Very Low Birth Weight Infants in the Republic of Ireland

NATIONAL PERINATAL EPIDEMIOLOGY CENTRE

NICORE Ireland

ANNUAL REPORT 2015

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Acknowledgements

Welcome to the second Very Low Birth Weight Infants in the Republic of Ireland (ROI) Annual Report, produced by the Neonatal Intensive Care Outcomes Research and Evaluation (NICORE) ROI group and facilitated by the National Perinatal Epidemiology Centre (NPEC). This report focuses on all babies born ≤1500g and/or ≤29 wks gestation in the Republic of Ireland for the calendar year 2015 and compares outcomes to 2014, the first year for which we have a complete ROI dataset.

Since 2003, nine neonatal centres in the ROI have participated in the Vermont Oxford Network (VON), the international network of health care professionals dedicated to improving the medical care of newborn infants and which is the entity which underpins this report. The remaining 10 ROI neonatal centres joined VON in 2013. Every neonatal centre in the country has submitted data on their very low birth weight (VLBW) infants to VON since 2014. It is a credit to everybody involved and it is truly a great achievement.

This report, similar to the 2014 report, is endorsed by the National Office of Clinical Audit (NOCA), as shown in Appendix A. NOCA supports institutions and individuals to review and action audit findings arising from national clinical audit: effectively it aims to close the audit loop. The first step in this process is to bench mark clinical care with identified standards, such as those set by the National Clinical Programme in Neonatology and the Faculty of Paediatrics. The creation of a national dataset of all VLBW infants was the first step in this process. The goal, ultimately, is to end with implementing change for the improvement of patient safety and quality of care. On the basis of our first report in 2014, the findings of which were reviewed by the National Advisory Group of the Royal College of Physicians of Ireland (RCPI), the Obstetric Working Group of the Health Service Executive (HSE) and the Faculty of Paediatrics of the RCPI, it was recommended, in view of the small numbers of infants involved, that the national dataset be reviewed again over a three to five year period before any meaningful recommendations could be made in the Irish context. It was also suggested that an expert group looking at the issues surrounding infants born at the limits of viability be convened under the auspices of the HSE Clinical Care Programme in Paediatrics and Neonatology. It is this sort of response and support that makes the publication of these reports so important. It is truly gratifying to see the NOCA vision in action.

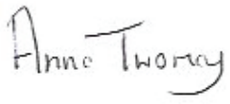
During the compilation of this report, and building on last year's report, the paucity of international data with which to compare national outcomes became evident. This was both a function of the fact that other studies drew on populations with slightly different inclusion criteria e.g. in terms of birth weight or gestational age, and on the fact that no other countries that we are aware of are reviewing their data on VLBW infants at a national level. This initiative of the ROI neonatal community to review its outcomes of care at both local and national levels demonstrates its commitment to improving outcomes for all VLBW infants in the ROI and their parents and families. On behalf of NICORE and the NPEC, we extend sincere thanks and appreciation to the many neonatal nurses, paediatricians and administration staff who have supported and contributed data to VON. In particular, we gratefully acknowledge the commitment of those who co-ordinate the collection of VON data at unit level.

The lack of timely analogous international comparisons also highlights the invaluable resource that VON is to the ROI. Participation in VON allows us to benchmark our care at

both local and national levels against the Network as a whole and against the most up-to-date data on VLBW infants available. We thank the team at VON who have whole-heartedly supported this initiative by working closely with the team at the NPEC in terms of collection of VON data and statistical analysis. Additionally, we extend our sincere thanks to the NPEC, led by Professor Richard Greene, for its continued support of the ROI's participation in VON, specifically by financing the annual membership fee to the Network for all 19 centres and for providing the logistical support for this project.

Lastly, we would like to thank the NICORE (Neonatal Intensive Care Outcomes Research and Evaluation) ROI group for their participation and support of this project from the onset, for their continuing intellectual input and for their vision of using national clinical audit data to improve neonatal services in the Republic of Ireland. The membership of NICORE ROI is listed in Appendix B.

Measurement of the outcome of care is central to the development of safe and high quality health care services. Support from all Irish neonatal centres is instrumental in the success of this important national programme. By assessing the outcomes of care, learning from the data and working together, we have great potential to improve outcomes for VLBW infants in Ireland.



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Executive summary

1. A total of 622 very low birth weight (VLBW) infants were born in the Republic of Ireland (ROI) in 2015, of which two infants were <401g but ≥22 weeks gestation and 27 infants were >1500g but ≤29 weeks gestation.

2. In all, 224 infants were born with a birth weight ≤1000g and 166 infants were born with a gestational age ≤26 weeks 6 days.

3. The survival rate for ROI VLBW infants in 2015 was 84% (n=525), one percentage lower than the rate (85%) for all infants reported to the Vermont Oxford Network (VON) in the same year.

4. Adjusting for the risk profile of the VLBW population, there was no significant difference in the risk of mortality for ROI infants compared to VON infants in 2015 [Standardised Mortality Ratio (SMR)=1.15; 95% CI: 0.91, 1.39]. In contrast, the mortality risk was significantly higher for ROI infants in 2014 (SMR=1.27, 95% CI: 1.03-1.51).

5. Adjusting for the risk profile of the VLBW population, there was no significant difference in the risk of mortality excluding early deaths (deaths in the delivery room or deaths within 12 hours of admission to the NICU) for ROI infants compared to VON infants in 2015 (SMR=1.01; 95% CI: 0.70, 1.31). This was also the case in 2014.

6. A significantly higher proportion of ROI infants died in the delivery room (7%, n=44) compared to VON infants (4%, n=2,304) (p<0.001) in 2015. Eleven (25%) of these 44 ROI infants had a major congenital anomaly and a further 28 (64%) were born at less than 24 weeks gestation.

7. Despite the above findings that mortality and mortality excluding early deaths were not significantly different between ROI and VON infants, VLBW infants born in the ROI in 2015 had significantly higher rates of death or morbidity (SMR=1.16, 95% CI: 1.03, 1.29). This was also the case in 2014 (SMR=1.14, 95% CI: 1.01, 1.27).

8. Adjusting for the risk profile of the VLBW population, Key Performance Indicators in the neonatal care of VLBW infants born in the ROI in 2015 compared to VON infants showed that:

   - ROI infants had significantly higher rates of pneumothorax (SMR=1.80, 95% CI: 1.37, 2.24). This was also reported in 2014.
   - ROI infants had significantly higher rates of coagulase negative staphylococcus infection (SMR=1.60, 95% CI: 1.22, 1.99). This was also reported in 2014.
   - ROI infants had significantly higher rates of nosocomial infection (SMR=1.43, 95% CI: 1.17, 1.69). This was also reported in 2014.
   - ROI infants had significantly higher rates of any late infection (SMR=1.44, 95% CI: 1.18, 1.70). This was a new finding for 2015, although the analogous SMR for 2014 was nearly statistically significant (SMR=1.26, 95% CI: 1.00, 1.52).
   - ROI infants had significantly higher rates of IVH (SMR=1.24, 95% CI: 1.05, 1.43). This was a new finding for 2015. However, rates of severe IVH were not significantly different from VON infants (SMR=1.15, 95% CI: 0.80, 1.51).
   - ROI infants had significantly higher rates of necrotizing enterocolitis (NEC) (SMR=1.47, 95% CI: 1.08, 1.86). This was a new finding in 2015.
   - ROI infants had significantly lower rates of retinopathy of prematurity (SMR=0.71, 95% CI: 0.53, 0.89). This was also reported in 2014.

9. Of 608 infants with available birth location data, 86% (n=342) of those born in tertiary neonatal centres; 91% (n=125) of those born in regional neonatal centres; and 64% (n=45) of those born in peripheral neonatal centres survived to discharge.

10. Of 608 infants with available birth location data, 7% (n=41) were transferred from their birth hospital/neonatal centre within 48 hours of birth to another neonatal centre or tertiary paediatric centre: these included 1% (n=3) of infants born in tertiary centres; 1% (n=2) of those born in regional centres; and over half (51%, n=36) of those born in peripheral centres.

11. Of 48 infants born less than 24 weeks gestation in the ROI in 2015, 39 (81%) died and nine (19%) survived to discharge: the survivors comprised 17% (n=5) of those born less than 24 weeks gestation in tertiary centres; 20% (n=1) of those born in regional centres; and 21% (n=3) of those born in peripheral centres.

12. In view of the number of infants involved, it is becoming evident that at least three to five years of data will be required before a more meaningful analysis of the national dataset can/should be undertaken. It is hoped to do this over the coming years so that specific recommendations addressing clinical care and patient safety in the Irish context can be made.

Background

The Vermont Oxford Network (VON) is a non-profit voluntary collaboration of health care professionals dedicated to improving the quality and safety of medical care for newborn infants and their families. Established in 1988, the Network is today comprised of nearly 1000 Neonatal Intensive Care Units around the world (Figure 1).

The Network maintains a database of information regarding the care and outcomes of high-risk newborn infants. The database provides unique, reliable and confidential data to participating units for use in quality management, process improvement, internal audit and peer review.

In the ROI, nine tertiary and regional neonatal centres joined VON in 2003, followed by the remaining 10 centres in 2013. This was on foot of a joint initiative between the NICORE (Neonatal Intensive Care Outcomes Research and Evaluation) group and the NPEC. In 2014, all 19 neonatal centres in the ROI submitted data to VON, signifying the first year for which a national dataset is available. The first annual report on all VLBW infants born in the Republic of Ireland was subsequently published for the year 2014. The current report represents the second year, 2015, of a complete ROI dataset.

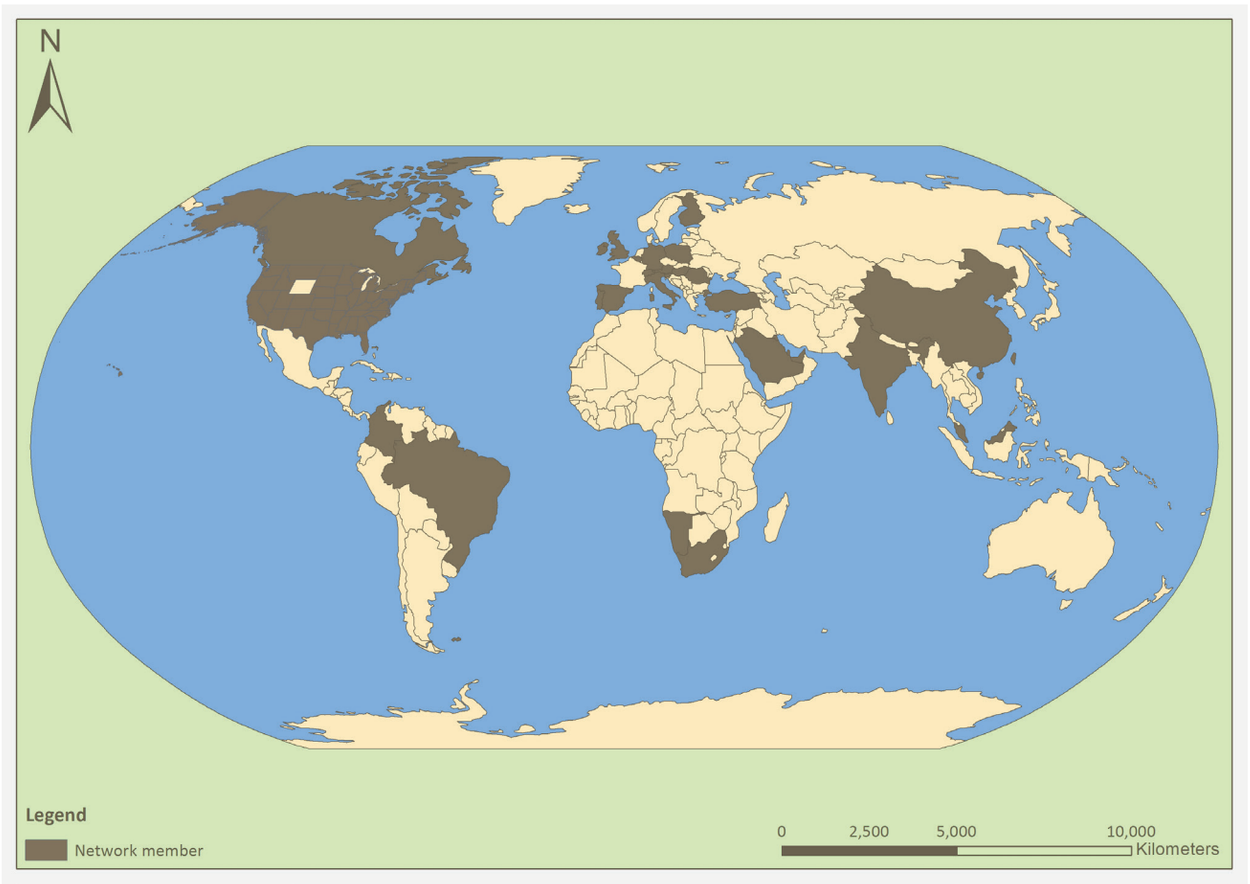

Figure 1: Member countries of the Vermont Oxford Network

Governance

For the ROI, data submitted to VON are controlled by NICORE ROI, a group of consultant neonatologists and paediatricians with formal representation from all 19 tertiary, regional and peripheral neonatal centres in the Republic. NICORE ROI is formally affiliated through a Memorandum of Understanding to the Faculty of Paediatrics, Royal College of Physicians of Ireland (RCPI). NICORE ROI is also formally affiliated to and functions in partnership with the National Perinatal Epidemiology Centre (NPEC) for the promotion and management of VON in the ROI.

NICORE ROI, incorporating all neonatal centres in the Republic, collaborates with the five neonatal centres in Northern Ireland (NI). This cross-border collaboration has been in existence since 2003 when only nine centres in the ROI were contributing data to VON. The collaborative group at that time was identified as NICORE Ireland. When all 19 centres in the ROI began submitting data to VON, the NICORE ROI group was created. Effectively, NICORE ROI is a subgroup of the parent group, NICORE Ireland. Figure 2 illustrates all units participating in VON in the island of Ireland.

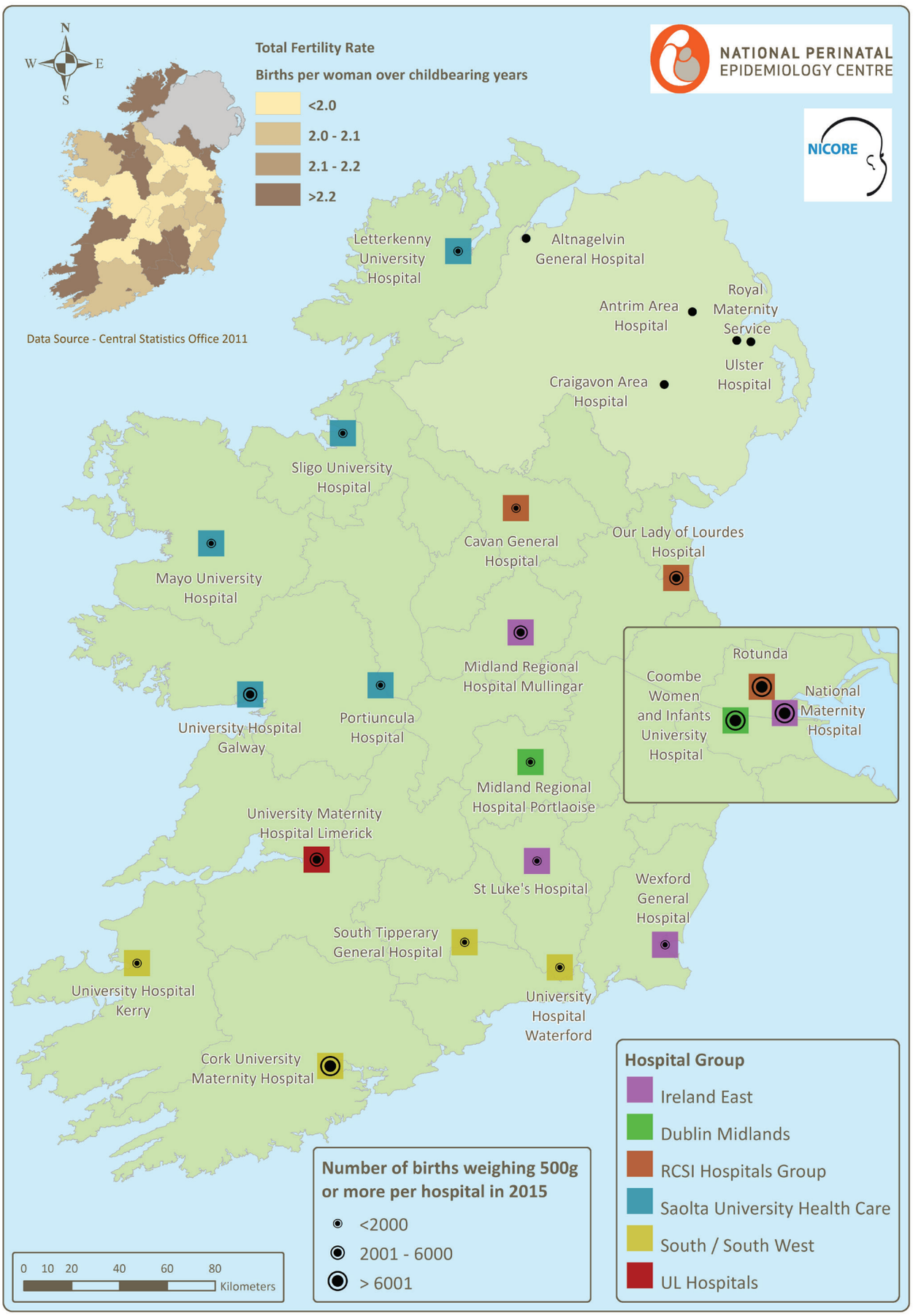

Figure 2: Neonatal centres in the Republic of Ireland and Northern Ireland participating in the Vermont Oxford Network. ROI centres are classified according to number of births weighing 500g or more in the associated obstetric centres in 2015

Methods

Data recording

In 2015, 19 neonatal centres participated in the VON's Very Low Birth Weight (VLBW) database. The definition of eligibility for the VLBW database is:

> Any infant who is born alive at your hospital and whose birth weight is between 401 and 1500 grams OR whose gestational age is between 22 weeks 0 days and 29 weeks 6 days (inclusive), regardless of where in your hospital the infant receives care

Anonymised data on VLBW infants born between 1st January and 31st December 2015 were submitted to VON's on-line database or alternatively by paper format to the NPEC. (Please see Appendix C for data collection forms). Figure 3 illustrates the flow of information involved.

On completion of all ROI submissions for 2015, VON forwarded a copy of the complete ROI dataset to the NPEC. The data presented in this report are based on both the ROI dataset and data from "Nightingale", VON's on-line data reporting system. Throughout the report, ROI data is compared to VON data, comprising data from all centres across the Network.

Definitions and terminology

Birth weight: Weight from the labour and delivery record. If this is unavailable, weight on admission to the neonatal unit or lastly, the weight obtained on autopsy (if the infant expired within 24 hours of birth).

Gestational age: The best estimate of gestational age in weeks and days using the following hierarchy:

- obstetric measures based on last menstrual period, obstetrical parameters, and prenatal ultrasound as recorded in the maternal chart.
- neonatologist's estimate based on physical criteria, neurologic examination, combined physical and gestational ages exam (Ballard or Dubowitz), or examination of the lens.

Inborn: Infant delivered at your hospital.

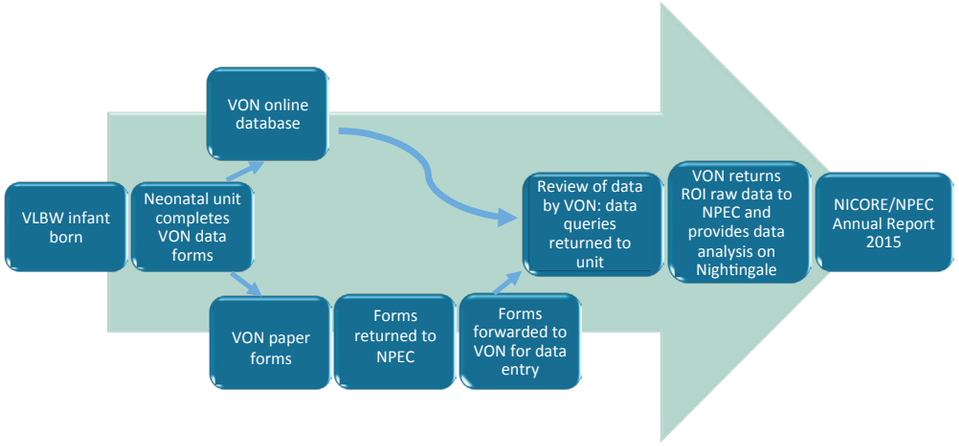

Figure 3: Flow of information in the VON data collection process

Outborn: Infant delivered outside your hospital. Any infant requiring ambulance transfer is considered outborn.

Died in the delivery room: Death of a live born baby who was never admitted to the NICU, and died in the delivery room or at any other location in your hospital within 12 hours after birth.

Mortality: Indicates whether the infant died.

Mortality excluding early deaths: Death excluding those who died in the Delivery Room or within 12 hours of admission to the NICU.

