NATIONAL PERINATAL
EPIDEMIOLOGY CENTRE

Perinatal Mortality National Clinical Audit in Ireland

Annual Report 2022

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NATIONAL PERINATAL
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List of Acronyms and Abbreviations

BBA: Born Before Arrival

BMI: Body Mass Index

CMACE: Centre for Maternal and Child Enquiries

ENND: Early neonatal death

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

ICU: Intensive Care Unit

IOG: Institute of Obstetricians and Gynaecologists

IUGR: Intra-Uterine Growth Restriction

LNND: Late neonatal death

LSCS: Lower Segment Caesarean Section

MCA: Major Congenital Anomaly

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

MECC: Making Every Contact Count

NaPro: Natural Procreative Technology

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

SB: Stillbirth

SGA: Small for Gestational Age

TGCS: Robson Ten Group Classification System

TOP: Termination of Pregnancy

TOW: Term Optimal Weight

Foreword

Welcome to the 2022 Annual Perinatal Mortality Report from the National Perinatal Epidemiology Centre (NPEC). This is report number 11 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 from the maternity units and colleagues across the maternity service; this continues to be achieved despite the increased workload in the service. In addition to the provision of data, we also greatly value the feedback and discussion from patients and colleagues across our maternity services and the whole community; it all goes to support 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 - 2018-2022. 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 potential further improvement - this has worked in other countries; an example previously provided, is included again 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 Reports , would I believe assist the maternity services in Ireland achieving 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. There is a real potential to enhance the propagation of learning by bringing recommendations from this and related reports and from individual case reviews at local sites and making them available on a learning platform.

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 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 Centre for Clinical Audit (NCCA) and the National Office of Clinical Audit (NOCA) to whose standards our audits are aligned. All these organizations 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 improved care through audits as in this report. 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.

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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 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. Their on-going support 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).

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 Joye McKernan, PhD. Research officer in the NPEC, and Dr Mike Robson, Consultant Obstetrician in the National Maternity Hospital, for their invited commentary on ''Auditing Perinatal Mortality Using the Robson 10 Group Classification.''

Introduction

This Perinatal Mortality National Clinical Audit (PMNCA) Report provides information on perinatal deaths occurring in Ireland for the reporting year 2022.

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 all perinatal deaths, to identify quality improvement initiatives and to make recommendations for the improvement of care for mothers 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 guides future clinical practice, the counselling of bereaved parents, public health interventions and informs policy makers within the health services.

Importantly, the NPEC PMNCA is the second audit to be quality assured by the National Clinical Effectiveness Committee (NCEC) and is now Clinical Audit No. 2 in the NCEC suite of National Clinical Audits.[1] 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 2022 report is divided into eight sections (Figure I) with additional information provided in the Appendices.

[1]National Clinical Effectiveness Committee National Clinical Audits. Available at: gov - National Clinical Effectiveness Committee National Clinical Audits (www.gov.ie)

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

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.

Section 2 contains maternal and infant characteristics:

- 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.

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.

Section 8 contains the invited expert commentary:

- Auditing Perinatal Mortality Using the Robson 10 Group Classification.

Figure I: Outline of the PMNCA report sections.

Executive summary

This is the eleventh report of the national clinical audit on Perinatal Mortality in Ireland, using the NPEC data collection tool and classification system on cause of death. For the first time, and in keeping with international practice, perinatal deaths following termination of pregnancy (TOP) are not included in the 2022 perinatal mortality national clinical audit (PMNCA) report analysis and the perinatal mortality rates (PMR). However, perinatal deaths following TOP who met the reporting criteria (i.e. the legislated and registerable birth definition for stillbirths and early neonatal deaths in the Irish civil registration system) are captured by the NPEC audit process and are described in this report.

All 19 Irish maternity units reported anonymised data on 290 perinatal deaths arising from 54,665 births occurring in 2022, of at least 500g birthweight or at least 24 weeks gestation and that were not due to TOP.

Stillbirths and early neonatal deaths accounted for 192 (66.2%) and 98 (33.8%) of the 290 deaths, respectively. There were a further 34 late neonatal deaths in 2022, of which 33 late neonatal deaths met the criteria of birthweight ≥500g or gestational age ≥24 weeks. The Perinatal Mortality Rate (PMR) was 5.31 deaths per 1,000 total births; corrected for Major Congenital Anomaly (MCA), the rate was 3.75 per 1,000 total births; the stillbirth rate was 3.51 per 1,000 total births (corrected stillbirth rate was 2.69 per 1,000 total births); the early neonatal death rate was 1.80 per 1,000 live births (corrected early neonatal death rate was 1.06 per 1,000 live births). The extended PMR including late neonatal deaths was 5.91 per 1,000 live births based on birthweight ≥500g or gestational age ≥24 weeks (corrected extended PMR was 4.13 per 1,000 total births).

The level of variation in the rate of PMR between maternity units was higher in 2022 compared to 2021. When adjusted for MCA and in-utero transfers, one maternity unit was considered an outlier as defined by NOCA escalation policy in 2022, as it was at least three standard deviations above the national rate.[3]

No statistically significant differences were noted when comparing national PMR rates without TOPs in 2022 to PMR in 2021 without TOPs. When comparing corrected PMR (i.e. PMR excluding perinatal deaths due to, or associated with, MCA) with or without TOP since 2019, no significant differences were found. The corrected PMR has remained static in recent years.

Among mothers experiencing perinatal death, the proportion of women attending their first antenatal visit at or after 20 weeks gestation was 4.6%. This was slightly lower compared to recent years (6.3% in 2021, 7.2% in 2020 and 5.5% in 2019).

In 13.1% of perinatal death cases in 2022, the care of the mother, with her fetus still in-utero, was transferred to another maternity unit, most commonly a tertiary referral maternity unit.

The rate of autopsy uptake in 2022 (47.1%) was similar to the rate in 2021 (44.6%), and lower than the rates of 52.3% reported in 2020, and 49.2% in 2019. Similar to previous years, a post-mortem examination was performed more often in stillbirths (57.8%) than in neonatal deaths (25.8%). In the vast majority of perinatal deaths not undergoing an autopsy, an autopsy was offered, and we understand, declined by parents (85.0%). There was a distinct variation in the rate of autopsy across maternity units in 2022,

[3]NOCA (2021) PRO 18 Monitoring of statistical outliers in national clinical audit and registries. Available on request.

including across maternity units with a large delivery rate.

It is reassuring that a high rate of placental histology examinations continues to be performed following perinatal death nationally (97.9% in stillbirths and in 92.9% of early neonatal deaths).

Specific placental conditions were the primary cause of death in stillbirths in 2022 (38.0%) similar to findings in 2021 but in contrast to previous years where Major Congenital Anomaly (MCA) was the most common cause of death in stillbirths. MCA was the second most common cause of stillbirth (23.4%). The cause of death was unexplained in just five percent of stillbirths (5.2%). In forty percent of these unexplained cases, it was reported that the maternity unit is still awaiting the final coroners' post-mortem results. This proportion of unexplained stillbirths is the lowest since the inception of the audit.

MCA was the primary cause of death in forty percent of the early neonatal deaths in 2022 (40.8%). Respiratory disorder was the second most common cause of death, accounting for one in four (25.5%) early neonatal deaths, most commonly associated with severe pulmonary immaturity. Major congenital anomaly was also the most common cause of late neonatal deaths (35.3%). Of significance, and in contrast to 2021, there were no perinatal deaths due to SARS-CoV-2 in 2022.

Low birthweight continues to be associated with perinatal deaths, particularly with stillbirths. One third (33.5%) 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 (38.6%), an improvement was observed compared to previous rates in 2021 (33.1%) and 2020 (24.8%).

An association between maternal age and perinatal mortality was identified. Compared to mothers aged between 30-34 years, women aged less than 25 or greater than 40 years had a 1.6- and 1.5-fold increased rate of perinatal mortality, respectively (p-value<0.05) in 2022.

An association between increased BMI and perinatal mortality was again identified in 2022. Women with a BMI higher than 30 kg/m2 had a 61% higher risk of perinatal mortality compared to women who gave birth during 2022 with a BMI less than 25 kg/m2 (p-value=0.001). The increased risk for overweight women was less evident in 2022.

While the numbers involved were small, Irish Travellers and Asian ethnicities were overrepresented in the mothers who experienced perinatal deaths across the five years, 2018-2022; the percentage who were Irish Travellers ranged from 2.2 to 5.1% versus 0.7% in the female population of reproductive age.

In 2022, the perinatal mortality rate for babies in multiple pregnancies was 3.51 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

Perinatal Mortality Rate (PMR)

TOP

For the **first time,** and in keeping with international practice, perinatal deaths following termination of pregnancy (TOP) are **not included** in the **2022 PMNCA analysis.**

The perinatal mortality rate (PMR) was **5.31** per 1,000 total births in 2022. **Corrected for Major Congenital Anomaly (MCA), the PMR** was **3.75** per 1,000 total births. There was no statistically significant difference in PMR in 2022 compared to 2021**.** The **stillbirth** rate associated was **3.51** per 1,000 total births and the early **neonatal** death rate was **1.80** per 1,000 live births (corrected stillbirth rate was 2.69 per 1,000 total births and corrected early neonatal death rate was 1.06 per 1,000 live births).

PMR IRELAND

In Ireland, **a reduction in the PMR has not been achieved** in the non-anomalous perinatal deaths in recent years, particularly in the case of stillbirths.

PMR VARIATION

The level of **variation** in the rate of PMR between maternity units was **higher in 2022 compared to 2021.** When adjusted for MCA and in-utero transfers, one maternity unit remained an outlier as defined by NOCA policy.

Maternal characteristics

AGE

Maternal age **(less than 25 and greater than 40 years)** was associated with an increased **risk of perinatal mortality.**

ETHNICITIES

While the numbers involved were small, **Irish Travellers and Asian ethnicities** were overrepresented in the mothers who experienced **perinatal deaths in 2022.**

ANTENATAL CARE

Twenty-two percent **(22.0%)** of mothers experiencing perinatal loss had booked into a hospital for **antenatal care before 12 weeks** gestation, with more than seventy percent **(70.7%) booking between 12- and 19-weeks'** gestation.

Infant characteristics

BIRTHWEIGHT

As in previous reports, **low birthweight** centiles were associated with **perinatal deaths** in 2022, particularly stillbirths.

MULTIPLE BIRTHS

An increased risk of perinatal mortality with **multiple births compared to singleton pregnancies** was again identified in 2022. Perinatal death from multiple births accounted for 11.4% of all perinatal deaths.

AUTOPSY

The rate of autopsy uptake continues to be higher in stillbirths compared to neonatal deaths.

Stillbirths

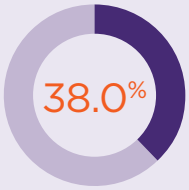
Stillbirths accounted for

66.2%

of perinatal deaths in 2022

CAUSE OF DEATH

Similar to 2021 and in contrast to previous years, **specific placental conditions was the most common cause of death in stillbirths** (n=73, 38.0%) followed by major congenital anomaly (n=45, 23.4%).



Intrapartum deaths accounted for **3.6%** of stillbirths. This rate is lower than previous years.

Early neonatal deaths

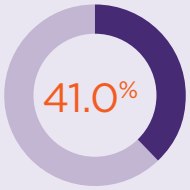
Early neonatal deaths accounted for

33.8%

of perinatal deaths in 2022

CAUSE OF DEATH

Major congenital anomaly was the **most common cause of early neonatal death** (n=40, 40.8%) followed by **respiratory disorders** (n=25, 25.5%), primarily due to severe pulmonary immaturity.



More than half (59.2%) of early neonatal deaths **occurred within 24 hours of delivery.**

Late Neonatal deaths

34 There were **34** late neonatal deaths reported to the **NPEC in 2022.**

CAUSE OF DEATH

Major congenital anomaly was the most common cause of late **neonatal death** (35.3%) followed by gastro-intestinal disease (17.6%)

In line with previous reports, the proportion of l**ate neonatal deaths decreased** across the second and third weeks of life in 2022 (i.e. of the 34 deaths occurring after the first week of life, 58.8% occurred in week two, 41.2% in week three and 0% in week 4).

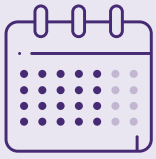
Early neonatal deaths

with a birthweight <500g and a gestational age at delivery **<24 weeks**

35 There were **35 early neonatal deaths** with a birthweight **< 500g** and a gestational age at delivery **< 24 weeks** excluding deaths following TOPs in 2022.

CAUSE OF DEATH

The assigned neonatal cause of death was **pre-viable** for the majority of cases (68.6%) followed by severe pulmonary immaturity (22.9%).



22 WEEKS

The **majority** of the 35 deaths occurred in babies delivered **less than 22 weeks** (94.3%) with 2 deaths occurring after 22 weeks.

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. Non-clinical staff trained in data collection and audit may offer a value for money approach, working with clinical staff and freeing their time for direct care. 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 that can capture this information consistently. Owner; the NPEC and the NWIHP.

- All healthcare professionals (obstetricians, GPs and midwives) should see every interaction with a woman as an opportunity to address weight, nutrition and lifestyle to optimise her health. This also supports the HSE Programme 'Making Every Contact Count' (MECC).[4] Owner; All Healthcare staff.

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

Recommendations from the PMNCA Annual Report 2021

- ''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.''

Progress: A letter regarding the development of a communication policy across maternity units and paediatric services regarding neonatal outcomes following the transfer of babies post-natally to another unit was sent by the NPEC Director to the following: the Faculty of Paediatrics, the clinical directors of Children's Health Ireland, Tallaght Hospital, Crumlin Hospital and Temple Street. A response was received from the Faculty of Paediatrics supporting such a communication policy, which has yet to be developed.

- ''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. ''

Progress: In close collaboration between the NPEC and the Pregnancy Loss Research Group in University College Cork, a proposed care bundle for the Irish context is being conceptualised as outlined below.[5,6]

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

1. Public health programmes which focus on:
   a) Raising awareness about stillbirth and modifiable risk factors.
   b) Reducing smoking and other substance use in pregnancy.
   c) Weight management to lower BMI and prepare women for a healthier entry to pregnancy.
   d) Raising awareness about the risks of sleep position in pregnancy.
   e) Encouraging adequate attendance at antenatal care.
2. Healthcare staff education on modifiable health risk factors for perinatal mortality.
3. Raising awareness about reduced fetal movements.
4. A care pathway for fetal growth restriction assessment and surveillance
5. Enhancing effective fetal wellbeing monitoring at term.
6. Integrating best practice research for prediction, prevention and management of preterm labour.
7. A standard approach to investigation of stillbirths including/consulting with bereaved parents in reviews of their care.

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

[5] Pregnancy Loss Research Group. RELEVANT [Internet]. 2023. Available from: https://www.ucc.ie/en/pregnancyloss/researchprojects/relevant/

[6] Escanuela Sanchez T. Invited Commentary: Exploring the complexity of stillbirth prevention: Insights from the RELEVANT Study on risk factors and implications for policy and practice. In: Perinatal Mortality National Clinical Audit in Ireland Annual Report 2021. 2023. p. 58–68.

Recommendations from previous PMNCA Annual Reports

- ''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 standardised 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). ''

Progress: The NWIHP and the Chief Clinical Officer (CCO), in collaboration with the NPEC, have agreed a process for a confidential review (CR) of perinatal deaths. The CR will initially focus on intrapartum-related perinatal deaths and cases for review will be identified from the NPEC perinatal mortality national clinical audit. Communication will be issued to hospitals in advance to outline the review in terms of methodology, scope, objective, outputs and governance.

- ''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: This item will be progressed by a working group of relevant stakeholders. The national working group will include representation across disciplines at both hospital and national level. NWIHP is hopeful that the group will convene by Quarter 3 2024.

- ''Standardised approach to improved antenatal detection of fetal growth restriction (FGR) with timely delivery is a potential preventative strategy to reduce perinatal mortality.[7,8] 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 national guideline is in development and anticipated for completion in Quarter 4 2024. 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.

Other valuable resources and learning.

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

- HIQA National Maternity Bereavement Experience Survey 2022. Available at: https://assets.publications.hse.ie/media/file_based_publications/national-maternity-bereavement-experience-survey-2022.pdf

- The HSE response to the findings of the National Maternity Bereavement Experience Survey 2022. Available at: https://about.hse.ie/publications/hses-response-to-national-maternity-bereavement-experience-survery/

- 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 Health regarding the Coroner's (Amendment) Act 2019 was made on behalf of the NPEC, the NWIHP, the NOCA and the PMNCAGC. More recently, The Minister for Justice, Helen McEntee T.D. launched a wide-ranging consultation to inform the development of proposals for comprehensive reform of the Coroner Service in Ireland. This consultation, which closed in January 2024, gave an opportunity for members of the public and stakeholder groups to express their views, observations and proposals on how the Coroner Service might be enhanced into the future.[9]

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.

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

[7]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 due November 2024)

[8]Lees CC, Stampalija T, Baschat AA, da Silva Costa F, Ferrazzi E, Figueras F, Hecher K, Poon LC, Salomon LJ, Unterscheider J. ISUOG Practice Guidelines: diagnosis and management of small-for-gestational-age fetus and fetal growth restriction. Ultrasound in Obstetrics & Gynecology. 2020;56(2):298-312.

[9]Coroner Reform Consultation. Published on 20 October 2023. Available at: https://www.gov.ie/en/consultation/473f5-coroner-reform-consultation/

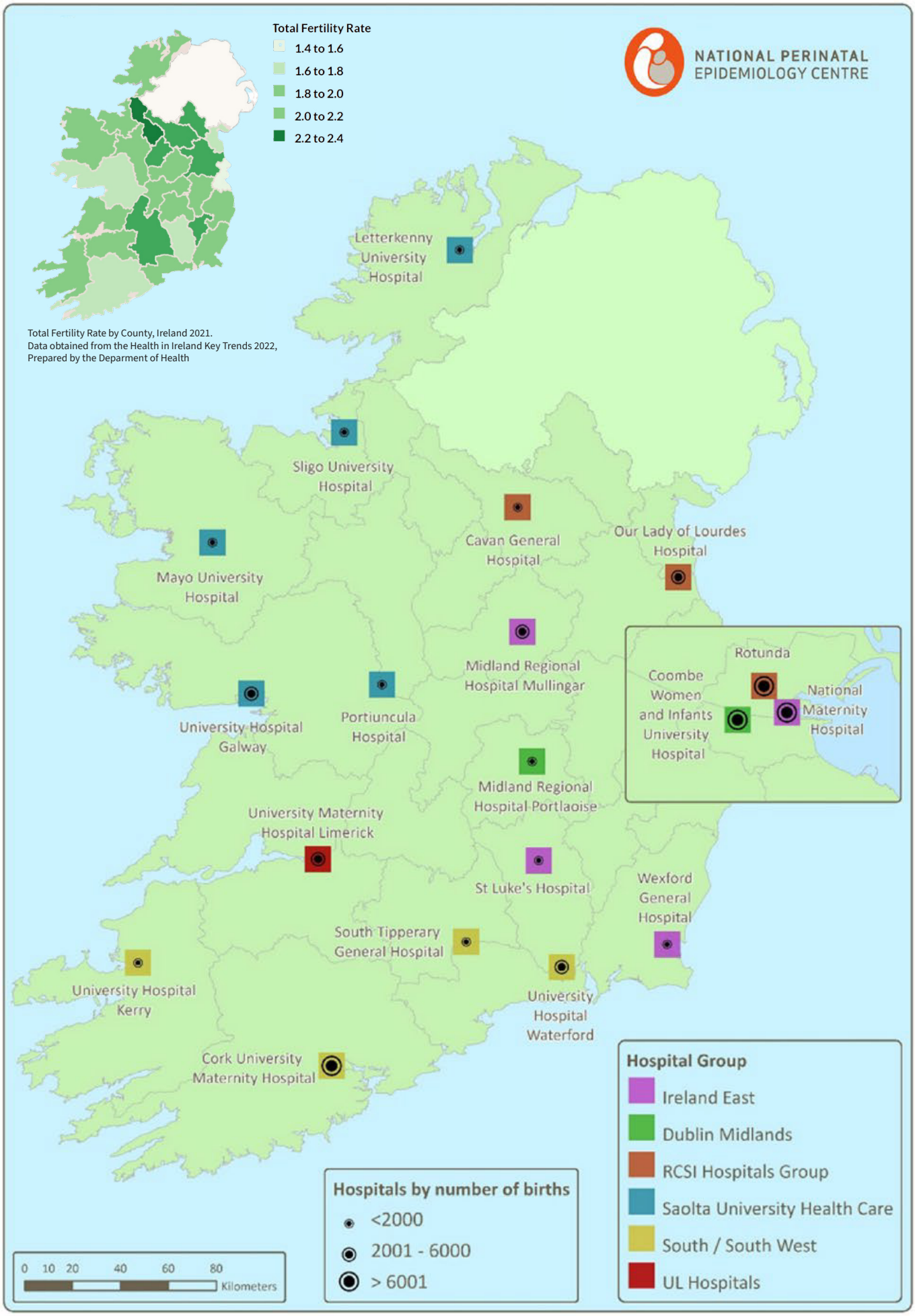


Figure II: Map of maternity units and hospital groups in Ireland, 2022

Methods

Data collection and management

In 2022, there were 19 maternity units in Ireland. Within each maternity unit, coordinators have been identified who are responsible for submitting perinatal mortality data to the NPEC. Pseudonymised data on perinatal deaths from births that occurred between January 1st and December 31st, 2022, are submitted to the NPEC by all 19 units using a standardised notification dataset electronically, via the secure online NPEC database. The Perinatal Mortality (PM) notification form/dataset is available on the NPEC website at: https://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[10] and has been endorsed by the Clinical Advisory Group at the Institute of Obstetricians and Gynaecologists, 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[11] 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 how we are doing, if there are areas that can be improved and if there is variance in our performance or outcomes. It is an area that is recognised 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 with some duplication. There needs to be a review of data requirements and a streamlining of processes in keeping with good data governance and the Health Information and Quality Authority (HIQA) data quality framework.[12] This work has been done by NPEC and is a live ongoing process. It is difficult to fund 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 once again call for more funding to be directed into 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. Non-clinical staff trained in data collection and audit may offer a value for money approach, working with clinical staff and freeing their time for direct care. Owner; the Quality and Patient Directorate in the HSE.

QR code to webpage with Perinatal mortality forms, manuals and reports

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

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

[12]Health information and Quality Authority (HIQA). Guidance on data quality framework for health and social care. Health Information and Quality. 2018. Available from: https://teams.microsoft.com/l/message/19:a5d3763c-3e33-41b5-a4ed-3c2675fa4c97_c15c26e3-e829-4562-9cbc-fca8defed36e@unq.gbl.spaces/1734089686341?context=%7B%22contextType%22%3A%22chat%22%7D

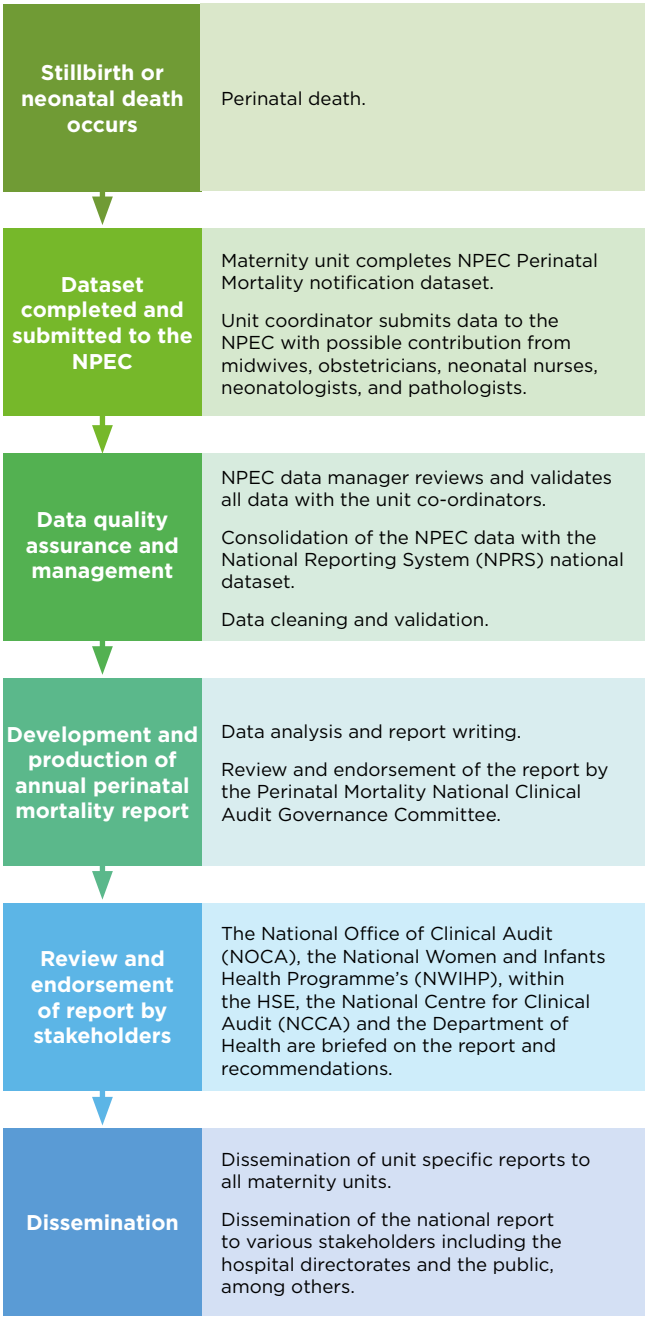


Figure III: NPEC data collection and management processes.

The 2022 birth cohort

For the first time, and in keeping with international practice, perinatal deaths following termination of pregnancy (TOP) are not included in the 2022 PMNCA cohort. This report describes the perinatal deaths that occurred among infants born from 1 January to 31 December 2022. Thus, neonatal deaths in January 2022 of infants born in December 2021 are not included while neonatal deaths in January 2023 of infants born in December 2022 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 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.[13] The NPEC Perinatal Mortality Reports for the years 2011-2014 were based on deaths in a calendar year; these have been 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 as was an "Extended PMR", 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[14]. Terminations of pregnancy (TOPs) were excluded from the total births and total live births figures given by the HPO in 2022. The perinatal mortality data was retrospectively reviewed since 2019, when TOP became legal in Ireland, and TOPs were also excluded from the PMR when examining trend data in this report (n=30 in 2019; n=39 in 2020; n=30 in 2021 and n=40 TOPs excluded in 2022). Additionally, perinatal deaths following TOP who met the reporting criteria (i.e. the legislated and registerable birth definition for stillbirths and early neonatal deaths in the Irish civil registration system) are captured by the NPEC audit process and are described in this report.

Data on BMI were collated for 32,507 maternities in 2022 from six maternity units. This is 59.5% of the 54,665 women who gave birth in hospital in Ireland in 2022, according to the HPO. We multiplied the BMI data on 32,507 women by 1.68 (i.e. 100%/59.5%) 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

[13]Gallimore ID, Matthews RJ, Page GL, Smith LK, Fenton AC, Knight M, Smith PW, Redpath S, Manktelow BN, on behalf of the MBRRACE-UK Collaboration. MBRRACE-UK Perinatal Mortality Surveillance, UK Perinatal Deaths of Babies Born in 2022: State of the Nation Report. Leicester: The Infant Mortality and Morbidity Studies, Department of Population Health Sciences, University of Leicester. 2024.

[14]Healthcare Pricing Office. Perinatal Statistics Report 2022. Dublin: Health Service Executive. [in press]

regression which calculates a rate ratio (i.e. 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 childbearing 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. In the 2022 audit, two cases of stillbirths were neither booked nor delivered under the care of a maternity unit, and therefore, were not assigned to a maternity unit's rate, but such cases were included in the national rate. 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, 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.**

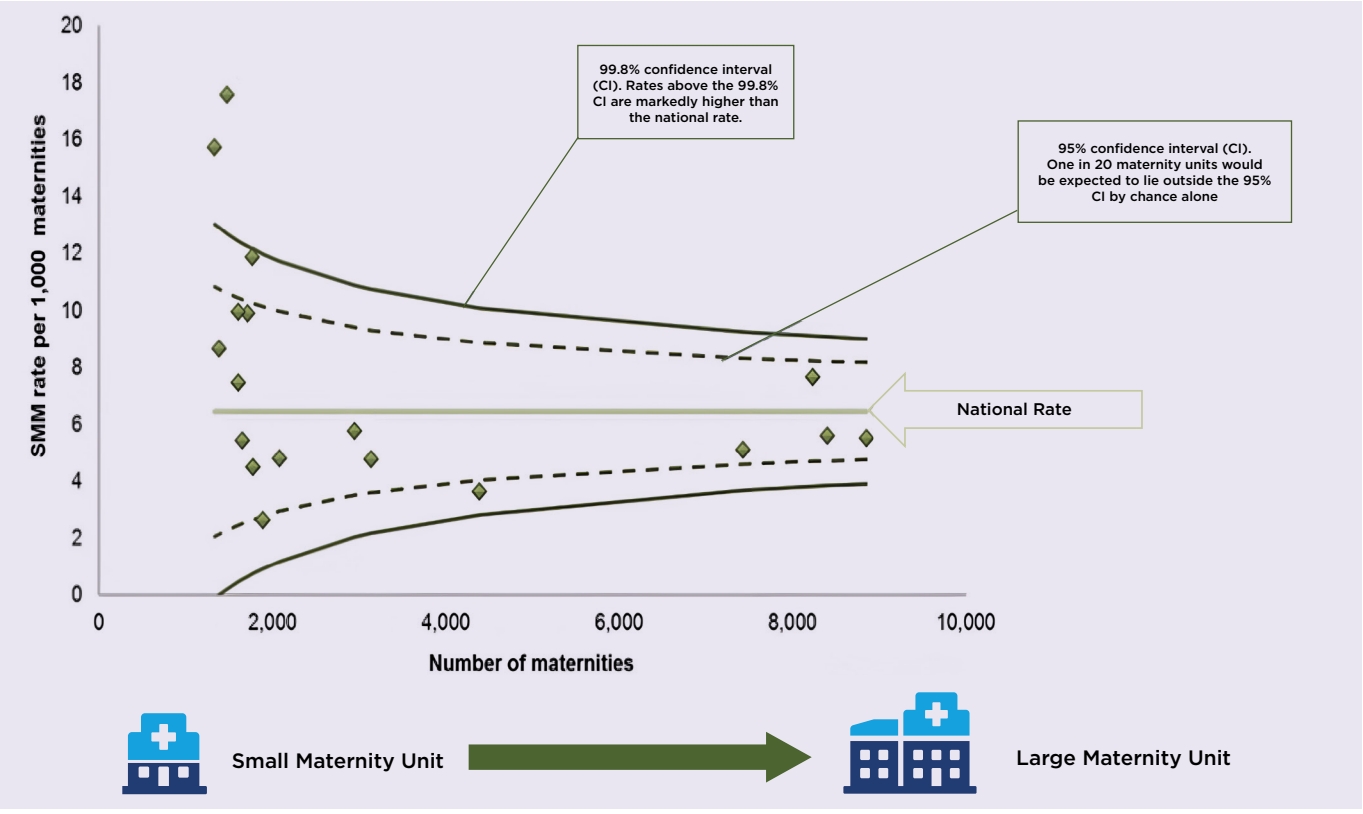


Figure IV: Diagram outlining the interpretation of a funnel plot.

Outliers

In line with the NOCA escalation policy[15], NPEC defines a hospital rate as a statistical outlier if it is at least three standard deviations above or below the national rate in one or more reporting period or if a hospital rate is at least two standard deviations above or below the national rate across two consecutive reporting periods.

