENTRE

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Professor R.A. Greene, MB, MRCOG, MRC
Director

15th March 2021

Dear Colleagues,

Regarding the National Perinatal Epidemiology Centre (NPEC) audit on Perinatal Mortality

Firstly, I would like to thank all units for your on-going commitment to submit perinatal mortality (PM) data to the NPEC. Following recent enquiries, I would like to take this opportunity to clarify definitions and inclusion criteria for this PM audit.

The inclusion criteria for the PM audit are all perinatal mortality deaths (stillbirths and neonatal deaths) that are required by law to be registered in the Irish Civil Registration Service. Definitions are as follows:

**Stillbirth:** Baby delivered without signs of life from 24 weeks gestation or with a birthweight ≥500g.[1]

**Neonatal death:** Death of a live born baby, regardless of birth weight or gestational age at time of delivery, occurring in the perinatal period.[2] The NPEC audit all neonatal deaths occurring within 28 completed days of birth.

As in previous years, the NPEC calculate the perinatal mortality rate (PMR), both nationally and at unit level, based on the number of stillbirths and neonatal deaths per 1,000 births, who delivered from 24weeks or had a birthweight ≥ 500g. A perinatal death is assigned to the unit where the baby delivered, regardless of place of death.

Neonatal deaths occurring in babies with a birthweight < 500g and delivered before 24 weeks are not included in the PMR. However, the collation of data on these perinatal events by the NPEC provides vital information surrounding adverse pregnancy outcomes in all registered live births.

[1] Stillbirths Registration Act, 1994.
[2] Smith B, Office of the Registrar General, (2016) Letter to NPEC, 12/10/2016

Recently, a specific issue has been raised with the NPEC regarding the reporting of perinatal deaths following termination of pregnancy (TOP). In such cases, if the delivered baby meets the criteria for a registered stillbirth or live born, as previously outlined, then that case should be reported to the NPEC audit. Since the inception of the PM audit, and going forward, a question in the NPEC dataset identifies if the birth occurred following a TOP.

Whether the indication for TOP is fatal fetal abnormality or in the interest of maternal health (before viability), if the birth falls within the definition of stillbirth or live birth (a small number of babies terminated before viability may show signs of life at birth), then that baby should be registered in the Civil Registration Service. These babies should be included in the unit's overall PMR (if delivered from 24 weeks or with a birth weight ≥ 500g).

It must be noted that the afore mentioned advice on definitions of perinatal deaths and calculation of PMR does not refer to the clinical viability of the fetus. A recent guidance document recommends a change in the threshold of fetal viability in Ireland from 24+0 weeks to 23+0 weeks gestation. Perinatal management and the provision of care to mothers and infants at extreme preterm births (gestation 23+0 – 24+6 weeks) should take into consideration all confounding clinical factors. [3]

I hope this clarifies any queries that may arise around this topic. Again, I would like to thank all units for your ongoing support. It is gratifying that the maternity services in Ireland, through the NPEC, are collecting data that can influence and improve patient care

Kind regards,

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Professor Richard Greene
Director

[3] Perinatal Management of Extreme Preterm Birth at the Threshold of Viability
A Framework for Practice (2020): The Clinical Programme in Neonatology, The Neonatal Clinical Advisory Group, The Faculty of Paediatrics, Institute of Obstetrics and Gynaecology and the National Women and Infants Health Programme. Available at: https://www.hse.ie/eng/about/who/cspd/ncps/paediatrics-neonatology/resources/perinatal-management-of-extreme-preterm-birth-at-the-threshold-of-viability.pdf

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