Death or morbidity: Indicates if an infant died or was known to have one or more of the following key morbidities: severe intraventricular haemorrhage (IVH), chronic lung disease (CLD) in infants <33 weeks, necrotising enterocolitis (NEC), pneumothorax, any late infection or cystic periventricular leukomalacia (PVL).

Chronic Lung Disease (CLD): Based on an algorithm that was tested with hospital data and is more accurate than just oxygen dependency at 36 wks gestational age. CLD is coded 'yes' if the infant is in your centre at 36 weeks postmenstrual age and 'oxygen at 36 weeks' is answered 'yes'. Infants are considered to 'be in your centre at 36 weeks' if they have not been discharged home on that date or if they have been transferred from your centre to another centre prior to the date of week 36 but have been readmitted to your centre before discharge home, death or first birthday or are not transferred a second time before 36 weeks.

If the infant is discharged home on or after 34 weeks postmenstrual age but before 36 weeks, then CLD is equal to the 'value of oxygen at discharge'. The latter is recorded as 'yes' for infants who went home and were on oxygen at the time of discharge. If the infant was transferred to another hospital on or after 34 weeks postmenstrual age but before the date of week 36, then CLD is equal to the 'value of oxygen at the time of discharge' from your institution. Again, the latter is recorded as 'yes' for infants who were transferred and were on oxygen at the time of discharge from your centre.

If the infant is discharged home before 34 weeks postmenstrual and is not on oxygen at the time of discharge, then CLD is coded as 'no'. If the infant is transferred before 34 weeks postmenstrual age and the infant is not on oxygen at discharge, then CLD is coded as 'no'. However, if the infant is discharged home or transferred to another hospital before 34 weeks postmenstrual age, and the infant is on oxygen at the time of discharge from our centre, then CLD is coded as 'unknown'.

Chronic Lung Disease (CLD) < 33 weeks gestation: The same algorithm applied as above but only includes infants < 33 weeks gestation.

Pneumothorax: Extra-pleural air diagnosed by chest radiograph or needle aspiration (thoracentesis).

Late Bacterial Infection: Bacterial pathogen recovered from blood and/or cerebrospinal fluid culture obtained after day 3 of life.

Coagulase Negative Infection: Coagulase negative staphylococcus recovered from a blood culture obtained from either a central line or a peripheral blood sample, and/or recovered from cerebrospinal fluid obtained by lumbar puncture, ventricular tap or ventricular drain after day 3 of life AND one or more signs of generalized infection AND treatment with 5 or more days of intravenous antibiotics.

Nosocomial Infection: Indicates whether the infant has either late bacterial infection and/or coagulase negative staphylococcal infection diagnosed after day 3 of life.

Fungal Infection: Fungus recovered from a blood culture obtained from either a central line or a peripheral blood sample after day 3 of life.

Any Late Infection: Indicates whether the infant has either any late bacterial infection,

coagulase negative infection and/or fungal infection after day 3 of life.

Any Intraventricular Haemorrhage (IVH): Indicates whether the infant has a grade 1, 2, 3 or 4 periventricular-intraventricular hemorrhage (PIH) on or before day 28.

Severe Intraventricular Haemorrhage (IVH): Indicates whether the infant has a grade 3 or 4 periventricular-intraventricular hemorrhage (PIH) on or before day 28.

Retinopathy of Prematurity (ROP): Indicates whether the infant has stage 1, 2, 3, 4 or 5 ROP.

Severe Retinopathy of Prematurity (ROP): Indicates whether the infant has stage 3, 4 or 5 ROP.

Cystic Periventricular Leukomalacia (PVL): Evidence of cystic periventricular leukomalacia on a cranial ultrasound, CT, or MRI scan obtained at any time prior to discharge.

Necrotising Enterocolitis (NEC): NEC diagnosed at surgery, at post-mortem examination or "clinically and radiographically". To be diagnosed "clinically and radiographically", there has to be at least one of the following clinical signs present: bilious gastric aspirate or emesis; abdominal distension; occult or gross blood in stool AND at least one of the following radiographic findings present: pneumatosis intestinalis, hepato-biliary air, pneumoperitoneum.

Referenced international comparisons

The most relevant comparator with which to compare outcomes of VLBW infants born in the ROI is the VON itself, as the comparison is based on identical inclusion criteria and data definitions, in addition to constituting the most up-to-date data available on VLBW infants. In the interests of comprehensiveness, relevant publications from the scientific literature have also been perused as sources of comparative data in this report, however, their inclusion criteria and data definitions differ slightly from those used in the report and by the VON. The following publications are referenced and their study populations and inclusion criteria are outlined below.

- P. Shah, K. Lui, G. Sjörs, L. Mirea, B. Reichman, M. Adams, et al. Neonatal outcomes of very low birth weight and very preterm neonates: an international comparison. J Pediatr, 177 (2016), pp. 144–152.

A retrospective cohort study of 58,004 infants born weighing < 1500g at 24 weeks 0 days to 31 weeks 6 days gestation and admitted to neonatal units of participating countries during the period 2007-2010: the participating countries were Australia/New Zealand, Canada, Israel, Japan, Spain, Sweden, Switzerland and the United Kingdom.

- Chen F, Bajwa NM, Rimensberger PC, Posfay-Barbe KM, Pfister RE and the Swiss Neonatal Network. Thirteen-year mortality and morbidity in preterm infants in Switzerland. Arch Dis Child Fetal Neonatal Ed 2016: 101: F377-F383. doi:10.1136/archdischild-2015-308579.

A prospective observational study including 95% of Swiss preterm infants of gestational age < 32 weeks born during three time periods: 2000-2004, 2005-2008 and 2009-2012.

- Stoll BJ, Hansen NI, Bell EF, et al. Trends in Care Practices, Morbidity, and Mortality of Extremely Preterm Neonates, 1993–2012. JAMA. 2015;314(10):1039-1051. doi:10.1001/jama.2015.10244.

A prospective cohort study of 34,636 infants, born at 22 to 28 weeks' gestation or birth weight of 401 to 1500g, and born at 26 neonatal centres in the USA between 1993 and 2012.

- Horbar JD, Carpenter JH, Badger GJ, Kenny MJ, Soll RF, Morrow KA, et al. Mortality and neonatal morbidity among infants 501 to 1500 grams from 2000 to 2009. Pediatrics. 2012;129(6):1019-26.

A prospective cohort study based on 355,806 infants whose data was submitted to the Vermont Oxford Network and weighing between 501 and 1500g born in 669 North American hospitals in 2000-2009.

- Isayama T, Lee SK, Mori R, Kusuda S, Fujimura M, Xiang YY, et al. Comparison of mortality and morbidity of very low birth weight infants between Canada and Japan. Pediatrics. 2012;130(4):e957-e65.

A retrospective cohort study of 5341 infants from the Canadian Neonatal Network and 9812 infants from the Neonatal Research Network of Japan, born with a birth weight < 1500g from 1 January 2006 to 31 December 2008.

Reference to *Very Low Birth Weight Infants in the Republic of Ireland Annual Report 2014*

Since publication of the 2014 report, some values stated in the 2014 report have since been updated by individual contributing neonatal centres and reported on Nightingale, the VON's internet reporting system. The current report utilises the most up-to-date values on infants born in 2014 as reported by Nightingale and thus some values may differ from those stated in the 2014 report.

Reliability of conclusions based on small numbers

Population rates and percentages are subject to random variation. This variation may be substantial when the measure, such as a rate, has a small number of events in the numerator or denominator. Typically, rates based on large numbers provide stable estimates of the true, underlying rate. Conversely, rates based on small numbers may fluctuate dramatically from year to year, or differ considerably from one centre to another, even when differences are not meaningful. Meaningful analysis of differences in rates between geographic areas or over time requires that the random variation be quantified and that multiple years of data be incorporated. In the current report, some rates are based on rare outcomes and thus have small numbers. It is correct to present these rates as this is what the data shows, but conclusions cannot be drawn from rates and outcomes based on small numbers.

Main findings

1. Overview

A total of 622 VLBW infants were reported to VON in 2015, constituting infants born in all 19 maternity centres and their affiliated Neonatal Intensive Care Units (NICUs) in the Republic of Ireland (ROI). A total of 608 VLBW infants were reported in 2014.

Table 1.1 outlines the gestational age of infants reported in 2015: 48 infants were born <24 weeks gestation, 114 were between 24 and 26 weeks gestation, 235 between 27 and 29 weeks gestation, 170 between 30 and 32 weeks gestation, and 55 infants were >32 weeks gestation. Table 1.1 also outlines the same information for 2014. In total, 7% (42 out of 622) of VLBW infants born in 2015 had a major congenital anomaly compared to a figure of 9% (56 out of 608) in 2014.

In terms of birth weight, 23 infants weighed ≤500g, three of whom were ≤401g but ≥22 weeks gestation (Table 1.2). A total of 100 infants had a birth weight in the 501-750g category, 98 in the 751-1000g category and 155 in the 1001-1250g category. Overall, 246 infants weighed more than 1250g, 26 of whom were ≥1500g but were ≤29$^{6/7}$ weeks gestation. Similar data for 2014 is included in Table 1.2.

In all, 62,258 VLBW infants were reported to the Network in 2015.

Table 1.1: Number of cases reported to VON in 2014 and 2015, according to gestational age

Gestational age	All cases		No. of cases excluding congenital anomalies	
	2014	2015	2014	2015
<24 weeks	41	48	40	48
24-26 weeks	117	114	108	103
27-29 weeks	240	235	220	221
30-32 weeks	161	170	142	160
>32 weeks	49	55	42	48
Total	**608**	**622**	**552**	**580**

Table 1.2: Number of cases reported to VON in 2014 and 2015, according to birth weight

Birth weight (g)	All cases		No. of cases excluding congenital anomalies	
	2014	2015	2014	2015
<501	26	23	26	23
501 – 750	86	100	82	95
751 – 1000	116	98	101	84
1001 – 1250	155	155	140	145
>1250	224	246	203	233
Total	**607**	**622**	**551**	**580**

Note: one infant in 2014 did not have a recorded birth weight

2. Infant Characteristics

Table 2.1 summarises the characteristics of ROI infants and compares them to those of all infants reported to VON in 2015.

The proportion which was exposed to chorioamnionitis; delivered by Caesarean section; and was small for gestational age (SGA) was the same amongst ROI infants as amongst VON infants. The higher proportion administered antenatal magnesium sulphate in the ROI did not reach statistical significance (p=0.076). Characteristics in which there were statistically significant differences between the two populations, included the higher proportion of ROI infants which received prenatal care (p=0.005) and the lower prevalence of maternal hypertension amongst ROI cases (p=0.012). Differences which were highly statistically significant (defined as a p value<0.001) between ROI and VON included the higher proportion of ROI infants administered antenatal steroids and the higher proportion of multiple gestations amongst ROI cases.

The higher number of major congenital anomalies amongst ROI infants in 2015 (7%, n=42) compared to VON infants (5%, n=3,297) just reached a statistically significant difference (p=0.045). In the previous year, the difference in rates of congenital anomaly between ROI infants (9%, n=54) and VON infants (5%, n=3,025) was highly statistically significant (P<0.001) (Table 2.2).

In comparing infant characteristics between 2014 and 2015, only the proportion receiving antenatal steroids was highly significantly different between the ROI and VON for both years (p<0.001), although the higher proportion of ROI infants receiving prenatal care (p<0.001 in 2014; p=0.005 in 2015) and the higher number of multiple gestations amongst ROI infants (p=0.008 in 2014; p<0.001 in 2015) was also consistent between the years (Table 2.2).

Elsewhere, differences in rates between countries have been detected for Caesarean section, multiple births and antenatal steroids. In the years 2007-2010, the rates of Caesarean section in VLBW infants ranged from 47% in the UK; 62% in Canada; 64% in Australia/New Zealand; 67% in Spain; 72% in Sweden; 73% in Israel; 77% in Japan; to 84% in Switzerland (1): the ROI rate for both 2014 and 2015 was 70%. The proportion of multiple births was lowest in Japan (24%) and greatest in Israel (42%) during the same period: the ROI 2015 rate was 36%. Administration of antenatal steroids ranged from 49% in Japan through to 90% in Australia/New Zealand (1) and was 87% in mothers in a study from the USA (2): the ROI 2015 rate was 88%. The marginally higher proportion of males born in the ROI is reflected in a number of studies. (1-3)

Proportions of major congenital anomaly in other countries have been reported to be 2% in the UK; 3% in Israel, Switzerland and Sweden; 4% in Australia/New Zealand; 7% in Japan and Spain; and 8% in Canada (1) and proportions of 5% have been reported in the USA and Switzerland (2, 3). The ROI rates for major congenital anomaly were 9% and 7% for 2014 and 2015 respectively.

Table 2.1: Infant characteristics in the Republic of Ireland and VON, 2015. The P-value refers to the significance of the value of the difference between the ROI and VON populations.

Characteristic	Republic of Ireland			VON		P-value
	Cases	N	%	N	%	
Male	336	622	54	62,199	51	0.132
Prenatal Care	608	619	98	61,975	96	0.005
Chorioamnionitis	87	610	14	61,491	13	0.354
Maternal Hypertension	162	616	26	61,851	31	0.012
Antenatal Steroids	542	616	88	61,875	81	<0.001
C-Section	433	622	70	62,211	72	0.185
Antenatal Magnesium Sulphate	359	613	59	60,565	55	0.076
Multiple Gestation	225	622	36	62,245	27	<0.001
Major Congenital Anomaly	42	622	7	62,200	5	0.045
Small for Gestational Age (SGA)	150	622	24	62,102	24	0.946

Note: N represents all babies for whom the variable applies (the denominator).

Table 2.2: Infant characteristics in the Republic of Ireland, 2014 and 2015. The P-value refers to the significance of the value of the difference between the ROI and VON populations.

Characteristic	2014			2015		
	ROI %	VON %	P-value	ROI %	VON %	P-value
Male	55	51	0.040	54	51	0.132
Prenatal Care	99	95	<0.001	98	96	0.005
Chorioamnionitis	16	13	0.020	14	13	0.354
Maternal Hypertension	25	30	0.014	26	31	0.012
Antenatal Steroids	87	80	<0.001	88	81	<0.001
C-Section	70	71	0.303	70	72	0.185
Antenatal Mag. Sulphate	51	52	0.720	59	55	0.076
Multiple Gestation	33	28	0.008	36	27	<0.001
Major Congenital Anomaly	9	5	<0.001	7	5	0.045
Small for Gestational Age	25	24	0.551	24	24	0.946

3. Survival

A total of 84% (n=525) of VLBW infants born in the ROI survived to discharge home or first birthday, one percentage below the VON rate (85%, n=52,680) (Table 3.1). The 2015 ROI survival rate represents an increase from 2014 (82%, n=492), whilst the VON survival rate dropped by 1% from 86% to 85% between 2014 and 2015 (Table 3.2). The ROI survival rate was not statistically different from the VON rate in 2015 (p=0.68). Previous studies have obtained survival to discharge rates of 79% (2) and 86% (3).

The percentages of those who survived without specified morbidities in 2015, i.e. the key morbidities of severe IVH, chronic lung disease in infants <33 weeks gestation, NEC, pneumothorax, any late infection or cystic PVL was 54% (n=337) in the ROI and 57% (n=34,894) in VON, a difference which was not statistically significant (p=0.16). The 2015 survival without specified morbidities rates represent an increase of 1% from 2014 for ROI infants and no change for VON infants (Table 3.2).

Comparisons with other studies highlight the variation internationally in survival to discharge without specified morbidities. For example, the Swiss Neonatal Network reporting on survival free of major complications (which was defined as survival of NICU stay and absence of bronchopulmonary dysplasia (BPD), severe IVH, NEC and cystic PVL), observed a rate of 72% for the period 2009-2012: notably these complications did not include severe ROP or late infection (3). In a USA study, the proportion which survived without the major morbidities of NEC, infections (early-onset sepsis, late-onset sepsis or meningitis), BPD, severe intracranial haemorrhage (ICH), PVL and severe ROP was 29% in 2012 (2). Some of the variation observed in international comparisons is likely due to variable inclusion criteria for major morbidities. However, the ROI and VON proportions of 54% and 57% respectively are comparable to each other.

Table 3.1: Survival of ROI and VON infants, including those with congenital anomalies, 2015. The P-value refers to the significance of the value of the difference between the ROI and VON populations.

	Republic of Ireland			VON			
Measure	Cases	N	%	Cases	N	%	P-value
Survival*	525	622	84%	52,680	61,759	85%	0.68
Survival without specified morbidities**	337	622	54%	34,894	61,759	57%	0.16

Note: N represents all babies for whom the variable applies (the denominator).
* Indicates whether the infant survived to discharge home or first birthday
**Denotes severe IVH, chronic lung disease in infants <33 weeks gestation, NEC, pneumothorax, any late infection or cystic PVL.

Table 3.2: Survival of ROI and VON infants, including those with congenital anomalies, 2014 and 2015. The P-value refers to the significance of the value of the difference between the ROI and VON populations.

	2014			2015		
Measure	ROI %	VON %	P-value	ROI %	VON %	P-value
Survival*	82	86	0.01	84	85	0.68
Survival without specified morbidities**	53	57	0.08	54	57	0.16

* Indicates whether the infant survived to discharge home or first birthday
**Denotes severe IVH, chronic lung disease in infants <33 weeks gestation, NEC, pneumothorax, any late infection or cystic PVL.

Survival to discharge of VLBW infants by gestational age and birth weight is reported in Tables 3.3 and 3.4 respectively for both 2014 and 2015.

Survival to discharge rose with increasing gestational age, albeit with some slight variation away from this pattern above 30 weeks gestational age (Table 3.3). The Swiss Neonatal Network previously reported survival rates of 4% for 23 weeks gestational age, 42% for 24 weeks gestational age, 61% for 25 weeks gestational age, 85% for 26 weeks gestational age, 90% for 27 weeks gestational age, 92% for 28 weeks, 96% for 29 weeks, 96% for 30 weeks and 97% for 31 weeks gestational age during 2009-2012 (3): the rates are similar to the ROI rates for every gestational age except for 23 and 24 weeks which were lower in the Swiss study. A USA study observed survival to discharge rates of 9% amongst 22 weeks gestational age infants, 33% amongst 23 weeks gestational age infants, 65% amongst 24 weeks gestational age infants, 81% amongst 25 weeks gestational age infants, 87% amongst 26 weeks gestational age and 94% amongst both 27 and 28 weeks gestational age infants in 2012 (2). These proportions are comparable to the ROI 2015 findings, but slightly less so in the context of the ROI 2014 findings (Table 3.3).

In terms of periviable births (broadly defined as $20^{0/7}$ to $25^{6/7}$ weeks gestational age), reports published since 2000 show remarkable variability in survival outcomes amongst studies. A summary of such studies has demonstrated multiple reasons for this variation, some of which include non-modifiable factors (e.g. sex and weight, singleton birth), modifiable factors (e.g. intent to intervene, antenatal corticosteroid administration, life-sustaining interventions at birth), and study design and reporting features (e.g. single-centre, regional, or national data; definition of mortality) (4).

Table 3.3: Gestational age breakdown and survival to discharge of ROI infants reported to VON, including those with congenital anomalies, 2014 (N=600) and 2015 (N=622)

Gestational Age	2014 Number of Survivors/ No. of liveborn infants (%)	2015 Number of Survivors/ No. of liveborn infants (%)
<22 weeks	0/2 (0%)	0/2 (0%)
22 weeks	0/18 (0%)	0/16 (0%)
23 weeks	4/21 (19%)	9/30 (30%)
24 weeks	17/35 (49%)	22/34 (65%)
25 weeks	26/36 (72%)	33/43 (77%)
26 weeks	28/43 (65%)	30/37 (81%)
27 weeks	53/56 (95%)	40/46 (87%)
28 weeks	76/84 (90%)	82/90 (91%)
29 weeks	93/99 (94%)	94/99 (95%)
30 weeks	68/71 (96%)	65/65 (100%)
31 weeks	44/49 (90%)	64/68 (94%)
32 weeks	35/37 (95%)	35/37 (95%)
>32 weeks	47/49 (96%)	51/55 (93%)
Total	**492/600 (82%)**	**525/622 (84%)**

Note: In 2014, 8 of 608 infants did not have a valid value for the survival variable, therefore, the denominator for survival is 600.

Table 3.4: Birth weight and survival to discharge of ROI infants reported to VON, including those with congenital anomalies, 2014 (N=599) and 2015 (N=622)

Gestational Age	2014 Number of Survivors/ No. of liveborn infants (%)	2015 Number of Survivors/ No. of liveborn infants (%)
<501g	2/26 (8%)	4/23 (17%)
501-600g	8/31 (26%)	19/37 (51%)
601-700g	25/37 (68%)	29/45 (64%)
701-800g	26/36 (72%)	26/37 (70%)
801-900g	29/37 (78%)	33/40 (83%)
901-1000g	51/58 (88%)	34/39 (87%)
1001-1100g	46/53 (87%)	54/59 (92%)
1101-1200g	58/62 (94%)	58/64 (91%)
1201-1300g	82/86 (95%)	63/67 (94%)
1301-1400g	68/72 (94%)	84/87 (97%)
>1400g	96/101 (95%)	121/124 (98%)
Total	**491/599 (82%)**	**525/622 (84%)**

Note: In 2014, 8 of 608 infants did not have a valid value for the survival variable and 1 did not have a recorded birth weight, therefore, the denominator for survival is 599.