Corrected stillbirths and early neonatal death rates without termination of pregnancies (TOP) for the combined four years (2019-2022)

In 2022, the corrected rate for stillbirths and early neonatal deaths, i.e. the rate adjusted to exclude deaths due to major congenital anomaly and deaths following TOPs, have been calculated for the combined years 2019-2022 (Figure 1.6 and Figure 1.7). 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 2022. To do so, we used the Gestation Related Optimal Weight (GROW) software[16] 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.[17] Other approaches to estimating customised birthweight centiles are available for example INTERGROWTH-21st (INTERGROWTH) , the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) Fetal Growth Studies, and World Health Organization Multicentre Growth Reference Study (WHO Fetal)[18]. A recent study found the GROW software a better method to identify SGA birthweight associated with adverse perinatal outcomes.[19]

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 2022). 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=25, 8.6%) and weight (n=22, 7.6%). 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 286 of the 290 perinatal deaths in 2022.

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 D). This is in keeping with recommendations in a publication from an international consensus meeting of pathology, often referred to as the 'Amsterdam convention'.[20] 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 E. 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 are made using the NPEC maternal and fetal classification system. In the case of neonatal deaths, the NPEC neonatal classification system is used to attribute the main neonatal cause of death and the NPEC maternal and fetal classification system is used to identify the underlying obstetric condition/sentinel event associated with the death.

[15]National Office of Clinical Audit (NOCA) Monitoring and escalation policy 2017. Available at: Available at: http://s3-eu-west-1. amazonaws.com/noca-uploads/general/NOCA-GEN-POL014_-_NOCA_-_Monitoring_Escalation_Policy_v2.1.pdf

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

[17]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

[18]Grantz KL, Hediger ML, Liu D, Louis GM. Fetal growth standards: the NICHD fetal growth study approach in context with INTERGROWTH-21st and the World Health Organization Multicentre Growth Reference Study. American journal of obstetrics and gynecology. 2018 Feb 1;218(2):S641-55.

[19]Fay E, Hugh O, Francis A, Katz R, Sitcov K, Souter V, Gardosi J. Customized GROW vs INTERGROWTH-21st birthweight standards to identify small for gestational age associated perinatal outcomes at term. American Journal of Obstetrics & Gynecology MFM. 2022 Mar 1;4(2):100545.

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

Definitions and terminology

As discussed in the methodology section of this report, for the first time, and in keeping with international practice, perinatal deaths following termination of pregnancy (TOP) are not included in this 2022 PMNCA cohort.

Termination of pregnancy (TOP) is defined following the Repeal of the Eighth amendment and the subsequent Health (Regulation of Termination of Pregnancy) Act 2018; termination of pregnancy became legal in Ireland 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/or for a condition likely to lead to death of fetus either before or within 28 days of birth. Since January 2019, data on perinatal deaths, as defined in this audit, following TOP are detailed in the NPEC Perinatal Mortality Audit Reports.

Of note, there is some variation among individual maternity units as to how perinatal deaths are defined. To allow for comparison across all units, the NPEC uses the following definitions the current report[21]:

Stillbirth: The NPEC applies 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.[22] 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.[23]

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

Stillbirth rate: Number of stillbirths per 1,000 total births (live births and stillbirths from 24 weeks gestation and/or weighing ≥500g). Of note, the reporting guideline used by the Irish Healthcare Pricing Office perinatal statistics report on stillbirths uses the criterion of birthweight ≥500g.[24] To ensure national consistency, we also report the stillbirth rate using the criterion of birthweight ≥500g.

Early neonatal death rate: Number of early neonatal deaths per 1,000 live births (from 24 weeks gestation and/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 and/or weighing ≥500g). Again, to ensure national 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 per 1,000 total births (live births and stillbirths from 24 weeks gestation and/or weighing ≥500g).

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 and/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 booking summary (either at hospital or via telehealth).

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.

[21]Blencowe H, Hug L, Moller AB, You D, Moran AC. Definitions, terminology and standards for reporting of births and deaths in the perinatal period: International Classification of Diseases (ICD-11). International Journal of Gynecology & Obstetrics. 2024.

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

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

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

Parity: The number of completed pregnancies, whether live birth or stillbirth, of at least 24 weeks gestation and/or with a birthweight ≥500g. We refer to parity prior to the pregnancy that resulted in a perinatal loss in 2022.

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 2022.

Chronological age: Chronological age is used in recording deaths in the neonatal period. It refers to the age since birth. Day 0 refers to the first 24 h after birth.

Neonatal period: The period from birth to 28 completed days after birth, i.e., includes days 0–27 after birth.

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 G, has been developed in line with guidance provided by the Health Information and Quality Authority (HIQA) on a data quality framework for health and social care.[25] 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
- 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

[25]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

TOP not included

In keeping with international practice, perinatal deaths following termination of pregnancy **(TOP) are not included in the perinatal mortality rate (PMR)** for the **2022 PMNCA cohort.**

5.31 PER 1,000 BIRTHS

PMR

The perinatal mortality rate (PMR) was **5.31 per 1,000 total births** with the criteria of birthweight **>500g** or gestational age **>24 weeks** and without cases due to TOP in 2022. There was **no statistically significant difference in PMR** in 2022 compared to 2021.

CORRECTED PMR

Corrected for Major Congenital Anomaly (MCA), the corrected PMR was **3.75 per 1,000 total births.**

STILLBIRTH RATE

The stillbirth rate was **3.51 per 1,000 total births** and the early neonatal death rate was **1.80 per 1,000 live births** (corrected stillbirth rate was 2.69 per 1,000 total births and corrected early neonatal death rate was 1.06 per 1,000 live births).

PMR

The level of variation in the rate of PMR between maternity units was higher in 2022 compared to 2021. When adjusted for MCA and in-utero transfers, one maternity unit was considered an outlier as defined by NOCA escalation policy.

This section of the report provides details of the perinatal mortality rate (PMR) and rates of stillbirth and neonatal death both nationally and across Irish maternity units. Separate sections are then provided for maternal and fetal characteristics associated with perinatal loss, stillbirths, early neonatal deaths and late neonatal deaths, describing clinical management and the main cause of death based on the NPEC Classification System (see Figure I).

As discussed in the methodology section of the report, for the first time, and in keeping with international practice, perinatal deaths following termination of pregnancy (TOP) are not included in this 2022 PMNCA. Table 1.1 shows the numbers and rates of perinatal deaths after excluding TOPs (n=40 in total). In 2022, the 19 Irish maternity units reported 54,665 births with a birthweight >500g or gestational age of ≥ 24 weeks. Of these 54,665 births, 290 were classified as perinatal deaths that met the criteria. Stillbirths and early neonatal deaths accounted for 192 (66.2%) and 98 (33.8%) of the 290 deaths, respectively. There were a further 34 late neonatal deaths in 2022, of which 33 met the criteria of birthweight >500g or gestational age >24 weeks.

As detailed in Table 1.1, the stillbirth rate associated with the criteria of birthweight >500g or gestational age >24 weeks, and without TOPs, was 3.51 per 1,000 total births and the early neonatal death rate using the same criteria was 1.80 per 1,000 live births. The overall PMR was 5.31 deaths per 1,000 total births and when corrected for major congenital anomaly was reduced to 3.75 per 1,000 total births. The extended PMR, which includes late neonatal deaths, was 5.91 per 1,000 total births (Table 1.1). The corrected extended PMR in Ireland (4.13 per 1,000 total births) is similar to the extended PMR excluding deaths due to chromosomal anomalies reported in the United Kingdom as a whole in 2022 (4.03 per 1,000 total births).[26]

[26] Gallimore ID, Matthews RJ, Page GL, Smith LK, Fenton AC, Knight M, Smith PW, Redpath S, Manktelow BN, on behalf of the MBRRACE-UK Collaboration. MBRRACE-UK Perinatal Mortality Surveillance, UK Perinatal Deaths of Babies Born in 2022: State of the Nation Report. Leicester: The Infant Mortality and Morbidity Studies, Department of Population Health Sciences, University of Leicester. 2024.

Table 1.1: Frequency and rate of perinatal mortality outcomes, 2022

	BWT ≥500g or gestational age ≥24 weeks	
	Number	**Rate (95% CI)**
Total births	54,665	
Stillbirths	192	3.51 (3.03-4.04)
Corrected stillbirths	147	2.69 (2.27-3.16)
Early neonatal deaths	98	1.80 (1.46-2.19)
Corrected early neonatal deaths	58	1.06 (0.81-1.38)
Perinatal deaths	290	5.31 (4.71-5.95)
Corrected perinatal deaths	205	3.75 (3.26-4.3)
Late neonatal deaths*	33	0.60 (0.42-0.85)
Extended perinatal deaths	323	5.91 (5.28-6.59)
Corrected extended PMR	226	4.13 (3.61-4.71)

Note: The table excludes births and perinatal deaths associated with termination of pregnancy (TOPs). BWT=Birthweight; Rate per 1,000 births; 95% CI=95% Poisson confidence interval; Corrected perinatal deaths exclude deaths due to, or associated with, a major congenital anomaly; Extended perinatal deaths include late neonatal deaths, early neonatal deaths and stillbirths. *One late neonatal death did not meet the criteria birthweight >500g or gestational age >24 weeks and it is excluded from the rates.

As per previous reports, and to allow for comparison of PMR over time and with the Irish Healthcare Pricing Office (HPO), rates including perinatal deaths following TOP since 2019 are also provided in this section. Table 1.2 shows the numbers and rates of perinatal deaths if termination of pregnancies are included in the calculation using both denominators (i.e. a birthweight >500g or gestational age of ≥ 24 weeks and a birthweight >500g).

In 2022, the 19 Irish maternity units reported 54,705 births with a birthweight >500g or gestational age of ≥ 24 weeks. Of these, 54,705 births, 330 met the criteria and included deaths due to termination of pregnancy (TOP). Stillbirths and early neonatal deaths accounted for 220 (66.7%) and 110 (33.3%) of the 330 deaths, respectively. There were a further 34 late neonatal deaths in 2022, of which 33 late neonatal deaths met the criteria of birthweight >500g or gestational age >24 weeks.

Similarly, 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 2022, there were 54,673 babies born weighing >500g. Of these 54,673 babies, 311 met the criteria and included deaths due to TOP. Stillbirths and early neonatal deaths accounted for 203 (65.3%) and 108 (34.7%) of the 311 deaths, respectively. A further 30 babies met the criteria and were classified as late neonatal deaths in 2022 (Table 1.2).

The overall PMR for 2022 including TOPs was 6.03 deaths per 1,000 total births and when corrected for major congenital anomaly was reduced to 3.82 whereas the respective rates based on birthweight >500g were 5.69 and 3.62 per 1,000 total births. The 'Extended' PMR, which includes late neonatal deaths was 6.64 per 1,000 total births based on birthweight >500g or gestational age >24 weeks. The extended PMR based on a birthweight >500g was 6.24 per 1,000 total births, as shown in Table 1.1.

Table 1.2: Comparison of frequency and rate of perinatal mortality outcomes including TOPs, 2022

	BWT ≥500g or gestational age ≥24 weeks		BWT ≥500g	
	Number	**Rate (95% CI)**	**Number**	**Rate (95% CI)**
Total births	54,705		54,673	
Stillbirths	220	4.02 (3.51-4.59)	203	3.71 (3.22-4.26)
Early neonatal deaths	110	2.02 (1.66-2.43)	108	1.98 (1.63-2.39)
Perinatal deaths	330	6.03 (5.4-6.72)	311	5.69 (5.08-6.35)
Corrected perinatal deaths	209	3.82 (3.32-4.37)	198	3.62 (3.14-4.16)
Late neonatal deaths*	33	0.6 (0.42-0.85)	30	0.55 (0.37-0.78)
Extended perinatal deaths	363	6.64 (5.97-7.35)	341	6.24 (5.59-6.93)

Note: The table includes births and perinatal deaths associated with TOPs. 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. *One late neonatal death did not meet the criteria birthweight >500g or gestational age >24 weeks and it is excluded from the rates.

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 Ireland in certain circumstances. Abortion in Ireland 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 or for a condition likely to lead to death of fetus either before or within 28 days of birth.

Of note, in 2022 the Irish birth registration process for the Civil Registration System, a legal requirement following all births, included stillbirths following TOP with a birthweight ≥500g and/or gestation at delivery ≥24 weeks and all neonatal deaths following TOP. These cases were also captured and reported on by the National Perinatal Reporting System (NPRS) at the Health Care Pricing Office (HPO).

In 2022, around twelve percent (n=40, 12.1%) of all the 330 perinatal deaths with a birthweight ≥500g and/or gestation at delivery ≥24 weeks reported to NPEC resulted from a TOP (stillbirths; n=28 of 220, 12.7% and neonatal deaths; n=12 of 110, 10.9%). This is higher than the percentage of TOP reported in 2021 (n=30 of 357, 8.4%).

Major congenital anomaly (MCA) was associated with all but three cases of stillbirth delivered following TOP (n=25, 89.3%). For the remaining three stillbirths, ascending infection (n=1) and pre-eclampsia (n=2) were the reported underlying obstetric antecedent complications. The majority of stillbirths delivered following TOP occurred between the gestational ages of 22 to 27 weeks (n=23 of 28, 82.1%). MCA was associated with all but one case of neonatal death following TOP (n=11, 91.7%) and most commonly occurred between the gestational ages of 22 to 27 weeks (n=9 of 12, 75.0%). Ascending infection was associated with the remaining neonatal death case.

As discussed in the methodology section of this report, in keeping with international practice, perinatal deaths following TOP with a birthweight ≥500g and/or a gestational age of ≥24 weeks at delivery are not included in the Perinatal Mortality Rate (PMR) in this PMNCA. Given that 36 of 40 perinatal deaths following TOP were associated with a MCA, and that such deaths have historically been adjusted for in the corrected PMR, TOP decreases the corrected PMR by a factor of just 1.9%. This subtle difference in PMR, demonstrated in Figure 1.1, is not statistically significant.

Also not included in the calculation of the PMR, are early neonatal deaths of live born babies born before 24 weeks gestation and weighing less than 500g captured in the PMNCA. In 2022, eleven such deaths following TOP were reported to the NPEC. Almost half (n=5, 45.5%) were associated with chorioamnionitis, MCA was associated with four of the eleven and premature rupture of membranes was the underlying complication for the remaining two cases.

Comparison of perinatal mortality, 2012-2022

Table 1.3 compares the perinatal mortality outcomes for 2022, based on the criteria of birthweight ≥500g or gestational age ≥24 weeks at delivery, with those of the previous 10 years and the PMR with and without TOP since its legislation in Ireland in 2019. The number of TOPs excluded from 2019 to 2022 were 30 in 2019, 39 in 2020, 30 in 2021 and 40 in 2022.

Table 1.3: Comparison of perinatal statistics, 2012-2022

	Total births	SB		ENND		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	2.35	456	6.59	296	4.28
2014	67,663	324	4.79	142	2.11	466	6.89	315	4.66
2015	65,904	287	4.35	166	2.53	453	6.87	279	4.23
2016	64,133	250	3.90	124	1.94	374	5.83	228	3.56
2017	62,076	235	3.79	111	1.79	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
excluding TOPs	59,544	219	3.68	111	1.87	330	5.54	221	3.71
2020	57,114	240	4.20	117	2.06	357	6.25	210	3.68
excluding TOPs	57,075	211	3.70	107	1.88	318	5.57	208	3.64
2021	60,841	238	3.91	119	1.96	357	5.87	230	3.78
excluding TOPs	60,811	212	3.49	115	1.90	327	5.38	229	3.77
2022	54,705	220	4.02	110	2.02	330	6.03	209	3.82
excluding TOPs	54,665	192	3.51	98	1.80	290	5.31	205	3.75

Note: SB=Stillbirths; ENND=Early neonatal deaths; TOPs=Terminations of pregnancy; Rates for SB and perinatal deaths are per 1,000 total births and rates for ENND are per 1,000 live births; RR=Rate ratio; 95% CI=Exact Poisson 95% confidence intervals; Corrected perinatal deaths exclude deaths due to a major congenital anomaly.

Rates of perinatal mortality in Ireland since 2011 have varied from 5.30 per 1,000 births in 2018 to 6.89 per 1,000 births in 2014 (Figure 1.1.). Decreasing rates of perinatal mortality were observed in the decade prior to 2012.[27] Then the rates levelled off, as illustrated in Figure 1.1, 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 was observed, but it was not statistically significant compared to previous years 2020 and 2019.

When comparing rates with and without TOPs since 2019, the biggest differences are found in the total perinatal mortality rates (Figure 1.1., dashed blue line). This difference seems to be driven by stillbirths (dashed grey line) more than by early neonatal deaths (dashed green line). No apparent differences are found when comparing corrected perinatal mortality rates, i.e excluding those cases with major congenital anomalies, with or without TOPs (orange lines). The vast majority of perinatal deaths following TOP were associated with a major congenital anomaly (n=36 of 40, 90%). This highlights the point that a reduction in the PMR rate in Ireland has not been achieved in the non-anomalous perinatal deaths in recent years, particularly in the case of stillbirths.

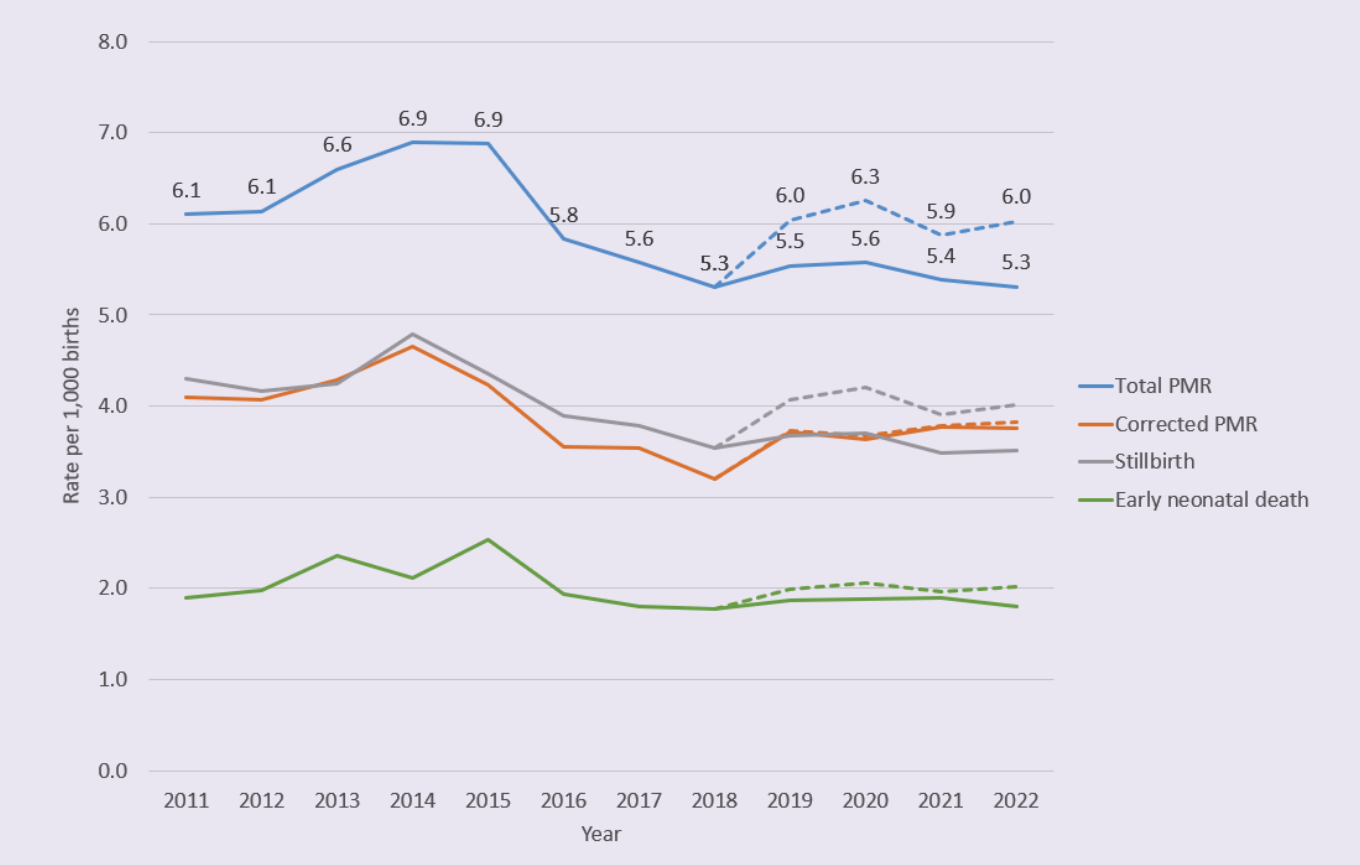


Figure 1.1: Trend in perinatal mortality rates in Ireland, 2012-2022

Note: Rates per 1,000 births; PMR = perinatal mortality rate; Corrected PMR excludes deaths due to a major congenital anomaly. The dashed line represents PMR including perinatal deaths following TOPs.

No statistically significant differences were noted when comparing PMR rates in 2022 to PMR in 2021 (Table 1.4).

Table 1.4: Comparing the rate ratio of perinatal mortality in 2021 and 2022

	2021		2022		
	Number	**Rate (95% CI)**	**Number**	**Rate (95% CI)**	**Rate Ratio (95%CI)**
Total births	60,811		54,665		
Stillbirths	212	3.49 (3.03-3.99)	192	3.51 (3.03-4.04)	1.01 (0.83-1.22)
Early neonatal deaths	115	1.90 (1.57-2.28)	98	1.80 (1.46-2.19)	0.95 (0.72-1.24)
Perinatal deaths	327	5.38 (4.81-5.99)	290	5.31 (4.71-5.95)	0.99 (0.84-1.56)
Corrected perinatal deaths	229	3.77 (3.29-4.28)	205	3.75 (3.25-4.3)	1.00 (0.82-1.20)

Note: 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. *One late neonatal death did not meet the criteria birthweight >500g or gestational age >24 weeks and it is excluded from the rates in 2022. RR=Rate ratio, comparing the rate of perinatal mortality in 2021 and 2022 excluding cases associated with TOPs.

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

In the Irish context, the NPEC advocates the introduction of a 'Care Bundle' approach, by the relevant agencies (the NWIHP, the IOG and the Department of Health and Well Being in the HSE) in an attempt to lower perinatal mortality. The value of a care bundle would be a service wide approach to more effective care utilising learnings from this audit along with international success and research around the topic of Perinatal Mortality. In collaboration between the NPEC and the Pregnancy Loss Research Group in University College Cork[28,29], a proposed care bundle for the Irish context is being conceptualised as outlined below:

1. Public health programmes which focus on:
    - Raising awareness about stillbirth and modifiable risk factors.
    - Reducing smoking and other substance use in pregnancy.
    - Weight management to lower BMI and prepare women for a healthier entry to pregnancy.
    - Raising awareness about the risks of sleep position in pregnancy.
    - Encouraging adequate attendance at antenatal care.
2. Healthcare staff education on modifiable health risk factors for perinatal mortality.
3. Raising awareness about reduced fetal movements.
4. A care pathway for fetal growth restriction assessment and surveillance
5. Enhancing effective fetal wellbeing monitoring at term.
6. Integrating best practice research for prediction, prevention and management of preterm labour.
7. A standard approach to investigation of Stillbirths including/consulting with bereaved parents in reviews of their care.

Variation by maternity unit

Based on the criteria of a birthweight ≥500g and/or a gestational age of ≥ 24 weeks at delivery, and excluding perinatal deaths following TOPS in 2022, the uncorrected PMR across the Irish maternity units ranged from 1.26 to 8.91 per 1,000 total births and the corrected PMR ranged from 0.60 to 7.89 per 1,000 total births (Table 1.5). This level of variation across units is higher in the updated rates for 2022 compared to the rates in 2021. There was a strong correlation between the unit specific corrected PMR in 2022 and 2021. 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 1.5: Perinatal mortality rates across Irish maternity units, 2022

	Uncorrected PMR (95% CI)		Corrected PMR (95% CI)	
Unit	**2021**	**2022**	**2021**	**2022**
Cavan (CGH)	2.18 (0.45-6.34)	3.19 (0.87-8.15)	1.45 (0.18-5.23)	2.39 (0.49-6.98)
Coombe (CWIUH)	4.92 (3.49-6.75)	5.50 (3.89-7.54)	3.63 (2.41-5.24)	3.47 (2.22-5.16)
Cork (CUMH)	5.62 (4.06-7.59)	5.50 (3.86-7.61)	3.75 (2.49-5.41)	4.13 (2.72-6.00)
Drogheda (OLOL)	4.96 (2.78-8.16)	3.49 (1.68-6.41)	4.29 (2.29-7.33)	3.14 (1.44-5.95)
Galway (UHG)	5.88 (3.43-9.4)	4.18 (2.09-7.46)	3.11 (1.42-5.9)	2.28 (0.84-4.95)
Kerry (UHK)	5.45 (2.19-11.2)	1.77 (0.21-6.37)	3.12 (0.85-7.96)	0.88 (0.02-4.92)
Kilkenny (SLHK)	3.99 (1.47-8.66)	4.29 (1.58-9.32)	3.32 (1.08-7.74)	2.86 (0.78-7.31)
Letterkenny (LUH)	3.15 (1.02-7.34)	4.02 (1.48-8.73)	1.89 (0.39-5.52)	3.35 (1.09-7.80)
Limerick (UMHL)	7.21 (4.9-10.22)	8.91 (6.22-12.37)	4.65 (2.84-7.18)	7.89 (5.37-11.19)
Mayo (MUH)	3.91 (1.44-8.49)	4.37 (1.6-9.48)	2.61 (0.71-6.66)	3.64 (1.18-8.47)
Mullingar (RHM)	5.54 (2.77-9.89)	4.05 (1.63-8.32)	4.03 (1.74-7.92)	2.31 (0.63-5.91)
National Maternity (NMH)	7.52 (5.73-9.68)	6.48 (4.73-8.67)	5.48 (3.97-7.37)	5.04 (3.51-7.01)
Portiuncula (PUH)	2.74 (0.75-7)	2.26 (0.47-6.59)	0.69 (0.02-3.81)	0.75 (0.02-4.19)
Portlaoise (MRHP)	4.53 (1.82-9.31)	3.67 (1.19-8.54)	4.53 (1.82-9.31)	2.93 (0.8-7.5.00)
Rotunda (RH)	5.57 (4.15-7.32)	6.03 (4.48-7.94)	3.71 (2.57-5.19)	3.74 (2.54-5.30)
Sligo (SUH)	2.86 (0.78-7.3)	8.88 (4.44-15.83)	2.14 (0.44-6.25)	5.65 (2.27-11.61)
Tipperary (TippUH)	4.22 (1.15-10.78)	1.26 (0.03-6.98)	4.22 (1.15-10.78)	1.26 (0.03-6.98)
Waterford (UHW)	5.67 (2.72-10.39)	2.99 (0.97-6.95)	5.10 (2.33-9.66)	0.60 (0.02-3.32)
Wexford (WGH)	4.09 (1.65-8.41)	4.49 (1.81-9.23)	2.34 (0.64-5.97)	2.57 (0.70-6.56)
National	5.38 (4.81-5.99)	5.31 (4.71-5.95)	3.77 (3.29-4.29)	3.75 (3.25-4.30)

Note: The table excludes births and perinatal deaths associated with termination of pregnancy. TOPs=Terminations of pregnancy; 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.

[28]Pregnancy Loss Research Group. RELEVANT [Internet]. 2023. Available from: https://www.ucc.ie/en/pregnancyloss/researchprojects/relevant/

[29]Escanuela Sanchez T. Invited Commentary: Exploring the complexity of stillbirth prevention: Insights from the RELEVANT Study on risk factors and implications for policy and practice. In: Perinatal Mortality National Clinical Audit in Ireland Annual Report 2021. 2023. p. 58–68.

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 for appropriate care for preterm deliveries, complex congenital fetal anomalies and maternal complications.

Of the 290 perinatal deaths in 2022, there were 38 cases (13.1%) where the care of the pregnant woman was transferred in-utero. These 38 in-utero transfers resulted in 10 stillbirths (26.3%) and 28 early neonatal deaths (73.7%). All but nine of the 38 in-utero transfer cases in 2022 were transferred to one of the country's four large maternity hospitals (i.e. the National Maternity Hospital, Dublin, the Rotunda Hospital, Dublin, the Coombe Hospital, Dublin, and Cork University Maternity Hospital). Of the nine babies who delivered outside of the four large tertiary maternity hospitals, all but one delivered in a maternity unit with the delivery less than 6,000 births per annum within their Regional Health Authority.

The solid horizontal line in Figure 1.2 represents the national PMR in 2022 (5.31 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 1.2, the red square markers represent each unit's PMR in 2022 if the 38 in-utero transfers had not occurred, 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 1.2, without these in-utero transfer cases, almost all of the small maternity units would have had a higher PMR while the PMR for the four large maternity hospitals, considered together, would have been 13.6% lower. This impact varied across the four large maternity hospitals, as illustrated in Figure 1.2. The PMR would have been 5.6-lower in the Cork University Maternity Hospital (P), 7.8% in the Coombe Hospital (Q) and 16.0% in the Rotunda Hospital (S). The PMR rate for the National Maternity Hospital (R) would have been 22.2% lower in 2022. It is important to state that the transfer of these cases are a mark of good care and appropriate to the national model of care.

One unit, Limerick (UMHL - O), had an uncorrected PMR above the national rate and above the upper 99.8% confidence limit. The rate for this unit was between the 95% and the 99.8% confidence limits after adjusting for in-utero transfers. One small unit, Sligo (SUH - C), had a PMR above the national rate and under the 95% confidence limits. After adjusting for in-utero transfers, the PMR was between the upper 95% and the 99.8% confidence limits.

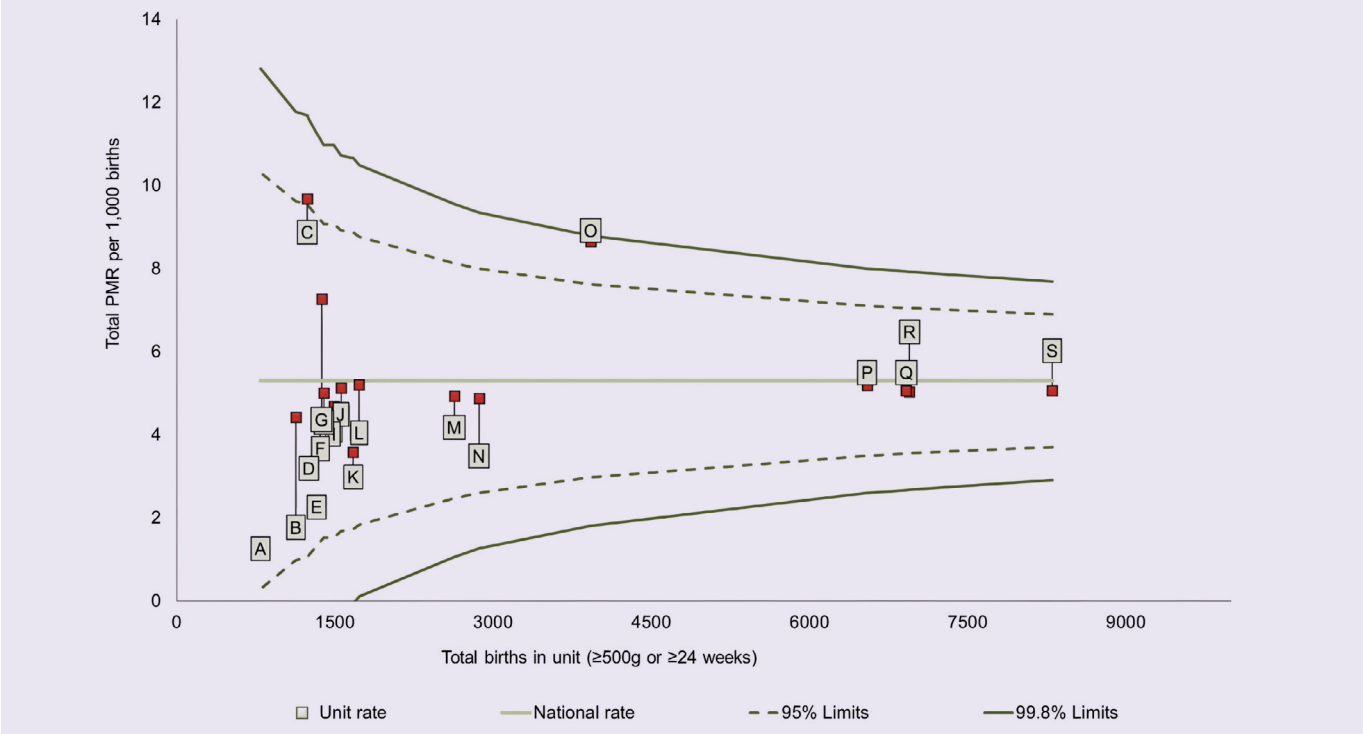


Figure 1.2: Funnel plot of the perinatal mortality rate (PMR) for Irish maternity units, 2022

Note: The funnel plot excludes births and perinatal deaths associated with TOP. Two units (H=4.29 & G=4.36) have similar unit rates 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 (TippUH)	F - Portlaoise (MRHP)	K - Waterford (UHW)	P - Cork (CUMH)
B - Kerry (UHK)	G - Mayo (MUH)	L - Mullingar (RHM)	Q - Coombe (CH)
C - Sligo (SUH)	H - Kilkenny (SLHK)	M - Galway (UHG)	R - National Maternity (NMH)
D - Cavan (CGH)	I - Letterkenny (LUH)	N - Drogheda (OLOL)	S - Rotunda (RH)
E - Portiuncula (PUH)	J - Wexford (WGH)	O - Limerick (UMHL)	

Corrected perinatal mortality rate

The solid horizontal line in Figure 1.3 represents the national corrected PMR in 2022 (3.75 deaths per 1,000 total births) based on the 205 perinatal deaths not due to major congenital anomaly and without TOPs.

