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Very Low Birth Weight Infants in the Republic of Ireland

NATIONAL PERINATAL EPIDEMIOLOGY CENTRE

NICORE Ireland

ANNUAL REPORT 2016

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Acknowledgements

Welcome to the third 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 weeks gestation in the Republic of Ireland for the calendar year 2016 and compares outcomes to the preceding two years.

Data on every Very Low Birth Weight (VLBW) infant born in the ROI in the years 2014 to 2016 is now available: this is over 1,800 infants and is a remarkable achievement, made all the more pertinent by the fact that we are one of very few countries reviewing outcomes of care of VLBW infants at national level.

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. Now that three years of data has been collected, the next step is to undertake an aggregated three-year analysis and publish these findings. This will be forthcoming in 2018 and it is envisaged that specific recommendations on clinical care of VLBW infants in the Irish context can be made.

We also keenly await the report of the expert group established by the HSE Clinical Care Programme in Paediatrics and Neonatology on foot of the 2014 report and whose remit is to examine issues surrounding infants born at the limits of viability.

This report is based on data submitted by all 19 neonatal centres in the ROI. It would not come to fruition without the many neonatal nurses, paediatricians and administration staff who have supported the data collection process. On behalf of NICORE and the NPEC, we extend our sincere thanks and appreciation and, in particular, we gratefully acknowledge the commitment of those who co-ordinate the collection of data at centre level.

We thank the team at Vermont Oxford Network, which is the international network of healthcare professionals dedicated to improving the medical care of newborn infants and is the entity which underpins this report: the VON continues to whole-heartedly support this initiative by working closely with the NPEC on data collection and statistical analysis. We also gratefully acknowledge the National Office of Clinical Audit (NOCA) for their continuing support to NPEC in ensuring that recommendations arising from national clinical audit are reviewed and actioned: this report, similar to previous reports, is endorsed by NOCA (Appendix A).

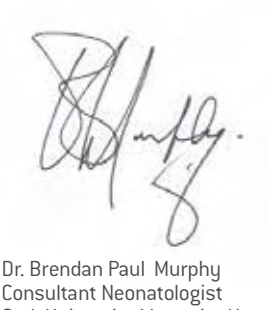
We thank the NICORE ROI group for their support of this project from the onset, for their continuing intellectual input and for their vision of using national clinical audit data to improve neonatal services in the Republic

of Ireland: the membership of NICORE ROI is listed in Appendix B. Lastly, 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 on behalf of all 19 centres and for providing the logistical support required to oversee this project.

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 families. By continuing to assess the outcomes of care, learning from the data and working together, we have great potential to improve the outcomes of VLBW infants in Ireland.



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Executive summary

1. A total of 593 very low birth weight (VLBW) infants were born in the Republic of Ireland (ROI) in 2016, of which 25 infants were ≥1500g but ≤29 weeks gestation.

2. In all, 250 infants were born with a birth weight ≤1000g and 182 infants were born with a gestational age ≤26 weeks 6 days.

3. The survival rate for ROI VLBW infants in 2016 was 84% (n=496), 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 2016 [Standardised Mortality Ratio (SMR)=1.10; 95% CI: 0.87, 1.34]. This was also the case in 2015, but not so in 2014.

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 2016 (SMR=1.12; 95% CI: 0.84, 1.41). This was also the case in 2015 and 2014.

6. A significantly higher proportion of ROI infants died in the delivery room (6%, n=35) compared to VON infants (3%, n=2,060) ($p<0.001$) in 2016. This is similar to findings in the two preceding years. Eight (23%) of these 35 ROI infants had a major congenital anomaly and 27 (77%) were born at less than 24 weeks gestation: three infants had both a major congenital anomaly and were born at less than 24 weeks gestation.

7. Adjusting for the risk profile of the VLBW population, there was no significant difference in the risk of death or morbidity for ROI infants compared to VON infants in 2016 (SMR=1.02, 95% CI: 0.89, 1.15). This is in contrast to the two preceding years when ROI infants had significantly higher rates of death or morbidity.

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 2016 compared to VON infants showed that:
   - ROI infants had significantly higher rates of necrotizing enterocolitis (NEC) (SMR=1.39, 95% CI: 1.01, 1.78). This was consistent with findings in 2015, but not in 2014.
   - ROI infants had significantly lower rates of retinopathy of prematurity (SMR=0.62, 95% CI: 0.45, 0.80). This was also reported in 2015 and 2014.
   - There were no significant differences in risk of the following outcomes for ROI infants compared to VON infants:
     - Pneumothorax (SMR=1.40, 95% CI: 0.98, 1.82): this contrasted with 2015 and 2014 findings;
     - Coagulase negative staphylococcus infection (SMR=1.13, 95% CI: 0.74, 1.52): this contrasted with 2015 and 2014 findings;
     - Nosocomial infection (SMR=1.17, 95% CI: 0.91, 1.43): this contrasted with 2015 and 2014 findings;
     - Any late infection (SMR=1.13, 95% CI: 0.88, 1.39): this contrasted with 2015 findings;
     - Intra-ventricular haemorrhage (SMR=1.06, 95% CI: 0.87, 1.24): this contrasted with 2015 findings but was similar to 2014 findings.