4. Survival according to designated category of neonatal unit

There are 19 neonatal centres in the ROI, each of which is designated a tertiary, regional or peripheral neonatal centre based on both the number of births per annum in the affiliated obstetric centre and the level of neonatal consultant cover in the neonatal centre. There are four designated tertiary neonatal centres, four designated regional neonatal centres and eleven designated peripheral neonatal centres (Table 4.1). Each of the tertiary centres deliver more than 8,000 births per annum and all provide 24 hour consultant neonatology cover. The regional centres have dedicated neonatal intensive care units (NICUs) in their centres but do not have 24-hour consultant neonatology cover. In 2015, one of these four centres delivered between 4,000-5,000 births per annum; one centre delivered between 3,000-4,000 births per annum; the third centre delivered between 2,000-3,000 births per annum; and the fourth centre delivered less than 2,000 births per annum when births weighing 500g or more are counted (Table 4.1). Peripheral centres do not have dedicated NICUs nor do they have dedicated consultant neonatology cover but they do have designated areas for newborn infants namely Special Care Baby Units (SCBUs). In 2015, all but one peripheral centre delivered less than 2,000 births per annum and that one centre delivered between 2,000-3,000 births per annum.

Table 4.1: Number of live births and stillbirths weighing greater than or equal to 500g in maternity centres in 2015

Hospital	Number of births
Designated Tertiary Neonatal Centres	
National Maternity Hospital	> 8,000
Coombe Women & Infants University Hospital	> 8,000
Rotunda Hospital	> 8,000
Cork University Maternity Hospital	> 8,000
Designated Regional Neonatal Centres	
University Maternity Hospital Limerick	4,000-5,000
Our Lady of Lourdes Hospital Drogheda	3,000-4,000
Galway University Hospital	2,000-3,000
University Hospital Waterford	< 2,000
Designated Peripheral Neonatal Centres	
Midland Regional Hospital Mullingar	2,000-3,000
Portiuncula Hospital Ballinasloe	< 2,000
Wexford General Hospital	< 2,000
Midland Regional Hospital Portlaoise	< 2,000
St Luke's Hospital Kilkenny	< 2,000
Cavan General Hospital	< 2,000
Mayo University Hospital	< 2,000
Letterkenny University Hospital	< 2,000
University Hospital Kerry	< 2,000
Sligo University Hospital	< 2,000
South Tipperary General Hospital	< 2,000

Source: Irish Maternity Indicator System National Report 2015 (5)

Of 622 VLBW infants reported to VON in 2015, 608 infants had birth location data suitable for analysis of survival outcome according to category of designated neonatal centre. Birth location data on the remaining 14 infants was either unavailable (nine) or the infants were born before arrival (five).

Of the 608 infants with available birth location data, 400 (66%) were born in one of four tertiary neonatal centres; 138 (23%) were born in one of four regional neonatal centres and the remaining 70 infants (11%) were born in one of eleven peripheral centres (Table 4.2).

Table 4.2: Survival of ROI Infants by category of neonatal centre, 2015, n=608

Survival	Tertiary Centres	Regional Centres	Peripheral Centres	Total
Number of liveborn infants	400	138	70	608
No. (%) who received resuscitation in the delivery room	316 (79%)	98 (71%)	49 (70%)	463 (76%)
No. who died in DR despite active resuscitation	3	1	4	8
No. (%) admitted to a NICU/SCBU	378 (95%)	130 (94%)	56 (80%)	564 (93%)
No. (%) transferred to another neonatal centre within 48 hours of birth	3 (1%)	2 (1%)	36 (51%)	41 (7%)
No. survived to discharge	342	125	45	512
% survival to discharge of liveborn infants	86%	91%	64%	84%

Of the 608 infants, 463 (76%) received intensive care/resuscitation in the delivery room (defined as the administration of face mask ventilation and/or endotracheal tube ventilation) (Table 4.2). Intensive care was provided to 79% of the infants born in tertiary centres, 71% of the infants born in regional centres and 70% of the infants born in peripheral centres. Of the 463 infants requiring resuscitation, 403 (87%) survived to discharge. The remaining 60 (13%) infants died, eight of whom died in the delivery room (Figure 4.1).

A total of 145 (24%) of the 608 infants did not receive intensive care/resuscitation in the delivery room, of whom 36 infants died in the delivery room and 109 survived to admission to a NICU/SCBU (Table 4.3 and Figure 4.1). These 109 infants were born in good enough condition so as not to require active resuscitation at birth: 75 of these infants were born at greater than 30 weeks gestation, 33 infants were in the 27 - 29 weeks gestational age range, and one infant was in the 24-26 weeks gestational age range.

Table 4.3: Survival outcomes of infants who did not receive intensive care/resuscitation in the delivery room by category of neonatal centre, 2015

Category Neonatal Centre	Resuscitation not required	Died in DR – Resuscitation not offered	Total
Tertiary	65	19	84
Regional	33	7	40
Peripheral	11	10	21
Total	109	36	145

Of the 608 infants with available birth location data, 564 (93%) were admitted to a NICU/SCBU, comprising 378 (95%) of the infants born at tertiary centres, 130 (94%) of those born at regional centres and 56 (80%) of those born in peripheral centres (Table 4.2). These included infants who were transferred out of the birth hospital and to another neonatal centre within 48 hours of birth. A total of 41 (7%) of 608 infants were transferred and the majority of these (88%, n=36) were born in peripheral centres. Three infants from tertiary centres were transferred out within 48 hours of birth, one to another tertiary neonatal centre and two to a paediatric hospital. Two infants from regional centres were transferred out to tertiary neonatal centres.

The overall survival rate of 608 infants with available birth location data was 84% (n=512): the highest survival rate occurred in the regional centres (91%, n=125), followed by 86% (n=342) at tertiary centres and 64% (n=45) at peripheral centres (Table 4.2 and Figure 4.1).

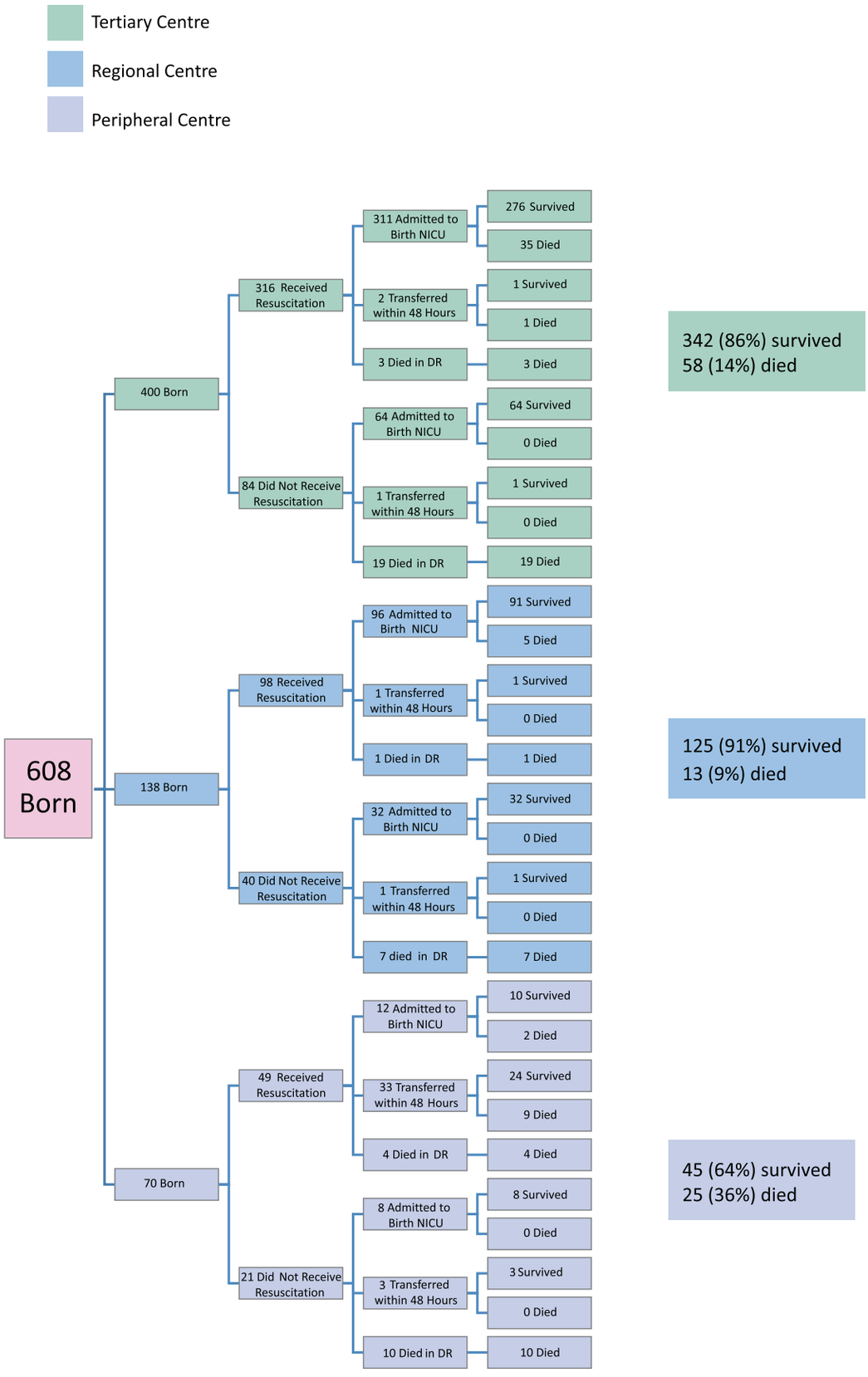

Figure 4.1: Flow chart illustrating survival outcomes of VLBW infants according to category of neonatal centre, 2015, n=608

Survival of infants born at less than 24 weeks gestation according to category of neonatal centre

Of 608 infants with available birth location data, 48 were infants born <24 weeks gestation (which were all of the infants born <24 weeks gestation in 2015, all having available birth location data). A total of 29 (60%) were born in one of the tertiary neonatal centres; five (10%) in one of the regional centres and the remaining 14 (29%) in one of the eleven peripheral centres (Table 4.4).

Twenty-two infants (46%) received intensive care/resuscitation in the delivery room (Table 4.4), including 14 (48%) of the infants born in tertiary centres, one (20%) of the infants born in regional centres and 7 (50%) of the infants born in peripheral centres. Of the 22 infants who received intensive care/resuscitation in the delivery room, two of these died in the delivery room despite active resuscitation. Hence 20 infants (42%) survived to admission to a NICU/SCBU.

Of the 26 infants who did not receive intensive care/resuscitation in the delivery room, one was 20 weeks gestation, another 21 weeks, 16 were 22 weeks and the remainder (eight) were 23 weeks gestation (five of the 16 infants born between 230/7 – 233/7 weeks and three of the 14 infants born between 234/7 – 236/7 weeks). All of these infants died in the delivery room. None had a congenital anomaly.

Of the 20 infants who survived to admission to a NICU/SCBU, one of these infants died within twelve hours of admission. This infant was born in a tertiary centre. Five infants were transferred from their hospital of birth soon after birth. All five of these infants were born in peripheral centres and all were transferred to one of the four tertiary centres. All were transferred on Day 2 (i.e. on the day after the date of birth irrespective of the time of birth) (Table 4.4 and Figure 4.2).

Of the 19 infants surviving >12 hours, a further ten died. In total, nine survived to discharge. Therefore, the overall survival rate for infants born <24 weeks gestation in the ROI in 2015 was 19% (n=9/48) which compares to a figure of 10% (n=4/41) in 2014. The overall survival rate for infants of this gestational age increases to 41% if only infants who were actively resuscitated in the delivery room are included in the analysis (n=22) and to 45% if only the infants who survived to admission to a NICU/SCBU are included in the analysis (n=20) (Table 4.4).

In total, 28 (58%) infants born <24 weeks gestation died in the delivery room in the ROI in 2015. This compares to a figure of 38% (1,604 of 4,277) for infants born <24 weeks gestation in the VON population, the difference between the two populations being statistically significant ($p<0.001$). In 2014, the figures for delivery room death of infants born <24 weeks gestation were 88% (n=36) for ROI infants and 39% for VON infants, also statistically significant ($p<0.001$). However, there has been a significant decrease in the number of ROI infants <24 weeks gestation dying in the delivery room in 2015 when compared to 2014, from 88% to 58% ($p<0.001$). Of the 48 infants <24 weeks gestation, none had an associated major congenital anomaly.

Survival for infants who were transferred within the first 48 hours of birth to another neonatal centre was 60% (n=3/5).

In summary, of 48 infants born less than 24 weeks gestation in the ROI in 2015, 39 (81%) ultimately died and 9 (19%) survived to discharge (Table 4.4).

Table 4.4: Survival of ROI Infants born at less than 24 weeks gestation by category of neonatal centre, 2015, n=48

Survival	Tertiary Centres	Regional Centres	Peripheral Centres	Total
Number of liveborn infants	29	5	14	48
No. (%) who required resuscitation in the delivery room	14 (48%)	1 (20%)	7 (50%)	22 (46%)
No. (%) admitted to a NICU/SCBU	14 (48%)	1 (20%)	5 (36%)	20 (42%)
No. (%) transferred to another neonatal centre within 48 hours of birth	0/29 (0%)	0/5 (0%)*	5/14 (36%)	5/48 (10%)
No. survived to discharge	5	1	3	9
% survival to discharge of liveborn infants	17%	20%	21%	19%
Survival to discharge of all liveborn infants offered resuscitation	36% (5/14)	100% (1/1)	43% (3/7)	41% (9/22)
% survival to discharge of all liveborn infants admitted to NICU/SCBU	36% (5/14)	100% (1/1)	60% 3/5	45% (9/20)

* One infant transferred to a tertiary neonatal centre on Day 81 of life

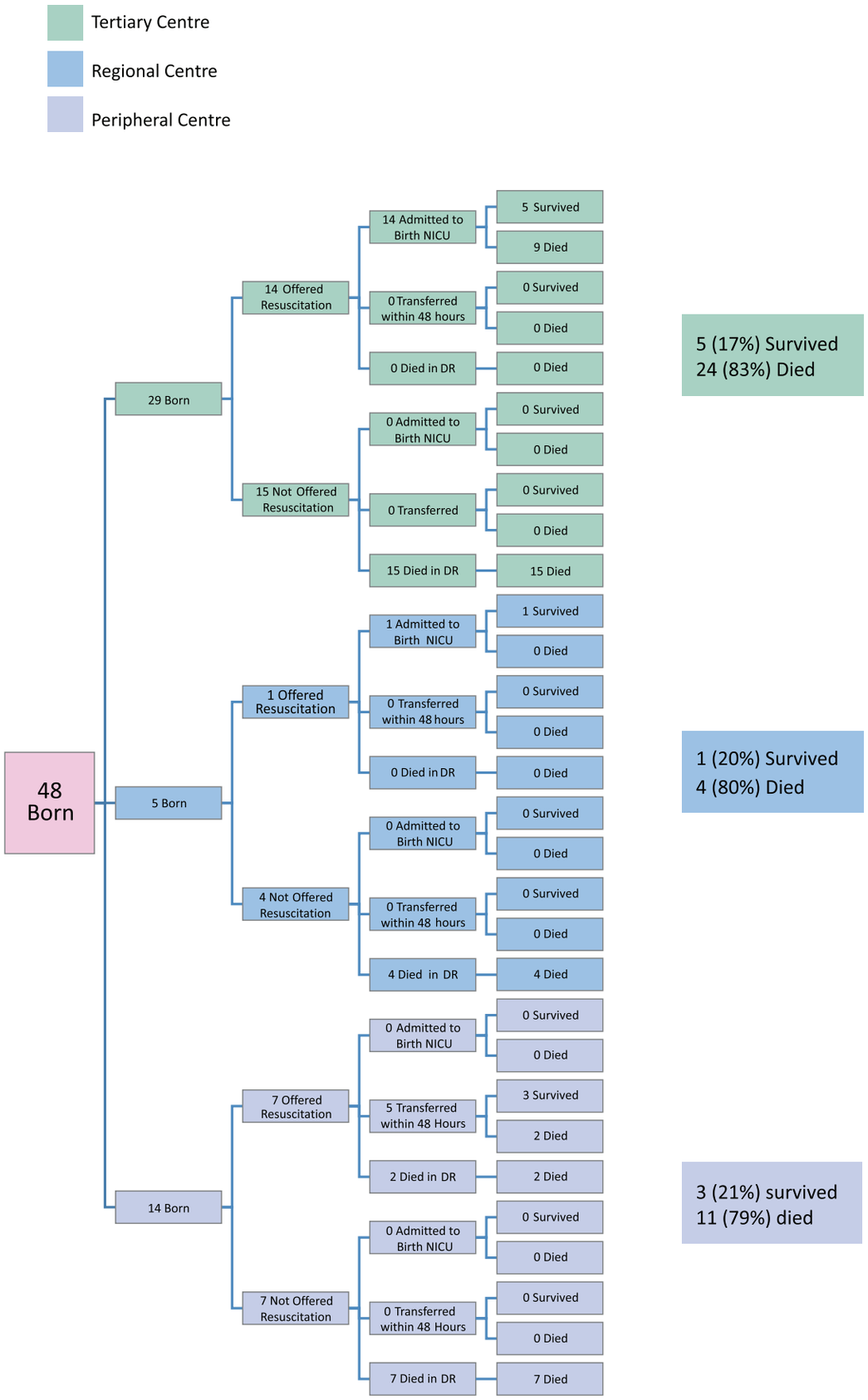

Figure 4.2: Flow chart illustrating survival outcomes of VLBW infants born <24 weeks gestation according to designated category of neonatal centre, 2015, n=48

Outcomes of infants born at 24-26 weeks gestation according to category of neonatal centre

Overall, there were 111 infants born at 24-26 weeks gestation for whom birth location data were available. Of these, 80 (72%) were born in one of the tertiary neonatal centres, 18 (16%) in one of the regional centres and 13 (12%) in one of the peripheral centres (Table 4.5).

Of the 111 infants born, 108 (97%) received intensive care/resuscitation in the delivery room, including 79 (99%) infants born in tertiary centres, 17 (94%) infants born in regional centres and 12 (92%) of the infants born in peripheral centres. Of the 108 infants offered intensive care/resuscitation, four infants died in the delivery room despite resuscitation. One of these deaths occurred in a tertiary centre, one in a regional centre and two in peripheral centres. The gestational age of two of these infants was $24^{0/7}$ weeks; one was $25^{0/7}$ weeks and the fourth was $25^{2/7}$ weeks: one had an associated major congenital anomaly.

Three infants did not receive intensive care/resuscitation in the delivery room. Two of these infants had major congenital anomalies: one infant had a diagnosis of congenital hydrocephalus/myelomeningocoele and the other infant, hydrops foetalis and both died in the delivery room. The third infant was born at $26^{4/7}$ weeks gestation in a tertiary centre and was born in such condition as to not require resuscitation in the delivery room.

In all, six (5%) infants born at 24-26 weeks gestation died in the delivery room. This compares to a figure of 2% (333 of 14,471) for infants born at 24-26 weeks gestation who died in the delivery room in the VON population, a difference which was statistically significant (p=0.02).

A total of 105 (95%) infants born at 24-26 weeks gestation survived to admission to a NICU/SCBU. Eleven of these (10% of those liveborn at 24-26 weeks gestation) were transferred from their hospital of birth soon after birth (Table 4.5). One of these infants was born in a tertiary centre; one infant in a regional centre, and a further nine in peripheral centres (Figure 4.3). All were transferred to tertiary neonatal centres within 48 hours of birth. One additional infant was transferred from a regional centre to a tertiary centre on Day 11 of life and therefore is not included in the transfer numbers in Table 4.5. Six of these eleven infants who were transferred died prior to discharge, one of whom was born in a tertiary centre and five of whom were born in peripheral centres.

In all, 82 (74%) infants born at 24-26 weeks gestation survived to discharge: 79% (n=63) of those born in tertiary centres, 78% (n=14) of those born in regional centres and 39% (n=5) of those born in peripheral centres (Table 4.5).

Table 4.5: Survival of ROI Infants born at 24–26 weeks gestation by category of neonatal centre, 2015, n=111

Survival	Tertiary Centres	Regional Centres	Peripheral Centres	Total
Number of liveborn infants	80	18	13	111
No. (%) who received resuscitation in the delivery room	79 (99%)	17 (94%)	12 (92%)	108 (97%)
No. (%) admitted to a NICU/SCBU	79 (99%)	16 (89%)	10 (77%)	105 (95%)
No. (%) transferred to another neonatal centre within 48 hours of birth	1 (1%)	1 (6%)*	9 (69%)	11 (10%)
No. survived to discharge	63	14	5	82
% survival to discharge of liveborn infants	79%	78%	39%	74%

* One other infant was transferred to a tertiary neonatal centre on Day 11 of life.