Twenty-two (10.7%) of the 205 perinatal deaths were associated with cases where the care of the pregnant woman was transferred with the fetus in-utero. One small unit, Waterford (UHW - K), had a corrected PMR below the lower 95% confidence limits, but was within the 95% confidence limits after adjusting for in-utero transfers. One unit, Limerick (UMHL - O), had a corrected PMR (7.9 per 1,000 total births), higher than the national rate and above the upper 99.8% confidence limit even after adjusting for in-utero transfers. In line with the NOCA escalation policy, which defines a hospital rate as a statistical outlier if it is at least three standard deviations above or below the national rate[30], senior management in this unit has been informed that it is a statistical outlier for perinatal mortality in 2022. This unit's PMR was not in this range in previous reporting years or in provisional 2023 data. Feedback from the unit assures that all perinatal deaths in 2022 were verified and subject to a multidisciplinary review.

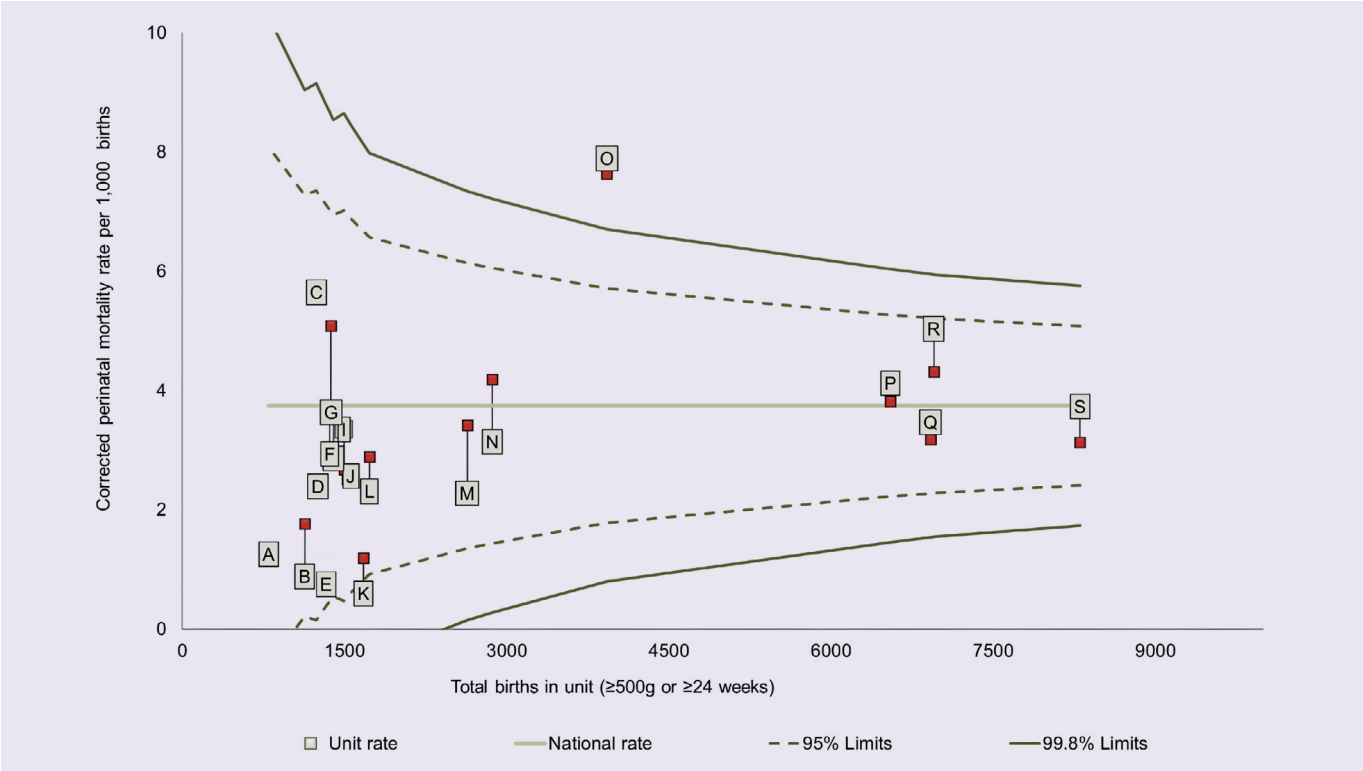


Figure 1.3: Funnel plot of the corrected perinatal mortality rate for Irish maternity units, 2022

Note: The figure excludes perinatal deaths associated with major congenital anomalies and TOPs. Two units (F=2.93 & H=2.86) have similar unit rates, as 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 (TippUH)	F - Portlaoise (MRHP)	K - Waterford (UHW)	P - Cork (CUMH)
B - Kerry (UHK)	G - Mayo (MUH)	L - Mullingar (RHM)	Q - Coombe (CH)
C - Sligo (SUH)	H - Kilkenny (SLHK)	M - Galway (UHG)	R - National Maternity (NMH)
D - Cavan (CGH)	I - Letterkenny (LUH)	N - Drogheda (OLOL)	S - Rotunda (RH)
E - Portiuncula (PUH)	J - Wexford (WGH)	O - Limerick (UMHL)	

[30]National Office of Clinical Audit (NOCA) Monitoring and escalation policy 2017. Available at: Available at: http://s3-eu-west-1. amazonaws.com/noca-uploads/general/NOCA-GEN-POL014_-_NOCA_-_Monitoring_Escalation_Policy_v2.1.pdf

Stillbirth and early neonatal death rate

In Figure 1.4, the solid horizontal line represents the annual national stillbirth rate of 3.51 per 1,000 total births based on cases without TOPs and reported for 2022. All the units, except for one unit, Limerick (UMHL - O), were within 95% confidence limits.

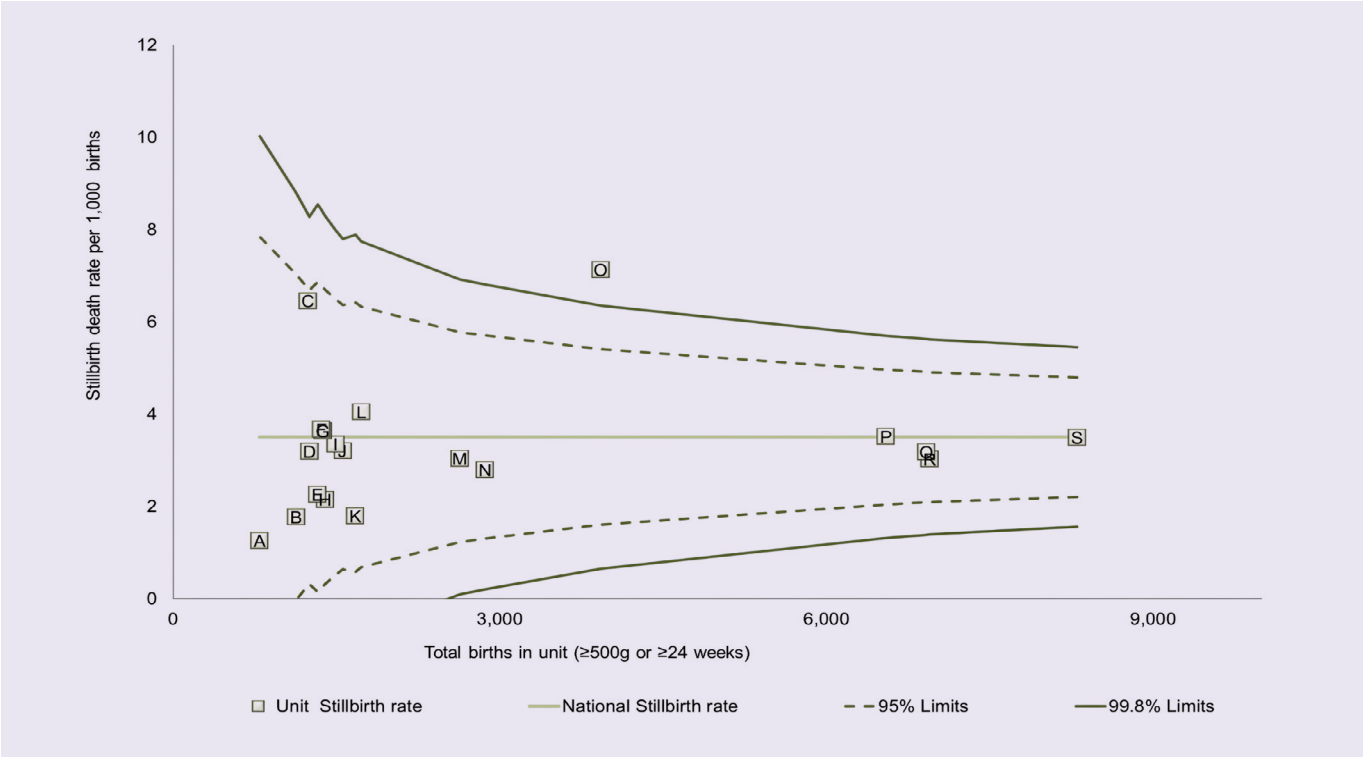


Figure 1.4: Funnel plot of the stillbirth rate for Irish maternity units, 2022

Note: The funnel plot excludes births and perinatal deaths associated with TOP. Two units (F=4.78 & G=4.83) have similar unit rates, as do two other units (Q=24.28 & R=24.39), represented by the overlapping lettered square markers. The letter identifying units will differ between funnel plots and between reporting years.

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

The solid horizontal line in Figure 1.5 represents the annual national early neonatal death rate of 1.80 per 1,000 live births based on cases reported for 2022. One large maternity hospital, National Maternity (NMH - R), had a rate higher than the national rate just above the upper 99.8% confidence limit. There were 12 perinatal deaths after in-utero transfer to this maternity hospital. Without these in-utero transfers, the early neonatal death rate would have been 1.73 per 1,000 births and thus under the upper 95% 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 unit (R). The remaining units were within 95% confidence limits.

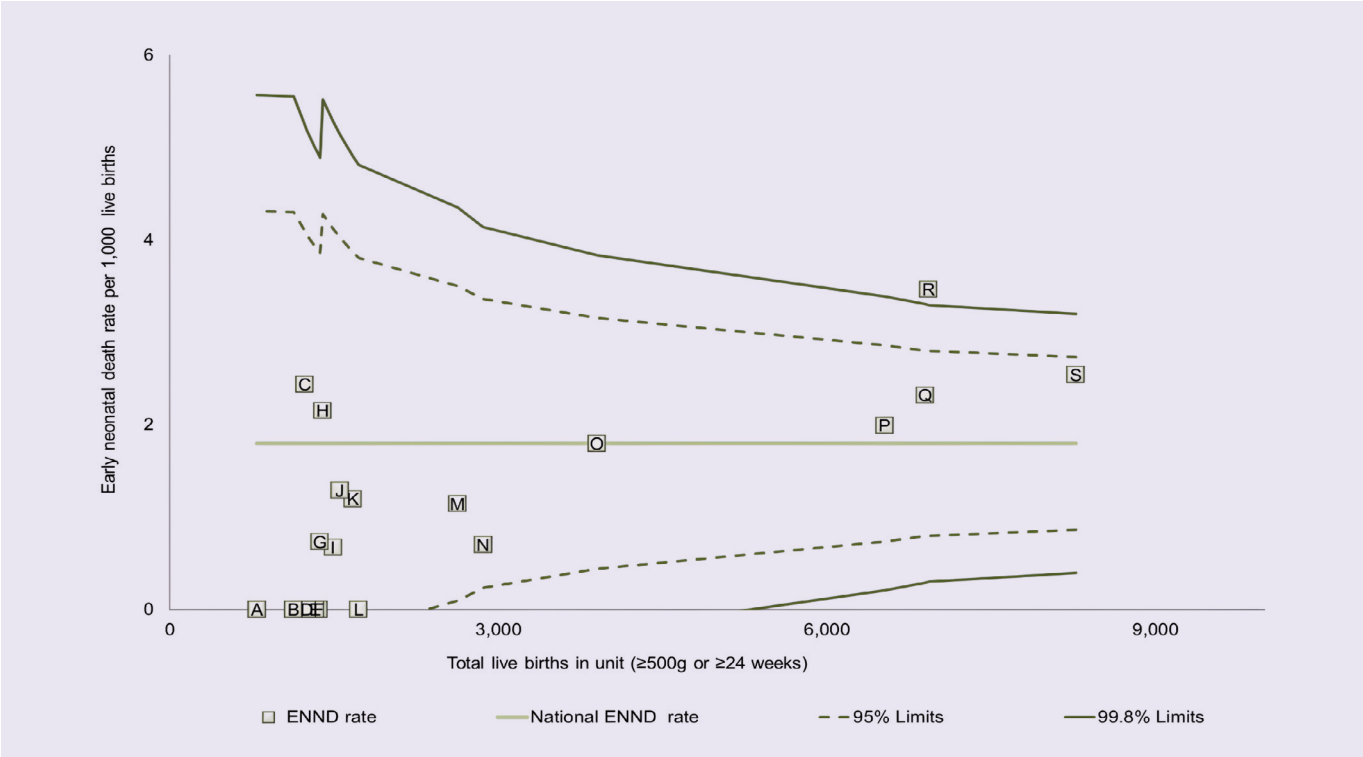


Figure 1.5: Funnel plot of the early neonatal death rate for Irish maternity units, 2022

Note: The funnel plot excludes births and perinatal deaths associated with TOP. The letter identifying units will differ between funnel plots and between reporting years.

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

Corrected stillbirths and early neonatal death rates without termination of pregnancies for the combined four years (2019-2022).

The corrected rate for stillbirths and early neonatal deaths, i.e. the rate adjusted to exclude deaths due to major congenital anomaly and deaths following TOPs have been calculated for the combined years 2019-2022 (Figure 1.6 and Figure 1.7). 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 1.6 represents the national corrected rate for stillbirths for the combined years 2019-2022 (2.78 deaths per 1,000 total births) based on the 645 stillbirths not due to major congenital anomaly and not due to TOP.

Thirty-five (5.4%) of the 645 stillbirths were associated with cases where the care of the pregnant woman was transferred in-utero. As indicated by the red markers in Figure 1.6, 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 unit, Limerick (UMHL - O), had a corrected stillbirth rate (3.63 per 1,000 total births) higher than the national rate and just above the upper 95% confidence limit. There were 4 stillbirths in babies following in-utero transfer of mothers to this maternity hospital. Without these in-utero transfers, the corrected stillbirth rate would have been 3.39 per 1,000 total births and thus comparable with the national rate. One small unit, Kilkenny (SLHK - F) was below the lower 95% confidence limit for stillbirths.

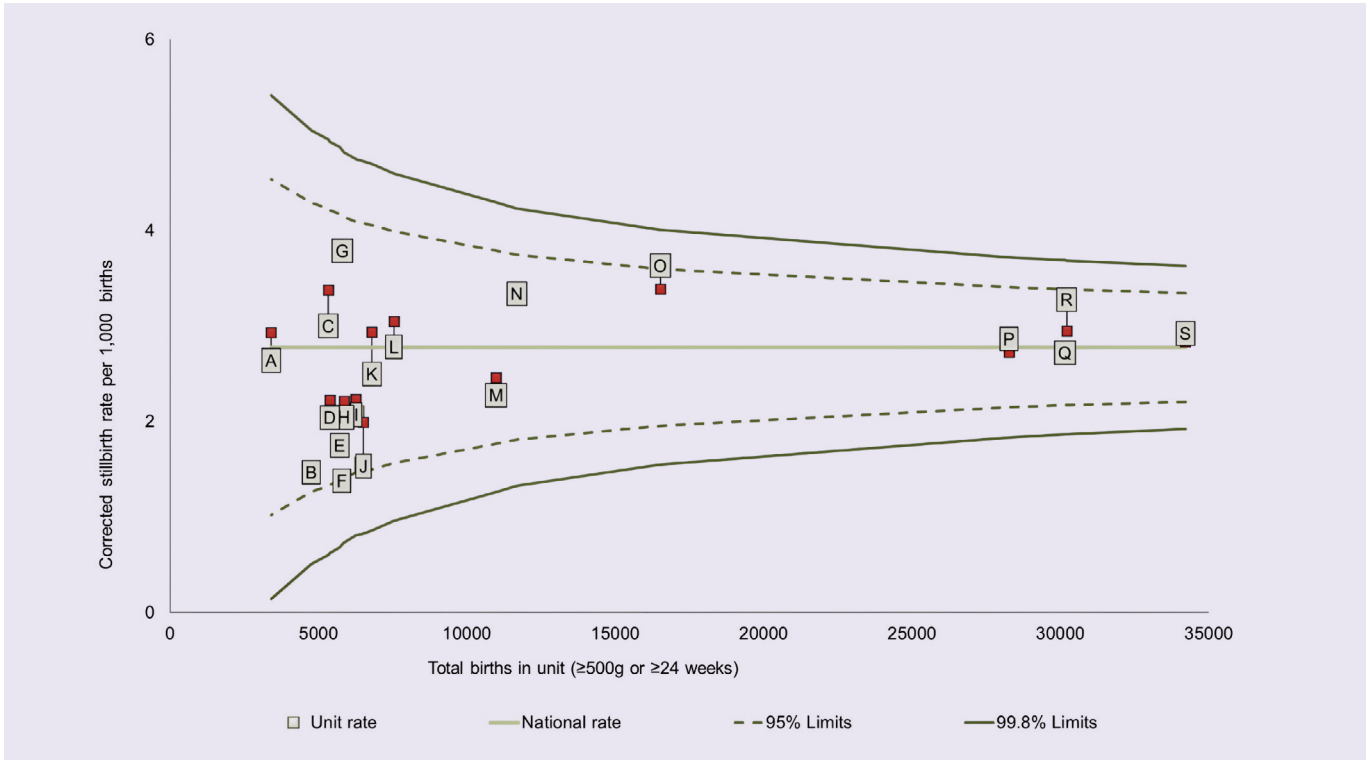


Figure 1.6: Funnel plot of the corrected stillbirth rate for Irish maternity units, 2019-2022

Note: The figure excludes perinatal deaths associated with major congenital anomalies and TOPs. 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 (TippUH)	F - Kilkenny (SLHK)	K - Waterford (UHW)	P - Cork (CUMH)
B - Kerry (UHK)	G - Portlaoise (MRHP)	L - Mullingar (RHM)	Q - Coombe (CH)
C - Sligo (SUH)	H - Mayo (MUH)	M - Galway (UHG)	R - National Maternity (NMH)
D - Cavan (CGH)	I - Letterkenny (LUH)	N - Drogheda (OLOL)	S - Rotunda (RH)
E - Portiuncula (PUH)	J - Wexford (WGH)	O - Limerick (UMHL)	

The solid horizontal line in Figure 1.7 represents the national corrected rate for early neonatal deaths for combined years 2019-2022 (0.94 deaths per 1,000 live births) based on the 218 early neonatal deaths not due to major congenital anomaly and not due to termination of pregnancies (TOPs).

Forty-four (20.2%) of the 218 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 1.7, 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, National Maternity (NMH - R), had a corrected neonatal death rate (1.96 per 1,000 live births) higher than the national rate and the upper 99.8% confidence limit. There were 21 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 1.26 per 1,000 live births and thus under the upper 95% confidence limit. One small unit, Kilkenny (SLHK - F), had a corrected neonatal death rate within the 95% confidence limits, but was above the upper 95% confidence limit after adjusting for in-utero transfers. The rates of the remaining units were within the 95% confidence limits after adjusting for in-utero transfers.

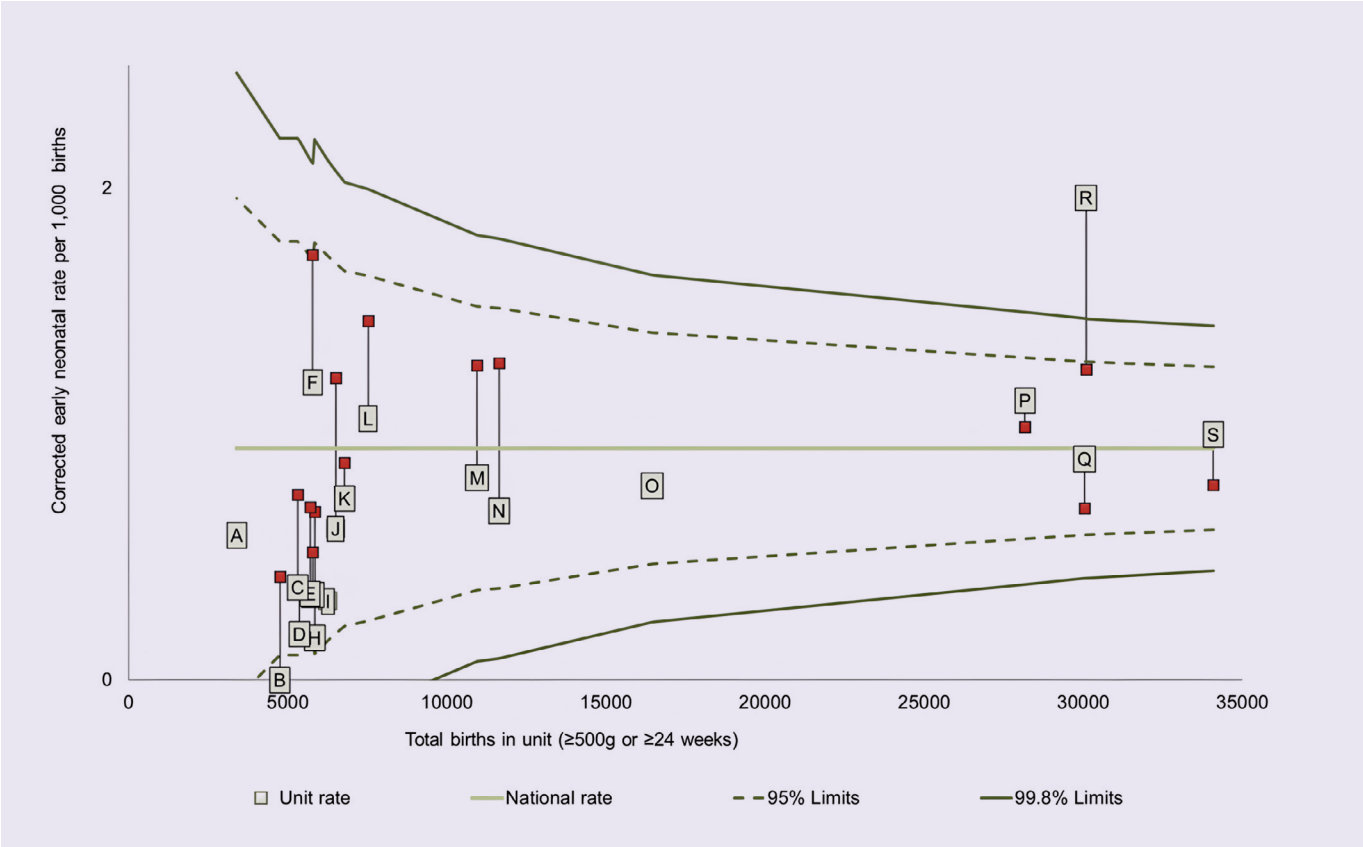


Figure 1.7: Funnel plot of the corrected early neonatal death rate for Irish maternity units, 2019-2022

Note: The figure excludes perinatal deaths associated with major congenital anomalies and TOPs. Two units (E=0.35 & G=0.35) have similar unit rates 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 (TippUH)	F - Kilkenny (SLHK)	K - Waterford (UHW)	P - Cork (CUMH)
B - Kerry (UHK)	G - Portlaoise (MRHP)	L - Mullingar (RHM)	Q - Coombe (CH)
C - Sligo (SUH)	H - Mayo (MUH)	M - Galway (UHG)	R - National Maternity (NMH)
D - Cavan (CGH)	I - Letterkenny (LUH)	N - Drogheda (OLOL)	S - Rotunda (RH)
E - Portiuncula (PUH)	J - Wexford (WGH)	O - Limerick (UMHL)	

2. Maternal characteristics

The findings presented below relate to characteristics of mothers of stillbirths and early neonatal deaths born with a birthweight ≥500g or having achieved a gestational age ≥24 weeks. Perinatal deaths following TOP are not included.

Key findings

AGE AND OBESITY

Maternal age (greater than 40 years) and **obesity** were associated with an increased risk of perinatal mortality.

ETHNICITIES

While the numbers involved were small, **Irish Traveller and Asian ethnicities were overrepresented** in the mothers who experienced **perinatal deaths** in 2022. This finding has been observed since 2018.

ANTENATAL CARE

The **majority** (70.7%) of mothers experiencing **perinatal loss** booked into hospital between **12- and 19-weeks'** gestation. The proportion of women presenting for antenatal care ≥20 weeks was lower in 2022 compared to previous years (4.6%).

Age

The age of mothers experiencing perinatal loss was known for all the perinatal deaths in 2022, (Table 2.1). The mothers who experienced perinatal loss in 2022 ranged in age from teenage years (the youngest 17 years of age) through to mid-forties (46 years of age). Their age distribution broadly reflected that of the population of mothers who gave birth in Ireland in 2022 (Table 2.1). Half of the population (50.3%) who gave birth in 2022 were aged 25-34 years, whereas a slightly lower proportion of mothers who experienced perinatal loss were in this age group (44.8%). 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 under 25 years old or aged 35-39 years old.

Table 2.1: Age distribution of mothers experiencing perinatal loss, 2022

Age group	All births N=54,665	All perinatal deaths N=290	Stillbirths N=192	Neonatal deaths N=98
<25yrs	5,005 (9.2)	37 (12.8)	23 (12)	14 (14.3)
25-29yrs	9,036 (16.5)	45 (15.5)	34 (17.7)	11 (11.2)
30-34yrs	18,454 (33.8)	85 (29.3)	57 (29.7)	28 (28.6)
35-39yrs	17,256 (31.6)	89 (30.7)	55 (28.6)	34 (34.7)
>40yrs	4,914 (9)	34 (11.7)	23 (12)	11 (11.2)

Note: The table excludes births and perinatal deaths associated with TOP. Values are shown as N(%) unless otherwise stated. Number of births by mothers' age including >/=500g or>/=24 weeks gestation for 2022 are provided by the Health Care Pricing Office (HPO)[31].

[31]Healthcare Pricing Office. Perinatal Statistics Report 2022. Dublin: Health Service Executive. [in press]

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 1.5-fold increase in the rate of perinatal mortality (p-value=0.045) in 2022. Women of less than 25 years old were 61% more likely to have a perinatal death compared to women aged 30-34 years (Table 2.2).

Table 2.2: Comparing the rate ratio of perinatal mortality by age group among mothers, 2022

Age group	Rate per 1,000 (95% CI)	Rate ratio (95% CI)	P-value
<25yrs	7.39 (5.21-10.18)	1.60 (1.09-2.36)	0.02
25-29yrs	4.98 (3.63-6.66)	1.08 (0.75-1.55)	0.67
30-34yrs	4.61 (3.68-5.69)	1.00 (reference)	
35-39yrs	5.16 (4.14-6.34)	1.12 (0.83-1.51)	0.46
>40yrs	6.92 (4.8-9.66)	1.50 (1.01-2.23)	0.045

Note: The table excludes births and perinatal deaths associated with TOP. 95% CI=Exact Poisson 95% confidence intervals; RR=Rate ratio, comparing the rate for women in each age group category versus the rate for women in the 30-34 yrs category.

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 2022, the majority of mothers who experienced perinatal loss were of white Irish ethnicity (n=192 of 287, 66.9%, data missing for three women; Table 2.3). This is lower to the proportion of white Irish women in the female population aged 15-49 years enumerated by the National Census 2022[32]. Across the five years, 2018-2022, among women whose baby died, the percentage who were Irish Travellers ranged from 2.2 to 5.1% versus 0.7% in the population of women of reproductive age.

Table 2.3: Ethnicity of mothers experiencing perinatal loss, 2022

	All perinatal deaths N=287	15-49 year-old female population, 2022
White Irish	192 (66.9)	74.7
Irish Traveller	10 (3.5)	0.7
Other white background	42 (14.6)	14.8
Asian/Asian Irish	20 (7.0)	4.9
Black/Black Irish	10 (3.5)	2.2
Other/mixed	13 (4.5)	2.7

Note: Values are shown as N(%) unless otherwise stated. Ethnicity status unknow for three women.

Employment Status

Lower socio-economic status has been shown to be associated with poor pregnancy outcomes[33]. In the NPEC national clinical audit, data on the mother's employment status at booking was sought. Data was not recorded for 14 (4.8%) of the 290 women who experienced perinatal loss, this was slightly lower than the proportion of unrecorded employment status in 2020 (5.3%) and similar to 2021 (4.5%). Table 2.4 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 (2022 data available by the Health Care Pricing Office, HPO), and for the 15–44-year-old female population from the National Census 2016[34].

Employment status was specified for 95.2% of the mothers for whom data were recorded (Table 2.4). It can be seen that unemployment status was recorded for 5.1% of the mothers experiencing perinatal loss compared to 4.6% of all

[32]Central Statistics Office. Census 2022 Profile 5 – Diversity, Migration, Ethnicity, Irish Travellers and Religion [Internet]. 2023. Available from: https://www.cso.ie/en/releasesandpublications/ep/p-cpp5/census2022profile5-diversitymigrationethnicityirishtravellersreligion/ethnicgroupbackground/

[33]MBRRACE-UK Perinatal Mortality Surveillance: Report for births in 2021. 'State of the Nation Report'. Available at: https://timms.le.ac.uk/mbrrace-uk-perinatal-mortality/surveillance/

[34]Population data from the National Census 2016. Available at: https://www.cso.ie/en/census/census2016reports/

births in 2022, 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 (19.9%) was higher than the percentage of all women engaged in home duties who gave birth (14.5%) in 2022, as in previous reports.

Table 2.4: Employment status at booking of mothers experiencing perinatal loss, 2022

	All perinatal deaths N=276	All births N=52,150	15-44 year-old female population, 2016[18] (%)
Employed	203 (73.6)	42,176 (80.9)	57.8
Unemployed	14 (5.1)	2,421 (4.6)	8.2
Home duties	55 (19.9)	7,553 (14.5)	10.4
Student	2 (0.7)	n/a	21.1
Others not in labour force	2 (0.7)	n/a	2.5
Others not in labour force	2 (0.7)	n/a	2.5

Note: The table excludes births and perinatal deaths associated with TOP. Values are shown as N(%) unless otherwise stated. Data not known on employment status for 14 mothers who experienced perinatal deaths. Number of births by occupation including >/=500g OR >/=24 weeks gestation for 2022 are provided by the Health Care Pricing Office, HPO. There were an additional 2,515 mothers in the births population whose employment status was not stated or not classifiable in 2022.

Gestation at booking

Gestation at the time of the mother's first antenatal visit to the maternity hospital was not recorded for 31 (10.7%) cases of perinatal death in 2022 (stillbirths n=8 and early neonatal deaths n=23). Of the 259 cases with data, approximately three percent were not booked (2.7%), twenty-two percent booked into hospital before 12 weeks gestation, and over seventy percent (70.7%) attended for antenatal care between 12- and 19-weeks' gestation (Table 2.5). In 2022, the median gestational age at booking was 12 weeks.

Table 2.5: Weeks gestation at date of first hospital booking, 2022

	All perinatal deaths N=259	Stillbirths N=184	Neonatal deaths N=75
Less than 12 weeks	57 (22)	33 (17.9)	24 (32)
12-19 weeks	183 (70.7)	136 (73.9)	47 (62.7)
20 weeks or later	12 (4.6)	9 (4.9)	3 (4)
Not booked	7 (2.7)	6 (3.3)	1 (1.3)

Note: Values are shown as N(%) unless otherwise stated. Gestation at booking unknown for 31 cases (8 stillbirths and 23 early neonatal deaths) in 2022.

The proportion of women presenting for first antenatal visit at 20 weeks gestation or later was lower in 2022 (4.6%) compared to previous years (Figure 2.1).

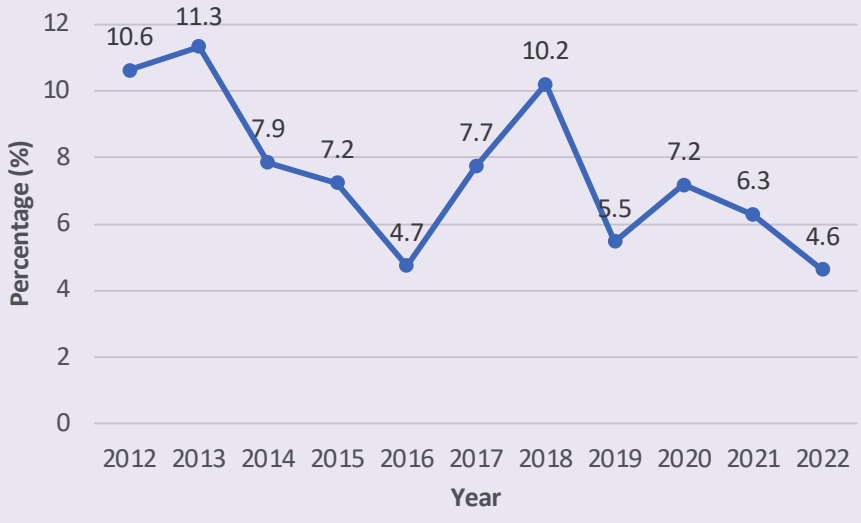


Figure 2.1: Proportion attending first booking appointment ≥20 weeks gestation among women who experienced perinatal loss in 2012-2022

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 women received an anatomy scan was available for all but one woman who experienced perinatal loss in 2022. Among the 289 women, the majority (n=262, 90.7%) had an anatomy scan. In 2022, every maternity unit provided an anatomy scan to at least 77.1% of the women.

Fertility treatment

Currently in Ireland there is no national data on the number pregnancies resulting from fertility treatment in the general pregnant population. The NPEC Perinatal Death Notification Form contains a specific question on whether the pregnancy was the result of fertility treatment.

In 2022, information was available for 267 of the 290 (92.1%) cases of perinatal death. In 21 of these 267 cases (7.9%), the pregnancy was reported to be the result of fertility treatment (n=11 of 174 stillbirths, 6.3% and n=10 of 93 early neonatal deaths, 10.8%). Over one quarter (n=6, 28.6%) of these 21 pregnancies were associated with multiple births ending in perinatal loss of one or more infants. The rate of multiples among pregnancies that were reported to be the result of fertility treatment was almost twice the rate of multiple pregnancies in the perinatal death cohort (11%).

The method of treatment was specified for all but two of the 21 pregnancies resulting from fertility treatment. In order of frequency, the methods were: in vitro fertilisation (including egg and sperm donation; n=16), ovulation induction therapy (n=1), Intrauterine insemination (n=1) and Natural Procreative Technology (NaPro) Technology (n=1).

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 BMI is not available. BMI was available for 267 of the 290 (92.1%) women who experienced perinatal loss in 2022 (Table 2.6).

In 2022, women with a BMI less than 25kg/m2 (40.1%) were underrepresented among women who experience perinatal loss compared to the population of women who gave birth in 2022 (49.1%). Overall, the percentage of women in this category in 2022 was similar to the percentage of women in this range across the years 2018 to 2022. In 2022, the percentage of women who experienced perinatal loss and who had a BMI of 30km/m2 or higher (30.0%) was higher than in 2021 (22.6%) but similar to 2020 (30.2%) and was higher than the population of women who gave birth in 2022 (20.8%).

Table 2.6: Body mass index (BMI) of mothers who experienced perinatal loss, 2018-2022

BMI Category (kg/m2)	2018 N=263	2019 N=257	2020 N=324	2021 N=314	2022 N=267	Maternities 2022 N=50,636
BMI: <25	110 (41.8)	101 (39.3)	121 (37.3)	127 (40.4)	107 (40.1)	24,854 (49.1)
BMI:25 to <30	77 (29.3)	72 (28)	105 (32.4)	116 (36.9)	80 (30.0)	14,240 (28.1)
BMI: ≥30	76 (28.9)	84 (32.7)	98 (30.2)	71 (22.6)	80 (30.0)	11,543 (22.8)

Note: Values are shown as N(%) unless otherwise stated; Percentage refers to the total 267 cases for which BMI was obtained in 2022. The percentage of missing BMI data ranged from 7.8% to 19.1% between 2018 and 2022. Data on BMI were collated for 32,507 maternities in 2022 from six maternity units. This is 59.5% of the 54,665 women who gave birth in hospital in Ireland in 2022, according to Healthcare Pricing Office (HPO). We multiplied the BMI data on 32,507 women by 1.68 (i.e. 100%/59.4%) in order to estimate the national number of maternities by BMI category.

As shown in Table 2.7, women in the obese category who experienced perinatal loss were overrepresented relative to the population of women who gave birth in 2022. This was reflected in the perinatal mortality rate of 6.92 per 1,000 for women in the obese category. Thus, women in the obese category had a 61% higher risk of perinatal mortality compared to women who gave birth in 2022 with a lean BMI (p-value=0.001). The increased risk for women in the overweight category was less evident in 2022 compared to recent years.

[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]Aune D, Saugstad OD, Henriksen T, Tonstad S. Maternal Body Mass Index and the Risk of Fetal Death, Stillbirth, and Infant Death: A Systematic Review and Meta-analysis. JAMA. 2014;311(15):1536–1546. doi:10.1001/jama.2014.2269

[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.

Table 2.7: Perinatal mortality by body mass index (BMI) among mothers, 2022

BMI Category (kg/m2)	Rate per 1,000 (95% CI)	Rate Ratio (95% CI)	P-Value
BMI: <25	4.30 (3.53-5.19)	1.00 (reference)	-
BMI:25 to <30	5.61 (4.45-6.98)	1.30 (0.98-1.74)	0.072
BMI: ≥30	6.92 (5.49-8.6)	1.61 (1.2-2.15)	0.001

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 optimise 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 270 (93.1%) of the 290 women. Of these, 37 (13.7%) were smokers at the time of booking. Nineteen were smoking between one and nine cigarettes per day (n=19 of 269, 7.1%, unknown for one woman), and seventeen were smoking at least 10 cigarettes per day (6.3%).

Information on smoking in late pregnancy was available for all the women who smoked at time of booking and only three (8.1%) 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]

Five women had a documented history of alcohol misuse prior to pregnancy and another one had a documented history of alcohol misuse during pregnancy. Five women had a documented history of drug misuse prior to pregnancy and a further four had a documented history of drug misuse during pregnancy. Women who had a documented history of alcohol misuse were not the same as the five women who had a documented history of drug misuse.

Previous pregnancy

Sixty-six percent of mothers who experienced perinatal loss in 2022 had at least one previous pregnancy (gravida > 0; 192 of 290, 66.2%). Table 2.8 specifies gravida/parity for the 290 women who experienced perinatal loss. Over one third of women (n=98, 33.8%) had never been pregnant before (gravida = 0). Of the 192 women who had been pregnant (gravida > 0), almost 50% (n=91, 47.4%) had pregnancies delivering from 24 weeks or with a birthweight of ≥ 500g (gravida = parity, indicated by green shading). Over one third of these 192 mothers (n=71, 37.0%) 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 15.6% (n=30) of these women, their previous pregnancies never exceeded 24 weeks gestation or 500g birthweight (gravida > parity = 0, indicated by orange shading).

Table 2.8: Gravida/parity of mothers prior to experiencing perinatal loss, 2022

	Parity								
	0	**1**	**2**	**3**	**4**	**5**	**6**	**>=7**	**Total**
0	98	0	0	0	0	0	0	0	98
1	24	53	0	0	0	0	0	0	77
2	6	24	19	0	0	0	0	0	49
3	0	6	8	9	0	0	0	0	23
4	0	2	9	6	6	0	0	0	23
5	0	0	0	2	3	2	0	0	7
6	0	0	1	3	1	0	1	0	6
7	0	0	0	0	0	0	0	1	1
>=8	0	0	0	2	0	0	1	3	6
Total	128	85	37	22	10	2	2	4	290

Note: We refer to gravida and parity prior to the pregnancy ending in perinatal death in 2022. 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.

[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

Of the 192 women who had a previous pregnancy, 33.5% (n=63) were reported to have had a previous pregnancy-related problem. Information in relation to previous pregnancy-related problems was unknown for four women (2%). Caesarean section delivery was the most common previous pregnancy-related problem with almost nineteen percent of mothers (n=36, 18.8%) having a previous caesarean section delivery (Table 2.9). Experiencing pre-term birth or mid-trimester loss and pre-eclampsia were the second most common previous pregnancy problems (n=7, 3.6% each) followed closely by experiencing three or more miscarriages, baby with congenital anomalies and previous neonatal death (n=6, 3.1% each). Under the "Other" category a wide range of problems were captured, including gestational diabetes, ectopic pregnancy, and pregnancy induced hypertension among other obstetric conditions. A review of the NPEC perinatal death notification form by the PMNCAGC in 2023 included a review of the categories of previous pregnancy-related problems. This will assess more accurately the range of previous obstetric problems associated with perinatal loss.

Table 2.9: Previous pregnancy-related problems in mothers who experienced perinatal loss in 2018-2022

	2018 N=230	2019 N=244	2020 N=252	2021 N=242	2022 N=192
Previous caesarean delivery	41 (16.8)	41 (16.8)	58 (23)	47 (21.2)	36 (18.8)
Pre-term birth or mid-trimester loss	18 (7.4)	18 (7.4)	12 (4.8)	19 (8.6)	7 (3.6)
Three or more miscarriages	12 (4.9)	12 (4.9)	21 (8.3)	15 (6.8)	6 (3.1)
Baby with congenital anomaly	5 (2.0)	5 (2.0)	5 (2)	7 (3.2)	6 (3.1)
Infant requiring intensive care	8 (3.3)	8 (3.3)	7 (2.8)	10 (4.5)	5 (2.6)
Stillbirth	7 (2.9)	7 (2.9)	4 (1.6)	8 (3.6)	3 (1.6)
Neonatal death	3 (1.2)	3 (1.2)	6 (2.4)	2 (0.9)	6 (3.1)
Pre-eclampsia	9 (3.7)	9 (3.7)	8 (3.2)	8 (3.6)	7 (3.6)
Placental abruption	1 (0.4)	0 (0)	2 (0.8)	3 (1.4)	1 (0.5)
Placenta praevia	2 (0.8)	2 (0.8)	4 (1.6)	1 (0.5)	1 (0.5)
Post-partum haemorrhage requiring transfusion	5 (2.0)	5 (2)	4 (1.6)	8 (3.6)	2 (1)
Other	30 (12.3)	30 (12.3)	32 (12.7)	26 (11.7)	18 (9.4)
***Any pre-existing medical problem**	102 (44.3)	95 (38.9)	113 (44.8)	104 (42.9)	63 (32.8)

Note: Values are shown as N (%) unless otherwise stated; Percentage relates to the total number of mothers who had a previous pregnancy (n=192); more than one previous pregnancy related problem may apply per woman. * "Any pre-existing medical problem" represents the number of women who had 'any pre-existing medical problem'.

In terms of parity, women who experienced perinatal loss in 2022 were more likely to have three or more previous births compared to the population of women who gave birth in 2022 (Table 2.10).

Table 2.10: Distribution of parity, 2018-2022

Parity	2018 N=325	2019 N=359	2020 N=357	2021 N=356	2022 N=290	All births 2022 N=54,665
Para 0	123 (37.8)	156 (43.5)	133 (37.3)	145 (40.7)	128 (44.1)	21,820 (39.9)
Para 1	88 (27.1)	96 (26.7)	120 (33.6)	114 (32)	85 (29.3)	19,336 (35.4)
Para 2	61 (18.8)	69 (19.2)	63 (17.6)	56 (15.7)	37 (12.8)	8,911 (16.3)
Para 3+	53 (16.3)	38 (10.6)	41 (11.5)	41 (11.5)	40 (13.8)	4,598 (8.4)

Note: The table excludes births and perinatal deaths associated with TOP. Values are shown as N(%) unless otherwise stated; Para 0 equals to nulliparous women. Number of births by parity including >/=500g OR >/=24 weeks gestation for 2022 are provided by the Health Care Pricing Office (HPO)[40].

In 2022, a parity of 3 or more showed a 48% increased risk for perinatal mortality compared to women who were nulliparous (Table 2.11).

[40]Healthcare Pricing Office. Perinatal Statistics Report 2022. Dublin: Health Service Executive. [in press]

Table 2.11: Comparing the rate ratio of perinatal mortality by parity among mothers, 2022

Parity	Rate per 1,000 (95% CI)	Rate Ratio (95% CI)	P-value
Nulliparous (Parous 0)	5.87 (4.9-6.97)	1.00 (reference)	-
Para 1	4.40 (3.51-5.43)	0.75 (0.57-0.99)	0.04
Para 2	4.15 (2.93-5.72)	0.71 (0.49-1.02)	0.06
Para 3+	8.70 (6.22-11.83)	1.48 (1.04-2.11)	0.03

Note: The table excludes births and perinatal deaths associated with TOP. 95% CI=Exact Poisson 95% confidence intervals; RR=Rate ratio, comparing the rate for women in each parity category versus the rate for women in the nulliparous category.

Pre-existing medical problems

Information about pre-existing medical conditions was available for 282 of the 290 mothers who experienced perinatal loss in 2022 (97.2%) (Table 2.12). Almost thirty-seven percent of these 282 women had a pre-existing medical problem (n=104, 36.9%). This was around the same distribution compared to previous years.

The most common type of pre-existing medical problems were psychiatric disorders with 10.3% of mothers (n=29 of 282 women) suffering from conditions of this type (Table 2.12). This was followed by endocrine disorders (n=21, 7.4%). 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 (19.1%), a review of the NPEC perinatal death notification form by the PMNCAGC included a review of subcategories of pre-existing medical problems to assess more accurately the impact of specific pre-existing maternal morbidities associated with perinatal loss.

Table 2.12: Pre-existing medical problems in mothers who experienced perinatal loss, 2018-2022

	2018 N=325	2019 N=360	2020 N=356	2021 N=348	2022 N=282
Psychiatric disorder	17 (5.2)	19 (5.3)	30 (8.4)	35 (10.9)	29 (10.3)
Endocrine disorder	16 (4.9)	23 (6.4)	17 (4.8)	23 (7.2)	21 (7.4)
Diabetes	8 (2.5)	13 (3.6)	7 (2)	8 (2.5)	8 (2.8)
Cardiac disease	6 (1.8)	2 (0.6)	1 (0.3)	3 (0.9)	5 (1.8)
Hypertension	11 (3.4)	8 (2.2)	12 (3.4)	11 (3.4)	8 (2.8)
Renal disease	1 (0.3)	2 (0.6)	6 (1.7)	4 (1.2)	2 (0.7)
Haematological disorder	4 (1.2)	1 (0.3)	5 (1.4)	4 (1.2)	3 (1.1)
Inflammatory disorder	4 (1.2)	1 (0.3)	9 (2.5)	12 (3.7)	9 (3.2)
Epilepsy	2 (0.6)	4 (1.1)	3 (0.8)	6 (1.9)	1 (0.4)
Other	54 (16.6)	75 (20.8)	73 (20.5)	65 (20.2)	54 (19.1)
***Any pre-existing medical problem**	100 (30.8)	118 (32.8)	121 (34)	115 (35.8)	104 (36.9)

Note: Percentage relates to the total number of mothers who had any information available for previous medical problems (n=282) in 2022; 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 70% of women who experienced a stillbirth (n=133 of 192, 69.3%) and in approximately 16% of those who experienced a neonatal death (n=16 of 98, 16.3%).

The type of care received at delivery was known for of all mothers who experienced perinatal loss (n=290). The vast majority of the babies (n=282, 97.2%) were delivered under obstetric-led care which is the predominant model of care in Ireland.

Nine babies (3.1%) were born before arrival at the maternity unit.

Presentation at delivery was known for 99.3% of all mothers who experienced perinatal loss (n=288 of 290). Over seventy percent of presentations at delivery were vertex presentations (n=205, 71.2%), twenty-eight percent were breech presentation (n=81, 28.1%) and in just two cases, the presentation was compound (0.7%).

The mode of delivery was known for 100% of women who experienced perinatal loss (Table 2.13). Spontaneous vaginal cephalic delivery was the mode of delivery for over sixty percent of stillbirths (n=119 of 192, 62.0%) and for almost thirty percent of the babies who died in the early neonatal period (n=29 of 98, 29.6%). Approximately fifteen percent of stillbirths involved caesarean section (n=30, 15.6%), predominantly pre-labour (n=22, 11.5%). For early neonatal deaths, over 50% (n=53, 54.1%) were delivered by caesarean section, again predominantly by pre-labour caesarean section (n=37, 37.8%) as opposed to caesarean section after the onset of labour (16.3%). Among perinatal deaths delivered by caesarean section (n=83, 28.6%), over forty percent of the mothers who had a stillbirth (n=13 of 30, 43.3%) and nineteen percent of mothers who had an early neonatal death (n=10 of 53, 18.9%) had a previous caesarean delivery. In comparison to the proportion of all births occurring with spontaneous and assisted breech delivery in 2022 (0.4%), this type of delivery is more common in stillbirths (20.3%) and neonatal deaths (15.3%).

Table 2.13: Mode of delivery for mothers who experienced perinatal loss, 2022

	All perinatal deaths N=290	Stillbirths N=192	ENND N=98		All births 2022 N=54,665
Spontaneous vaginal cephalic	148 (51)	119 (62.0)	29 (29.6)	Vaginal birth	26,158 (47.9)
Breech; spontaneous and assisted	54 (18.6)	39 (20.3)	15 (15.3)	Breech; spontaneous and assisted	206 (0.4)
Pre-labour caesarean section	59 (20.3)	22 (11.5)	37 (37.8)	Caesarean section	21,229 (38.8)
Caesarean section after the onset of labour	24 (8.3)	8 (4.2)	16 (16.3)		
Ventouse	1 (0.3)	1 (0.5)	0 (0)	Ventouse	5,402 (9.9)
Forceps	4 (1.4)	3 (1.6)	1 (1)	Forceps	1,670 (3.1)

Note: The table excludes births and perinatal deaths associated with TOP. Values are N(%) unless otherwise stated. Number of births by method of delivery including >/=500g OR >/=24 weeks gestation for 2022 are provided by the Health Care Pricing Office (HPO).

The type of caesarean section was known for all stillbirth cases delivered by caesarean section (n=30). Emergency caesarean section delivery was the most common type of caesarean section delivery in stillbirths (n=14, 46.7%) in 2022, followed by elective caesarean section (i.e. maternal or fetal compromise which is not immediately life threatening) and urgent caesarean section (i.e. maternal or fetal compromise which is an immediate threat to life of women or fetus) with 27% each (n=8, 26.7%).

The type of caesarean section was known for all early neonatal cases delivered by caesarean section (n=53). Emergency caesarean delivery was the most common type of caesarean delivery in neonatal deaths in 2022 (n=30, 56.6%), followed by elective caesarean section delivery and urgent caesarean delivery which were carried out in approximately 21% of neonatal deaths each (n=11, 20.8%). One neonatal death had a caesarean section following failed instrumental delivery in 2022.

Level of care for mothers post-delivery

For women who experienced perinatal loss in 2022, 7.9% (n=23 of 290) were admitted to a high dependency unit (HDU). Admission to HDU was similar for the mothers in cases of early neonatal deaths compared to stillbirths in 2022 (8.2% versus 7.8%, respectively). Five cases (n=5 of 290, 1.7%) were admitted to an intensive care unit (ICU), a lower percentage than reported in the previous two years (Table 2.14). Deliveries by emergency/urgent caesarean section were associated with high levels of admission to the HDU (n=11 of 23) and ICU (n=3 of 5).

Table 2.14: Post-delivery outcome for mothers who experienced perinatal loss, 2018-2022

	2018 N=325	2019 N=360	2020 N=357	2021 N=356	2022 N=290	Stillbirths 2022 N=192	Early neonatal deaths 2022 N=98
Admitted to HDU	25 (7.7)	23 (6.4)	43 (12)	20 (5.6)	23 (7.9)	15 (7.8)	8 (8.2)
Admitted to ICU	7 (2.2)	5 (1.4)	18 (5)	13 (3.7)	5 (1.7)	4 (2.1)	1 (1)

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 2022. In 2022 no women experiencing perinatal loss were admitted to both HDU and ICU.

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. Following a revision of the NPEC Perinatal Notification Form by the PMNCAGC, the indication for HDU/ICU admission will be captured in future audits from 2024.

In 2022 no women experiencing perinatal loss were admitted to both HDU and ICU.

Of the 15 women delivering stillbirths who were admitted to HDU, placental abruption was associated with over half of the cases (n=8, 53.3%). Of the remaining seven cases, an associated maternal disorder was reported in all cases including: Pre-eclampsia toxaemia (PET) (n=2), chorioamnionitis (n=4) and uterine rupture before labour (n=1).

Similarly, of the 8 women experiencing an early neonatal death (ENND) admitted to an HDU, three cases were associated with placental abruption, two cases with chorioamnionitis and a further two cases with PET. For the remaining case, there were no maternal complications associated with the neonatal death.

Of the five women experiencing perinatal loss who were admitted to ICU (n=4 stillbirths and n=1 ENND), placental abruption was reported as the cause of the perinatal death in 60% of cases (n=3). Of the remaining two cases, sepsis was reported as an associated maternal morbidity, with both women being cared for in an ICU in an acute general hospital.

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

BIRTHWEIGHT

As in previous reports, **low birthweight** centiles were associated with **perinatal deaths** in 2022, particularly stillbirths.

MULTIPLE BIRTHS

An increased risk of perinatal mortality with **multiple births compared to singleton pregnancies** was again identified in 2022. Perinatal death from multiple births accounted for 11.4% of all perinatal deaths.

AUTOPSY

The rate of autopsy uptake continues to be higher in stillbirths compared to neonatal deaths.

Sex

In 2022 there was one stillbirth for which the sex of the baby was indeterminate (Table 2.15). Of the 290 perinatal deaths, 58.6% were male (n=170). In the overall population of births in 2022, 51.3% were male and 48.7% female. Male babies outnumbered female babies among stillbirths and early neonatal deaths.

Table 2.15: Sex of baby in stillbirths and neonatal deaths, 2022

	Stillbirths N=192	Early neonatal deaths N=98	All births N=54,665
Male	105 (54.7)	65 (66.3)	28,063 (51.3)
Female	86 (44.8)	33 (33.7)	26,598 (48.7)
Indeterminate	1 (0.5)	0 (0)	4 (0)

Note: The table excludes births and perinatal deaths associated with TOP. Values are N(%) unless otherwise stated. Number of births by sex including >/=500g or >/=24 weeks gestation and without TOPs for 2022 are provided by the Health Care Pricing Office (HPO).

Multiple births

An increased risk of perinatal mortality associated with multiple pregnancy compared to singleton pregnancy was again found in 2022. There were 33 perinatal deaths from multiple births, making up 11.4% of all perinatal deaths in 2022 (Table 2.16). This is around three times the proportion of multiples among all births in 2022 (3.5%).

Table 2.16: Perinatal deaths from singleton and multiple births, 2022

	Stillbirths N=192	Early neonatal deaths N=98	Perinatal deaths N=290		All births 2022 N=54665
Singleton	177 (92.2)	80 (81.6)	257 (88.6)	Singleton	52,736 (96.5)
Twin	15 (7.8)	16 (16.3)	31 (10.7)	Multiple	1,929 (3.5)
Triplet	0 (0)	2 (2)	2 (0.7)		

Note: The table excludes births and perinatal deaths associated with TOP. Values are N(%) unless otherwise stated. Number of births by plurality including >/=500g or >/=24 weeks gestation for 2022 are provided by the Health Care Pricing Office, HPO.

In 2022, the perinatal mortality rate for babies in multiple pregnancies was 3.51 times higher than singleton births at 17.11 per 1,000 live births (p<0.001; Table 2.17).

Table 2.17: Comparing the rate ratio of perinatal mortality by single and multiple births among mothers, 2022

Parity	Rate per 1,000 (95% CI)	Rate Ratio (95% CI)	P-value
Singleton	4.87 (4.29-5.51)	1.00 (reference)	-
Multiple	17.11 (11.8-23.94)	3.51 (2.44-5.04)	<0.001

Note: The table excludes births and perinatal deaths associated with TOP. 95% CI=Exact Poisson 95% confidence intervals; RR=Rate ratio, comparing the rate for multiple births versus the rate for singleton births.

The 33 perinatal deaths from multiple births comprised of 18 early neonatal deaths and 15 stillbirths. The majority (n=6, 33.3%) of the 18 early neonatal deaths from multiple births were due to major congenital anomalies, followed by five deaths due to neurological conditions (27.8%). A further five (27.8%) deaths were due to respiratory disorders, primarily related to immaturity and one case due to twin-to-twin transfusion. There was one neonatal death from multiple births where the cause of death was unexplained in 2022.

The main cause of death for the 15 stillbirths from multiple births was major congenital anomalies (n=7, 46.7%), followed by specific fetal conditions (e.g. includes twin-to-twin transfusion, n=3, 20.0%). Infection and specific placental conditions accounted for a further two deaths each. In the remaining case, the cause of death was due to mechanical factors.

Chorionicity was reported for all of the perinatal deaths from multiple births. The majority were dichorionic diamniotic (n=22, 66.7%), followed by monochorionic diamniotic (n=9, 27.3%) twins. The remaining cases were trichorionic (n=2, 6.1%), both of which delivered prematurely.

In 2022, there were 19 cases where one twin died, six pairs of twins where both twins died (n=12), and one set of triples where two triplets died (n=2), representing a total of 33 perinatal losses.

Gestational age at delivery

The vast majority of perinatal deaths in 2022 were associated with delivery before 37 weeks gestation (n=198 of 286, 69.2%, missing information for four cases; Figure 2.2). This was the case for 68.1% of stillbirths (n=128 of 188, missing information for four cases) and 71.4% of early neonatal deaths (n=70 of 98). Unsurprisingly, the majority of stillbirths delivered at 37-41 weeks (n=60 of 188, 31.9%) while the majority of early neonatal deaths delivered at 22-27 weeks (n=37 of 98, 37.8%). Extreme preterm delivery (i.e. less than 28 weeks gestation) was more often associated with cases of early neonatal deaths compared to stillbirth (38.8% versus 27.7%, respectively).

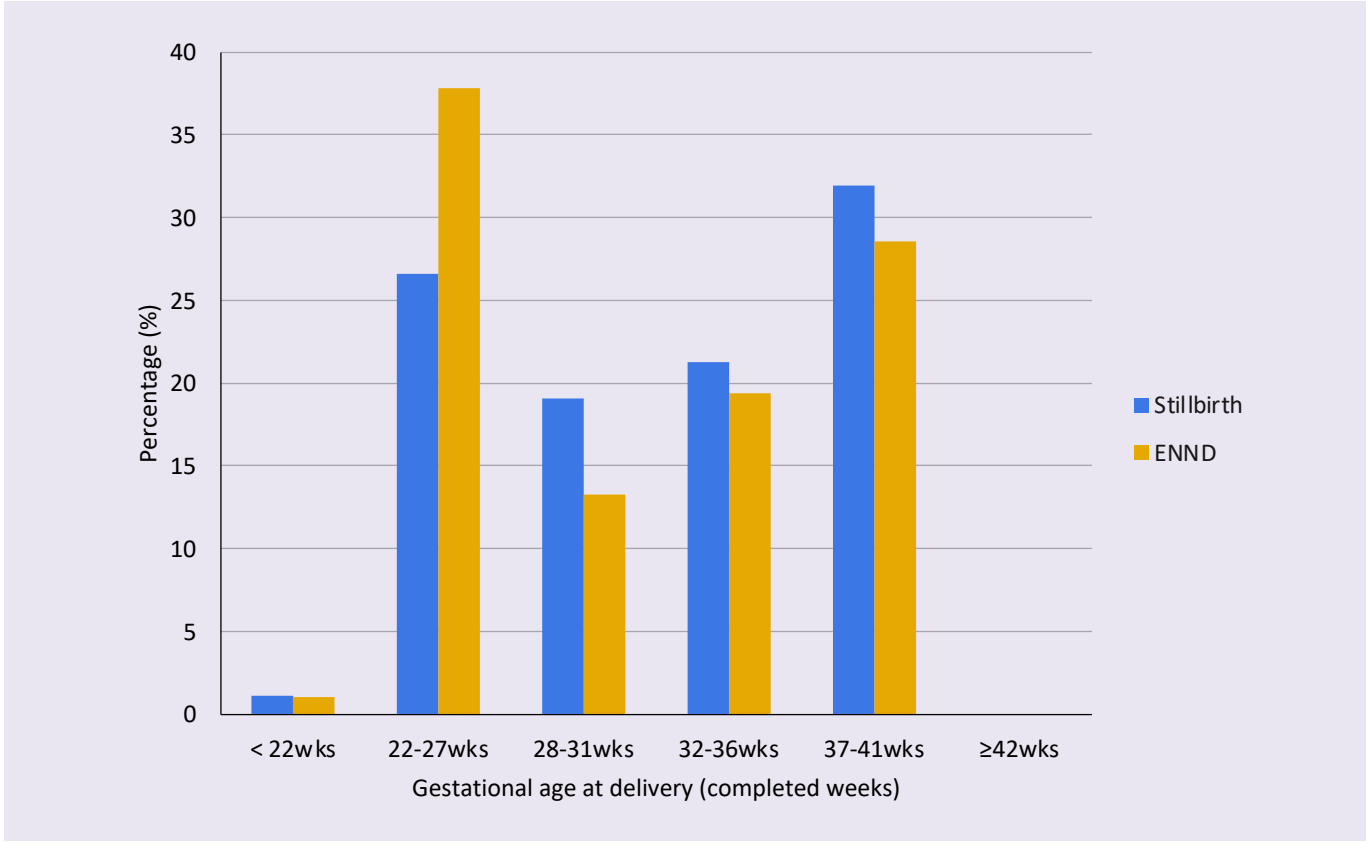


Figure 2.2: Distribution of gestational age at delivery in stillbirths and neonatal deaths, 2022

Note: Data on gestational age was unknown for four stillbirths. ENND= Early neonatal death

Birthweight

The most represented birthweight in cases of perinatal death was in the range 500-999 grams (n=81 of 290, 27.9%; Figure 2.3).