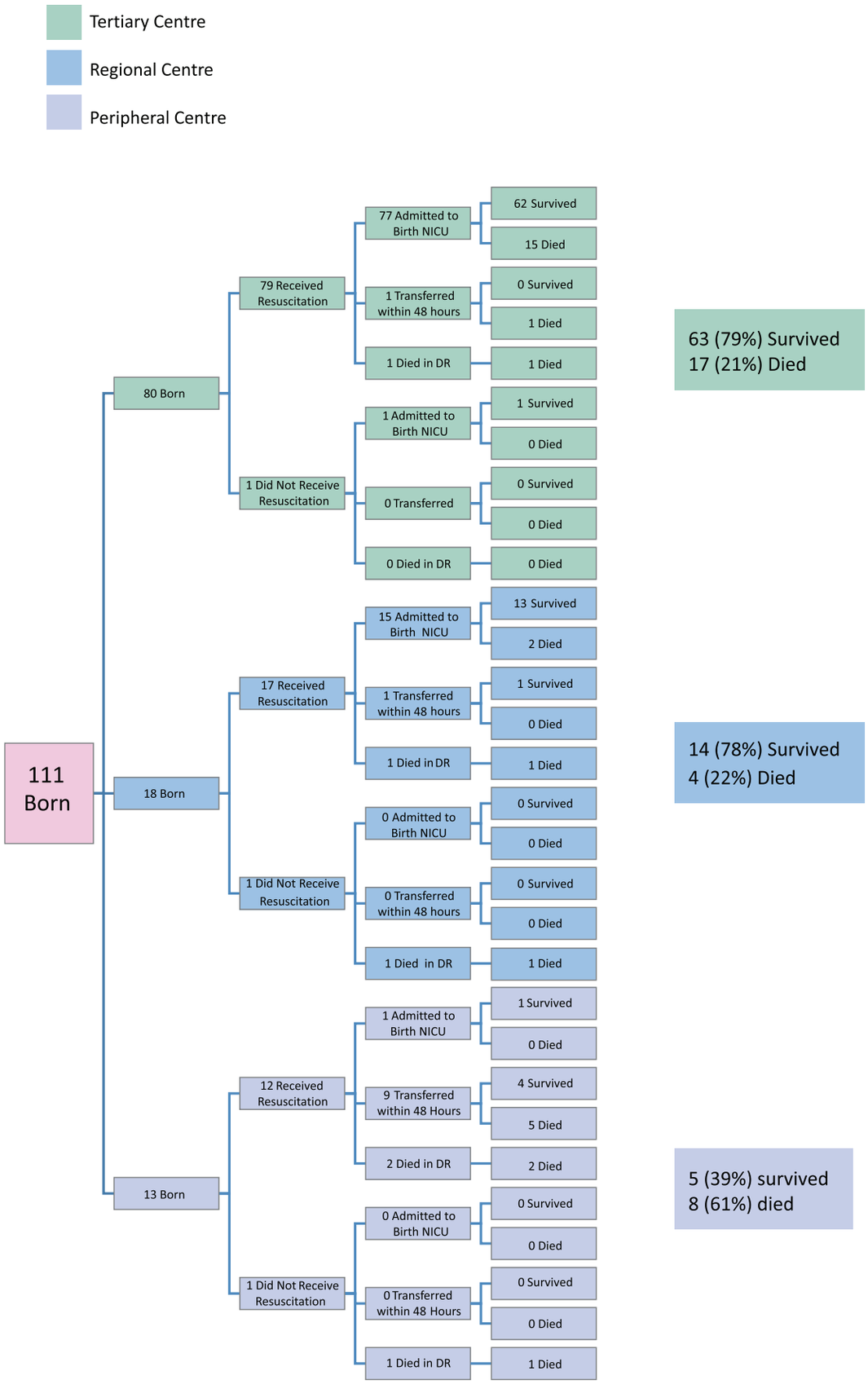

Figure 4.3: Flow chart illustrating survival outcomes of VLBW infants born at 24–26 weeks gestation according to category of neonatal centre, 2015, n=111

Outcomes of infants born at 27-29 weeks gestation according to category of neonatal centre

Overall, there were 226 infants born at 27-29 weeks gestation for whom birth location data were available. Of these, 158 (70%) were born in one of the tertiary neonatal centres, 52 (23%) in one of the regional centres and 16 (7%) in one of the peripheral centres (Table 4.6).

Of the 226 infants, 191 (85%) received intensive care/resuscitation in the delivery room, including 134 (85%) infants born in tertiary centres, 45 (87%) infants born in regional centres and 12 (75%) infants born in peripheral centres. Two of these infants died in the delivery room despite receiving resuscitation, of whom one had a major congenital anomaly. Both of these infants were born in tertiary centres (Figure 4.4).

A total of 35 infants did not receive resuscitation in the delivery room. Of these 35 infants, 33 were born in good condition, were subsequently admitted to a NICU/SCBU and all survived to discharge. Two infants died in the delivery room, one had a diagnosis of anencephaly and the other had a life threatening birth defect not specifically listed by VON. One of these infants was born in a regional centre and one in a peripheral centre (Figure 4.4).

A total of 222 (98%) infants born at 27-29 weeks gestation were admitted to a NICU/SCBU including 13 (6% of 226 born) infants who were subsequently transferred from their peripheral birth centres to tertiary centres within 48 hours. At 27-29 weeks gestation, no infants were transferred from tertiary or regional centres. Of the thirteen infants who transferred, twelve survived and one died (Figure 4.4).

In all, 208 (92%) infants born at 27-29 weeks gestation survived to discharge: 148 (94%) of those born in tertiary centres, 48 (92%) of those born in regional centres and 12 (75%) of those born in peripheral centres (Table 4.6).

Table 4.6: Survival of ROI Infants born at 27-29 weeks gestation by category of neonatal centre, 2015, n=226

Survival	Tertiary Centres	Regional Centres	Peripheral Centres	Total
Number of liveborn infants	158	52	16	226
No. (%) who received resuscitation in the delivery room	134 (85%)	45 (87%)	12 (75%)	191 (85%)
No. (%) admitted to a NICU/SCBU	156 (99%)	51 (98%)	15 (94%)	222 (98%)
No. (%) transferred to another neonatal centre within 48 hours of birth	0 (0%)	0 (0%)	13 (81%)	13 (6%)
No. survived to discharge	148	48	12	208
% survival to discharge of liveborn infants	94%	92%	75%	92%

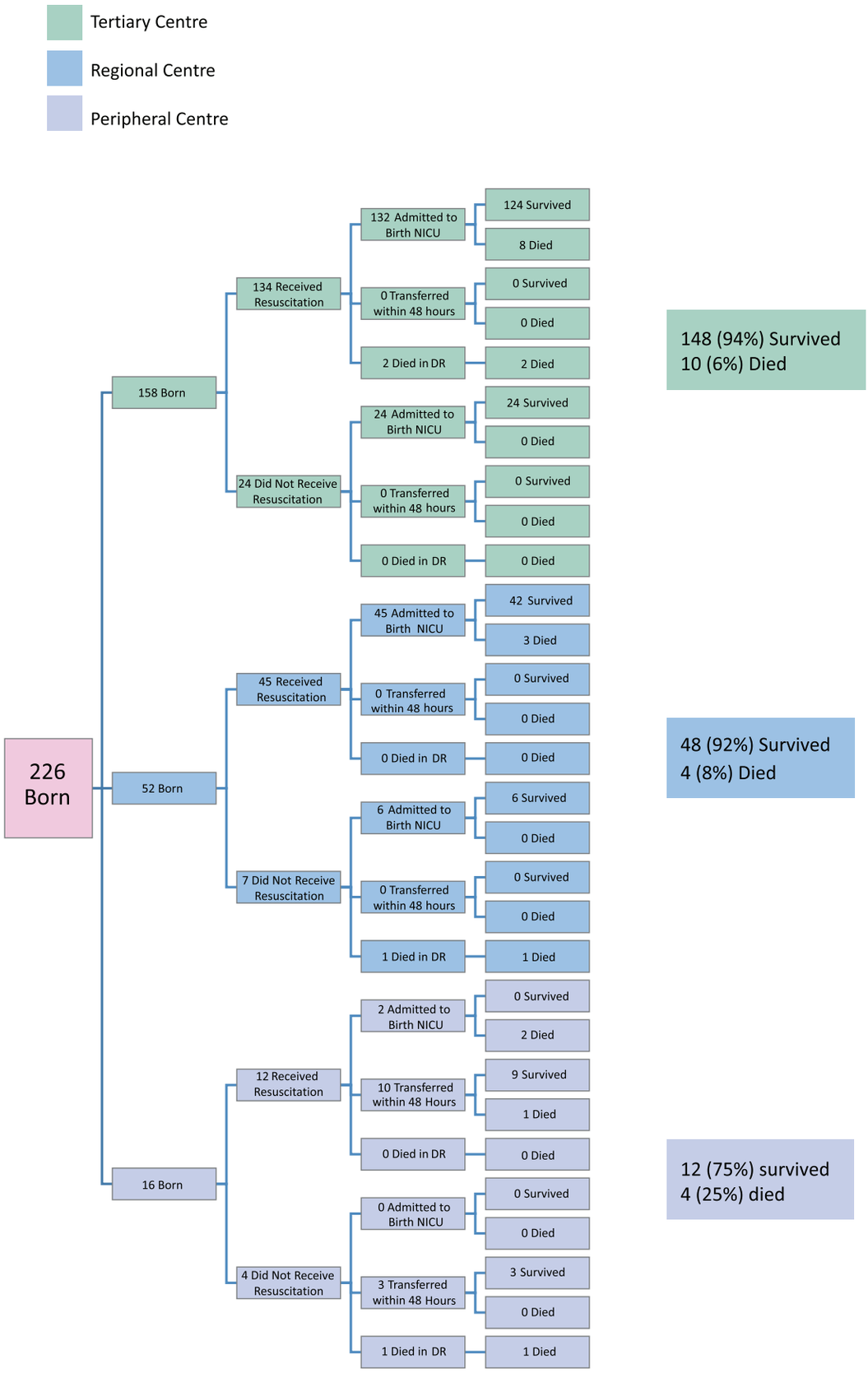

Figure 4.4: Flow chart illustrating survival outcomes of VLBW infants born at 27-29 weeks gestation according to designated category of neonatal centre, 2015, n=226

Outcomes of infants born at greater than 30 weeks gestation according to category of neonatal centre

Overall, there were 223 infants born at >30 weeks gestation for whom birth location data were available. Of these, 133 (60%) were born in one of the tertiary neonatal centres, 63 (28%) in one of the regional neonatal centres and 27 (12%) in one of the peripheral centres (Table 4.7).

A total of 142 (64%) infants received intensive care/resuscitation in the delivery room, including 89 (67%) infants born in tertiary centres, 35 (56%) infants born in regional centres and 18 (67%) infants born in peripheral centres. All survived to admission to a NICU/SCBU but four died prior to discharge (Figure 4.5). Eighty-one infants did not receive resuscitation in the delivery room, of whom six died in the delivery room. Of these, five had a congenital anomaly. Four of the deaths occurred in tertiary centres, one in a regional centre and another in a peripheral centre. The remaining 75 who did not receive resuscitation were admitted to a NICU/SCBU and all survived to discharge.

In total, 217 (97%) infants born at >30 weeks gestation were admitted to a NICU/SCBU, of which twelve were transferred to another neonatal centre within 48 hours, including two born at tertiary centres, one born at a regional centre and nine born at peripheral centres (Table 4.7 and Figure 4.5). Eleven of these infants survived to discharge. The one infant who died was born in a peripheral centre.

In all, 213 (96%) infants born at >30 weeks gestation survived to discharge: 126 (95%) of those born in tertiary centres, 62 (98%) of those born in regional centres and 25 (93%) of those born in peripheral centres (Table 4.7).

Table 4.7: Survival of ROI Infants born at >30 weeks gestation by category of neonatal centre, 2015, n=223

Survival	Tertiary Centres	Regional Centres	Peripheral Centres	Total
Number of liveborn infants	133	63	27	223
No. (%) who received resuscitation in the delivery room	89 (67%)	35 (56%)	18 (67%)	142 (64%)
No. (%) admitted to a NICU/SCBU	129 (97%)	62 (98%)	26 (96%)	217 (97%)
No. (%) transferred to another neonatal centre within 48 hours of birth	2 (2%)	1 (2%)	9 (33%)	12 (5%)
No. survived to discharge	126	62	25	213
% survival to discharge of liveborn infants	95%	98%	93%	96%

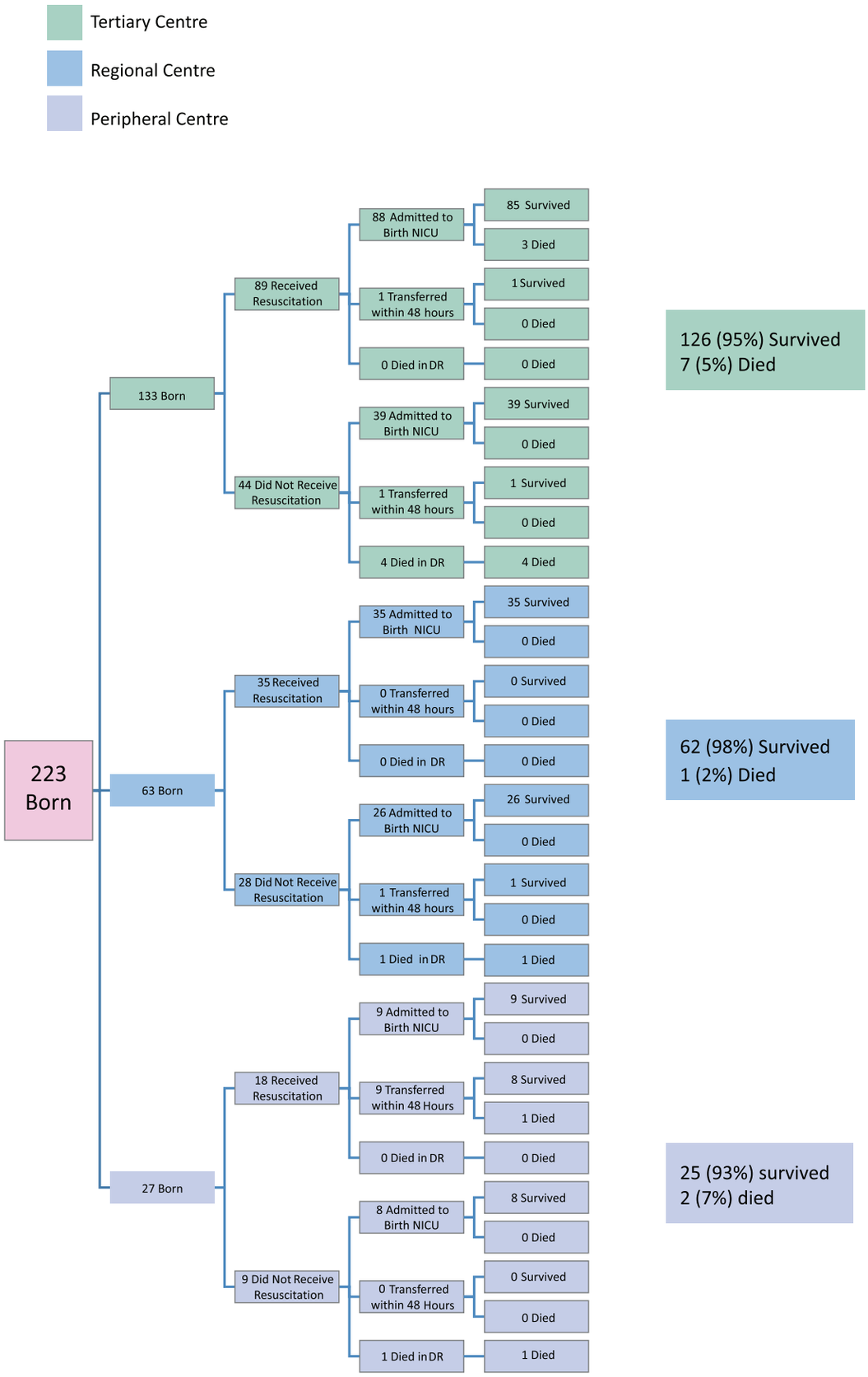

Figure 4.5: Flow chart illustrating survival outcomes of VLBW infants born > 30 weeks gestation according to category of neonatal centre, 2015, n=223

Summary survival outcomes of infants according to category sof neonatal centre

The three categories of neonatal centre had similar survival outcomes in terms of the <24 weeks and >30 weeks gestational age groups: 17%, 20% and 21% for tertiary, regional and peripheral centres respectively for <24 weeks gestation; and 95%, 98% and 93% for tertiary, regional and peripheral centres respectively for >30 weeks gestation (Table 4.8). With regards to the 24-26 weeks and 27-29 weeks gestational age ranges, tertiary and regional centres had similar rates, but the collective of peripheral centres had lower survival rates. However, these rates are based on numbers that are too small (numerators of 3, 5, 12 and 25 and denominators of 14, 13, 16 and 27) for conclusions to be drawn.

Table 4.8: Survival rates for gestational age categories of VLBW infants born in the ROI according to category of neonatal centre, 2015, n=608

	Survival				
Gestational Age Group	**Tertiary Centres**	**Regional Centres**	**Peripheral Centres**	**ROI Total**	**VON Total**
<24 weeks	17% (5/29)	**20% (1/5)**	21% (3/14)	**19% (9/48)**	29%
24-26 weeks	79% (63/80)	**78% (14/18)**	39% (5/13)	**74% (82/111)**	76%
27-29 weeks	94% (148/158)	**92% (48/52)**	75% (12/16)	**92% (208/226)**	92%
>30 weeks	95% (126/133)	**98% (62/63)**	93% (25/27)	**96% (213/223)**	96%
Total	86% (342/400)	**91% (125/138)**	64% (45/70)	**84% (512/608)**	85%

5. Key Performance Indicators

VON reports on a number of Key Performance Indicators (KPIs). This allows the ROI to compare its outcomes to VON as a whole. It is important for benchmarking performance in the ROI in addition to identifying areas of strengths and areas where continuous improvements could/should be made.

The KPIs are listed below and relevant definitions are outlined above in the Definitions and Terminology section:

1. Mortality
2. Mortality Excluding Early Deaths
3. Death or Morbidity
4. CLD
5. Pneumothorax
6. Late Bacterial Infection
7. Coagulase Negative Infection
8. Nosocomial Infection
9. Fungal Infection
10. Any Late Infection
11. Any IVH
12. Severe IVH
13. ROP
14. Severe ROP
15. Cystic PVL
16. Necrotising Enterocolitis

For each KPI, the number and percentage of ROI infants that experienced the outcome in 2015 is reported and illustrated in the following charts alongside the equivalent figures for all infants recorded in the VON database. The reporting of the KPIs in numbers and percentages for ROI and VON infants is provided for descriptive purposes. Observed differences in KPIs may be related to the medical care provided but may also be due to differences between the ROI and VON infant populations. Robust comparison of KPIs between the ROI and VON requires that pertinent differences between the infant populations are taken into account. This is done through the calculation of standardised mortality/morbidity ratios (SMRs).

Standard Mortality/Morbidity Ratios (SMRs)

Based on all VON data for infants with birth weights 501-1500g, our VON colleagues use multivariable logistic regression models for each KPI to quantify the risk of the outcome associated with each of the following infant characteristics: gestational age, SGA, multiple gestation, Apgar score at 1 min, gender, vaginal birth, location (inborn or outborn) and birth defect severity. Coefficients from these regression models were provided to the NPEC for use in the calculation of SMRs for each KPI. SMRs were calculated for ROI babies with birth weights 501-1500g and with complete data for the KPI in question and the infant characteristics used in the regression models. For each KPI, the coefficients were applied to the data of these eligible ROI infants to estimate the risk of the outcome for each infant. Summing these individual risk estimates gives the total number of infants that would be expected to experience the outcome, i.e. the expected number taking into account the risk profile of the ROI infants.

To obtain the SMR for each KPI, the number of eligible ROI infants that actually experienced the outcome, i.e. the observed number of cases, was divided by the expected number of cases (SMR = Observed/Expected).

SMR values equal or close to one indicate that there is little or no difference between the observed and expected number of infants that experienced the outcome, i.e. the number observed was to be expected given the risk profile of the ROI infant population. SMRs greater than one indicate that more infants experienced the outcome than expected given the risk profile of the ROI infants. SMRs less than one indicate that fewer cases were observed among ROI infants than expected.

A 95% confidence interval was calculated for each SMR in order to facilitate making inferences about whether the SMRs indicated if the difference between observed and expected was statistically significant. If the 95% confidence interval did not include the value one, it may be inferred that the difference between the numbers of observed and expected cases was statistically significant, i.e. there were more or fewer cases among the ROI infants than expected given their risk profile.

For each KPI, the absolute difference between the observed and expected number of cases is reported and the 95% confidence interval for this difference is also reported in order to provide statements in terms of the actual number of infants affected.

Table 5.1 displays Standardised Mortality/ Morbidity Ratios (SMR = Observed/Expected), the lower and upper bounds of its 95% confidence interval, the difference between the Observed and Expected number of cases and the lower and upper bound of the 95% confidence interval for this difference.`

Table 5.1: Risk Adjusted Standardised Mortality/Morbidity Ratios for Key Performance Indicators, Republic of Ireland, 2015

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Mortality	77	67	1.15	(0.91, 1.39)	10	(-6, 26)
Mortality excluding early death	41	41	1.01	(0.70, 1.31)	0	(-12, 13)
Death or Morbidity	256	221	1.16	(1.03, 1.29)	35	(6, 64)
Chronic Lung Disease	104	97	1.07	(0.87, 1.27)	7	(-13, 26)
Pneumothorax	37	21	1.80	(1.37, 2.24)	16	(8, 25)
Late Bacterial Infection	45	46	0.97	(0.68, 1.26)	-1	(-15, 12)
Coagulase Negative Infection	41	26	1.60	(1.22, 1.99)	15	(6, 25)
Nosocomial Infection	80	56	1.43	(1.17, 1.69)	24	(10, 39)
Fungal Infection	3	4	0.70	(0, 1.65)	-1	(-5, 3)
Any Late Infection	83	58	1.44	(1.18, 1.70)	25	(10, 40)
Intraventricular Haemorrhage	131	106	1.24	(1.05, 1.43)	25	(5, 46)
Severe Intraventricular Haemorrhage	36	31	1.15	(0.8, 1.51)	5	(-6, 16)
Retinopathy of Prematurity	81	114	0.71	(0.53, 0.89)	-33	(-54, -12)
Severe Retinopathy of Prematurity	22	20	1.10	(0.66, 1.54)	2	(-7, 11)
Cystic Periventricular Leukomalacia	16	13	1.26	(0.71, 1.82)	3	(-4, 10)
Necrotising Enterocolitis	37	25	1.47	(1.08, 1.86)	12	(2, 22)

O is the number of observed cases with the outcome and E is the expected number with the outcome of ROI infants with birth weights 501-1500g. 95% confidence intervals (CIs) are provided for the SMR and the difference in observed and expected cases.

Relative Risks (RRs)

The year 2014 was the first year that SMRs for each KPI were calculated for ROI infants with birth weights 501-1500g, thereby allowing an assessment of whether the risk of a KPI changed from 2014 to 2015. This was done by comparing the SMRs calculated for 2015 to those calculated for 2014 using the methods described by Breslow and Day (1987) (6). For each KPI, this involved calculating the relative risk by dividing the SMR for 2015 by the SMR for 2014 (RR=SMR 2015 / SMR 2014).

A 95% confidence interval was calculated for each relative risk in order to facilitate making inferences about whether the change in the risk of the KPI from 2014 to 2015 was statistically significant. If the 95% confidence interval did not include the value one, it may be inferred that the change in the risk of the KPI from 2014 to 2015 was statistically significant, i.e. the risk of the KPI among the ROI infants was higher or lower in 2015 than it was in 2014.

This approach has the advantage of adjusting for the risk profile of the ROI infants in each year and any change in this risk profile from one year to the next.

For each KPI, Table 5.2 displays the SMR and its 95% confidence interval for 2014 and 2015 and the relative risk comparing the two years and its 95% confidence interval.

Table 5.2: Risk Adjusted Standardised Mortality/Morbidity Ratios for Key Performance Indicators, Republic of Ireland, 2014 and 2015, and the relative risk in 2015 compared to 2014

	2014		2015		
Outcome	**SMR**	**(95% CI)**	**SMR**	**(95% CI)**	**RR (95% CI)**
Mortality	1.27	(1.03, 1.51)	1.15	(0.91, 1.39)	0.90 (0.66, 1.24)
Mortality excluding early death	1.23	(0.92, 1.54)	1.01	(0.70, 1.31)	0.82 (0.53, 1.26)
Death or Morbidity	1.14	(1.01, 1.27)	1.16	(1.03, 1.29)	1.01 (0.85, 1.21)
Chronic Lung Disease	1.08	(0.88, 1.28)	1.07	(0.87, 1.27)	0.99 (0.75, 1.31)
Pneumothorax	1.67	(1.25, 2.10)	1.80	(1.37, 2.24)	1.08 (0.66, 1.76)
Late Bacterial Infection	0.90	(0.58, 1.22)	0.97	(0.68, 1.26)	1.08 (0.68, 1.74)
Coagulase Negative Infection	1.84	(1.45, 2.23)	1.60	(1.22, 1.99)	0.87 (0.56, 1.36)
Nosocomial Infection	1.30	(1.04, 1.57)	1.43	(1.17, 1.69)	1.10 (0.79, 1.54)
Fungal Infection	0.55	(0, 1.57)	0.70	(0, 1.65)	1.28 (0.15, 15.35)
Any Late Infection	1.26	(1.00, 1.52)	1.44	(1.18, 1.7)	1.14 (0.82, 1.59)
Intraventricular Haemorrhage	1.07	(0.88, 1.26)	1.24	(1.05, 1.43)	1.16 (0.90, 1.51)
Severe Intraventricular Haemorrhage	1.22	(0.85, 1.58)	1.15	(0.80, 1.51)	0.95 (0.58, 1.55)
Retinopathy of Prematurity	0.51	(0.33, 0.70)	0.71	(0.53, 0.89)	1.39 (0.98, 1.98)
Severe Retinopathy of Prematurity	0.83	(0.37, 1.29)	1.10	(0.66, 1.54)	1.33 (0.66, 2.76)
Cystic Periventricular Leukomalacia	0.32	(0, 0.87)	1.26	(0.71, 1.82)	3.97 (1.28, 16.33)
Necrotising Enterocolitis	1.21	(0.84, 1.59)	1.47	(1.08, 1.86)	1.22 (0.74, 2.01)

Note: RR = relative risk in 2015 compared to 2014; increase in risk if RR>1; decrease if RR<1; statistically significant if 95% CI does not include the value 1.

KPI 1: Mortality and KPI 2: Mortality Excluding Early Death

In 2015, 16% (n=97) of VLBW babies born in the ROI died, one percentage higher than the proportion of VON infants who died (15%, n=9,079). Over half of these ROI infants died either within the first 12 hours of life (7%, n=44) or within 12 hours of admission to the NICU (2%, n=10; Figure 5.1). After excluding these early deaths, a further 7% (n=43) of ROI infants died. When early deaths are excluded, 10% (n=6,046) of VON VLBW infants died.

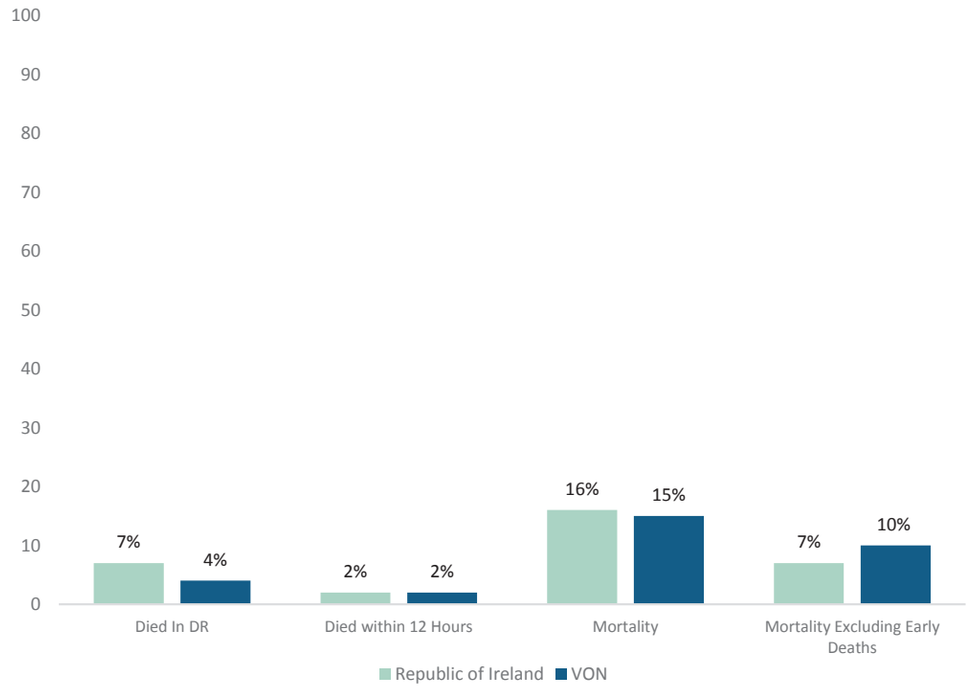

Figure 5.1: Distribution of mortality amongst ROI and VON infants, 2015..

Deaths in the Delivery Room 2015

In 2015, a significantly higher proportion of ROI infants died in the delivery room (7%, n=44) compared to VON (4%, n=2,304; p<0.001). A similar statistically significant finding was obtained in 2014 when 8% (n=50) of ROI infants died in the delivery room compared to 4% (n=2,200) in VON. The reduction in ROI delivery room deaths from 8% in 2014 to 7% in 2015 was not statistically significant (p=0.39).

Eleven of the 44 (25%) ROI infants who died in the delivery room in 2015 had a major congenital anomaly and a further 28 (64%) were born at less than 24 weeks gestation (Table 5.3): the analogous figures for 2014 were 14% (n=7) having major congenital anomalies and 72% (n=36) born at less than 24 weeks gestation. In total, 39 of 44 infants (89%) who died in the delivery room in the ROI in 2015 had either a major congenital anomaly or were less than 24 weeks gestation. This was similar to the figure of 86% (43 out of 50) in 2014. Of note, as in 2014, none of the infants less than 24 weeks gestation who died in the delivery room had a major congenital anomaly. Rather, three infants in each of the 24-26 weeks, 27-29 weeks and 30-32 weeks gestational age categories, as well as two infants from the >32 weeks gestational age category, who died in the delivery room, were born with major congenital anomalies (Table 5.3).

Table 5.3 Deaths in the delivery room, by gestational age category and presence of major congenital anomaly, 2015, n=44

Gestational Age Category	Major Congenital Anomaly Present	Absent	Total
< 24 weeks	0	28	28
24-26 weeks	3	3	6
27-29 weeks	3	1	4
30-32 weeks	3	0	3
> 32 weeks	2	1	3
Total	11	33	44

Figure 5.2 illustrates the change in the number of cases of mortality across gestational age categories. As gestational age increases, there was a clear statistically significant decrease in mortality in ROI infants ($p<0.001$). Similarly, there was a statistically significant decrease in mortality excluding early deaths amongst ROI infants ($p<0.001$) (Figure 5.3).

Amongst ROI infants with birth weights 501-1500g, there were 77 deaths observed whereas the expected number based on the risk profile of the infants in the ROI population was 67 (Table 5.4). The SMR was 1.15 (95% CI: 0.91, 1.39), indicating that the number of observed cases was 1.15 times the expected number. In absolute numbers there were 10 more deaths than expected. This was not a statistically significant excess in mortality (95% CI: -6, 26).

Excluding early deaths, there were 41 observed deaths which was identical to the expected number (Table 5.4; SMR=1.01, 95% CI: 0.70, 1.31). Thus, there was no difference in the observed and expected numbers of deaths excluding early death.

The relative risk for mortality, at 0.90, indicated that the risk was lower in 2015 than in 2014 but this reduction was not statistically significant (95% CI: 0.66, 1.24; Table 5.2). The relative risk for mortality excluding early death, at 0.82, also indicated that the risk was lower in 2015 than in 2014 but again the difference was not statistically significant (95% CI: 0.53, 1.26; Table 5.2).

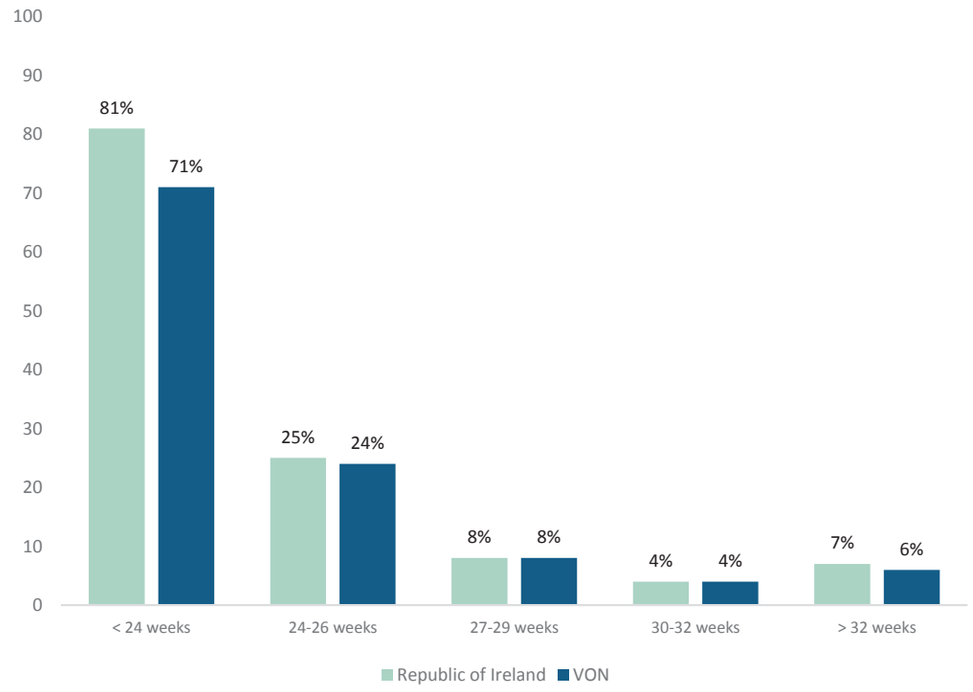

Figure 5.2: Distribution of mortality amongst infants by gestational age, 2015

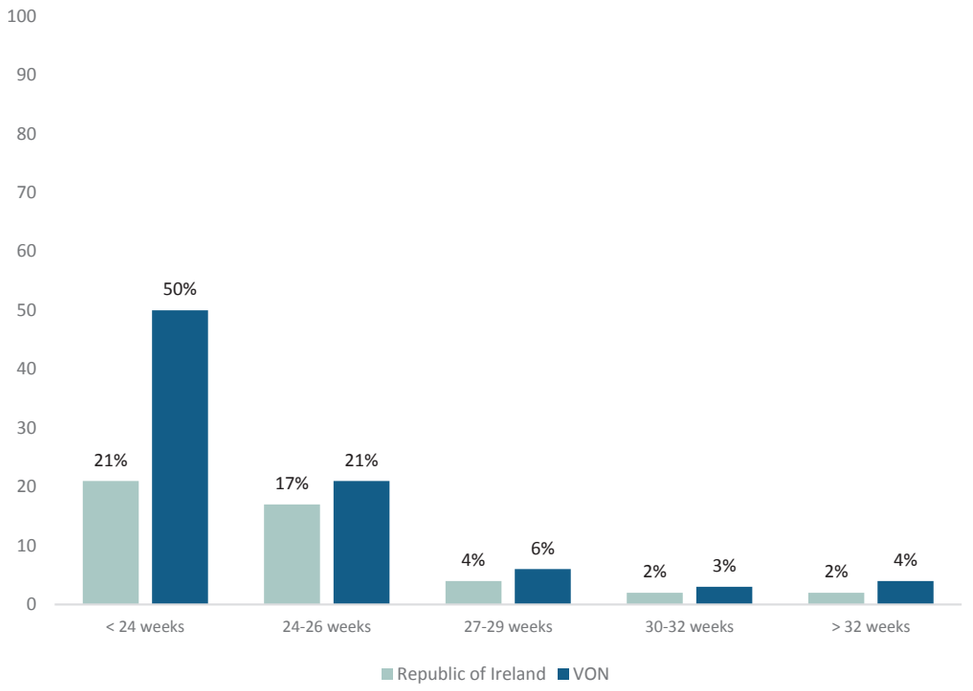

Figure 5.3: Distribution of mortality excluding early deaths amongst infants by gestational age, 2015

Table 5.4: Risk Adjusted Standardised Mortality Ratios for Key Performance Indicators - KPI 1: mortality and KPI 2: mortality excluding early death, ROI, 2015

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Mortality	77	67	1.15	(0.91, 1.39)	10	(-6, 26)
Mortality excluding early death	41	41	1.01	(0.70, 1.31)	0	(-12, 13)

O=observed, E=expected, SMR=standardised mortality ratio, CI=confidence interval

KPI 3: Death or Morbidity

The KPI, death or morbidity, indicates if an infant died or was known to have one or more of the key morbidities of severe IVH, CLD in infants <33 weeks, NEC, pneumothorax, any late infection or cystic PVL. In 2015, 46% of ROI infants (n=285) suffered death or morbidity. This compares to 44% (n=26,865) of VON infants.

Figure 5.4 illustrates the change in the number of cases of death or morbidity across gestational age categories. As gestational age increases, there was a clear statistically significant decrease in death or morbidity in ROI infants (p<0.001).

Amongst ROI infants with birth weights 501-1500g, there were 256 observed cases of death or morbidity, whereas the expected number based on the risk profile of the infants in the Irish population was 221 (Table 5.5). The SMR was 1.16 (95% CI: 1.03, 1.29), indicating that the number of observed cases was 1.16 times the expected number. In absolute numbers there were 35 more cases of death or morbidity in the ROI than expected, a statistically significant excess in death or morbidity (95% CI: 6, 64).

The relative risk for death or morbidity, at 1.01, indicated that the risk in 2015 was almost identical to that in 2014 (Table 5.2). Therefore, there was a statistically significant excess risk of death or morbidity for ROI infants of a similar magnitude in both years (SMR=1.14 in 2014 vs. 1.16 in 2015; Table 5.2).

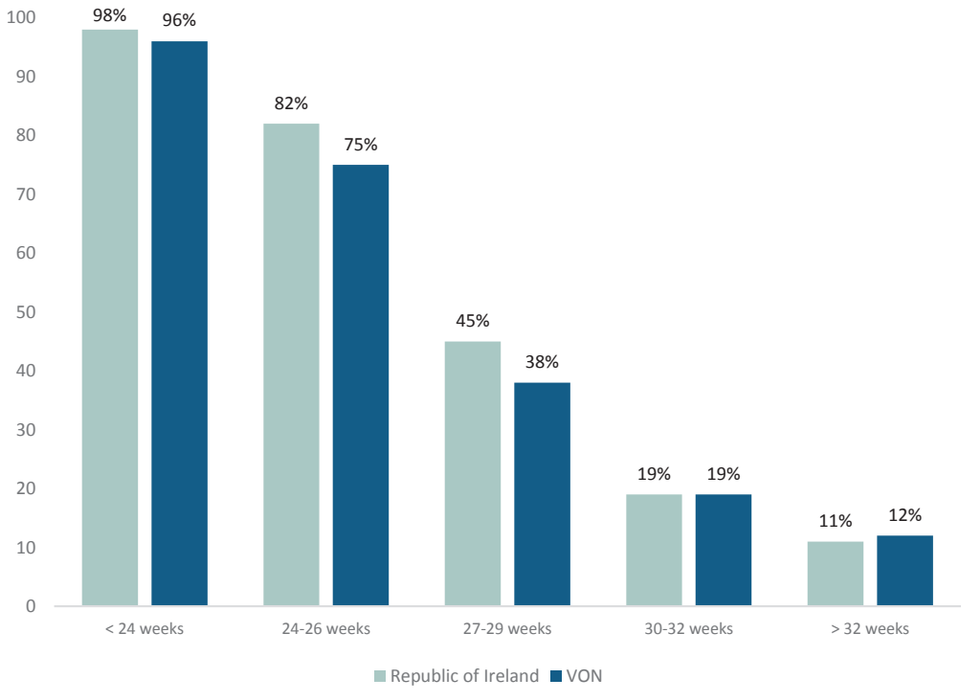

Figure 5.4: Distribution of death or morbidity amongst infants by gestational age, 2015

Table 5.5: Risk Adjusted Standardised Mortality Ratios for Key Performance Indicators - KPI 3: death or morbidity, ROI, 2015

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Death or Morbidity	256	221	1.16	(1.03, 1.29)	35	(6, 64)

O=observed, E=expected, SMR=standardised mortality ratio, CI=confidence interval

KPI 4: CLD

In 2015, 21% of ROI infants (n=109) were classified as having CLD. This compares to 24% of VON infants (n=12,500).

Figure 5.5 illustrates the change in CLD cases across all gestational age categories. As gestational age increases, there was a significant decrease in CLD cases amongst ROI infants (p<0.001).

There were 104 observed cases of CLD amongst ROI infants with birth weights 501-1500g whereas the expected number based on the risk profile of infants in the Irish population was 97 (Table 5.6). The SMR was 1.07 (95% CI: 0.87, 1.27), indicating that the number of observed cases was 1.07 times the expected number. In absolute numbers there were seven more cases of CLD than expected: this was not a statistically significant excess (95% CI:-13, 26).

The relative risk for CLD, at 0.99, indicated that the risk in 2015 was almost identical to that in 2014 (Table 5.2). There was a risk of CLD of similar magnitude in both years, but this risk was not statistically significant in either year (SMR=1.08 in 2014 vs. 1.07 in 2015; Table 5.2).