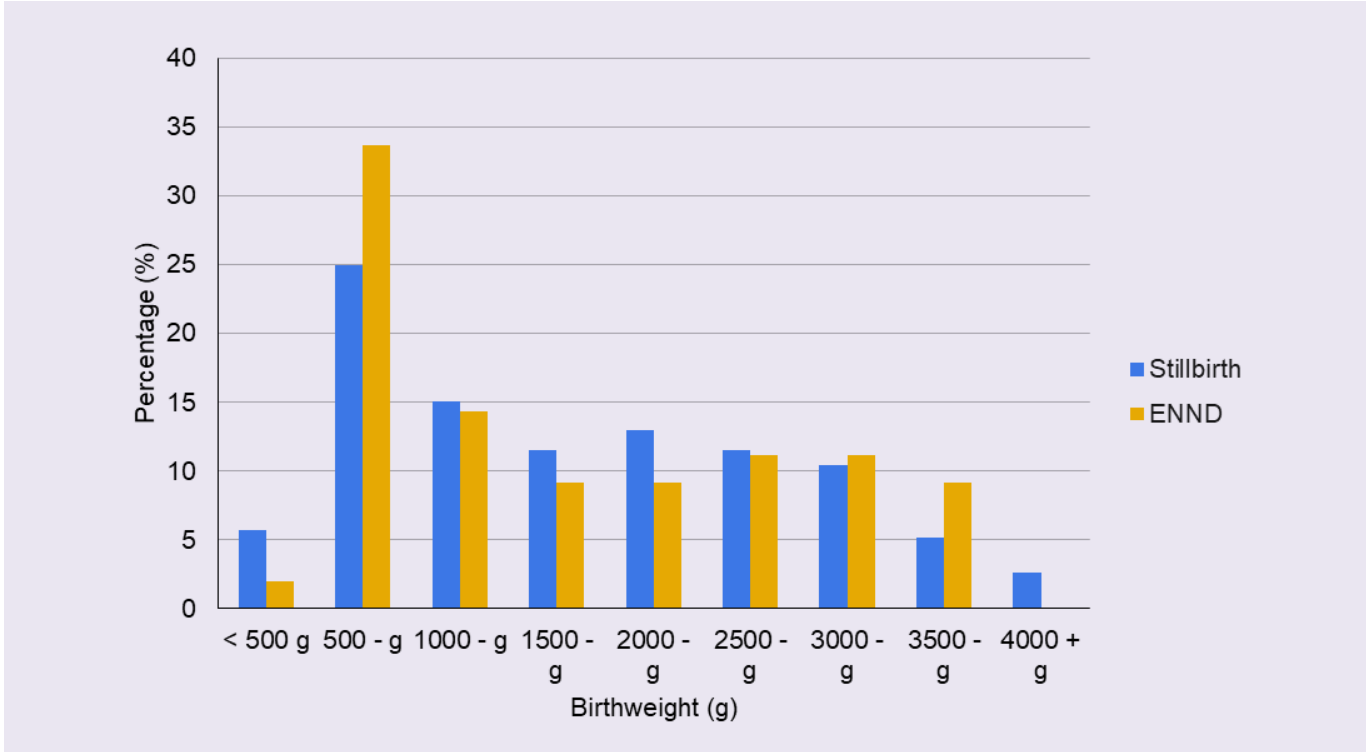


Figure 2.3: Distribution of birthweight in stillbirths and neonatal deaths, 2022

Note: ENND= Early neonatal death

Almost half of the perinatal deaths in 2022 (n=137 out of 290, 47.2%) had a birthweight below 1,500g compared to the 1% of the overall population in the same year (n=565 out of 54,665, 1.0%). A total of 45 stillbirths and 40 early neonatal deaths were due to MCAs (n=85 out of 137, 62%).

In approximately seventy percent of perinatal deaths (n=202, 69.7%), the birthweight was less than 2,500 grams (Table 2.18). For stillbirths, 70.3% had a birthweight below 2,500g (n=135) and 68.4% of neonatal deaths (n=67) also registered weight below this value. This is in contrast to the overall population of births in 2022, of whom approximately 6% had a birthweight below 2,500g (n=3,420 of 54,665, 6.3%). Thus, highlighting the association between perinatal deaths and low birth weight.

Table 2.18: Distribution of birthweight in stillbirths and early neonatal deaths, 2022

	Stillbirths N=192	Early neonatal deaths N=98	Perinatal deaths N=290	All births N=54,665
< 500g*	11 (5.7)	2 (2)	13 (4.5)	26 (0)
500 - 999g	48 (25)	33 (33.7)	81 (27.9)	235 (0.4)
1000 - 1499g	29 (15.1)	14 (14.3)	43 (14.8)	304 (0.6)
1500 - 1999g	22 (11.5)	9 (9.2)	31 (10.7)	661 (1.2)
2000 - 2499g	25 (13)	9 (9.2)	34 (11.7)	2,194 (4)
2500 - 2999g	22 (11.5)	11 (11.2)	33 (11.4)	7,361 (13.5)
3000 - 3499g	20 (10.4)	11 (11.2)	31 (10.7)	18,454 (33.8)
3500 - 3999g	10 (5.2)	9 (9.2)	19 (6.6)	18,488 (33.8)
4000 or more g	5 (2.6)	0 (0)	5 (1.7)	6,941 (12.7)

Note: The table excludes births and perinatal deaths associated with TOP. Values are N(%) unless otherwise stated. *All babies who had a birthweight less than 500g had a gestational age of ≥ 24 weeks. Number of births by birthweight including >/=500g OR >/=24 weeks gestation for 2022 are provided by the Health Care Pricing Office, HPO, and it was not stated for one woman.

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 2022. To do so, we used the Gestation Related Optimal Weight (GROW) software[41] 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.[42]

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 2022). 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 2022 in Figure 2.4, and with the birthweights for cases of early neonatal death in 2022 in Figure 2.5. For stillbirths across all gestational ages, a high proportion were below the lower limit of the normal range (10th centile). This was observed to a lesser extent among early neonatal deaths.

Figures 2.4 and 2.5 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.[43] Small-for-gestational-age (SGA) refers to birthweights below the 10th centile and severely SGA refers to birthweights less than the 3rd centile.[44]

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

[42]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

[43]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.

[44]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

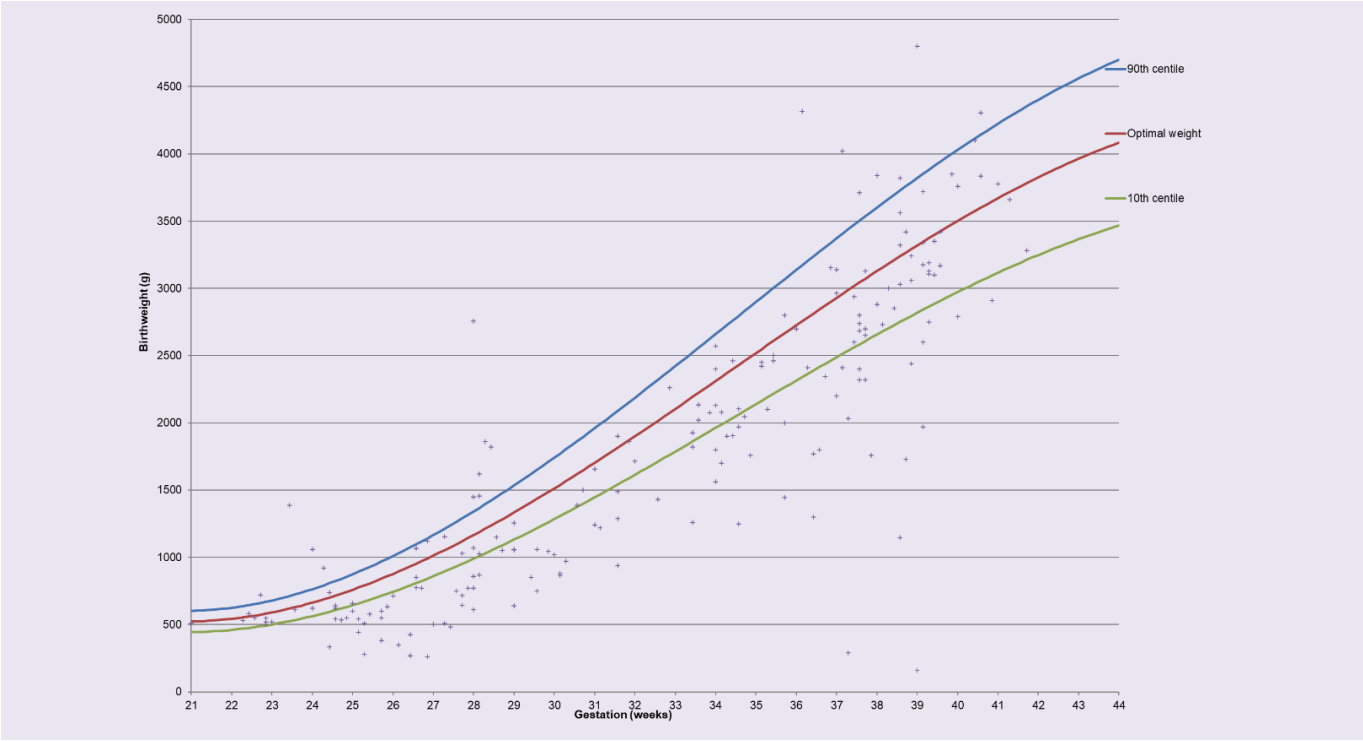


Figure 2.4: Optimal birthweight and normal range compared to actual birthweights of stillbirths, 2022

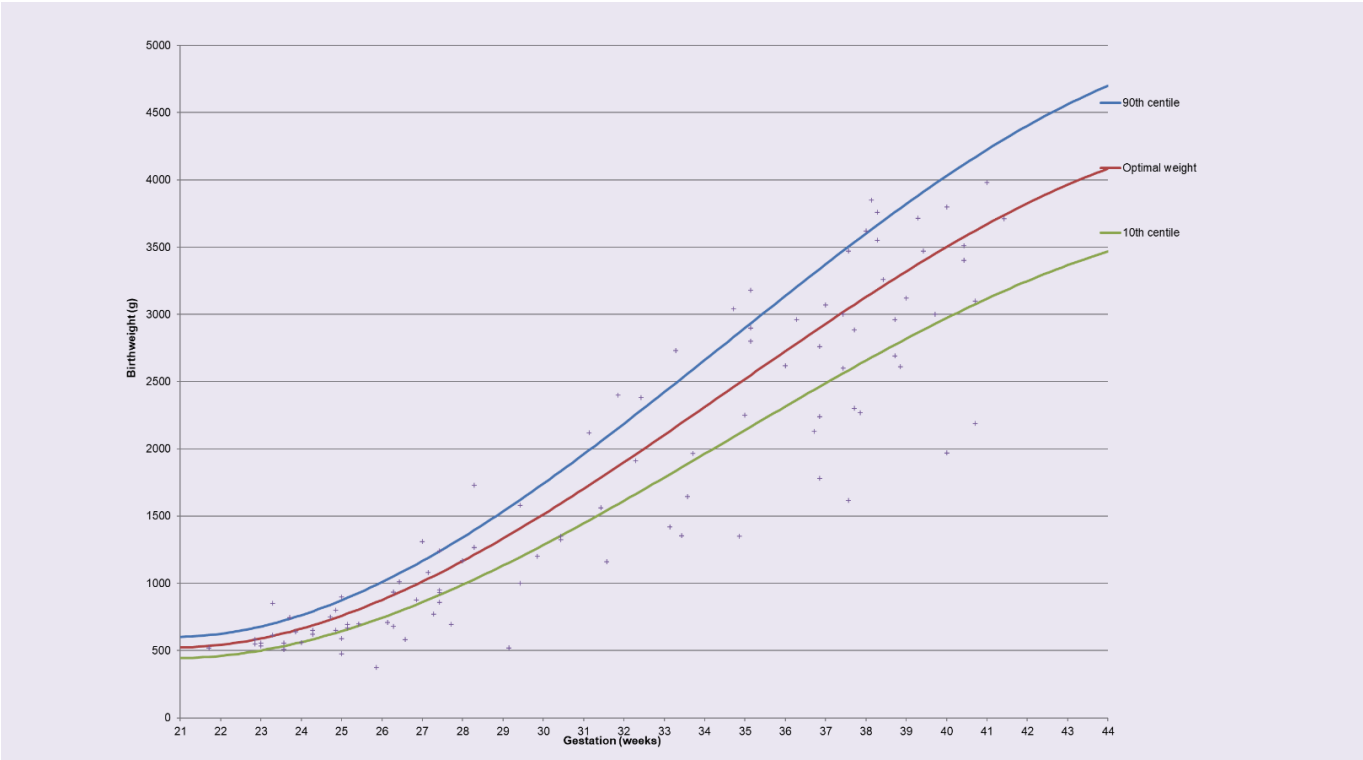


Figure 2.5: Optimal birthweight and normal range compared to actual birthweights in early neonatal deaths, 2022

Customised birthweight centiles were derived using the GROW software.[45] There was missing data for maternal height (n=25, 8.6%) and weight (n=22, 7.6%). 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 286 of the 290 perinatal deaths in 2022, unknown for four stillbirths.

The distribution of customised birthweight centiles at all gestations is illustrated for stillbirths in Figure 2.6 and for early neonatal deaths in Figure 2.7. 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).

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

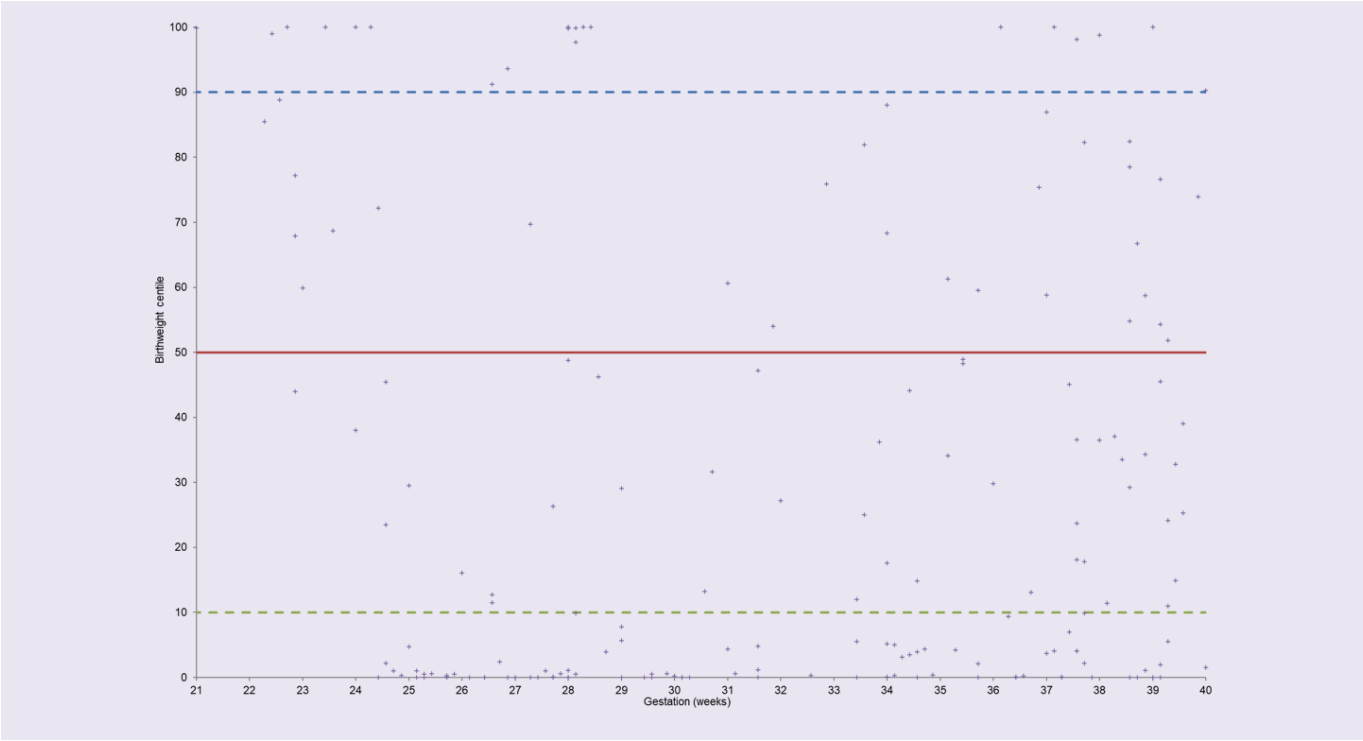


Figure 2.6: Distribution of customised birthweight centiles for stillbirths, 2022

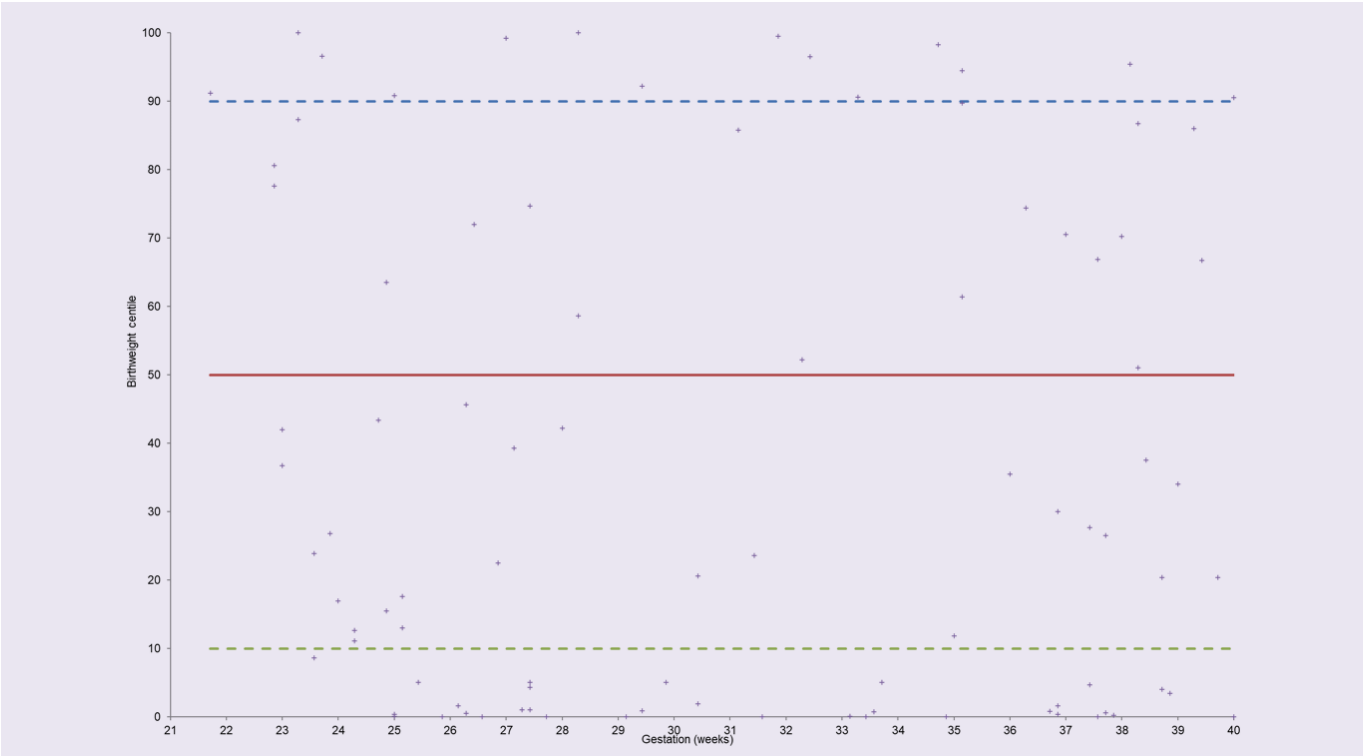


Figure 2.7: Distribution of customised birthweight centiles for early neonatal deaths, 2022

Table 2.19 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-four percent (n=63 of 188, 33.5%, missing information for four cases) of all stillbirths were classified as severely SGA (i.e. <3rd customised birthweight centile), and almost 50% (n=87, 46.3%) were SGA (i.e. <10th customised birthweight centile) compared to 26.0% (n=25 of 98, 25.5%) and 36% (n=35, 35.7%) 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 2022 (Table 2.19). 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 2.19: Distribution of customised birthweight centiles, 2022

Centile	Stillbirth (N=188 of 192)	Neonatal death (N=98 of 98)
< 3rd	63 (33.5)	25 (25.5)
< 10th *	87 (46.3)	35 (35.7)
10-49th	47 (25.0)	28 (28.6)
50-89th	31 (16.5)	21 (21.4)
90th+	23 (12.2)	14 (14.3)
Total	188 (100)	98 (100)

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

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 2.20). Almost 56% of the 45 stillbirths due to major congenital anomaly (n=25, 55.6%) were severely SGA in comparison to 27% of the stillbirths due to other causes (n=38, 26.6%). Similarly, thirty-eight percent of the 40 early neonatal deaths due to major congenital anomaly (n=15, 37.5%) were severely SGA compared to seventeen percent (n=10, 17.2%) of the 58 early neonatal deaths due to other causes.

Table 2.20: Distribution of customised birthweight centiles of perinatal deaths with and without major congenital anomaly, 2022

	Stillbirth N=188 of 192		Early neonatal death N=98 of 98	
	Cause of death: MCA		Cause of death: MCA	
	Yes N=45	No N=143	Yes N=40	No N=58
< 3rd	25 (55.6)	38 (26.6)	15 (37.5)	10 (17.2)
< 10th*	30 (66.7)	57 (39.9)	20 (50.0)	15 (25.9)
10-49th	9 (20.0)	38 (26.6)	6 (15.0)	22 (37.9)
50-89th	1 (2.2)	30 (21)	9 (22.5)	12 (20.7)
90th+	5 (11.1)	18 (12.6)	5 (12.5)	9 (15.5)

Note: Values are N(%) unless otherwise stated; *Includes cases from the category <3rd Centile. Centiles could not be calculated for four stillbirths. MCA= major congenital anomaly.

Diagnosis of fetal growth restriction (FGR)

Data on diagnosis of fetal growth restriction (FGR) were recorded for 275 of the 290 perinatal deaths (i.e. FGR diagnosis unknown for eleven stillbirths, and four neonatal death). A diagnosis of FGR was reported for 53 (19.3%) of the 275 deaths. An antenatal diagnosis of FGR (as opposed to diagnosis based on observation at delivery or post-mortem) was reported for 39 of the 275 perinatal deaths (14.2%). Of these 39 cases, more than half were deaths due to MCAs (n=20 out of 39, 51.3%).

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), 38.6% (n=34 of 88) had an antenatal diagnosis of FGR (Table 2.21). The level of antenatal diagnosis of FGR was slightly lower for stillbirths and early neonatal deaths that were SGA (stillbirths=26.4%, neonatal deaths=37.1%) compared to stillbirths and early neonatal deaths that were severely SGA (stillbirths=34.9%, neonatal deaths=48.0%). While detection rates were low, an improvement in the diagnosis of FGR among stillbirths and neonatal deaths that were severely SGA was observed in 2022 compared to corresponding figures in 2021 (stillbirths=32.2%, neonatal deaths=35.3%), and in 2020 (stillbirths=25.3%, neonatal deaths=23.8%).

Table 2.21: Antenatal diagnosis of fetal growth restriction (FGR) for small-for-gestational-age (SGA) and severely SGA perinatal deaths, 2022

Centile	Stillbirth		Early neonatal death	
	Severely SGA (<3rd centile) N=63	SGA (<10th centile)* N=87	Severely SGA (<3rd centile) N=25	SGA (<10th centile)* N=35
Antenatal diagnosis of FGR n of N (%)	22 (34.9)	23 (26.4)	12 (48.0)	13 (37.1)

Note: Values are N(%) unless otherwise stated; SGA cases include severely SGA cases; *Includes cases from the category <3rd Centile. FGR diagnosis unknown for eleven stillbirths, and four neonatal deaths.

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.[46] In this 2022 audit, data on autopsy uptake was reported for 289 of the 290 perinatal deaths. Autopsy uptake data was missing for one ENND as it is unknown if an autopsy was performed. This death occurred in a paediatric hospital. Notably, feedback from maternity units has highlighted the lack of formal notification between paediatric hospitals and maternity units on events surrounding a neonatal death such as the cause of death and/or the performance of an autopsy. Of the 289 cases, 47.1% (n=136) underwent an autopsy. The rate of autopsy uptake in 2022 is higher than the rates reported in 2021 (44.6%) but lower than the rates reported in previous years (52.3% in 2020, 49.2% reported in 2019). The trend in the perinatal autopsy rate is illustrated in Figure 2.8. The autopsy uptake rate in stillbirths continues to be higher than in cases of early neonatal death.

In Ireland in 2022, an autopsy was undertaken following 57.8% of stillbirths (n=111 of 192) and 25.8% of early neonatal deaths (n=25 of 97, unknown for one case), see Figure 2.8. These figures are similar to rates reported in the United Kingdom in 2022; i.e. full autopsy for 49.9% of stillbirths and 26.9% of neonatal deaths (with an additional 2.4% of examinations by the coroner or procurator fiscal of neonatal deaths).[47]

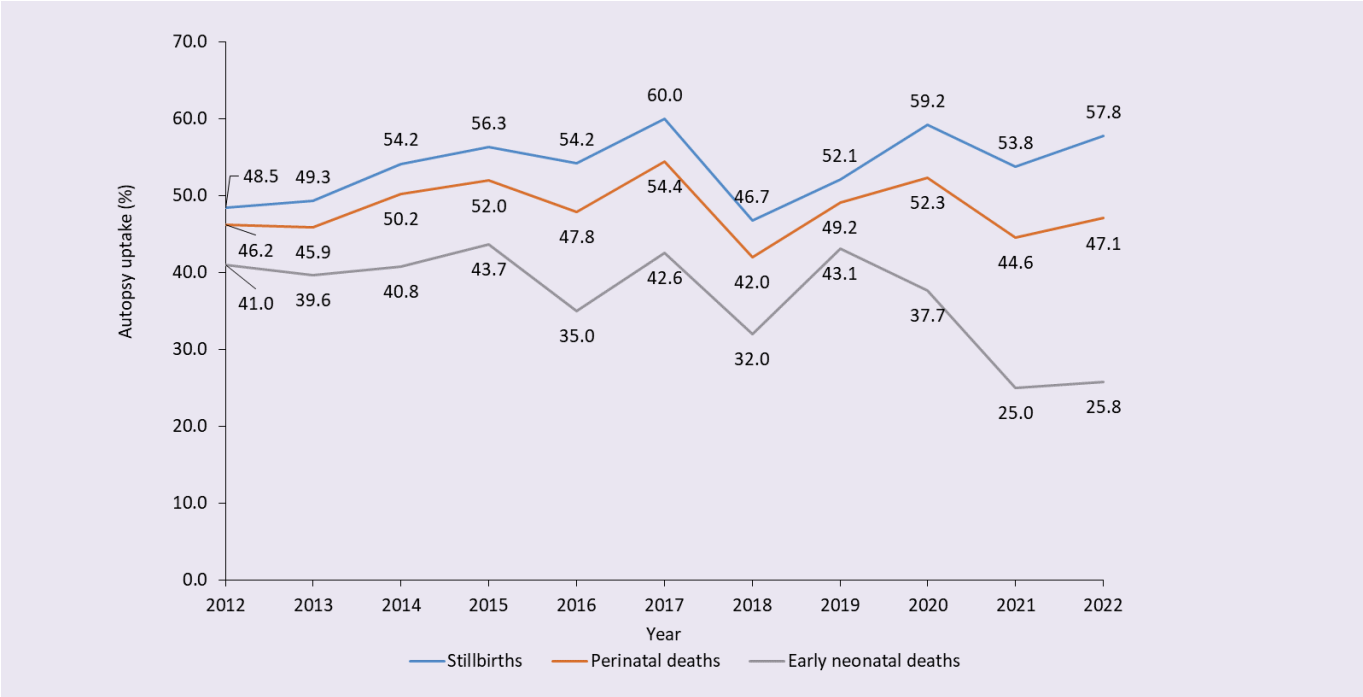


Figure 2.8: Autopsy uptake percentage, 2012-2022

There was much variation in the rate of autopsy uptake across the 19 maternity units in 2022, with rates of 15.6%, 42.0%, 44.7% and 80.6% being found across the four large maternity units. The variation is illustrated in Figure 2.9 and Figure 2.10 for stillbirths and early neonatal deaths, respectively. This may reflect variation in access to dedicated perinatal pathology services across smaller units.

[46]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.

[47]Gallimore ID, Matthews RJ, Page GL, Smith LK, Fenton AC, Knight M, Smith PW, Redpath S, Manktelow BN, on behalf of the MBRRACE-UK Collaboration. MBRRACE-UK Perinatal Mortality Surveillance, UK Perinatal Deaths of Babies Born in 2022: State of the Nation Report. Leicester: The Infant Mortality and Morbidity Studies, Department of Population Health Sciences, University of Leicester. 2024.

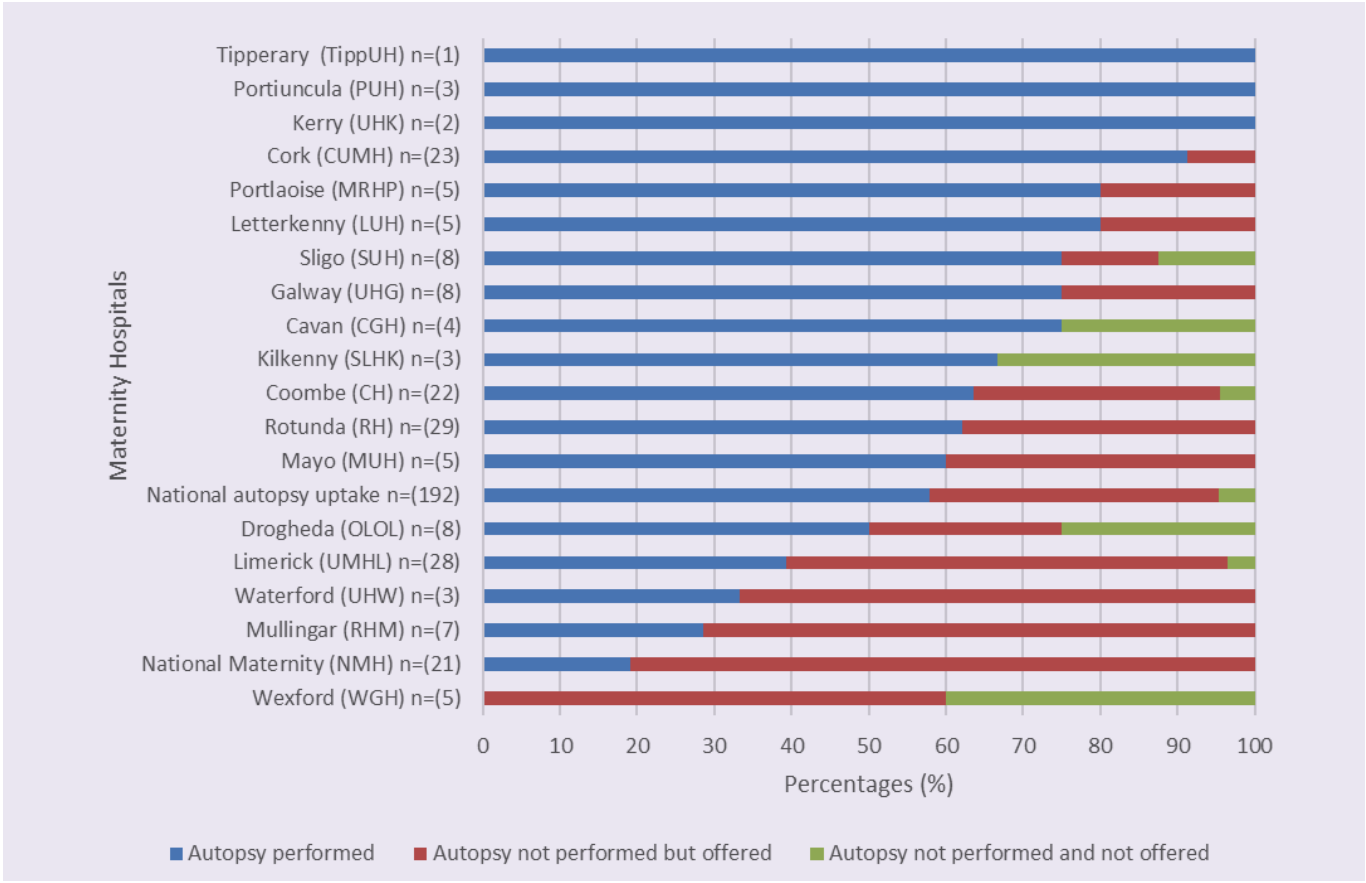


Figure 2.9: Percentages of autopsy uptake and offer of autopsy among stillbirths in the 19 Irish maternity units, 2022

Note: "N=(x)" refers to the number of stillbirths per maternity unit.

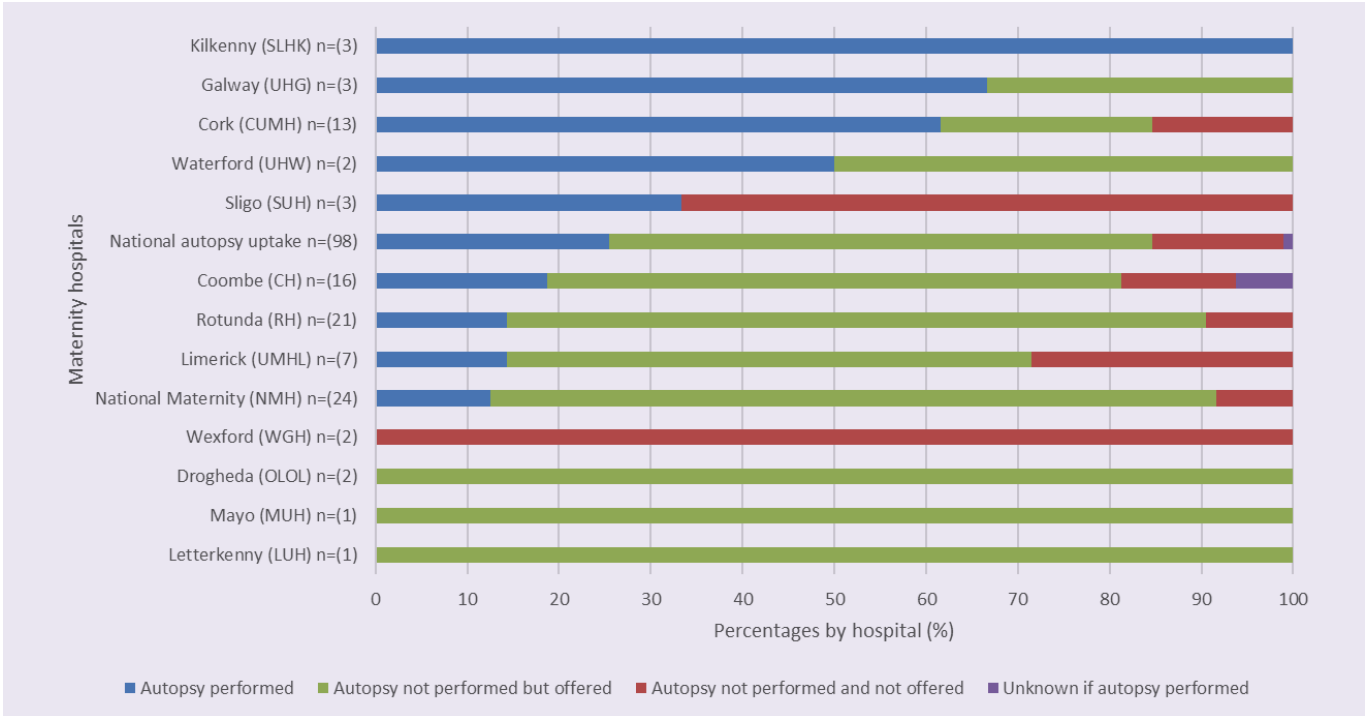


Figure 2.10: Percentages of autopsy uptake and offer of autopsy among early neonatal deaths in Irish maternity units, 2022

Note: "N=(x)" refers to the number of early neonatal deaths per maternity unit.

However, as detailed in Figure 2.11 and Table 2.22, in the vast majority of the 153 cases where an autopsy was not performed, an autopsy was offered in 85% of the cases; therefore, we understand the autopsy was declined by the parents (n=130 of 153). As such, variation in autopsy rates across units may likely be influenced by parental consent to the procedure.

Compared to previous years, an autopsy was declined in similar proportions between cases of stillbirths (n=72 of 81, 88.9%) and cases of early neonatal deaths (n=58 of 72, 80.6%) in 2022. Of the 153 cases where an autopsy was not performed, there were 23 perinatal deaths for which an autopsy was not offered (n=23 of 153, 15.0%). Corresponding figures for the year 2021 was 21.8%, for the year 2020 was 17.8%, and the years 2018-2019 was 19.4%.

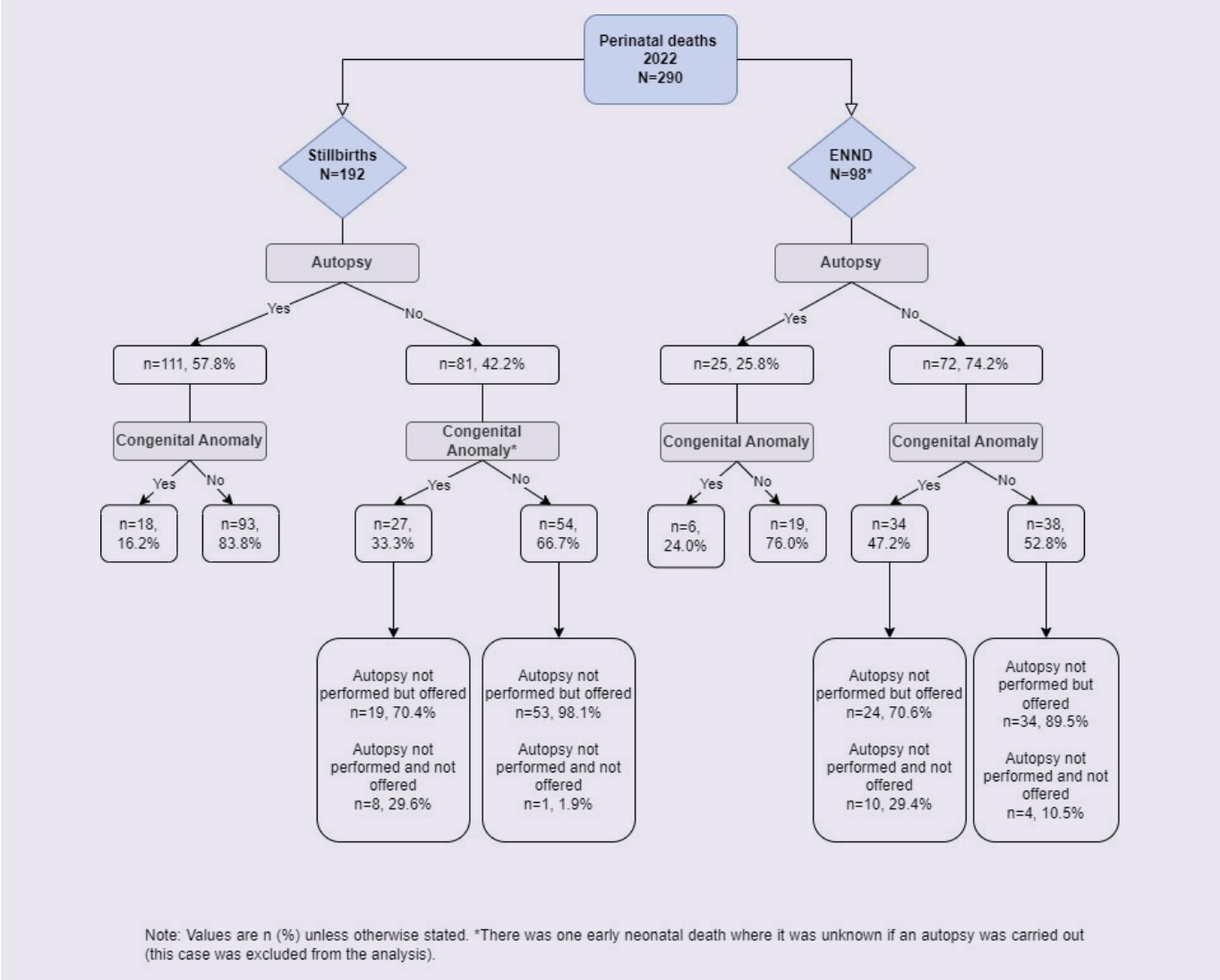


Figure 2.11: Flowchart outlining autopsy-related steps taken after 290 perinatal deaths, 2022

Note: Values are N(%) unless otherwise stated. *One early neonatal death where it was unknown if an autopsy was carried out. This death 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 the death was due to another cause (Table 2.22).

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 PMNCAGC. More recently, The Minister for Justice, Helen McEntee T.D. launched a wide-ranging consultation to inform the development of proposals for comprehensive reform of the Coroner Service in Ireland. This consultation, which closed in January 2024, gave an opportunity for members of the public and stakeholder groups to express their views, observations and proposals on how the Coroner Service might be enhanced into the future.[48]

[48]Coroner Reform Consultation. Published on 20 October 2023. Available at: https://www.gov.ie/en/consultation/473f5-coroner-reform-consultation/

Table 2.22: Uptake and offer of autopsy of perinatal deaths with and without a major congenital anomaly, 2022

	Stillbirth N=192		Early neonatal death N=97 of 98	
	Cause of death: MCA		Cause of death: MCA	
	Yes N=45	No N=147	Yes N=40	No N=57
Performed	18 (40)	93 (63.3)	6 (15)	19 (33.3)
Offered	19 (42.2)	53 (36.1)	24 (60)	34 (59.6)
Not offered	8 (17.8)	1 (0.7)	10 (25)	4 (7)

Note: Values are N(%) unless otherwise stated. MCA = Major congenital anomaly

Placental examination

The value of placental examination in determining cause of perinatal death is well documented.[49] In 2022, placental histology examinations were conducted for almost all stillbirths (n=188 of 192, 97.9%) and for over 90% of early neonatal deaths (n=91 of 98, 92.9%). These figures are slightly higher than the figures reported in 2021 (94.5% for stillbirths and 87% for early neonatal deaths), and similar to those reported for stillbirths (98.3%) and for early neonatal deaths (96.1%) in 2020. The 2022 rate of placental examinations (96.2%) is similar to levels of placental histology examinations reported for stillbirths in the United Kingdom as a whole in 2022 (93.7%).[50]

Specific placental conditions

Abnormal placental findings have been classified in line with recommendations from the publication from the international consensus meeting of pathology.[51] 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 75% of all perinatal deaths had an associated placental pathology (n=216 of 290, 74.5%; Table 2.23). Placental conditions were generally more prevalent among stillbirths (n=163 of 192, 84.9%) than among cases of early neonatal death (n=53 of 98, 54.1%; Table 2.23. In the case of stillbirths and early neonatal deaths in 2022, conditions within fetal vascular malperfusion and maternal vascular malperfusion were the two most commonly reported categories. The third condition more commonly reported for stillbirths was cord pathology and for early neonatal deaths was chorioamnionitis.

Table 2.23: Placental histology findings for stillbirths and early neonatal deaths, 2022

	Stillbirth N=192	Neonatal death N=98	Perinatal deaths N=290
Fetal vascular malperfusion	56 (29.2)	10 (10.2)	66 (22.8)
Maternal vascular malperfusion	58 (30.2)	10 (10.2)	68 (23.4)
Cord pathology	41 (21.4)	6 (6.1)	47 (16.2)
Delayed villous maturation	22 (11.5)	7 (7.1)	29 (10.0)
Chorioamnionitis	31 (16.1)	20 (20.4)	51 (17.6)
Cord pathology with distal disease	29 (15.1)	0 (0)	29 (10.0)
Fetal vasculitis	9 (4.7)	10 (10.2)	19 (6.6)
Villitis	16 (8.3)	4 (4.1)	20 (6.9)
Other placental condition*	47 (24.5)	12 (12.2)	59 (20.4)

Note: More than one placental condition was present for some cases. Percentages for "placental condition" are calculated using the total of perinatal deaths in 2022. *Other placental condition includes conditions such as placental disease due to diffuse chorionic hemosiderosis and increased perivillous fibrin.

[49]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

[50]Gallimore ID, Matthews RJ, Page GL, Smith LK, Fenton AC, Knight M, Smith PW, Redpath S, Manktelow BN, on behalf of the MBRRACE-UK Collaboration. MBRRACE-UK Perinatal Mortality Surveillance, UK Perinatal Deaths of Babies Born in 2022: State of the Nation Report. Leicester: The Infant Mortality and Morbidity Studies, Department of Population Health Sciences, University of Leicester. 2024.

[51]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 fifty-five percent of the perinatal deaths in 2022 (n=159 of 290, 54.8%). This is slightly higher than to previous years (43.9% in 2021, 49.0% in 2020 and 42.8% in 2019; Table 2.24). Computerised tomography scans (CT scan) and magnetic resonance imaging (MRI) tests were rarely undertaken. Similar to 2021, X-Ray examinations were carried out more often following cases of stillbirth (n=82, 42.7%) rather than for cases of early neonatal death (n=13, 13.3%) in 2022.

Table 2.24: Other examinations performed in investigating perinatal deaths, 2021-2022

Examination	Perinatal deaths 2021 N=355	Perinatal deaths 2022 N=290	Stillbirths 2022 N=192	Neonatal deaths 2022 N=98
External	156 (43.9)	159 (54.8)	120 (62.5)	39 (39.8)
X-Ray	97 (27.3)	95 (32.8)	82 (42.7)	13 (13.3)
CT scan	3 (0.8)	7 (2.4)	5 (2.6)	2 (2)
MRI	1 (0.3)	2 (0.7)	0 (0)	2 (2)

Note: Values are N(%) unless otherwise stated. CT=Computerised tomography, MRI=magnetic resonance imaging. Categories are not mutually exclusive. *Data missing for one neonatal death in 2021

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.[52] In the event of a chromosomal disorder, a specific question on the NPEC Perinatal Death Notification form asks how the diagnosis was made.

In 2022, a chromosomal disorder was the most commonly reported major congenital anomaly causing death (39 perinatal deaths: 29 stillbirths and 10 early neonatal deaths). In approximately ninety-five percent of these cases (n=37 of 39, 94.9%), the diagnosis was made by cytogenetic analysis (n=27 of 29 stillbirths, 93.1%; n=10 of 10 neonatal deaths, 100.0%).

Genetic analysis was also carried out as a post-natal investigation in over forty percent of perinatal deaths not associated with a chromosomal disorder in 2022 (n=106 of 251, 42.2%).

[52]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.

3. Stillbirths

Key Findings

Stillbirths accounted for

66.2%

(n=192)

of perinatal deaths in 2022

CAUSE OF DEATH

Similar to findings in 2021, **specific placental conditions was the most common cause of death in stillbirths** (38.0%) followed by major congenital anomaly (23.4%).

Intrapartum deaths accounted for **3.6%** of stillbirths. This rate is lower than 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 2022 (n=73 of 192, 38.0%) (Figure 3.1). This is similar to findings in 2021, and 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 last year and in 2017 (Table 3.1). Figure 3.2 outlines the classification of the specific placental conditions causing the stillbirth. The most commonly occurring placental conditions were fetal vascular malperfusion and maternal vascular malperfusion accounting for 21 deaths each (n=21 of 73, 28.8%). They were followed by cord pathology with distal disease (n=14 of 73, 19.2%). Cord pathology (n=7, 9.6%) and delayed villous maturation (n=6, 8.2%) were the next most common causes among specific placental conditions (Figure 3.2). Of significance and in contrast to 2021, there were no perinatal deaths due to SARS-CoV-2 in 2022. 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 2022 (n=45 of 192, 23.4%). There was a chromosomal disorder in more than 60% of the stillbirths in 2022 due to major congenital anomaly (n=28 of 45, 62.2%), as shown in Figure 3.3. In the cases with a chromosomal disorder, the diagnosis was made using a combination of several methodologies (unknown for two stillbirths); cytogenetic analysis in 96% of cases (n=25 of 26, 96.2%), ultrasound in 27% of cases (n=7, 26.9%) and clinically in 46% of cases (n=12, 46.2%). Overall, four stillbirths were diagnosed using the three diagnostic procedures (i.e. clinical diagnostic, cytogenetic analysis and ultrasound), ten stillbirths using two procedures and twelve deaths using one of these diagnostic procedures.

Of all the stillbirths due to major congenital anomalies, 75% (n=33 of 44, unknown for one case) had an antenatal diagnosis made by a consultant fetal medicine specialist either in the unit of reference (n=21) or in another unit (n=12). Anomalies of the cardiovascular system (n=5), multiple anomalies (n=4), central nervous systems (n=3), urinary tract (n=1), respiratory (n=1) system and ''other'' major congenital anomalies (n=3) led to 17 (37.8%) stillbirths. No cases were identified for anomalies in the gastro-intestinal system, musculoskeletal and metabolic disorders categories in 2022.

In 2022, infection was the next most common cause of stillbirth with 10% (n=19 out of 192, 9.9%). This was the highest rate of infection since the rate reported in 2015 (n=25 out of 287, 8.7%). 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=16 of 192 each, 8.3%).

In just five percent of stillbirths (n=10 of 192, 5.2%), the cause of death was unexplained in 2022. This proportion of unexplained stillbirths is the lowest since the inception of the audit. As detailed in Table 3.1, for 40% of the stillbirths with an unexplained cause of death, it was reported that the maternity unit was still awaiting final post-mortem results for these cases (n=4 of 10, 40.0%). These four stillbirths are coronial cases and so a cause of death may be identified when the post-mortem reports are available. Of the remaining sixty percent of stillbirths with an unexplained cause of death, 50.0% had antecedent or associated obstetric factors (n=5), but 10% had no antecedent or associated

factors (n=1, 10.0%). For the vast majority of unexplained stillbirths, an autopsy was performed (n=7 of 10, 70.0%). For the remaining unexplained stillbirths, an autopsy was offered and presumably declined (n=3 of 10, 30.0%). However, a placental histology was performed in all of these three cases.

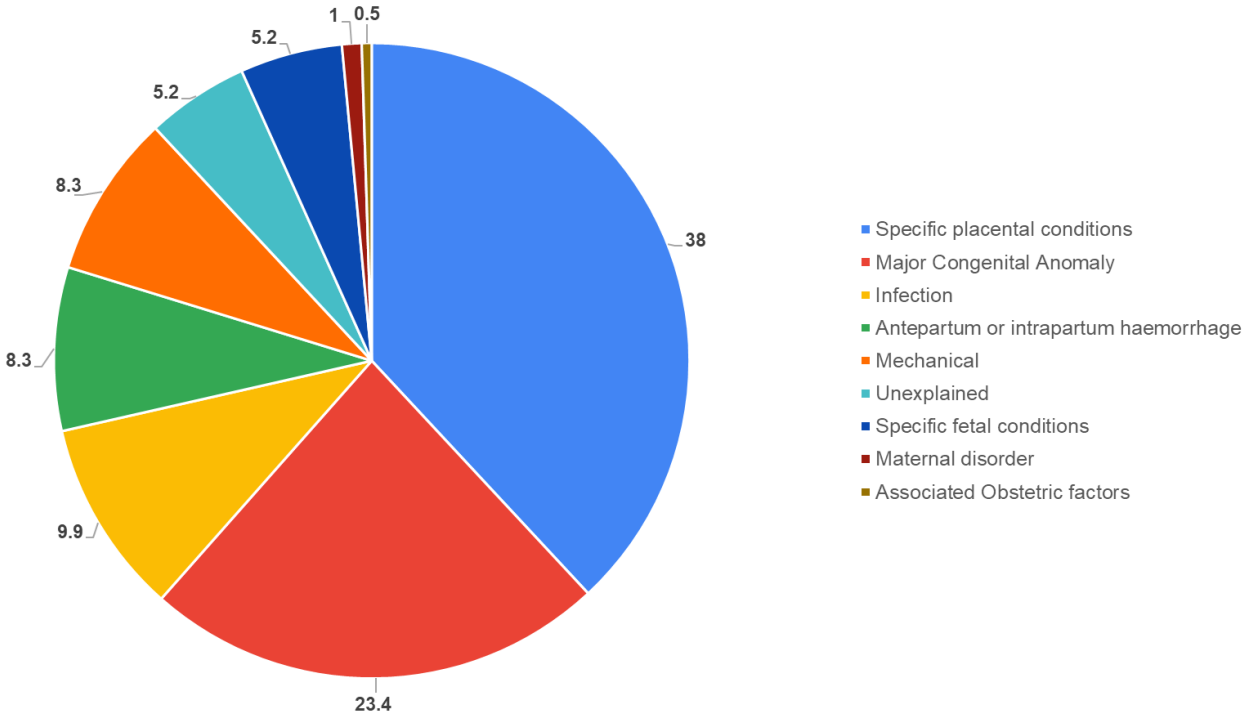


Figure 3.1: Main cause of death in stillbirths in percentages, 2022 (n=192)

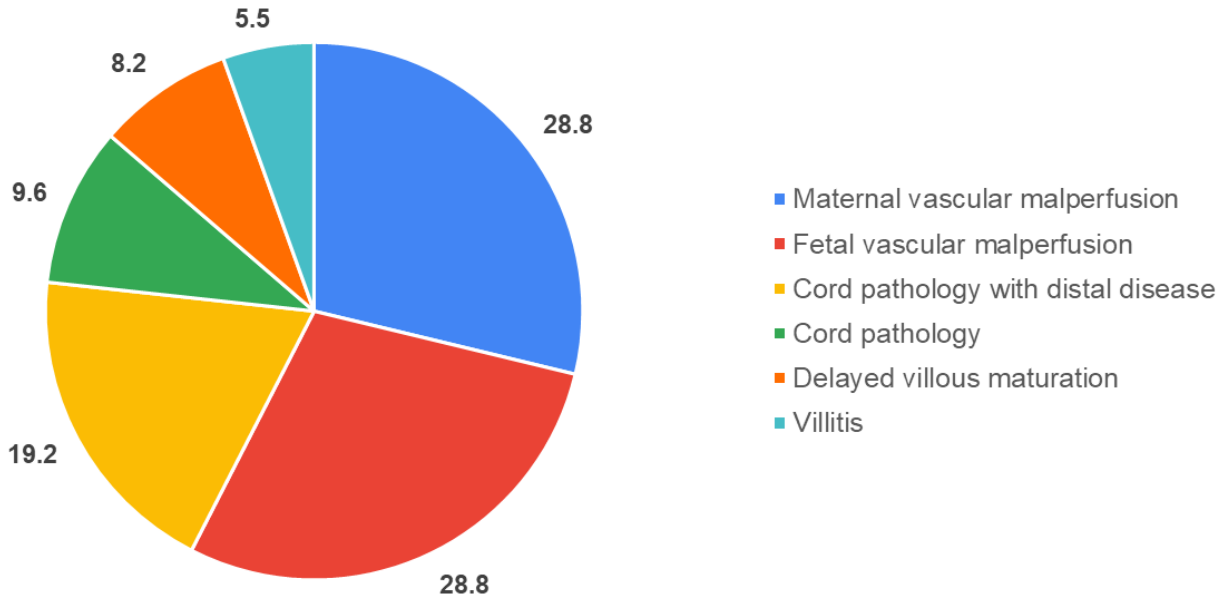


Figure 3.2: Detailed cause of death in cases of specific placental conditions in stillbirths in percentages, 2022 (n=73)

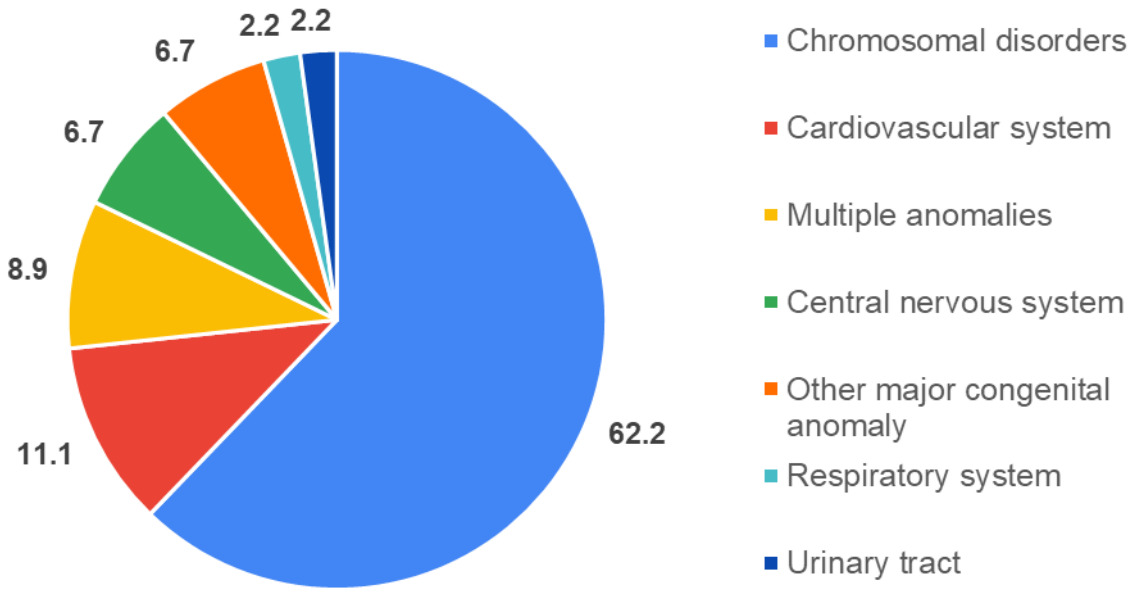


Figure 3.3: Detailed cause of death in cases of major congenital anomalies in stillbirths in percentages, 2022 (n=45)

Table 3.1: Stillbirth main cause of death in 2018-2022, NPEC Classification System

	2018 N=217	2019 N=242	2020 N=240	2021 N=238	2022 N=192
Major congenital anomaly	**67 (30.9)**	**74 (30.6)**	**79 (32.9)**	**68 (28.6)**	**45 (23.4)**
Chromosomal disorders	37	40	40	33	28
Central nervous system	9	4	6	5	3
Cardiovascular system	5	11	7	10	5
Urinary tract	1	2	1	2	1
Multiple anomalies	7	8	12	10	4
Gastro-intestinal system	0	1	4	3	0
Musculo-skeletal system	2	2	4	4	0
Respiratory system	2	3	1	0	1
Metabolic disorders	0	0	0	1	0
Other major congenital anomaly	4	3	4	0	3
Specific placental conditions[1]	**57 (26.3)**	**73 (30.2)**	**73 (30.4)**	**78 (32.8)**	**73 (38)**
Maternal vascular malperfusion	16	25	19	16	21
Fetal vascular malperfusion	13	12	14	18	21
Cord pathology	10	11	12	7	7
Cord pathology with distal disease	7	14	17	16	14
Delayed villous maturation[2]	6	3	8	8	6
Chorioamnionitis	0	0	0	0	0
Villitis	4	2	2	1	4
Other placental condition	1	6	1	12	0
Mechanical	**9 (4.1)**	**18 (7.4)**	**19 (7.9)**	**14 (5.9)**	**16 (8.3)**
Prolapse cord	1	0	1	1	2
Cord around neck	4	11	10	5	8
Uterine rupture before labour	3	0	1	1	1
Mal-presentation	0	0	0	0	0
Shoulder dystocia	0	1	0	0	0
Other cord entanglement or knot	1	6	7	7	5
Antepartum or intrapartum haemorrhage	**12 (5.5)**	**22 (9.1)**	**13 (5.4)**	**14 (5.9)**	**16 (8.3)**
Praevia	1	0	0	1	0
Abruption	10	21	13	13	16

Uncertain haemorrhage	0	1	0	0	0
	1	0	0	0	0
Infection	**6 (2.8)**	**16 (6.6)**	**10 (4.2)**	**10 (4.2)**	**19 (9.9)**
Bacterial	0	1	1	0	0
Syphilis	0	0	1	0	0
Viral diseases	0	0	0	1	1
Group B Streptococcus	0	1	0	1	0
Other maternal infection	0	1	0	0	0
Chorioamnionitis	5	13	8	8	16
Other ascending infection	1	0	0	0	2
Specific fetal conditions	**8 (3.7)**	**11 (4.5)**	**13 (5.4)**	**13 (5.5)**	**10 (5.2)**
Twin-twin transfusion	2	2	7	9	0
Feto-maternal haemorrhage	3	7	5	2	3
Non immune hydrops	1	1	1	0	3
Iso-immunisation	0	0	0	0	0
Other fetal condition	2	1	0	2	4
Intra-uterine growth restriction	**5 (2.3)**	**3 (1.2)**	**0 (0)**	**1 (0.4)**	**0 (0)**
IUGR-Suspected antenatally	3	3	0	1	0
IUGR-Observed at delivery	0	0	0	0	0
IUGR-Observed at post- mortem	2	0	0	0	0
Associated obstetric factors	**4 (1.8)**	**1 (0.4)**	**6 (2.5)**	**2 (0.8)**	**1 (0.5)**
Premature rupture of membranes	1	1	1	0	0
Prolonged rupture of membranes >24 hrs	1	0	1	1	0
Intrapartum asphyxia	1	0	0	0	0
Intracranial haemorrhage	0	0	0	0	0
Birth injury to scalp	0	0	0	0	0
Fracture	0	0	0	0	0
Other birth trauma	0	0	1	0	0
Polyhydramnios	0	0	0	0	0
Oligohydramnios	0	0	0	0	0
Spontaneous premature labour	0	0	1	1	1
Other obstetric factors	1	0	2	0	0
Maternal disorder	**0 (0)**	**0 (0)**	**1 (0.4)**	**3 (1.3)**	**2 (1)**
Pre-existing hypertensive disease	0	0	0	0	0
Diabetes	1	0	1	0	0
Thrombophilias	0	0	0	0	0
Uterine anomalies	1	0	0	0	0
Other maternal disorder	1	1	0	3	1
Other endocrine conditions	0	0	0	0	0
Obstetric cholestasis	1	0	0	0	1
Drug misuse	0	0	0	0	0
Hypertensive disorders of pregnancy	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**
Pregnancy induced hypertension	0	0	0	0	0
Pre-eclampsia toxaemia	0	0	0	0	0
HELLP syndrome	0	0	0	0	0
Eclampsia	0	0	0	0	0
Unexplained	**45 (20.7)**	**23 (9.5)**	**26 (10.8)**	**35 (14.7)**	**10 (5.2)**
No antecedent or associated obstetric factors	17	8	6	6	1
Antecedent or associated obstetric factors present	21	10	5	8	5
Pending post-mortem or other investigation	7	5	15	21	4
Very limited information available	0	0	0	0	0

Note: All values are reported as numbers (percentages). 1The 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.

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.[53]

In the reporting year 2022, 160 women experienced antepartum stillbirth (83.3% of all the stillbirths; unknown for five cases, Table 3.3). The management of clinical care (i.e. whether the care involved planned induction of labour, awaiting spontaneous labour or elective delivery by caesarean section) was recorded for all the 160 women who experienced antepartum stillbirth. Labour was induced for eighty percent of the women who experienced antepartum stillbirth (n=130, 81.3%) whereas labour was spontaneous for 15.6% (n=25).