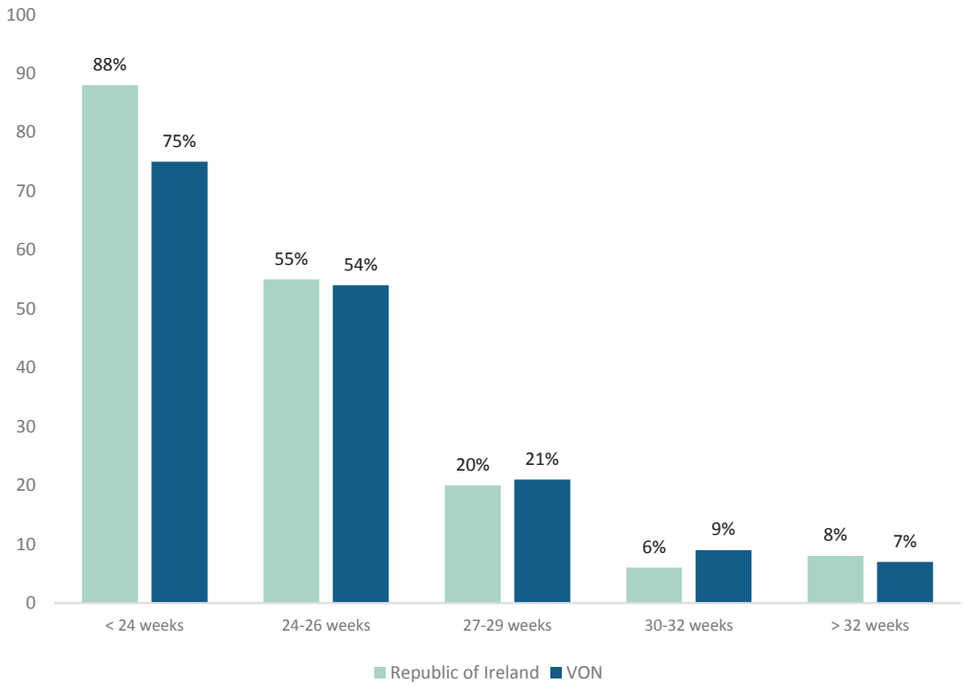

Figure 5.5: Distribution of chronic lung disease amongst infants by gestational age, 2015

Table 5.6: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 4: chronic lung disease, ROI, 2015

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Chronic Lung Disease	104	97	1.07	(0.87, 1.27)	7	(-13, 26)

O=observed, E=expected, SMR=standardised morbidity ratio, CI=confidence interval

KPI 5: Pneumothorax

In 2015, 7% of ROI infants (n=40) were classified as having pneumothorax. This compares to 4% (n=2,637) of VON infants.

Figure 5.6 outlines the proportion of pneumothorax in ROI and VON infants according to gestational age categories. In ROI infants, increasing gestational age was associated with a slight decrease in cases of pneumothorax but this decrease was not statistically significant (p=0.281). It must be noted that the number of pneumothorax cases seen across gestational age categories in ROI infants was quite small.

There were 37 observed cases of pneumothorax amongst ROI infants with birth weights 501-1500g whereas the expected number based on the risk profile of the infants in the Irish population was 21 (Table 5.7). The SMR was 1.80 (95% CI: 1.37, 2.24), indicating that the number of observed cases was 1.80 times the expected number. This was a statistically significant excess of 16 cases of pneumothorax (95% CI: 8, 25).

The relative risk for pneumothorax, at 1.08, indicated that the risk was higher in 2015 than in 2014, but this increase was not statistically significant (95% CI: 0.66, 1.76; Table 5.2).

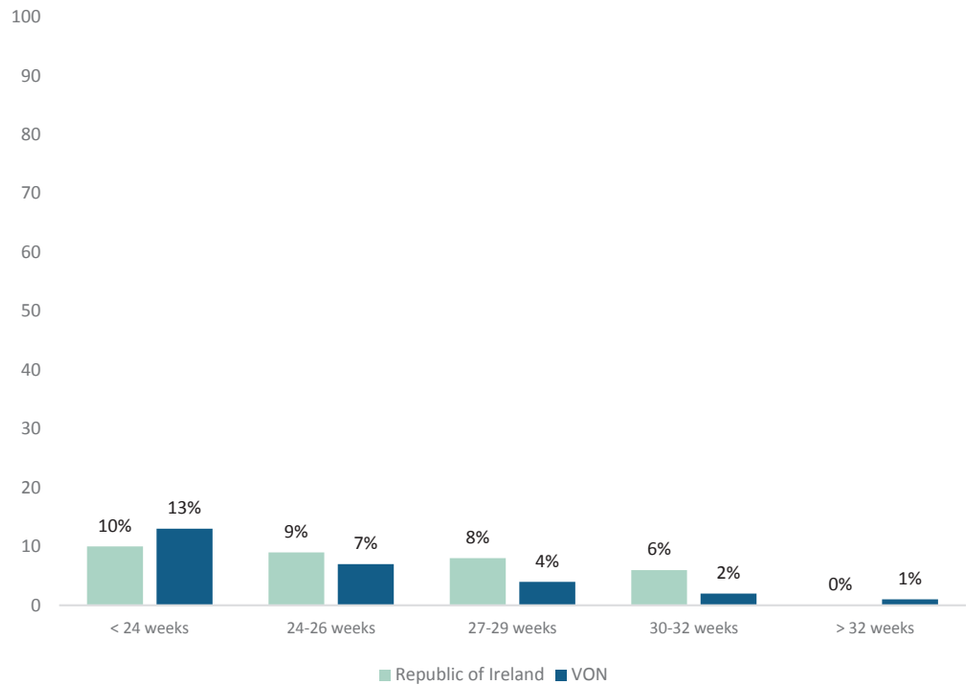

Figure 5.6: Distribution of pneumothorax amongst infants by gestational age, 2015

Table 5.7: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 5: pneumothorax, ROI, 2015

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Pneumothorax	37	21	1.80	(1.37, 2.24)	16	(8, 25)

O=observed, E=expected, SMR=standardised morbidity ratio, CI=confidence interval

KPIs 6 – 10: Infections: late bacterial infection, coagulase negative infection, nosocomial infection, fungal infection and any late infection.

Figure 5.7 compares the proportion of infections in ROI and VON infants. There was no significant difference in rates of any infection between the two populations (late bacterial infection: p=0.522; coagulase negative infection: p=0.092; nosocomial infection: p=0.194; fungal infection: p=0.363; any late infection: p=0.094). The slightly lower percentage of late bacterial infection and slightly higher percentages of coagulase negative infection, nosocomial infection and any late infection seen in ROI infants reflects the pattern observed in 2014 (7).

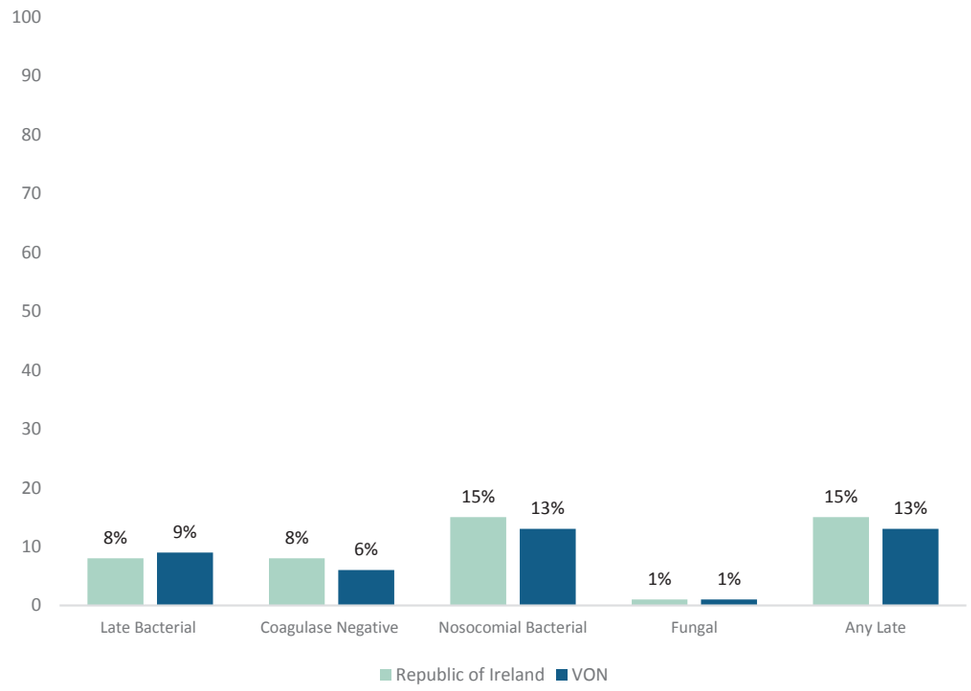

Figure 5.7: Distribution of infections in ROI and VON infants, 2015

KPI 6: Late Bacterial Infection

The proportion of late bacterial infection in ROI infants was 8% (n=46) compared to 9% (n=4,933) in all VON infants. Figure 5.8 illustrates the prevalence of late bacterial infection across all gestational age categories. As gestational age increases, there was a statistically significant decrease in cases of late bacterial infection in ROI infants (p<0.001).

Amongst ROI infants with birth weights 501-1500g, there were 45 observed cases of late bacterial infection compared to an expected number of 46 cases (Table 5.8). Thus, the observed number was 0.97 times the expected number (SMR=0.97, 95% CI: 0.68, 1.26). In absolute numbers there was one less case of late bacterial infection than expected, which was not statistically significant (95% CI: -15, 12).

The relative risk for late bacterial infection, at 1.08, indicated that the risk was slightly higher in 2015 than in 2014, but this increase was not statistically significant (95% CI: 0.68, 1.74; Table 5.2).

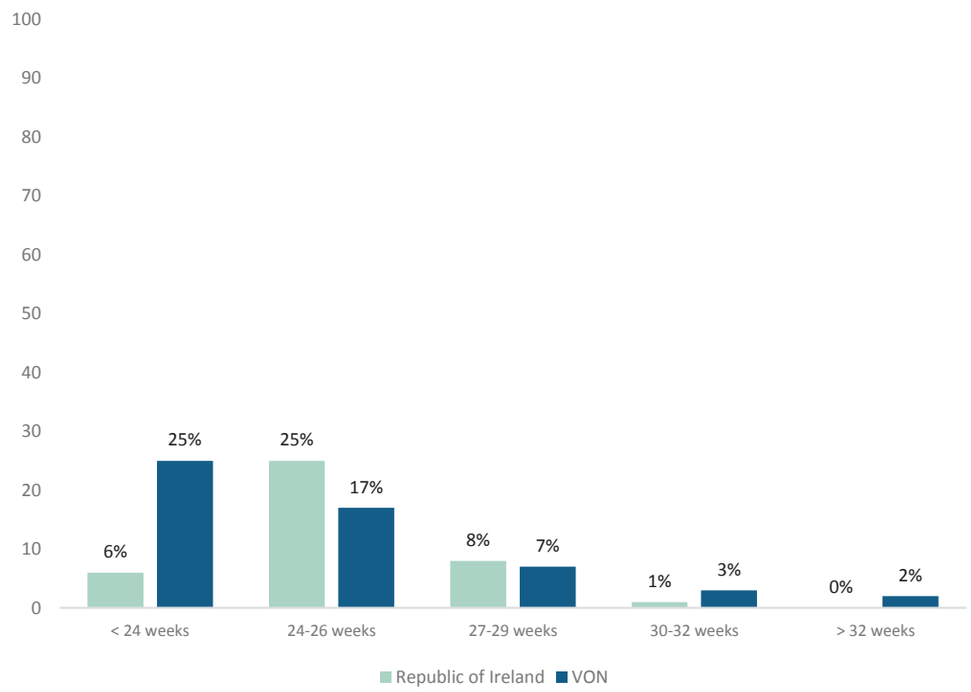

Figure 5.8: Distribution of late bacterial infection amongst infants by gestational age, 2015

Table 5.8: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 6: late bacterial infection, ROI, 2015

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Late Bacterial Infection	45	46	0.97	(0.68, 1.26)	-1	(-15, 12)

O=observed, E=expected, SMR=standardised morbidity ratio, CI=confidence interval

KPI 7: Coagulase Negative Infection

Coagulase negative infection was observed in 8% (n=43) of ROI infants and 6% of VON infants (n=3,385). Figure 5.9 illustrates the change in cases of coagulase negative infection across all gestational age categories. In ROI infants, increasing gestational age was associated with a statistically significant decrease in cases of coagulase negative infection ($p<0.001$).

Adjusting for the risk profile of ROI infants born weighing 501-1500g, there were 41 observed cases of coagulase negative infection compared to an expected number of 26 cases (Table 5.9). Thus, the observed number was 1.60 times the expected number (SMR=1.60, 95% CI: 1.22, 1.99). In absolute numbers there were 15 more cases of coagulase negative infection than expected, which was a statistically significant excess (95% CI: 6, 25).

The relative risk for coagulase negative infection, at 0.87, indicated that the risk was lower in 2015 than in 2014 but this reduction was not statistically significant (95% CI: 0.56, 1.36; Table 5.2).

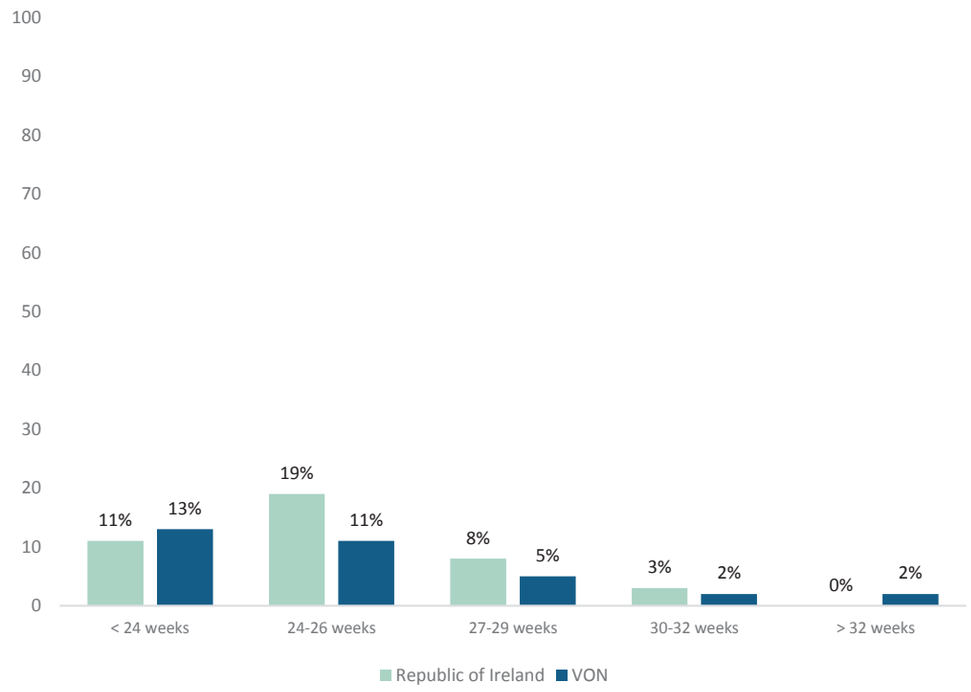

Figure 5.9: Distribution of coagulase negative infection amongst infants by gestational age, 2015

Table 5.9: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 7: coagulase negative infection, ROI, 2015

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Coagulase Negative Infection	41	26	1.60	(1.22, 1.99)	15	(6, 25)

O=observed, E=expected, SMR=standardised morbidity ratio, CI=confidence interval

KPI 8: Nosocomial Infection

Nosocomial infection was reported in 15% (n=83) of the ROI infant population and 13% (n=7,227) of the VON population. Figure 5.10 illustrates the change in cases of nosocomial infection across all gestational age categories. As gestational age increases, there was a statistically significant decrease in cases of nosocomial infection in ROI infants ($p<0.001$).

There were 80 observed cases of nosocomial infection amongst ROI infants with birth weights 501-1500g, whereas the expected number based on the risk profile of the infants was 56 cases (Table 5.10). Thus, there were 1.43 times more cases observed than expected (SMR=1.43, 95% CI: 1.17, 1.69). In absolute numbers this equated to an excess of 24 cases, a statistically significant difference (95% CI: 10, 39).

At 1.10, the relative risk indicated that the risk for nosocomial infection was higher in 2015 than in 2014, but this increase in risk was not statistically significant (95% CI: 0.79, 1.54; Table 5.2).

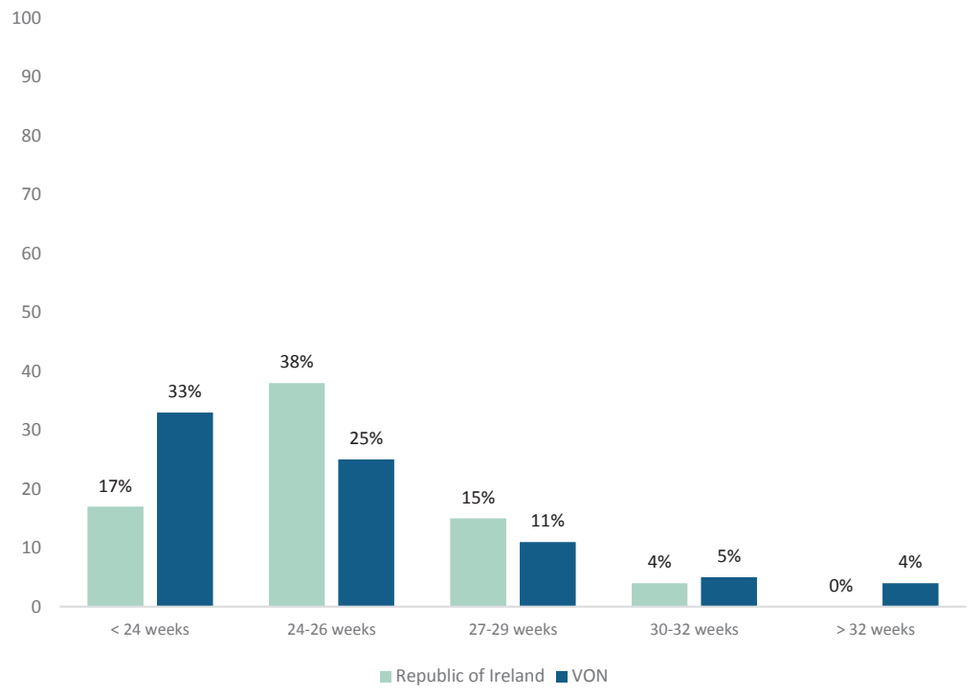

Figure 5.10: Distribution of nosocomial infection amongst infants by gestational age, 2015

Table 5.10: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 8: nosocomial infection, ROI, 2015

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Nosocomial Infection	80	56	1.43	(1.17, 1.69)	24	(10, 39)

O=observed, E=expected, SMR=standardised morbidity ratio, CI=confidence interval

KPI 9: Fungal Infection

Three (0.5%) ROI infants experienced fungal infection in 2015, compared to 516 (0.9%) infants in VON. One ROI infant was in the < 24 weeks gestational age category and two in the 27-29 weeks category. Graphs are not included.

The three observed cases of fungal infection were amongst the infants born weighing 501-1500g. Based on the risk profile of ROI infants, there was an expected number of four cases (Table 5.11). One less case of fungal infection than expected did not constitute a statistically significant reduction in fungal infection cases (95% CI: -5, 3).

The relative risk for fungal infection in 2015, at 1.28, was greater than the risk in 2014 but this increase in risk was not statistically significant (95% CI: 0.15, 15.35; Table 5.2).

Table 5.11: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 9: fungal infection, ROI, 2015

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Fungal Infection	3	4	0.70	(0, 1.65)	-1	(-5, 3)

O=observed, E=expected, SMR=standardised morbidity ratio, CI=confidence interval

KPI 10: Any Late Infection

Any late infection was reported for 15% of ROI infants (n=86) and 13% of VON infants (n=7,456). Figure 5.11 illustrates the change in cases of any late infection across gestational age categories. As gestational age increases, there was a statistically significant decrease in cases of any late infection in ROI infants (p<0.001).

Considering ROI infants born weighing 501-1500g for whom risk adjustment was performed, there were 83 observed cases with any late infection compared to an expected number of 58 cases (Table 5.12). Thus, the observed number equated to 1.44 times the expected number (SMR=1.44, 95% CI: 1.18, 1.70) and the excess of 25 cases was statistically significant (95% CI: 10, 40).

The relative risk for any late infection in 2015 was 1.14 times the risk in 2014: this difference between the years was not statistically significant (95% CI: 0.82, 1.59; Table 5.2).