As shown in Figure 3.4, the time from diagnosis of fetal demise to delivery was different for women whose labour was induced as opposed to women whose labour was spontaneous in 2022. The confirmation of death and delivery took place on the same day for over half (n=13 of 25; 52.0%) of the women whose labour was spontaneous. For women whose labour was induced, it was common for up to four days to pass between diagnosis and delivery (n=109 of 130, 83.9%). As can be observed from Figure 3.4, a very small number of antepartum stillbirths were delivered greater than 14 days after confirmation of fetal demise (n=2), both cases were from multiple births and with a live born twin.

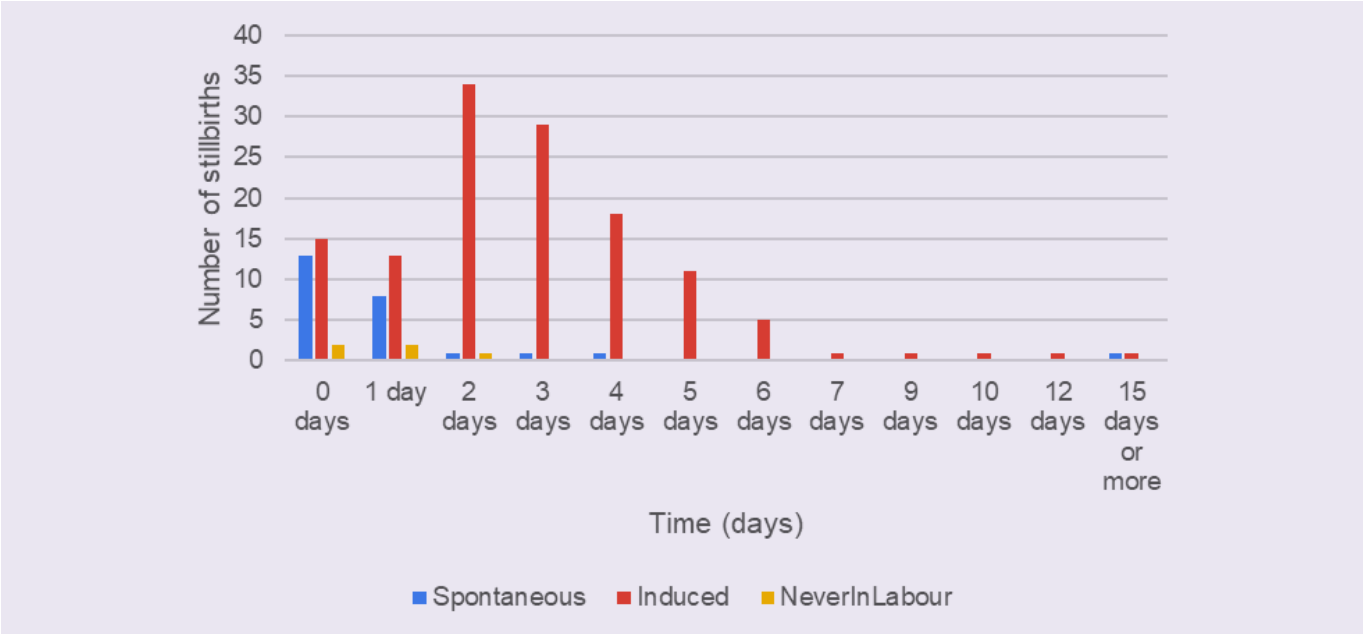


Figure 3.4: Time (days) from confirmation of fetal demise to delivery for women who experienced antepartum stillbirth, 2022

Vaginal birth is the recommended mode of delivery for most women experiencing antepartum stillbirth, but caesarean section may be clinically indicated in some cases. Vaginal cephalic delivery was the most common mode of delivery in cases of antepartum stillbirth in 2022 (n=111, 69.4%).

Of the 160 antepartum stillbirths, 10 women delivered by caesarean section (n=5 cases each for pre-labour caesarean section and caesarean section performed after onset of labour).

Of these 10 caesarean sections, the procedure was classified as 'elective' in 30.0% of the cases, 40.0% were 'urgent' and another 30.0% were 'emergency' (Table 3.2). Fifty percent (n=5, 50.0%) of these 10 women had previously had a caesarean section that may have influenced the mode of delivery, and one woman (n=1, 10.0%) had a multiple delivery.

Table 3.2: Indication for caesarean section in women experiencing antepartum stillbirth, 2022

Indication for caesarean section	N=10 N(%)
Elective: At a time to suit the woman or the maternity team	3 (30)
Urgent: Maternal or fetal compromise which is not immediately life threatening	4 (40)
Emergency: Immediate threat to life of woman or baby	3 (30)

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

[53]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.

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.[54,55] Intrapartum deaths in this audit are 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 five cases in 2022 (Table 3.3). Of these five cases, there was one baby with a chromosomal disorder, one case awaiting a Coronial report, one with Chorioamnionitis and two babies with other causes of death.

There were seven cases of stillbirths where the baby was known to be alive at the onset of care in labour. Thus, intrapartum deaths accounted for 3.7% of stillbirths (equivalent to 0.13 per 1,000 births) in Ireland in 2022 (Table 3.3). This was lower than in 2018-2021 when 5.4-5.9% of stillbirths were intrapartum deaths, and the rate was 0.22-0.28 per 1,000 births. The rate of intrapartum death in 2022 in the United Kingdom was 0.27 per 1,000 total births.[56]

Table 3.3: Life status of baby at the onset of care in labour for stillbirths, 2022

Type of stillbirth case	Description	N=192 N (%)
Antepartum	Baby not alive at onset of care in labour	160 (83.3)
	Never in labour	17 (8.9)
Intrapartum	Baby alive at onset of care in labour	7 (3.6)
Not known		5 (2.6)
Unattended		3 (1.6)

Note: All the stillbirths who were unattended (n=3) were born before arrival (BBA) at maternity units, of which two were not booked to a maternity unit.

Major congenital anomaly was the main cause of death for forty-three percent of the seven intrapartum deaths (n=3, 42.9%). Infection, antepartum or intrapartum haemorrhage, and placental conditions was the cause of death in a further three intrapartum stillbirths (n=3). There was one unexplained case among intrapartum stillbirths in 2022 and a coronial report is still pending at time of report writing. 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.[57] As in previous reports, we make a recommendation in this area.

[54]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

[55]Murzakanova G, Räisänen S, Jacobsen AF, Yli BM, Tingleff T, Laine K. Trends in Term Intrapartum Stillbirth in Norway. JAMA Netw Open. 2023 Sep 5;6(9):e2334830. doi: 10.1001/jamanetworkopen.2023.34830. Erratum in: JAMA Netw Open. 2024 Jan 2;7(1):e240314. doi: 10.1001/jamanetworkopen.2024.0314. PMID: 37755831; PMCID: PMC10534268.

[56]Gallimore ID, Matthews RJ, Page GL, Smith LK, Fenton AC, Knight M, Smith PW, Redpath S, Manktelow BN, on behalf of the MBRRACE-UK Collaboration. MBRRACE-UK Perinatal Mortality Surveillance, UK Perinatal Deaths of Babies Born in 2022: State of the Nation Report. Leicester: The Infant Mortality and Morbidity Studies, Department of Population Health Sciences, University of Leicester. 2024.

[57]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

Early neonatal deaths accounted for

33.8%

of perinatal deaths in 2022.

CAUSE OF DEATH

Major congenital anomaly was the **most common cause of early neonatal death** (n=40, 40.8%) followed by **respiratory disorders** (n=25, 25.5%), primarily due to severe pulmonary immaturity.

More than half (59.2%) of early neonatal deaths **occurred within 24 hours of delivery.**

Cause of early neonatal death

The cause of early neonatal deaths in 2022 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 systems 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, gastrointestinal disease and unexplained cause of death.

Major congenital anomaly was the most common cause of early neonatal death in 2022 (n=40 of 98, 40.8%; Figure 4.1) followed by respiratory disorder, accounting for one fourth of early neonatal deaths (n=25, 25.5%; Figure 4.1). Neurological disorder was the next most common cause of death (n=19, 19.4%), which was higher than the rate in previous years (10.9% in 2021, 14.5% in 2020 and 12.7% in 2019). Seven deaths (7.1%) 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 98 early neonatal deaths occurring in 2022 is given at the end of this section of the report (Table 4.3).

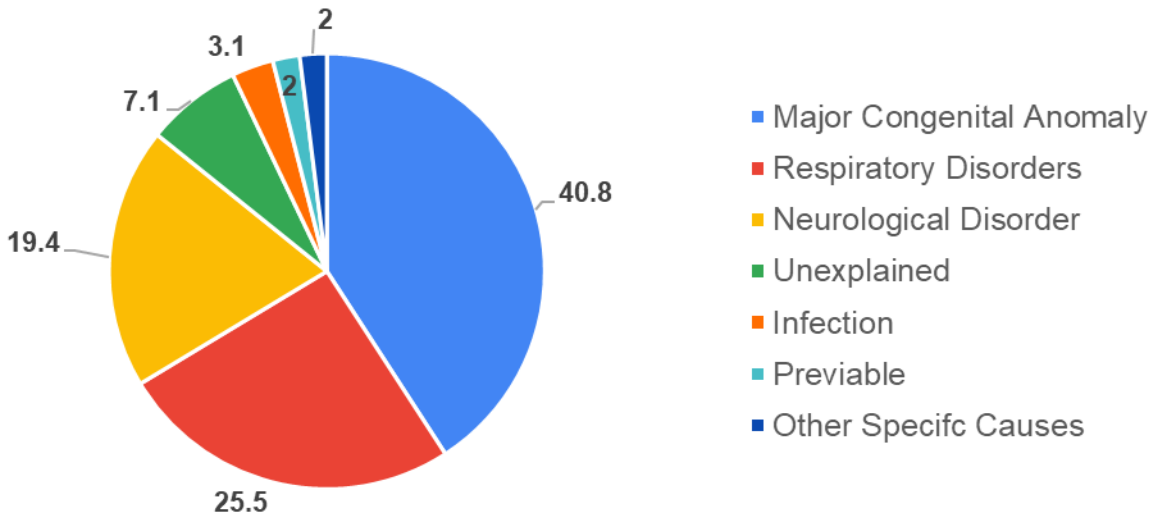


Figure 4.1: Main cause of early neonatal death in percentages, 2022

Major congenital anomalies

The types of major congenital anomalies, which caused 40 of the 98 neonatal deaths in 2022, are illustrated in Figure 4.2. Chromosomal disorders were most common type of major congenital anomaly, occurring in almost twenty-three percent of neonatal deaths due to major congenital anomaly (n=9, 22.5%). The second most frequent anomalies were multiple anomalies and cardiovascular system disorders, each accounting for eight deaths in this cohort (n=8, 20.0%). Urinary tract disorders occurred in seventeen percent of the cases within the major congenital anomaly group (n=7, 17.5%). Other anomalies included central nervous system (n=4, 10.0%), and musculo-skeletal system (n=2, 5.0%). Anomalies of the respiratory system and gastro-intestinal system accounted for one death each (n=1, 2.5%).

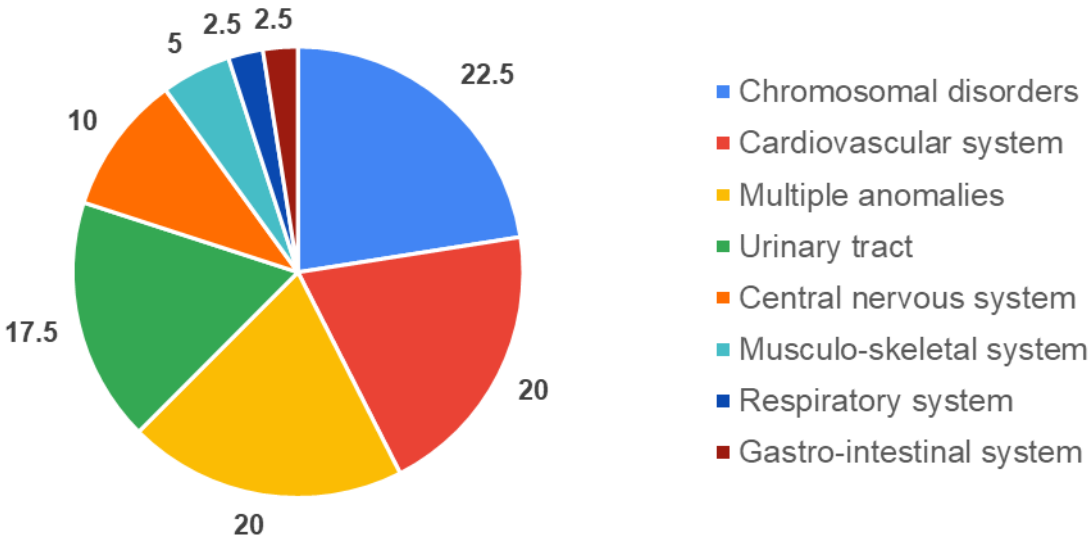


Figure 4.2: Detailed cause of death in cases of major congenital anomaly in neonatal deaths in percentages, 2022

Data on whether the diagnosis of a major congenital anomaly was confirmed/suspected by a consultant fetal medicine specialist was recorded for all the 40 neonatal deaths that occurred in 2022. In the vast majority of these cases a diagnosis was confirmed/suspected by a consultant fetal medicine specialist (n=39, 97.5%). Among the nine neonatal deaths attributed to a chromosomal disorder, a number of diagnostic investigations were carried out: cytogenetic analysis in 100.0% (n=9), ultrasound in 77.8% (n=7) and clinically in 66.7% (n=6). Overall, six neonatal deaths were diagnosed using the three diagnostic procedures (i.e. clinical diagnostic, cytogenetic analysis and ultrasound), one death using two procedures and two deaths using one of these diagnostic procedures.

Respiratory disorders

Figure 4.3 details causes of death in cases of respiratory disorders in neonatal deaths in 2022. Of the early neonatal deaths caused by a respiratory disorder, almost half of them (n=12 of 25, 48.0%) were due to severe pulmonary immaturity. Pulmonary hypoplasia accounted for nine deaths (36.0%) and other respiratory disorders occurred in three further early neonatal deaths (n=3, 12.0%). For one early neonatal death, the main cause of death was attributed to surfactant deficiency lung disease (4.0%).

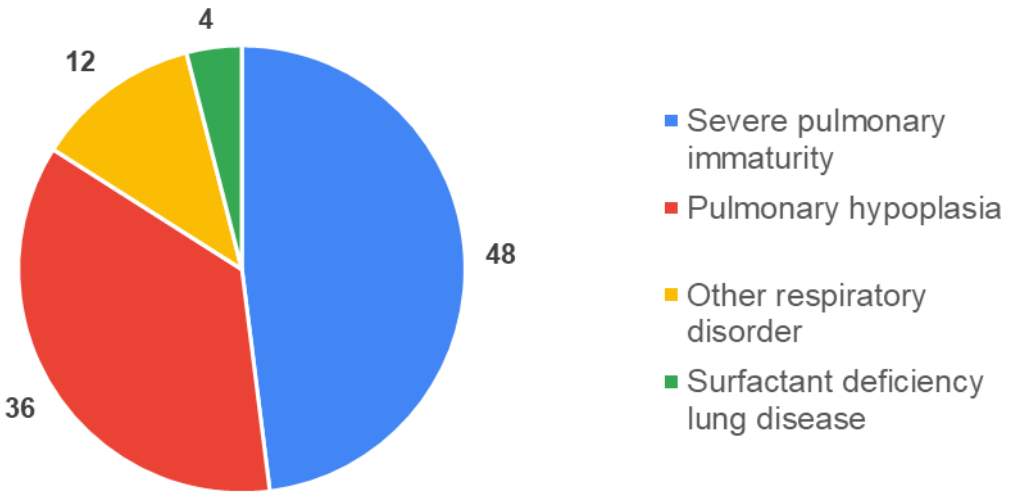


Figure 4.3: Detailed cause of death in cases of respiratory disorder in neonatal deaths in percentages, 2022

Neurological disorders

A neurological disorder was attributed as the main cause of death in 19 (19.4%) early neonatal deaths in 2022. For 11 of these 19 cases, the condition involved was due to hypoxic ischaemic encephalopathy (HIE, 57.9%) and for eight cases death was due to intraventricular/periventricular haemorrhage (IVH/PVH, 42.1%) Table 4.1 details the gestational age in weeks, customised birthweight centile and main antecedent or obstetric factor associated with the 19 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. Eight of the 19 early neonatal deaths due to neurological disorders had an autopsy performed (42.1%), all of which were HIE cases and seven became Coronial cases (36.8%).

Table 4.1: Details of early neonatal deaths due to neurological disorders, 2022

Type	Gestational age (weeks)	Birthweight centile	Main antecedent or obstetric factor associated with the death	Autopsy	Coroner case
IVH/PVH	22-27	5	Twin-twin transfusion	Autopsy not performed but offered	No
IVH/PVH	22-27	12.6	Prolapse cord	Autopsy not performed but offered	No
IVH/PVH	22-27	11.1	Spontaneous premature labour	Autopsy not performed but offered	No
IVH/PVH	22-27	45.6	Prolonged rupture of membranes (>24 hrs)	Autopsy not performed but offered	No
IVH/PVH	22-27	17.6	Spontaneous premature labour	Autopsy not performed but offered	No
IVH/PVH	22-27	96.6	Spontaneous premature labour	Autopsy not performed but offered	No
IVH/PVH	28-31	1.9	Abruption	Autopsy not performed but offered	No
IVH/PVH	22-27	0	Spontaneous premature labour	Autopsy not performed but offered	No
HIE	32-36	94.5	Abruption	Autopsy not performed and not offered	No
HIE	37-41	90.5	Abruption	Autopsy performed	No
HIE	32-36	61.4	Feto-maternal haemorrhage	Autopsy performed	Yes
HIE	37-41	66.4	Pending results of post mortem or other investigations	Autopsy performed	Yes
HIE	37-41	86	Fetal vascular malperfusion	Autopsy performed	Yes
HIE	37-41	66.9	Abruption	Autopsy not performed but offered	No
HIE	28-31	20.6	Pre-existing hypertensive disease	Autopsy not performed but offered	No
HIE	37-41	95.4	Other birth trauma	Autopsy performed	Yes
HIE	28-31	42.2	Twin-twin transfusion	Autopsy performed	Yes
HIE	37-41	15.1	Maternal vascular malperfusion	Autopsy performed	Yes
HIE	37-41	4.5	Pending results of post mortem or other investigations	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 2022 by main cause of death. All but two of the 25 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=30 of 40, 75.0%), of which fifty percent (n=16 of 30, 53.3%) were delivered at term (37-41 weeks gestation).

Table 4.2: Gestational age distribution in neonatal deaths by main cause of death, 2022

	<21+6 weeks	22+0-27+6 weeks	28+0-31+6 weeks	32+0-36+6 weeks	37+0-41+6 weeks	≥42+0 weeks	Total
Respiratory disorder	0 (0)	23 (92)	2 (8)	0 (0)	0 (0)	0 (0)	25 (100)
Major congenital anomaly	0 (0)	3 (7.5)	7 (17.5)	14 (35.0)	16 (40)	0 (0)	40 (100)
Other causes	1 (3)	11 (33.3)	4 (12.1)	5 (15.2)	12 (36.4)	0 (0)	33 (100)

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

Table 4.3 presents a detailed listing of the main cause of death for the 98 early neonatal deaths occurring in 2022.

Table 4.3: Early neonatal main cause of death in 2018-2022, NPEC Classification System

	2018 N=108	2019 N=118	2020 N=117	2021 N=119	2022 N=98
Major congenital anomaly	**62 (57.4)**	**64 (54.2)**	**68 (58.1)**	**59 (49.6)**	**40 (40.8)**
Chromosomal disorders	12	15	22	23	9
Cardiovascular system	9	7	8	7	8
Central nervous system	12	8	7	2	4
Urinary tract	7	8	8	12	7
Multiple anomalies	14	12	8	7	8
Musculo-skeletal system	4	3	1	2	2
Respiratory system	2	5	9	3	1
Gastro-intestinal system	0	0	1	0	1
Metabolic disorders	0	0	2	1	0
Other major congenital anomaly	2	6	2	2	0
Pre-viable (<22 weeks)	**0 (0)**	**0 (0)**	**0 (0)**	**1 (0.8)**	**2 (2)**
Respiratory disorders	**25 (23.1)**	**28 (23.7)**	**25 (21.4)**	**31 (26.1)**	**25 (25.5)**
Severe pulmonary immaturity	18	20	10	15	12
Surfactant deficiency lung disease	3	0	8	8	1
Pulmonary hypoplasia	2	3	3	4	9
Primary persistent pulmonary hypertension	1	1	1	1	0
Meconium aspiration syndrome	0	1	0	0	0
Chronic lung disease/bronchopulmonary dysplasia	0	0	0	0	0
Other respiratory disorder	1	3	3	3	3
Gastro-intestinal disease	**0 (0)**	**1 (0.8)**	**1 (0.9)**	**1 (0.8)**	**0 (0)**
Necrotising enterocolitis	0	1	1	1	0
Other gastro-intestinal disease	0	0	0	0	0
Neurological disorder	**13 (12)**	**15 (12.7)**	**17 (14.5)**	**13 (10.9)**	**19 (19.4)**
Hypoxic ischaemic encephalopathy	7	9	15	3	11
Intraventricular/periventricular haemorrhage	6	6	2	10	8
Other neurological disorder	0	0	0	0	0
Infection	**2 (1.9)**	**2 (1.7)**	**2 (1.7)**	**5 (4.2)**	**3 (3.1)**
Sepsis	1	1	0	2	1
Pneumonia	1	0	0	1	0
Meningitis	0	0	0	0	0
Other infection	0	1	2	2	2
Other specific causes	**1 (0.9)**	**5 (4.2)**	**0 (0)**	**2 (1.7)**	**2 (2)**

Malignancies/tumours	0	0	0	0	0
Other specific causes	1	5	0	2	2
Sudden unexpected deaths	**1 (0.9)**	**0 (0)**	**0 (0)**	**0 (0)**	**(0)**
Sudden infant death syndrome (SIDS)	1	0	0	0	0
Infant deaths - Cause unascertained	0	0	0	0	0
Unexplained	**4 (3.7)**	**3 (2.5)**	**4 (3.4)**	**7 (5.9)**	**7 (7.1)**
Pending post mortem or other investigations	3	2	4	7	7
Antecedent or associated obstetric factors present	1	0	0	0	0
No antecedent or associated obstetric factors present	0	1	0	0	0
Very limited information available	0	0	0	0	0

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

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 approximately thirty percent of these early neonatal deaths that occurred during 2022 (n=29 of 97, 29.9%, unknown for one case) spontaneous respiratory activity was absent or ineffective at five minutes following delivery, and in approximately 27%, the heart rate was persistently less than 100 beats per minute (n=26 of 96, 27.1%, unknown for two cases).

In 2022, active resuscitation was offered in the delivery room in over half of early neonatal deaths (n=62 of 98, 63.3%). Of the early neonatal deaths not receiving resuscitation (n=36), the majority (n=25, 69.4%) were associated with a major congenital anomaly (Table 4.4). Most early neonatal deaths born without major congenital anomaly and not offered resuscitation were delivered prematurely at less than 28 weeks gestation (n=9 of 11, 81.8%).

Table 4.4: Early neonatal deaths due to major congenital anomaly not offered resuscitation in the delivery room, 2022

Gestation at delivery	Total early neonatal deaths not offered resuscitation N=36	Death due to major congenital anomaly not offered resuscitation N=25	Death without major congenital anomaly not offered resuscitation N=11
< 22 wks	1 (2.8)	0 (0)	1 (9.1)
22-27 wks	10 (27.8)	2 (8)	8 (72.7)
28-31 wks	5 (13.9)	5 (20)	0 (0)
32-36 wks	6 (16.7)	6 (24)	0 (0)
37-41 wks	14 (38.9)	12 (48)	2 (18.2)

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

In 2022, over 60% of babies who died in the early neonatal period were admitted to a neonatal unit (n=63 of 98, 64.3%) and eight percent (n=8 of 98, 8.2%) were transferred to another maternity or paediatric unit. All the babies that were transferred were admitted to a neonatal unit, and six of them had active resuscitation. Of the remaining 55 cases that were admitted to a neonatal unit but were not transferred to another unit, 51 of them had active resuscitation (n=51 of 55, 92.7%). Over ninety percent of the deaths that were admitted to a neonatal unit had active resuscitation offered in the delivery room (n=57 of 63, 90.5%; Table 4.5). Seventy-five percent of early neonatal deaths that were transferred to another maternity or paediatric unit had active resuscitation offered in the delivery room (n=6 of 8, 75.0%).

Table 4.5: Management at birth of babies who died within the first week of birth, 2022

	Baby admitted to neonatal unit N=98		Baby transferred to another unit N=98	
Resuscitation	**No N=35**	**Yes N=63**	**No N=90**	**Yes N=8**
No	30 (85.7)	6 (9.5)	34 (37.8)	2 (25)
Yes	5 (14.3)	57 (90.5)	56 (62.2)	6 (75)

Note: Values are N(%) unless otherwise stated. Active resuscitation in the delivery room includes bag and mask ventilation (BMV), positive pressure ventilation (PPV), intubation, cardiac massage.

Age of neonate at death

Approximately 60% of early neonatal deaths occurred within 24 hours of delivery – 1 completed day (n=58 of 98, 59.2%, Table 4.6). Within this cohort, major congenital anomaly (n=24 of 58, 41.4%) and respiratory disorders (n=21 of 58, 36.2%), mainly severe pulmonary immaturity (n=11 of 21, 52.4%), were the main cause of death.

Table 4.6: Age of neonate at death, 2022

Completed days	1	2	3	4	5	6	7
Number	58	11	12	5	2	9	1
%	59.2	11.2	12.2	5.1	2.0	9.2	1.0
Cumulative %	59.2	70.4	82.7	87.8	89.8	99.0	100.0

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

Location of neonatal death

The vast majority of early neonatal deaths in 2022 occurred either in the neonatal unit, the labour ward, or in another maternity ward (Table 4.7). A very small proportion of deaths occurred in a paediatric centre, in theatre or at home. Babies who died at home were discharged from the maternity unit with a known major congenital anomaly.

Table 4.7: Location of neonatal death, 2022

Place of death	N=98
Neonatal Unit	56 (57.1)
Labour Ward	17 (17.3)
Ward of the maternity unit	13 (13.3)
Theatre	4 (4.1)
Paediatric Centre	4 (4.1)
At home	4 (4.1)*

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

All of the 17 neonatal deaths that occurred in the labour ward occurred within 24 hours of delivery (Figure 4.4). These 17 deaths in the labour ward accounted for less than one third of the neonatal deaths that occurred within the first day (i.e. <24 hours or one completed day) of the birth (n=17 of 58, 29.3%). In 2022, a further 43.1% of first day neonatal deaths occurred in a neonatal unit (n=25 of 58). As detailed in Table 4.6, the daily number of neonatal deaths was significantly lower once 24 hours had elapsed after delivery (Figure 4.4).

Figure 4.4: Place of neonatal death 1-7 completed days after birth, 2022

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 2022 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 2022, there were 21 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=19 early neonatal deaths). Of the 19 early neonatal death cases, over forty percent were due to due to major congenital anomaly (n=8 of 19, 42.1%). One further case of neonatal death was excluded from the cohort as the death was due to infection.

In total, there were twelve perinatal deaths (two stillbirths and ten 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. The majority (n=8, 72.7%, unknown for one case) of these deaths became 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 2022 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	34 - 36	10th - 49th	Placental abruption	Not Applicable	No
SB	37 - 40	90+	Pending results of coroner's post-mortem	Not Applicable	Yes (Coroner case)
ENND	37 - 40	3rd – 10th	Pending results of coroner's post-mortem	HIE	Yes (Coroner case)
ENND	37 - 40	10th - 49th	Retroplacental haemorrhage	HIE	Yes (Coroner case)
ENND	37 - 40	10th - 49th	Breech delivery with birth injury	HIE	Yes (Coroner case)
ENND	37 - 40	10th - 49th	Pending results of coroner's post-mortem	Pending results of coroner's post-mortem	Yes (Coroner case)
ENND	34 - 36	10th - 49th	Emergency LSCS in labour, Twin 1	HIE	No
ENND	40 - 42	10th - 49th	Admitted to paediatric hospital from home	Pending results from paediatric hospital	Unknown
ENND	40 - 42	50th – 89th	Pending results of coroner's post-mortem	Pending results of coroner's post-mortem	Yes (Coroner case)
ENND	40 - 42	50th – 89th	Pending results of coroner's post-mortem	HIE	Yes (Coroner case)
ENND	34 – 36	90+	Placental abruption	HIE	No
ENND	37 - 40	90+	Subgaleal haemorrhage Birth injury (impacted head at LSCS)	HIE	Yes (Coroner case)

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

- **Recommendation:** While perinatal deaths are subject to review under the HSE Incident Management Framework, a national standardised approach to the review of perinatal deaths associated with intrapartum events at unit level would be valuable. The NPEC recommends the use of the online Perinatal Morbidity Mortality Event Report Tool (PMMERT), a joint NPEC/NWIHP initiative, to assist with this process. Findings from these anonymised reviews could be made available for national learning. Owner; the NPEC and the NWIHP.

6. Late neonatal deaths

Key Findings

34

There were **34 late neonatal deaths** reported to the NPEC in 2022.

CAUSE OF DEATH

Major congenital anomaly was the most common cause of late **neonatal death** (35.3%) followed by gastro-intestinal disease (17.6%)

In line with previous reports, the proportion of l**ate neonatal deaths decreased** across the second and third weeks of life in 2022 (i.e. of the 34 deaths occurring after the first week of life, 58.8% occurred in week two, 41.2% in week three and 0% in week 4).

For the purposes of this clinical audit, data were reported to the NPEC relating to 34 late neonatal deaths that occurred among babies born in 2022. This figure is in line with the numbers reported in previous years. On average, 33 late neonatal deaths per year were reported for 2014-2021 and the annual number ranged from 28 to 40. 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 34 deaths occurring in 2022, 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 figures fluctuate from year to year, slightly more babies who died in the late neonatal period were male for the reporting years 2014 to 2018. In 2022, this pattern is shown again with almost 59% of the babies being males. 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 2022, more than half of the babies, who died in the late neonatal period, were born by pre-labour caesarean section (n=18, 52.9%). Vaginal cephalic delivery and caesarean section after the onset of labour accounted for the other 40% (n=15, 44.1%). Over half of the late neonatal deaths for 2022 had a gestational age between 22-27 weeks and one third had a gestational age between 37-41 weeks at birth (n=19, 55.9% and n=11, 32.4%, respectively). Sixty-eight percent of the babies (n=23; 67.6%) had a birthweight less than 2,500 grams. Approximately forty percent of babies were small for gestational age (SGA; <10th centile, n=14, 41.2%).

In line with previous reports, the proportion of late neonatal deaths was found to decrease across the second and third weeks of life in 2022 (i.e. 58.8% in week two and 41.2% in week three).

Similar to previous years, over half (n=20, 58.8%) of late neonatal deaths in 2022 occurred in the neonatal unit and approximately thirty-eight percent died in a paediatric centre (n=13, 38.2%). 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.

Based on the recommendation in the 2021 PMNCA report, a letter regarding the development of a communication policy across maternity units and paediatric services regarding neonatal outcomes following the transfer of babies post-natally to another unit was sent by the NPEC Director to the Faculty of Paediatrics, the clinical directors of Children's Health Ireland, Tallaght Hospital, Crumlin Hospital and Temple Street. A response was received from the Faculty of Paediatrics supporting such a communication policy, which has yet to be developed.