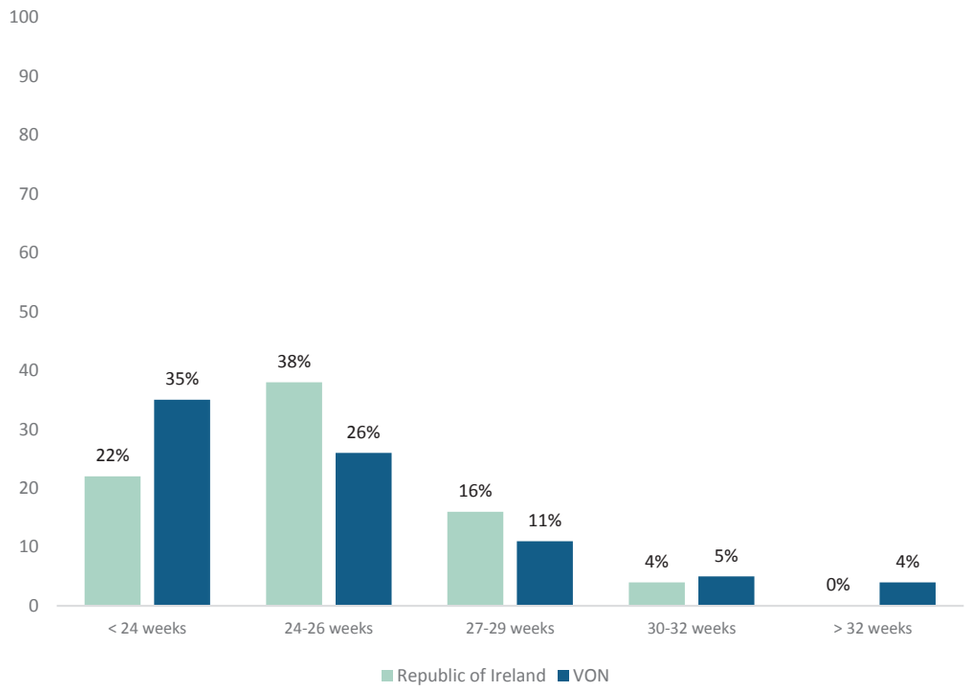

Figure 5.11: Distribution of any late infection amongst infants by gestational age, 2015

Table 5.12: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 10: any late infection, ROI, 2015

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Any Late Infection	83	58	1.44	(1.18, 1.70)	25	(10, 40)

O=observed, E=expected, SMR=standardised morbidity ratio, CI=confidence interval

KPI 11: Any IVH and KPI 12: Severe IVH

Overall, 27% (n=140) of ROI infants experienced IVH compared to 25% (n=13,330) of VON infants. Of these, 7% (n=38) of ROI infants had severe IVH, i.e. Grade 3 or 4, compared to 8% (n=4,227) of VON infants. Figures 5.12 and 5.13 illustrate the change in cases of IVH and severe IVH respectively across gestational age categories. As gestational age increases, there was a statistically significant decrease in cases of both IVH ($p<0.001$) and severe IVH ($p<0.001$) in ROI infants.

IVH was observed in 131 ROI infants weighing 501-1500g at birth whereas the number of cases expected based on the infants' risk profile was 106 (Table 5.13). The observed number was statistically significantly higher than expected (SMR=1.24, 95% CI: 1.05, 1.43). In absolute numbers, there were 25 more cases than expected, which was also statistically significant (95% CI: 5, 46). The relative risk for IVH in 2015, at 1.16, was greater than the risk in 2014, but this increase was not statistically significant (95% CI: 0.90, 1.51; Table 5.2).

In cases of severe IVH, there were 36 observed cases compared to an expected number of 31 cases (SMR=1.15, 95% CI: 0.8, 1.51): this excess of five cases was not statistically significant (95% CI: -6, 16; Table 5.13). The relative risk for severe IVH in 2015 was 0.95 times the risk in 2014: this reduction in risk was not statistically significant (95% CI: 0.58, 1.55; Table 5.2).

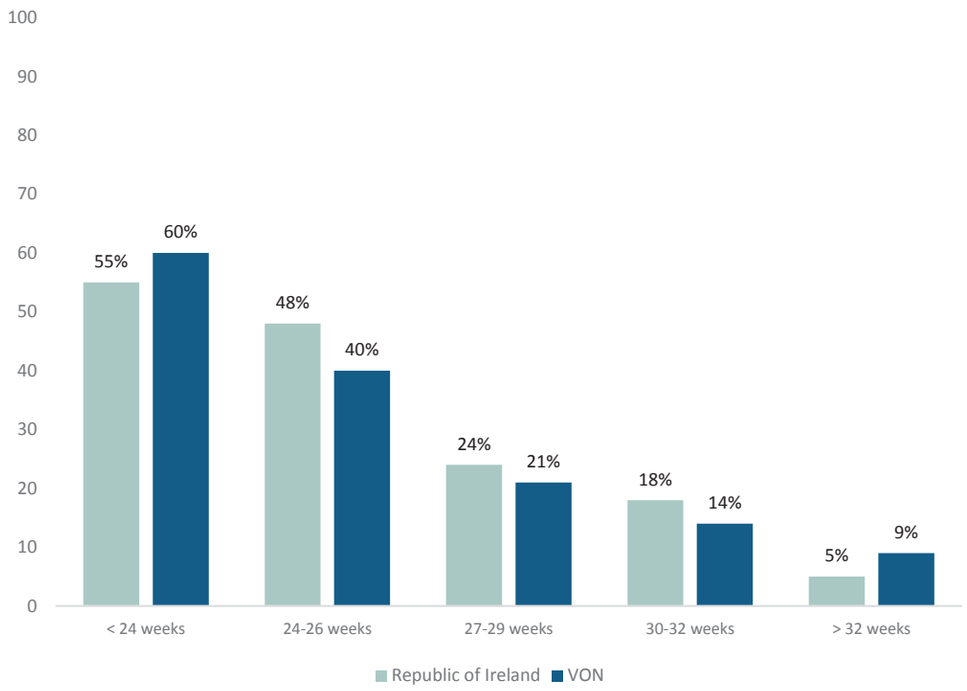

Figure 5.12: Distribution of any IVH amongst infants by gestational age, 2015

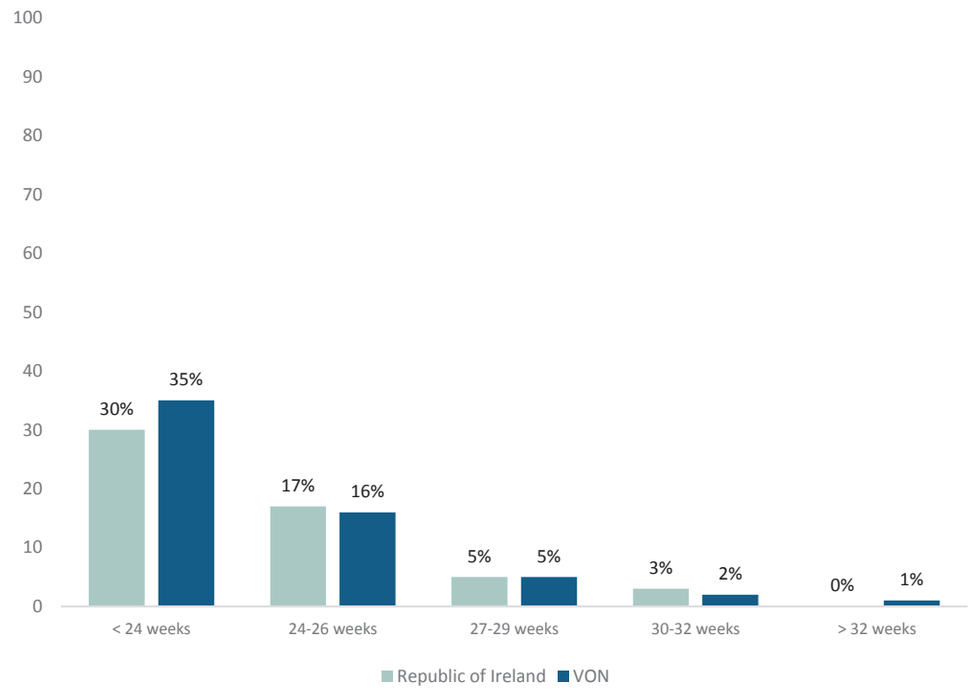

Figure 5.13: Distribution of severe IVH amongst infants by gestational age, 2015

Table 5.13: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 11: intraventricular haemorrhage and KPI 12: severe intraventricular haemorrhage, ROI, 2015

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Intraventricular Haemorrhage	131	106	1.24	(1.05, 1.43)	25	(5, 46)
Severe Intraventricular Haemorrhage	36	31	1.15	(0.8, 1.51)	5	(-6, 16)

O=observed, E=expected, SMR=standardised morbidity ratio, CI=confidence interval

KPI 13: ROP and KPI 14: Severe ROP

ROP was reported in 19% (n=86) of ROI infants and 31% (n=13,679) of VON infants. Severe ROP (stage 3, 4 or 5) was reported for 5% (n=24) of ROI infants and 6% (n=2,648) of VON infants. Figures 5.14 and 5.15 illustrate the change in cases of ROP and severe ROP respectively across gestational age categories. As gestational age increases, there was a statistically significant decrease in both cases of ROP ($p<0.001$) and cases of severe ROP ($p<0.001$) in ROI infants.

Considering ROI infants born weighing 501-1500g for whom risk adjustment was performed, there were 81 observed cases of ROP compared to an expected number of 114 cases (Table 5.14). Thus, the observed number equated to 71% of the expected number, which constituted a statistically significant difference (SMR=0.71, 95% CI: 0.53, 0.89). In absolute numbers, there were 33 fewer cases of ROP than expected, which was a statistically significant reduction (95% CI: -54, -12).

The relative risk for ROP, at 1.39, indicated that the risk for ROP was higher in 2015 than in 2014, but this increase was not statistically significant (95% CI: 0.98, 1.98; Table 5.2).

With regard to severe ROP, there were 22 observed cases compared to 20 cases which would be expected based on the risk profile of infants in the ROI population (SMR=1.10, 95% CI: 0.66, 1.54): the difference of two cases between the observed and the expected values was not statistically significant (95% CI: -7, 11; Table 5.14).

The relative risk, at 1.33, for severe ROP indicates that the risk was greater in 2015 than in 2014, but this difference was not statistically significant (95% CI: 0.66, 2.76; Table 5.2).

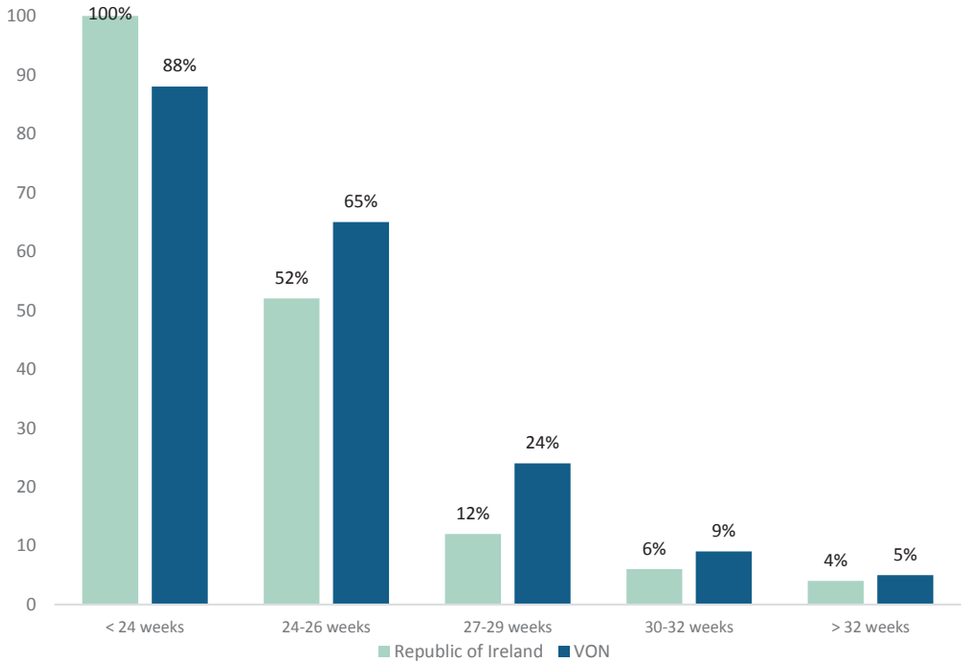

Figure 5.14: Distribution of ROP amongst infants by gestational age, 2015

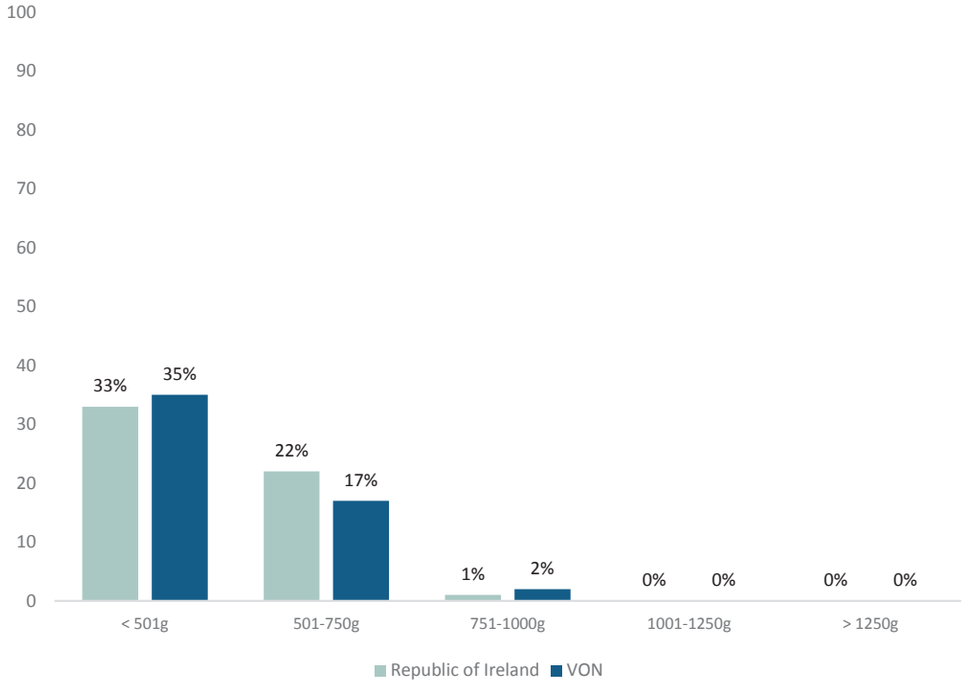

Figure 5.15: Distribution of severe ROP amongst infants by gestational age, 2015

Table 5.14: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 13: retinopathy of prematurity and KPI 14: severe retinopathy of prematurity, ROI, 2015

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Retinopathy of Prematurity	81	114	0.71	(0.53, 0.89)	-33	(-54, -12)
Severe Retinopathy of Prematurity	22	20	1.10	(0.66, 1.54)	2	(-7, 11)

O=observed, E=expected, SMR=standardised morbidity ratio, CI=confidence interval

KPI 15: Cystic PVL

Similar proportions of cystic PVL were observed in ROI and VON infants in 2015, at 3% (n=17) and 3% (n=1,655) respectively. Figure 5.16 illustrates the change in cases of cystic PVL across gestational age categories. There was no significant change in number of cases of cystic PVL as gestational age (p=0.307) increased and it is noted that the overall number of cystic PVL cases observed in ROI infants was small.

Considering ROI infants with 501-1500g birth weights, there were 16 observed cases of cystic PVL whereas the number expected based on their risk profile was 13 (Table 5.15). Thus, the observed number equated to 1.26 times the expected number (SMR=1.26, 95% CI: 0.71, 1.82). In absolute numbers the three more cases observed did not represent a statistically significant difference from the expected number (95% CI: -4, -10).

At 3.97, the relative risk for cystic PVL in 2015 was statistically significantly greater than the risk in 2014 (95% CI: 1.28, 16.33; Table 5.2). However, the small number of cases in both years (three in 2014 and 17 in 2015) preclude definitive conclusions being drawn.

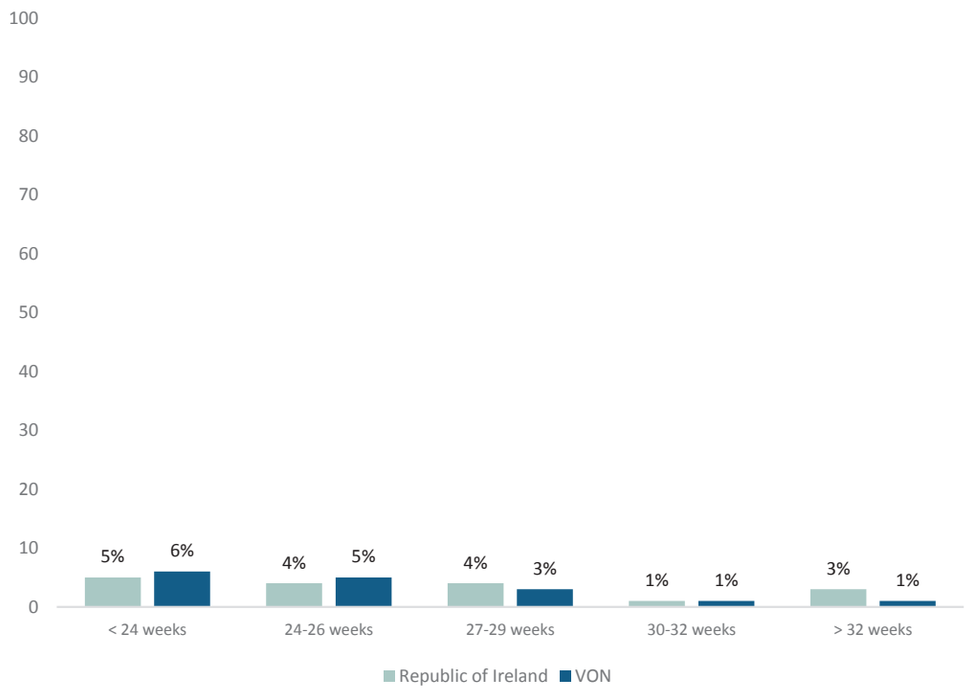

Figure 5.16: Distribution of cystic PVL amongst infants by gestational age, 2015

Table 5.15: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 15: cystic periventricular leukomalacia, ROI, 2015

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Cystic Periventricular Leukomalacia	16	13	1.26	(0.71, 1.82)	3	(-4, 10)

O=observed, E=expected, SMR=standardised morbidity ratio, CI=confidence interval

KPI 16: Necrotising Enterocolitis (NEC)

NEC was observed in 7% (n=40) of ROI infants and 5% (n=3,056) of VON infants in 2015. Figure 5.17 illustrates the change in cases of NEC across all gestational age categories. As gestational age increases, there was a statistically significant decrease in cases of NEC in ROI infants (p<0.001).

Amongst the ROI infants born weighing 501-1500g there were 37 observed cases of NEC and an expected number of 25 cases (SMR=1.47, 95% CI: 1.08, 1.86; Table 5.16). This was a statistically significant excess of 12 cases of NEC (95% CI: 2, 22).

The relative risk for NEC, at 1.22, indicated that the risk was higher in 2015 than in 2014, but this increase was not statistically significant (95% CI: 0.74, 2.01; Table 5.2).

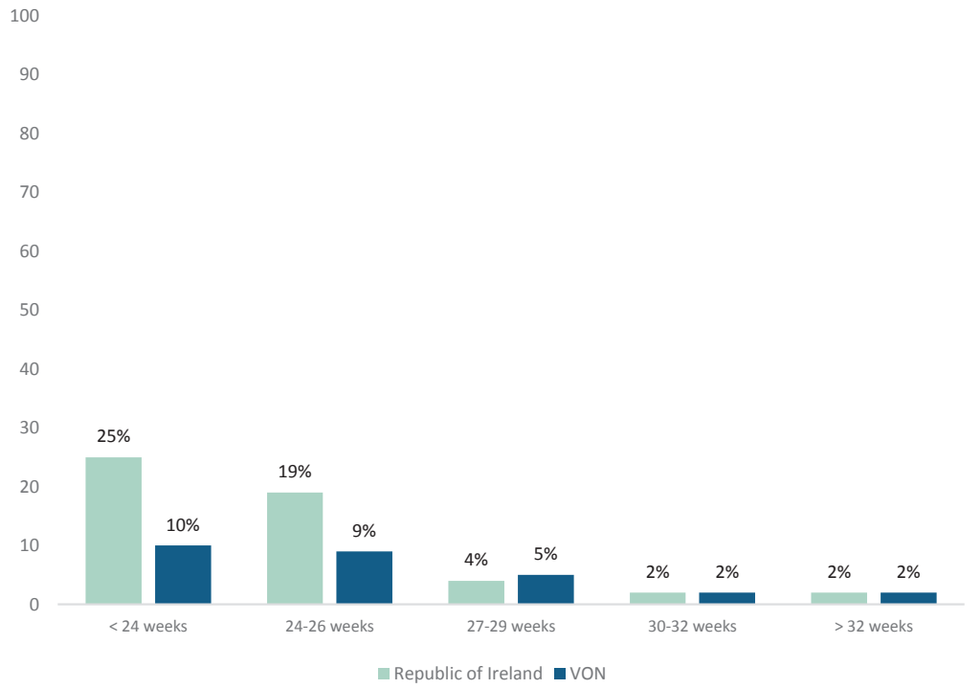

Figure 5.17: Distribution of NEC amongst infants by gestational age, 2015.

Table 5.16: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 16: necrotising enterocolitis, ROI, 2015

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Necrotising Enterocolitis	37	25	1.47	(1.08, 1.86)	12	(2, 22)

O=observed, E=expected, SMR=standardised morbidity ratio, CI=confidence interval

Appendix A: Endorsement by the National Office of Clinical Audit (NOCA)

NOCA National Office of Clinical Audit

Dr. Brendan Paul Murphy
Consultant Neonatologist
Cork University Maternity Hospital
Wilton
Cork

11th April 2017

Very Low Birth Weight Infants in the Republic of Ireland - Annual Report 2015

Dear Dr Murphy,

On behalf of the NOCA Governance Board and our Executive Team, I wish to congratulate you, Dr Anne Twomey, the Neonatal Intensive Care Outcomes Research and Evaluation (NICORE) group and the National Perinatal Epidemiology Centre (NPEC) and all participating neonatal units for your combined efforts in initiating and supporting this valuable quality improvement initiative.

The NOCA Board and Executive Team will continue to support NPEC governance efforts and in particular highlight the national requirement for resource commitment to ensure sustainable clinical audit of perinatal and maternal outcomes.

Please accept this as formal endorsement from the NOCA Governance Board of the Very Low Birth Weight Infants in the Republic of Ireland - Annual Report 2015

Yours sincerely,

Yours sincerely,

J. Conor O'Keane

Professor Conor O' Keane FFPath FRCPI
Chair
National Office of Clinical Audit Governance Board

c.c. Dr. Anne Twomey, National Maternity Hospital, Holles Street, Dublin 2, Ireland
Prof Richard Greene, National Perinatal Epidemiology Centre, CUMH, Cork

National Office of Clinical Audit, 2nd Floor, Ardilaun House, 111 St Stephen's Green, Dublin 2 Tel: + (353) 1 4028577

Tús Áite do Shábháilteacht Othar / Patient Safety First

Appendix B: NICORE Group Members, 2015

Dr Muhammad Azam, *Consultant Paediatrician*, Wexford General Hospital

Dr Paula Cahill, *Consultant Paediatrician*, Portiuncula Hospital

Dr David Corcoran, *Consultant Neonatologist*, Rotunda Hospital

Dr Animitra Das, *Consultant Neonatologist*, University Hospital Waterford

Dr Anne Doolan, *Consultant Paediatrician,* University Maternity Hospital Limerick
(From 2016, Coombe Women & Infants University Hospital)

Dr Alan Finan, *Consultant Paediatrician,* Cavan General Hospital

Dr Emma Gordon, *Consultant Neonatologist,* Our Lady of Lourdes Hospital

Dr Rizwan Gul, *Consultant Paediatrician,* Midland Regional Hospital Portlaoise

Dr Rizwan Khan, *Consultant Paediatrician,* University Hospital Kerry
(From 2017, University Maternity Hospital Limerick)

Dr Imelda Lambert, *Consultant Paediatrician,* Midland Regional Hospital, Mullingar

Dr Jan Miletin, *Consultant Neonatologist,* Coombe Women & Infants University Hospital

Dr Brendan Paul Murphy, *Consultant Neonatologist,* Cork University Maternity Hospital

Dr Donough O'Donovan, *Consultant Neonatologist,* University Hospital Galway

Dr Justin Roche, *Consultant Paediatrician,* South Tipperary General Hospital

Dr Hilary Stokes, *Consultant Paediatrician,* Mayo University Hospital

Dr Mathew Thomas, *Consultant Paediatrician,* Letterkenny University Hospital

Dr Hilary Greaney, *Consultant Paediatrician,* Sligo University Hospital

Dr Anne Twomey, *Consultant Neonatologist,* National Maternity Hospital

Dr David Waldron, *Consultant Paediatrician,* St. Luke's General Hospital

Appendix C: Vermont Oxford Network Data Collection Forms

Center Number:_____ **Network ID Number:** ☐☐☐☐☐

VERMONT OXFORD NETWORK
PATIENT DATA BOOKLET FOR INFANTS BORN IN 2015

The Patient Identification Worksheet contains personal patient identifiers and must NOT be submitted to the Vermont Oxford Network. The Vermont Oxford Network does not accept protected health care information.

Contents:

PATIENT IDENTIFICATION WORKSHEET

W1. Patient's Name: _____

W2. Mother's Name: _____

W3. Patient's Medical Record Number: _____

W4. Date of Birth: _____/_____/_____ (MM DD YYYY)

W5. Date of Admission: _____/_____/_____ (MM DD YYYY)
For inborn infants, the date of admission is the Date of Birth.
For outborn infants, the date of admission is the date the infant was admitted to your hospital.

W6. Date of Day 28: ____/____/____ (MM DD YYYY)

W7. Date of Week 36: ____/____/____ (MM DD YYYY)

Use the Calculation Charts for Date of Day 28 and Date of Week 36 for the infant's birth year.

W8. Date of Initial Disposition: _____/_____/_____ (MM DD YYYY)

W9. If Infant Transferred, Date Discharged Home, Died or First Birthday (if still hospitalized), whichever is soonest: _____/_____/_____ (MM DD YYYY)

DO NOT SUBMIT THIS WORKSHEET
Protected Health Care Information

Vermont Oxford NETWORK

Rel 19.0

Center Number:_____ **Network ID Number:** ☐☐☐☐☐

LENGTH OF STAY CALCULATION WORKSHEET FOR INFANTS BORN IN 2015

Protected Health Care Information. ***DO NOT SUBMIT this Worksheet to Vermont Oxford Network.***

Use items W5, W8 and W9 from the Patient Identification Worksheet when completing this form.

Find the day numbers corresponding to dates using the Day Number Chart for 2015-2016 (www.vtoxford.org).

Part A. Initial Length Of Stay

Enter Date of Initial Discharge, Transfer or Death (**W8**): ____/____/____ ☐☐☐ Day #

Subtract Date of Admission to Your Hospital (**W5**): ____/____/____ − ☐☐☐ Day #

For inborn infants, the date of admission is the Date of Birth.
For outborn infants, the date of admission is the date the infant was admitted to your hospital. ☐☐☐

Add 1: + 1

L1. INITIAL LENGTH OF STAY = ☐☐☐ **Days**

Note: the maximum value of Initial Length of Stay is 366 (or 367 if leap day must be added), because tracking ends on the infant's first birthday.

Part B. Total Length Of Stay

Only For Infants Transferred From Your Hospital to Another Hospital.

Enter Date of Final Discharge or Death (**W9**): ____/____/____ ☐☐☐ Day #

Subtract Date of Admission (**W5**): ____/____/____ − ☐☐☐ Day #

For inborn infants, the date of admission is the Date of Birth.
For outborn infants, the date of admission is the date the infant was admitted to your hospital. ☐☐☐

Add 1: + 1

L2. TOTAL LENGTH OF STAY = ☐☐☐ **Days**

Note: the maximum value of Total Length of Stay is 366 (or 367 if leap day must be added), because tracking ends on the infant's first birthday.

SAMPLE CALCULATION OF INITIAL LENGTH OF STAY

Enter Date of Initial Discharge, Transfer or Death: **02 / 26 / 2015** ☐57 **Day #**

Subtract Date of Admission: **01 / 13 / 2015** − ☐13 **Day #**

☐44

Add 1: + 1

L1. INITIAL LENGTH OF STAY = ☐45 **Days**

Explanation: Date of 02/26/2015 is Day Number 57. Date of 01/13/2015 is Day Number 13. The day numbers for each date are found in the 2015-2016 Day Number Chart on the Network web site, www.vtoxford.org.

PLEASE DO NOT SUBMIT THIS WORKSHEET

Protected Health Care Information

Vermont Oxford NETWORK

28 DAY FORM - *For Infants Born in 2015*

Vermont Oxford NETWORK

Center Number: _____ **Network ID Number:** ☐☐☐☐☐ **Year of Birth:** _____

1. Birth Weight:	_____ grams
2. Gestational Age:	**a) Weeks** _____ **b) Days (0-6)** _____
3. Died in Delivery Room:	☐ Yes ☐ No **(*If Yes*, Use Delivery Room Death Form.)**
4. a) Location of Birth:	☐ Inborn ☐ Outborn
b) If Outborn, Day of Admission to Your Center (Range: 1 to 28. Date of Birth is Day 1): _____	
c) If Outborn, Transfer Code of Center from which Infant Transferred: _____ (List available at http://www.vtoxford.org/transfers)	
5. Head Circumference at Birth (in cm to nearest 10th)**:**	☐☐.☐
6. Maternal Ethnicity/Race (Answer both a and b):	
a) Ethnicity of Mother:	☐ Hispanic ☐ Not Hispanic
b) Race of Mother:	☐ Black or African American ☐ White ☐ Asian ☐ American Indian or Alaska Native ☐ Native Hawaiian or Other Pacific Islander ☐ Other
7. Prenatal Care:	☐ Yes ☐ No
8. Antenatal Steroids:	☐ Yes ☐ No
9. Antenatal Magnesium Sulfate:	☐ Yes ☐ No
10. Chorioamnionitis:	☐ Yes ☐ No
11. Maternal Hypertension, Chronic or Pregnancy-Induced:	☐ Yes ☐ No
12. Mode of Delivery:	☐ Vaginal ☐ Cesarean Section
13. Sex of Infant:	☐ Male ☐ Female
14. a) Multiple Gestation:	☐ Yes ☐ No **b) If Yes, Number of Infants Delivered:** _____
15. APGAR Scores:	**a) 1 minute** _____ **b) 5 minutes** _____
16. Initial Resuscitation:	**a) Oxygen:** ☐ Yes ☐ No
	b) Face Mask Vent: ☐ Yes ☐ No
	c) Endotracheal Tube Vent: ☐ Yes ☐ No
	d) Epinephrine: ☐ Yes ☐ No
	e) Cardiac Compression: ☐ Yes ☐ No
	f) Nasal CPAP ☐ Yes ☐ No
17. a) Temperature Measured within the First Hour after Admission to Your NICU:	☐ Yes ☐ No ☐ N/A
b) *If Yes*, Temperature Within the First Hour after Admission to Your NICU (in degrees *centigrade* to nearest 10th)**:**	☐☐.☐
18. Bacterial Sepsis on or before Day 3:	☐ Yes ☐ No
19. Oxygen on Day 28:	☐ Yes ☐ No ☐ N/A (*See Manual for N/A criteria*)
20. Periventricular-Intraventricular Hemorrhage (PIH):	
a) Cranial Imaging (US/CT/MRI) on or before Day 28:	☐ Yes ☐ No
b) *If Yes*, Worst Grade of PIH (0-4): _____	
c) *If PIH Grade 1-4*, Where PIH First Occurred:	☐ Your Hospital ☐ Other Hospital ☐ N/A
21. Died Within 12 Hours of Admission to Your NICU:	☐ Yes ☐ No

DISCHARGE FORM - *For Infants Born in 2015* - PAGE 2

Vermont Oxford Network

Center Number: _____ **Network ID Number:** ☐☐☐☐☐☐ **Year of Birth:** _____

DIAGNOSES

37. Respiratory Distress Syndrome: ☐ Yes ☐ No

38. a) **Pneumothorax:** ☐ Yes ☐ No
b) ***If Yes*, Where Occurred:** ☐ Your Hospital ☐ Other Hospital ☐ Both

39. Patent Ductus Arteriosus: ☐ Yes ☐ No

40. a) **Necrotizing Enterocolitis:** ☐ Yes ☐ No
b) ***If Yes*, Where Occurred:** ☐ Your Hospital ☐ Other Hospital ☐ Both

41. a) **Focal Intestinal Perforation:** ☐ Yes ☐ No
b) ***If Yes*, Where Occurred:** ☐ Your Hospital ☐ Other Hospital ☐ Both

Sepsis and/or Meningitis, Late (after day 3 of life): (See Manual for N/A criteria)

42. a) **Bacterial Pathogen:** ☐ Yes ☐ No ☐ N/A
b) ***If Yes*, Where Occurred:** ☐ Your Hospital ☐ Other Hospital ☐ Both

43. a) **Coagulase Negative Staph:** ☐ Yes ☐ No ☐ N/A
b) ***If Yes*, Where Occurred:** ☐ Your Hospital ☐ Other Hospital ☐ Both

44. a) **Fungal Infection:** ☐ Yes ☐ No ☐ N/A
b) ***If Yes*, Where Occurred:** ☐ Your Hospital ☐ Other Hospital ☐ Both

45. Cystic Periventricular Leukomalacia: ☐ Yes ☐ No ☐ N/A (see Manual for N/A criteria)

46. ROP: a) **Retinal Exam Done:** ☐ Yes ☐ No
b) ***If Yes*, Worst Stage of ROP** (0-5)**:** _____

47. Major Birth Defect: ☐ Yes ☐ No
***If Yes*, enter codes:** _____ _____ _____ _____ _____
Include description for Codes 100, 504, 601, 605, 901, 902, 903, 904 & 907: _____
_____

DISCHARGE

48. Enteral Feeding at Discharge:
☐ None
☐ Human Milk Only
☐ Formula Only
☐ Human milk in combination with either fortifier or formula

49. Oxygen and Monitor at Discharge:
a) Oxygen at Discharge**:** ☐ Yes ☐ No
b) Monitor at Discharge**:** ☐ Yes ☐ No

50. Initial Disposition (check only one):
☐ Home
☐ Died
☐ Transferred to another Hospital (★ Complete Transfer and Readmission Form)
☐ Still Hospitalized as of First Birthday

51. Weight at Initial Disposition: _____ grams

52. Head Circumference at Initial Disposition (in cm to the nearest10th)**:** ☐☐.☐

53. Initial Length of Stay: _____ day(s) (Item L1 on Length of Stay Calculation Worksheet)

TRANSFER & READMISSION FORM - *For Infants Born in 2015*

Vermont Oxford NETWORK

Center Number: _____ **Network ID Number:** ☐☐☐☐☐ Year of Birth: _____

Part A. Complete for ALL Transferred Infants

If an infant is transferred to another hospital, complete Items 54 - 56. Post Transfer Disposition (Item 56) refers to the infant's disposition upon leaving the "transferred to" hospital.

54. Reason for Transfer: (Check Only One)
☐ Growth/Discharge Planning ☐ Medical/Diagnostic Services
☐ Surgery ☐ ECMO ☐ Chronic Care ☐ Other

55. Transfer Code of Center to which Infant Transferred: _____ (List available at http://www.vtoxford.org/transfers)

56. Post Transfer Disposition (check only one):

☐ Home	*Skip Parts B and C. Complete Part D.*
☐ Transferred Again to Another Hospital (2nd Transfer)	*Skip Part B. Complete Parts C and D when data are available.*
☐ Died	*Skip Parts B and C. Complete Part D.*
☐ Readmitted to Any Location in Your Hospital	*Complete Parts B and D (and C if applicable) when data are available.*
☐ Still Hospitalized as of First Birthday	*Skip Parts B and C. Complete Part D.*

Part B. Complete ONLY for Readmitted Infants

If a patient is readmitted to your center after transferring once to another hospital without having been home, answer Items 57 - 58. When infants are readmitted to your center, continue to update Items 18 - 20 on the 28 Day Form, and Items 22 – 49 on the Discharge Form based on all events at both hospitals until the date of Disposition after Readmission. If your hospital participates in the Expanded Database and definition criteria are met, update Items S1.B, S1.C.1, S1.C.2, S2.A.1, S2.A.2 and S2.C based on events that occur following transfer and readmission.

57. Disposition after Readmission (check only one):

☐ Home	*Skip Part C. Complete Part D.*
☐ Died	*Skip Part C. Complete Part D.*
☐ Transferred Again to Another Hospital	*Complete Parts C and D when data are available.*
☐ Still Hospitalized as of First Birthday	*Skip Part C. Complete Part D.*

58. Weight at Disposition after Readmission: _____ grams

Part C. Complete ONLY for Infants Who Transferred More Than Once

Answer Item 59 if an infant transferred from your center to another hospital and was then either (1) transferred again to another hospital, or (2) readmitted to your center and then transferred again to another hospital.

59. Ultimate Disposition (check only one):

☐ Home	*Complete Part D.*
☐ Died	*Complete Part D.*
☐ Still Hospitalized as of First Birthday	*Complete Part D.*

Part D. Complete for ALL Transferred Infants

Complete Item 60 when the infant has been discharged Home, Died or is Still Hospitalized as of First Birthday, whichever comes first.

60. Total Length of Stay: _____day(s) (Item L2 on Length of Stay Calculation Worksheet)

Center Number: _____ **Network ID Number:** ☐☐☐☐☐

VERMONT OXFORD NETWORK
DELIVERY ROOM DEATH BOOKLET FOR INFANTS BORN IN 2015

Use the Delivery Room Death Booklet for eligible inborn infants who die in the delivery room or at any other location in your hospital within 12 hours of birth and prior to admission to the NICU.

The Delivery Room Death Patient Identification Worksheet contains personal patient identifiers and must NOT be submitted to the Vermont Oxford Network. The Vermont Oxford Network does not accept protected health care information.

Contents:

DELIVERY ROOM DEATH
PATIENT IDENTIFICATION WORKSHEET

W1. Patient's Name: _____

W2. Mother's Name: _____

W3. Patient's Medical Record Number: _____

W4. Date of Birth: _____/_____/_____
MM DD YYYY

PLEASE DO NOT SUBMIT THIS WORKSHEET
Protected Health Care Information

Vermont Oxford NETWORK

DELIVERY ROOM DEATH FORM – *For Infants Born in 2015*

Vermont Oxford Network

Center Number: _____ **Network ID Number:** ☐☐☐☐☐ **Year of Birth:** _____

1. Birth Weight: _____ grams

2. Gestational Age: **a)** Weeks _____ **b)** Days (0-6) _____

3. Died in Delivery Room: ☐ Yes ☐ No (***If NO*, do not use this Form**)

4. a) Location of Birth: ☐ Inborn ☐ Outborn (***If OUTBORN*, do not use this Form**)

b and c: Not Applicable

5. Head Circumference at Birth (in cm to the nearest 10th): ☐☐.☐

6. Maternal Ethnicity/Race: (answer both a and b)

a) Ethnicity of Mother: ☐ Hispanic ☐ Not Hispanic

b) Race of Mother: ☐ Black or African American ☐ White ☐ Asian
☐ American Indian or Alaska Native ☐ Native Hawaiian or Other Pacific Islander
☐ Other

7. Prenatal Care: ☐ Yes ☐ No

8. Antenatal Steroids: ☐ Yes ☐ No

9. Antenatal Magnesium Sulfate: ☐ Yes ☐ No

10. Chorioamnionitis: ☐ Yes ☐ No

11. Maternal Hypertension, Chronic or Pregnancy-Induced: ☐ Yes ☐ No

12. Mode of Delivery: ☐ Vaginal ☐ Cesarean Section

13. Sex of Infant: ☐ Male ☐ Female

14. a) Multiple Gestation: ☐ Yes ☐ No **b) *If Yes*, Number of Infants Delivered:** _____

15. APGAR Scores: **a)** 1 minute _____ **b)** 5 minutes _____

16. Initial Resuscitation:

a) Oxygen:	☐ Yes	☐ No
b) Face Mask Vent:	☐ Yes	☐ No
c) Endotracheal Tube Vent:	☐ Yes	☐ No
d) Epinephrine:	☐ Yes	☐ No
e) Cardiac Compression:	☐ Yes	☐ No
f) Nasal CPAP:	☐ Yes	☐ No

17 – 23: Not Applicable

24. Surfactant Treatment:

a) Surfactant during Initial Resuscitation: ☐ Yes ☐ No

b) Surfactant at Any Time: ☐ Yes ☐ No (Part b must be answered "**Yes**" if Part a is "**Yes**")

***If Yes*, Age at First Dose:** **c)** hours _____ **d)** minutes (0-59) _____

25 – 46: Not Applicable

47. Major Birth Defect: ☐ Yes ☐ No ***If Yes*, enter codes** _____ _____ _____ _____ _____

Include description for Codes 100, 504, 601, 605, 901, 902, 903, 904 & 907: _____

_____

48 – 60: Not Applicable

If your center participates in the Expanded Database, answer Items S2. B.1 and S2. B.2 from the Supplemental Data Form. Items S1.A. to S1.C. and Items S2.A and S2.C are not applicable.

S2. B. 1. Meconium Aspiration: ☐ **Yes** ☐ **No**

B. 2. Tracheal Suction for Meconium Attempted in the DR: ☐ **Yes** ☐ **No** ☐ **N/A**

References

1. Shah PS, Lui K, Sjörs G, Mirea L, Reichman B, Adams M, et al. Neonatal Outcomes of Very Low Birth Weight and Very Preterm Neonates: An International Comparison. The Journal of Pediatrics. 2016;177:144-52.e6.

2. Stoll BJ, Hansen NI, Bell EF, Walsh MC, Carlo WA, Shankaran S, et al. Trends in care practices, morbidity, and mortality of extremely preterm neonates, 1993-2012. Jama. 2015;314(10):1039-51.

3. Chen F, Bajwa NM, Rimensberger PC, Posfay-Barbe KM, Pfister RE, Meyer P, et al. Thirteen-year mortality and morbidity in preterm infants in Switzerland. Archives of Disease in Childhood-Fetal and Neonatal Edition. 2016;101(5):F377-F83.

4. Raju TN, Mercer BM, Burchfield DJ, Joseph GF. Periviable birth: executive summary of a joint workshop by the Eunice Kennedy Shriver National Institute of Child Health and Human Development, Society for Maternal-Fetal Medicine, American Academy of Pediatrics, and American College of Obstetricians and Gynecologists. American journal of obstetrics and gynecology. 2014;210(5):406-17.

5. Health Service Executive (HSE) 2016. Irish Maternity Indicator System National Report 2015 [Online]. http://www.thehealthwell.info/node/1036116

6. International Agency for Research on Cancer, Heseltine E, Day NE, Breslow NE. Statistical Methods in Cancer Research-V. 2-The Design and Analysis of Cohort Studies. 1987.

7. Twomey A, Murphy BP, Drummond L, Corcoran P, O'Farrell I, Greene RA, on behalf of NICORE Republic of Ireland. Very Low Birth Weight Infants in the Republic of Ireland Annual Report 2014. Cork: National Perinatal Epidemiology Centre, 2016.

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