Table 6.1: Characteristics of late neonatal deaths, 2018-2022

		2018 N=30	2019 N=32	2020 N=35	2021 N=40	2022 N=34
Infant sex	**Male**	**18 (60)**	**14 (43.8)**	**17 (48.6)**	**20 (50)**	**20 (58.8)**
	Female	12 (40)	18 (56.3)	18 (51.4)	20 (50)	14 (41.2)
Mode of delivery	**Vaginal cephalic delivery**	**12 (40)**	**10 (31.3)**	**11 (31.4)**	**17 (42.5)**	**11 (32.4)**
	Vaginal breech delivery	4 (13.3)	3 (9.4)	0 (0)	0 (0)	1 (2.9)
	Pre-labour caesarean section	9 (30)	13 (40.6)	21 (60)	17 (42.5)	18 (52.9)
	Caesarean section after onset of labour	4 (13.3)	3 (9.4)	3 (8.6)	3 (7.5)	4 (11.8)
	Forceps	1 (3.3)	0 (0)	0 (0)	1 (2.5)	0 (0)
	Assisted breech	0 (0)	2 (6.3)	0 (0)	0 (0)	0 (0)
	Ventouse	0 (0)	1 (3.1)	0 (0)	2 (5)	0 (0)
Gestational age at delivery	**22-27 weeks**	**13 (43.3)**	**13 (40.6)**	**10 (28.6)**	**17 (43.6)**	**19 (55.9)**
	28-31 weeks	5 (16.7)	1 (3.1)	6 (17.1)	5 (12.8)	0 (0)
	32-36 weeks	4 (13.3)	3 (9.4)	5 (14.3)	6 (15.4)	4 (11.8)
	37-41 weeks	8 (26.7)	15 (46.9)	14 (40)	11 (28.2)	11 (32.4)
	42+ weeks	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Birthweight	**<500g**	**2 (6.7)**	**2 (6.3)**	**0 (0)**	**0 (0)**	**4 (11.8)**
	500<1000g	13 (43.3)	10 (31.3)	8 (22.9)	17 (42.5)	14 (41.2)
	1000<1500g	3 (10)	2 (6.3)	7 (20)	5 (12.5)	2 (5.9)
	1500<2000g	4 (13.3)	0 (0)	3 (8.6)	4 (10)	0 (0)
	2000<2500g	1 (3.3)	6 (18.8)	2 (5.7)	2 (5)	3 (8.8)
	2500<3000g	2 (6.7)	1 (3.1)	8 (22.9)	6 (15)	1 (2.9)
	3000<3500g	3 (10)	5 (15.6)	4 (11.4)	4 (10)	7 (20.6)
	3500<4000g	2 (6.7)	5 (15.6)	3 (8.6)	2 (5)	3 (8.8)
	4000g+	0 (0)	1 (3.1)	0 (0)	0 (0)	0 (0)
Customised birthweight centile category	**<3rd**	**10 (33.3)**	**6 (18.8)**	**12 (34.3)**	**9 (23.1)**	**9 (26.5)**
	<10th*	12 (40)	10 (31.3)	15 (42.9)	16 (41)	14 (41.2)
	10-49th	7 (23.3)	9 (28.1)	10 (28.6)	11 (28.2)	10 (29.4)
	50-89th	7 (23.3)	11 (34.4)	10 (28.6)	11 (28.2)	7 (20.6)
	90th+	4 (13.3)	2 (6.3)	0 (0)	1 (2.6)	3 (8.8)
Timing of death	**2nd week of life**	**17 (56.7)**	**24 (75.0)**	**18 (51.4)**	**17 (42.5)**	**20 (58.8)**
	3rd week of life	7 (23.3)	4 (12.5)	11 (31.4)	23 (57.5)	14 (41.2)
	4th week of life	6 (20.0)	4 (12.5)	6 (17.1)	0 (0)	0 (0)
Location of death	**Neonatal unit**	**21 (70.0)**	**16 (50)**	**19 (54.3)**	**21 (52.5)**	**20 (58.8)**
	Ward of the maternity unit	0 (0)	1 (3.1)	1 (2.9)	(0)	(0)
	Paediatric centre	5 (16.7)	13 (40.6)	12 (34.3)	17 (42.5)	13 (38.2)
	Home	4 (13.3)	2 (6.3)	3 (8.6)	2 (5)	1 (2.9)
	In transit home	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Note: Data was missing for the following variables: 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 2022 (n=12, 35.3%). The next most common cause was gastro-intestinal disorders (n=6, 17.6%). Respiratory and neurological disorders each accounted for five deaths (n=5, 14.7%, respectively). Other causes of death in 2022 included infections (n=3, 8.8%). Sudden infant death syndrome accounted for one death (n=1, 2.9%). Two further deaths were unexplained pending post-mortem or other investigation (n=2, 5.9%).

Table 6.2: Late neonatal main cause of death in 2018-2022, NPEC Classification System

	2018 N=30	2019 N=32	2020 N=35	2021 N=40	2022 N=34
Major congenital anomaly	**12 (40.0)**	**12 (37.5)**	**18 (51.4)**	**13 (32.5)**	**12 (35.3)**
Central nervous system	0	0	0	0	0
Cardiovascular system	3	5	5	3	4
Respiratory system	1	0	3	0	0
Gastro-intestinal system	0	0	1	0	1
Musculo-skeletal system	1	0	0	0	0
Multiple anomalies			1	4	2
Chromosomal disorders	6	2	4	4	5
Metabolic disorders	1	0	1	1	0
Urinary tract	0	1	1	0	0
Other major congenital anomaly	0	4	2	1	0
Respiratory disorders	**3 (10.0)**	**6 (18.8)**	**1 (2.9)**	**7 (17.5)**	**5 (14.7)**
Severe pulmonary immaturity	1	2	0	1	1
Surfactant deficiency lung disease	1	2	0	5	3
Pulmonary hypoplasia	0	0	0	0	0
Meconium aspiration syndrome	0	0	0	0	0
Primary persistent pulmonary hypertension	0	0	0	0	0
Chronic lung disease/bronchopulmonary dysplasia	0	0	0	0	0
Other respiratory disorder	1	2	1	1	1
Gastro-intestinal disease	**5 (16.7)**	**3 (9.4)**	**4 (11.4)**	**4 (10)**	**6 (17.6)**
Necrotising enterocolitis	4	3	4	4	5
Other gastro-intestinal disease	1	0	0	0	1
Neurological disorder	**4 (13.3)**	**3 (9.4)**	**5 (14.3)**	**7 (17.5)**	**5 (14.7)**
Hypoxic-ischaemic encephalopathy	1	2	4	2	1
Intraventricular/periventricular haemorrhage	3	1	0	5	4
Other neurological disorder	0	0	1	0	0
Infection	**4 (13.3)**	**3 (9.4)**	**5 (14.3)**	**3 (7.5)**	**3 (8.8)**
Sepsis	4	3	3	1	3
Pneumonia	0	0	1	0	0
Meningitis	0	0	0	0	0
Other infection	1	0	1	2	0
Injury/Trauma	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**
Other specific causes	**0 (0)**	**1 (3.1)**	**0 (0)**	**1 (2.5)**	**0 (0)**
Malignancies/tumours	0	0	0	0	0
Other specific cause	0	1	0	0	0
Sudden unexpected deaths	**1 (3.3)**	**2 (6.3)**	**1 (2.9)**	**2 (5)**	**1 (2.9)**
Sudden infant death syndrome (SIDS)	1	2	1	2	1
Infant Deaths - Cause Unascertained	0	0	0	0	0
Unexplained	**0 (0)**	**2 (6.3)**	**1 (2.9)**	**3 (7.5)**	**2 (5.9)**

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

Key Findings

35

There were **35 early neonatal deaths** with a birthweight **< 500g** and a gestational age at delivery **< 24 weeks** excluding deaths following TOPs in 2022.

CAUSE OF DEATH

The assigned neonatal cause of death was **pre-viable** for the majority of cases (68.6%) followed by severe pulmonary immaturity (22.9%).

22 WEEKS

The **majority** of the 35 deaths occurred in babies delivered **less than 22 weeks** (94.3%) with 2 deaths occurring after 22 weeks.

While not included in the calculation of perinatal mortality rates in Ireland, 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 Ireland. For 2022, 46 such deaths were reported, of which 11 cases were following termination of pregnancy and were excluded from the analysis. Given the limited number of such deaths, a brief summary of the submitted NPEC audit data for 2022 is provided in Table 7.1.

For the reporting year 2022, the majority of the 35 deaths occurred in babies delivered between 20-22 weeks' gestation (n=18, 51.4%) and at less than 20 weeks gestation (n=15, 42.9%). Two deaths occurred in babies after 22-weeks' gestation. The birthweights of babies born in 2022 were in the range of 80g to 495g. Details of the 35 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 2022 (n=24, 68.6%). The second most common cause of death was severe pulmonary immaturity (n=8, 22.9%) of which the majority were attributed to spontaneous premature labour (n=7, 87.5%). Multiple anomalies, hypoxic ischaemic encephalopathy and other infection accounted for one each (n=1, 2.9%).

In 2022, all the babies in this cohort died within 24 hours of being delivered (n=35, 100.0%). In line with 2021 data, most of the babies who died within 24 hours died on a ward (n=20, 57.1%) and approximately 31% died in the labour ward (n=11, 31.4%). This is in contrast to that reported in previous years (2013-2019) where the location of death in the vast majority of cases was in the labour ward.

In 2022, an autopsy was performed in only a small number of cases (n=3, 8.8%, unknown for one case). Among the cases where an autopsy was not performed (n=31, 91.2%), an autopsy was offered in 58% of the cases (n=18), not offered in approximately 42% of them (n=13).

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[58].

In Ireland in 2022, the legal definition of stillbirths was "a child born weighing 500 grammes or more or having a gestational age of 24 weeks or more who shows no sign of life"[59]. This definition is not consistent with international definitions, which generally use the criterion of ≥ 22 weeks gestational age at delivery in the developed world[60]. This has not only has economic and psychosocial ramifications but also impacts on potential learning for clinicians and hampers robust international comparison[61]. The definition of stillbirth in Ireland has recently been amended in the Civil Registration (Electronic Registration) Act 2024 as follows: a child born weighing 400 grammes or more or having a gestational age of 23 weeks or more who shows no sign of life[62].

According to the criteria used in this report of gestational age ≥24 weeks or birthweight ≥500g, there were 98 early neonatal deaths in 2022. There were 10 early neonatal deaths of infants born from 22 weeks and less than 24 weeks gestation with a birthweight

[58] Smith B, Assistant Registrar General 2016, personal communication, 12th October.
[59] Stillbirth Registration Act, 1994. Available at: https://www.irishstatutebook.ie/eli/1994/act/1/enacted/en/print#sec2
[60] 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
[61] 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
[62] Civil Registration (Electronic Registration) Act 2024. Available at: https://www.irishstatutebook.ie/eli/2024/act/27/enacted/en/html

less than 500g in 2022. Therefore, applying the criteria of gestational age ≥22 weeks or birthweight ≥500g increases the number of early neonatal deaths by 9.3% (from 98 to 108).

Table 7.1: Early neonatal deaths in 2022 with a birthweight <500g and a gestational age at delivery <24 weeks without deaths following TOPs.

Gestation age (weeks)	Number of cases	Birth weight in grams (range)	Location of death	Cause of neonatal death	Autopsy	Coroner Case
16	n=2	80-109	Ward	Pre-viable (<22 weeks)	Autopsy not performed but offered and Autopsy not performed and not offered	No
18	n=2	152-255	Ward	Pre-viable (<22 weeks)	Autopsy not performed but offered and Autopsy not performed and not offered	No
19	n=11	187-290	Ward (n=8); Labour ward (n=3)	Pre-viable (<22 weeks)	Autopsy performed (n=1), Autopsy not performed but offered (n=4) and Autopsy not performed and not offered (n=6)	No
20	n=2	303-400	Ward (n=1); Labour ward (n=1)	Pre-viable (<22 weeks) n=1, other infection n=1	Autopsy not performed but offered (n=2)	No
21	n=8	310-455	Ward (n=5); Labour ward (n=2); In transit (n=1)	Pre-viable (<22 weeks)	Autopsy not performed but offered (n=5) and Autopsy not performed and not offered (n=3)	No
22	-	460	Labour ward	Severe pulmonary immaturity	Autopsy not performed but offered	No
22	-	340	Unknown	Multiple anomalies	Unknown if autopsy performed	.
22	-	455	Theatre	Severe pulmonary immaturity	Autopsy not performed and not offered	No
22	-	470	Labour ward	Severe pulmonary immaturity	Autopsy not performed but offered	No
22	-	465	Labour ward	Severe pulmonary immaturity	Autopsy not performed but offered	No
22	-	440	Ward	Severe pulmonary immaturity	Autopsy not performed but offered	No
22	-	370	Ward	Severe pulmonary immaturity	Autopsy not performed but offered	No
22	-	440	Labour ward	Severe pulmonary immaturity	Autopsy not performed and not offered	No
23	-	495	Neonatal Unit	Hypoxic ischaemic encephalopathy	Autopsy performed	Yes
23	-	400	Labour ward	Severe pulmonary immaturity	Autopsy performed	No

8. Invited commentary:

Auditing Perinatal Mortality Using the Robson 10 Group Classification

McKernan J[63] Greene R[63], Corcoran P[63], Egan, G[64], Robson M[64]

The Robson Ten Group Classification system (TGCS) was first popularised in 2001 as a classification system for use in the audit of Caesarean Sections (CS) and to identify the groups of women in which CS were more prevalent. (1) It is endorsed by the WHO,(2) International Federation of Gynaecology and Obstetrics,(3) and European Board and College of Obstetrics and Gynaecology and also NHS England I will send reference. (4) The TGCS involves systematically categorising all deliveries into one of the ten groups as part of routine care. The TGCS method divides women into ten groups based on previous obstetric record, category of pregnancy (lie and presentation), pathway of labour and delivery and gestation. Importantly as opposed to other classifications the system is simple, clinically relevant, prospective and the groups mutually exclusive and totally inclusive. (1) The TGCS is valuable for monitoring trends over time, understanding the impact of clinical interventions, and identifying areas for improvement in labour and delivery management.

The reasoning behind the development of this classification system was to be able to compare different practices and outcomes; one of those being CS. (5) In 2015, the World Health Organisation issued a statement regarding CS and recommended that the Robson TCGS be used as a global standard for monitoring CS rates. In addition, this statement also acknowledged that this system could be utilised more broadly in assessing other perinatal outcomes and together it would be possible to assess and achieve an appropriate CS rate. An appropriate CS rate could be different in different settings.(2)

As this classification system categorizes all pregnant women into mutually exclusive groups with specific clinical and risk characteristics, the TGCS allows a more meaningful assessment of labour and delivery events and outcomes within the identified groups or subgroups. It opens the potential for greater learning. It is essential to consider the other parameters of perinatal care such as morbidity mortality and other perinatal outcomes. These outcomes can be evaluated using a robust classification system that identifies more suitable denominators and avoids averaging effects.

The full potential of the TGCS will only be realised when it is adopted as standard practice, enabling clinicians to learn from each other, with a common starting point for more detailed analysis. (6) The TGCS was intended as an overview tool for CS quality of care; more in-depth analysis into reasons behind all the outcomes is needed. It provides a common starting point for further analyses for all labour and delivery events and outcomes and its principles of simplicity and clarity of thought help to stimulate interest, discussion, and education. (7) Many institutions and countries remain unable to publish their results because of poor quality data collection. An unexpected benefit of using the TGCS has been the capacity to assess data quality.

It provides us with common ground to look at care in similar populations with consistent denominators to allow more in-depth analysis, assisting us to learn from each other. Variables such as the population, ethnicity, complexity and other information can then be analysed within classified groups, to allow real assessment of different outcome between units, regions, and countries. This invited commentary takes a national audit of perinatal mortality data and incorporates TGCS into the analysis.

Maternity services in Ireland are predominantly hospital based, with 99% of births occurring within a hospital. (8) The services in Ireland are managed by the Health Service Executive (HSE). There are 19 maternity units in Ireland, 15 are co-located within general hospital grounds and four currently are stand-alone hospitals. (9)

Methods:

The National Perinatal Epidemiology Centre (NPEC) collects perinatal mortality data. Within each maternity unit coordinators with the responsibility of submitting data to the NPEC have been identified. Pseudonymised data on perinatal deaths from births that occurred during the calendar years 2016 to 2022 were submitted to the NPEC by all 19 units using a standardised notification dataset. The notification dataset was constructed using data on fetal and maternal characteristics documented in clinical records. Stillbirth was defined as the birth of an infant weighing 500 grams or more, or with a gestational age of 24 weeks or greater, showing no signs of life. Early neonatal death was classified as the death of a live-born infant occurring within the first seven completed days post-birth. For the purposes of this study, cases involving congenital anomalies and terminations of pregnancy were excluded from the analysis. The rate was calculated per 1,000 births (babies delivered).

From 2016 to 2019, different numbers of units contributed data on all deliveries classified by the Robson Ten Group Classification System (TGCS). In 2016, 13 out of 19 units participated; in 2017, 14 units; in 2018, 16 units; and in 2019, 17 units took part. From 2020 to 2022, all 19 units were involved, enabling the classification of perinatal deaths according to the Ten Groups.(9–11).

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Groups 1 and 2, as well as Groups 3 and 4, were combined into single cohorts. Combining these two groups allows for analysis of outcomes in term, low-risk pregnancies with a cephalic presentation (Table 1). Since both groups are expected to have low perinatal mortality rates due to their low-risk nature, combining them allows for a clearer, more meaningful analysis of mortality outcomes without getting distracted by the specific method of labour onset. This simplifies the comparison with higher-risk groups, helping to better understand how factors like prematurity or other complications increase the risk of perinatal mortality. Combining Groups 6, 7, and 9 in the Robson Ten-Group Classification System for perinatal mortality cases is also useful because all these groups represent pregnancies with higher risk factors due to unusual fetal presentations. These groups involve non-cephalic presentations (breech or transverse), which are known to be associated with higher perinatal mortality and complications, combining them allows for a more cohesive analysis of perinatal mortality in pregnancies where the baby's position is a significant risk factor. Grouping them helps to better assess how non-cephalic presentations contribute to overall mortality and compare this with lower-risk groups.[66]

Results:

The total number of deliveries recorded for the years 2016 – 2022 was 411,591. The PMR was 4.18/1,000, for stillbirths it was 3.12/1,000 and Early Neonatal Death was 1.06/1,000.

Prematurity was strongly correlated with perinatal mortality, a relationship that was particularly evident through the application of the TGCS. Group 10, which includes all preterm, singleton, cephalic pregnancies, accounted for 4% of deliveries and exhibited the highest perinatal mortality rate (PMR). Almost half of the national PMR is due to group 10.

Table 1: Incidence of stillbirth and early neonatal death by Robson Ten Group Classification System in Irish maternity units, 2016-2022

Group	Group description	Number of babies delivered*	Stillbirths		ENND		Perinatal Deaths		Group contribution to rate
			N	Rate	N	Rate	N	Rate	
All*		411,591	1284	3.12 (2.95-3.30	436	1.06 (0.96-1.16)	1720	4.18 (3.98 -4.38)	
1	Nulliparous, singleton, cephalic, >37/40, spontaneous labour	139,096	122	0.88 (0.73-1.05)	27	0.19 (0.12-0.28)	149	1.07 (0.96-1.25)	0.36
2	Nulliparous, singleton, cephalic, >37/40 induced or elective CS								
3	Multiparous (excluding previous CS), singleton, cephalic, >37/40, spontaneous labour	157,420	181 (0.99-1.33)	1.15 (0.99-1.33)	31	0.20 (0.13-0.27)	212	1.35 (1.17-1.54)	0.51
4	Multiparous (excluding previous CS), singleton, cephalic, >37/40 induced or elective CS								
5	Previous CS, singleton, cephalic, >37/40, induced or elective CS	64,848	46	0.71 (0.52-0.95)	4	0.06 (0.01-0.15)	50	0.77 (0.57-1.06)	0.12
6	All nulliparous deliveries with a single breech pregnancy	17,593	181	10.29 (8.84-11.90)	91	5.17 (4.16-6.35)	272	15.46 (13.6-14.41)	0.66
7	All multiparous breech (including previous CS)								
8	All women with a single pregnancy with a transverse or oblique lie, including women with previous uterine scars								
9	All multiple pregnancies (including previous CS)	15,067	114	7.57 (6.24-9.09)	94	6.24 (5.04-7.63)	208	13.80 (11.99-15.81)	0.58
10	All singleton, cephalic, <37/40 (including previous CS)	17,568	640	36.43 (33.66-39.37	189	10.76 (9.27-12.06	829	47.17 (44.03-50.51)	2.01

Note: Rate is per 1,000 babies delivered; CS=Caesarean Section

[66]Robson Classification: Implementation Manual. Geneva: World Health Organization; 2017.

Table 2: Relative risk of perinatal mortality across the Robson Ten Group Classification System

10Groups		Rate (95% CI)	Rate ratio (95% CI)	p-value
1	Nulliparous, singleton, cephalic, >37/40, spontaneous labour	1.07 (0.96-1.25)	0.80 (0.64-0.98)	0.032
2	Nulliparous, singleton, cephalic, >37/40 induced or elective CS			
3	Multiparous (excluding previous CS), singleton, cephalic, >37/40, spontaneous labour	1.35 (1.17-1.54)	Reference	
4	Multiparous (excluding previous CS), singleton, cephalic, >37/40 induced or elective CS			
5	Previous CS, singleton, cephalic, >37/40, induced or elective CS	0.77 (0.57-1.06)	0.57 (0.42-0.78)	<0.001
6	All nulliparous deliveries with a single breech pregnancy	15.46 (13.6-14.41)	11.48 (9.59-13.74)	<0.001
7	All multiparous breech (including previous CS)			
8	All women with a single pregnancy with a transverse or oblique lie, including women with previous uterine scars			
9	All multiple pregnancies (including previous CS)	13.80 (11.99-15.81)	10.25 (8.47-12.41)	<0.001
10	All singleton, cephalic, <37/40 (including previous CS)	47.17 (44.03-50.51)	35.04 (30.13-40.75)	<0.001

In relative terms compared to the combined Groups 3 and 4, the PMR was 20% lower in Groups 1 and 2 and 43% lower in Group 5. In contrast, the PMR was 11.5 times higher in the combined Groups 6, 7 and 9 and ten times higher in Group 8. However, by far the highest risk was associated with Group 10 with a 35-times higher PMR. Table 2 illustrates the relative risk of PMR by obstetric group, highlighting the variation in risk based on clinical and obstetric factors. It emphasizes the groups where targeted interventions could most effectively reduce perinatal mortality. Specifically, Group 10 stands out as the highest-risk category, suggesting that addressing risk factors associated with this group could significantly improve overall outcomes.

Discussion:

The TGCS is a feasible system for monitoring perinatal outcomes other than CS.(12–18) It is evident that this system is very effective in assessing several outcomes in the classified groups; more importantly linking all events and outcomes together and interpreting them together. However, assessment of common outcomes is a struggle in studies due to different definitions and incomplete data.(18) The variables needed to classify women according to TGCS are routinely collected on admission to hospital.

Previous studies have assessed various perinatal outcomes including perinatal mortality using the TGCS. (18) They found that nulliparous singleton cephalic term pregnancies (groups 1 and 2) had higher combined rates of perinatal mortality than multiparous singleton cephalic term pregnancies (groups 3 and 4) combined. Groups 1 and 2 had a rate of 1.3, 1.4 and 1.2 per 1000 whereas groups 3 and 4 had 0.1, 0.8 and 1.2 per 1000 in 3 geographically distinct regions (Norway, Ireland and Slovenia). Group 5 (multiparous with previous CS) had a disproportionately elevated rate in Norway at 5.5/1000. (18)

Perinatal mortality (Neonatal death and stillbirth) was twice as high in the preterm non-cephalic group when compared to the preterm cephalic infants, with no significant difference was noted in term pregnancies.

In the study by Litorp et al noted that preterm and all non-cephalic deliveries (groups 10, 7, 6, 9) had the highest perinatal mortality ratio. However overall, that ratio has decreased across the span of this study, between 2000 and 2011, in nulliparous single cephalic and breech term deliveries, multiparous single cephalic with previous CS and multiple pregnancies (groups 1, 2, 5, 6, 8). (14)

The philosophy of the TGCS in assessing maternity care is based on the premise that all epidemiological information, maternal and fetal events and outcomes will be more clinically relevant if analysed within the 10 groups or their subgroups . (19) The TGCS is not widely used for auditing perinatal events other than CS, therefore the current literature is limited. This paper uses it on a large cohort of perinatal deaths and shows value in the analysis of such deaths. There is little doubt that reference models (good quality, classified and adjusted perinatal audit) continually refined, will be used as the guide to the quality of perinatal care provided in the future. Furthermore, the most valuable reference models may be in individual groups of women rather than in an overall population (20).

However, the TGCS needed to be modified in some incidences due to a lack of information or if it was deemed unsuitable for the population. As Rossen et al. concluded, non-cephalic presentations make up a small minority of deliveries, so these should be recommended to represent one Robson group. Robson groups were modified in this group by combining all single non-cephalic presentations into one group and separating induced labour and CS

prior to labour into separate groups. Modifications to the TGCS were also necessary for Liang et al. because the database used for analyzing and categorizing women didn't routinely collect information on the course of labour, i.e., spontaneous or induced. For this reason, eight groups were used without distinction of course of labour. (15)

A range of populations has been studied in 10 countries (Ireland et al.) across four continents. This diverse array of studies proved that the Robson TGCS is applicable in most countries worldwide. Even though the countries included varied significantly in socioeconomics and health care, similar results were shown in each study. All non-cephalic presentations had dramatically higher rates of adverse outcomes, followed by the preterm delivery and multiple pregnancy groups.

Our study on a national population shows a very significant contribution to the perinatal mortality rate from groups 6-10 – non-cephalic presentations, multiple pregnancies and preterm deliveries. By acknowledging these women to be at risk universally, it is possible to justify more focussed care in these cases. A significant variation in PMR was observed across the obstetric groups. These findings emphasise the profound impact of clinical and obstetric factors on perinatal outcomes. Targeted strategies to mitigate risks in this group could significantly reduce overall perinatal mortality and improve outcomes across the population.

Conclusion - impact on health policy

The TGCS has a significant impact on health policy by offering a standardised classification for analyzing and addressing perinatal outcomes. It facilitates improved monitoring, data-driven policy-making, and targeted interventions. This approach supports broader objectives in maternal health, such as improving care quality and reducing health disparities across different regions and populations. While the TGCS has its predominant use in assessing CS rates, which most previous studies analysed, the classification is gaining increasing momentum in other areas of perinatal audit. By comparing outcomes between different units and connecting them to practice allows for a greater understanding to take place and may lead to a change in practice. (20) More research needs to be carried out in using this system to examine other outcomes. Shakuntala et al (2024) comment that there is a need to intensify actions to improve labour management, and the categories supports the review of labour progress. (21) In addition to mortality and morbidity, areas such as maternal satisfaction, healthcare costs and resource use could also be assessed using the TGCS. The Robson TGCS may reach its full potential it is fully supported by national organisations and used by all.

Our findings emphasises the insights offered by applying the Robson ten group classification system to perinatal outcomes, particularly in highlighting PMR variations between groups. By identifying these high-risk groups and understanding the challenges, this work provides data that shows where targeted interventions may improving outcomes.

Overall, this piece of work explores the value of this classification system in perinatal care, not only as a tool for monitoring trends but as a catalyst for informed decision-making and resource allocation.

There is a need for continued research and collaborative efforts to refine interventions and ultimately reduce perinatal mortality rates across all groups.

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In Summary

For the first time, and in keeping with international practice, perinatal deaths following termination of pregnancy (TOP) are not included in this 2022 PMNCA.

The PMR was 5.30 per 1,000 total births in 2022.

Corrected for Major Congenital Anomaly (MCA), the PMR was 3.75 per 1,000 live births in 2022.

No statistically significant differences were noted when comparing PMR rates without TOPs in 2022 to PMR in 2021 without TOPs. The corrected PMR has remained static in recent years.

Similar to findings in 2021, specific placental conditions were the most common cause of death in stillbirths followed by major congenital anomaly in 2022. However, MCA was the most common cause of neonatal death followed by severe pulmonary immaturity.

Small for gestational age (SGA) babies at delivery were again associated with perinatal deaths, particularly stillbirths. This is similar to findings in successive PMNCA reports and highlights the need for a standardised approach to improve antenatal detection of fetal growth restriction (FGR).

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

A national standardised approach to review perinatal deaths associated with intrapartum events at unit level would be valuable. The NPEC recommends the use of the online Perinatal Morbidity Mortality Event Report Tool (PMMERT), a joint NPEC/NWIHP initiative, to assist with this process. Findings from these anonymised reviews could be made available for national learning.

Appendix A: Hospital Co-ordinators and Contributors 2022

Hospital	Co-ordinators	Additional contributors
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University Hospital Galway	Ms Clare Greaney	
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Appendix B: Perinatal Mortality National Clinical Audit Governance Group

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Chair, Director of the National Perinatal Epidemiology Centre

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Siobhan Whelan, Patient Representative

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Appendix C: NPEC Governance Committee Members

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Appendix D: 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: **distal villous hypoplasia** **accelerated villous maturation** **ischaemic villous crowding** **placental infarction** **retroplacental haemorrhage** **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: **patchy hypoperfusion** **villous stromal-vascular karyorrhexis** **scattered avascular villi** **thrombosis in fetal circulation** **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: **hypercoiled cord (Umbilical coiling index (UCI) of ≥ 0.3)** **cord stricture** **hypocoiled cord (UCI < 0.1)** **meconium associated vascular necrosis** **velamentous or marginal (<10mm) cord insertion** **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.

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Appendix E: NPEC Maternal and fetal classification system: definitions.

STILLBIRTHS AND NEONATAL DEATHS	
Definition Of Terms	**Subcategory**
MAJOR CONGENITAL ANOMALY Any genetic or structural defect **arising at conception or during embryogenesis** incompatible with life or potentially treatable but causing death	Central nervous system Cardiovascular system Respiratory system Gastro-intestinal system Musculo-skeletal anomalies Multiple anomalies Chromosomal disorders Metabolic diseases Urinary tract Other
HYPERTENSIVE DISORDERS OF PREGNANCY	Pregnancy induced hypertension Pre-eclampsia HELLP syndrome Eclampsia
ANTEPARTUM OR INTRAPARTUM HAEMORRHAGE After 20 w gestation, whether revealed or not. If associated with PET, APH will be a secondary diagnosis. Ignore minor degrees of haemorrhage (e.g. 'shows', cervical polyps etc). Recurrent bleeding of uncertain origin followed by preterm labour should not be ignored.	Praevia Abruption Other
MECHANICAL Any death attributed to uterine rupture, deaths from birth trauma or intrapartum asphyxia associated with problems in labour such as cord compression, malpresentation, shoulder dystocia etc. 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** Prolapse cord Cord around neck Other cord entanglement or knot **Uterine Rupture** Before labour During labour **Mal-presentation** Breech / Transverse Face / Compound Other **Shoulder dystocia**
MATERNAL DISORDER Specify hypertensive disease present before pregnancy or any other maternal disease or condition sufficient to jeopardise the baby such as diabetes, cardiac disease etc. Infection is classified separately.	Pre-existing hypertensive disease Diabetes Other endocrine conditions Thrombophilias Obstetric cholestasis Uterine anomalies Connective Tissue disorders Other
INFECTION **Confirmed by microbiology / placental histology.** 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. 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** Bacterial / Viral diseases Syphilis /Group B Streptoccus Protozoal Other **Ascending infection** Chorioamnionitis Other

STILLBIRTHS AND NEONATAL DEATHS	
Definition Of Terms	**Subcategory**
SPECIFIC FETAL CONDTIONS. Document only those specific conditions **arising in the fetal period.**	Twin-twin transfusion Feto-maternal haemorrhage Non-immune hydrops Iso-immunisation 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 Fetal vasculitis Maternal vascular malperfusion Fetal vascular malperfusion Delayed villous maturation defect Villitis Cord Pathology 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 Observed at delivery 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 Intracranial haemorrhage Subgaleal haematoma* Fracture Intrapartum fetal blood sample <7.25 Other Polyhydramnios Oligohydramnios Premature rupture of membranes Prolonged rupture of membranes Spontaneous premature labour Vasa Praevia 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. **Use as sparingly as possible.**	

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

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