9. After taking account of the risk profile of the VLBW babies, the frequency of each of the key performance indicators in 2016 was similar to their frequency in 2015.

10. Of 577 infants with available birth location data, 83% (n=350) of those born in tertiary neonatal centres; 86% (n=99) of those born in regional neonatal centres; and 83% (n=34) of those born in peripheral neonatal centres survived to discharge.

11. Of 577 infants with available birth location data, 5% (n=31) were transferred from their birth hospital/neonatal centre within 48 hours of birth to another neonatal centre or tertiary paediatric centre: these included one (0.2%) infant born in a tertiary centre; 6% (n=7) of those born in regional centres; and over half (56%, n=23) of those born in peripheral centres.

12. Of 47 infants with available birth location data who were born less than 24 weeks gestation in the ROI in 2016, 37 (79%) died and 10 (21%) survived to discharge: the survivors comprised 21% (n=7) of those born less than 24 weeks gestation in tertiary centres; 20% (n=2) of those born in regional centres; and one (33%) infant born in a peripheral centre.

13. Three years of data on VLBW infants born in Ireland have now been collected, for the years 2014 through to 2016. In order to draw meaningful conclusions, a national report on the aggregated data of over 1,800 VLBW infants born in Ireland in the years 2014 to 2016 is forthcoming. It is hoped that specific recommendations addressing clinical care and patient safety in the Irish context can thus 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.

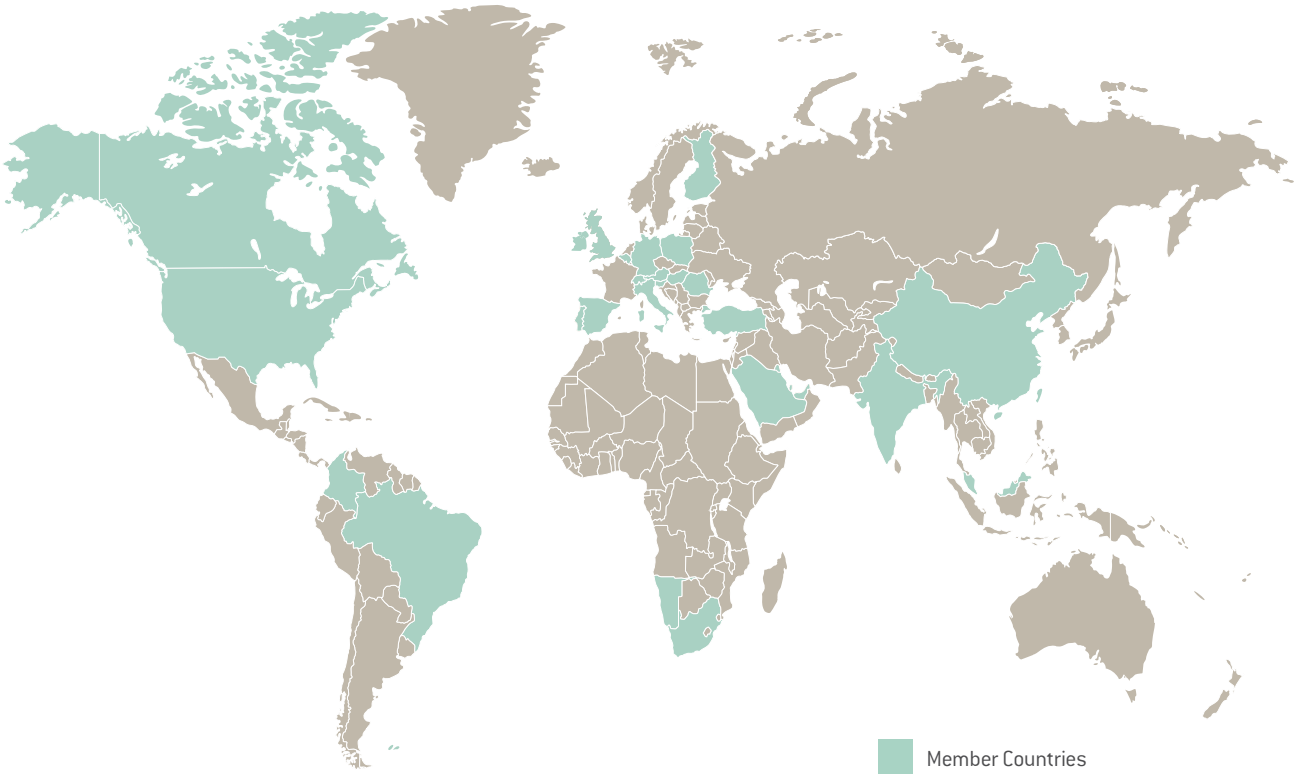


Figure 1: Member countries of the Vermont Oxford Network

In the ROI, nine tertiary and regional neonatal centres had joined VON by 2003, followed by the remaining 10 centres in 2013. This was on foot of a joint initiative between the NICORE 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 third year, 2016, of a complete ROI dataset.

Governance

For the ROI, data submitted to VON are controlled by NICORE (Neonatal Intensive Care Outcomes Research and Evaluation) 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.

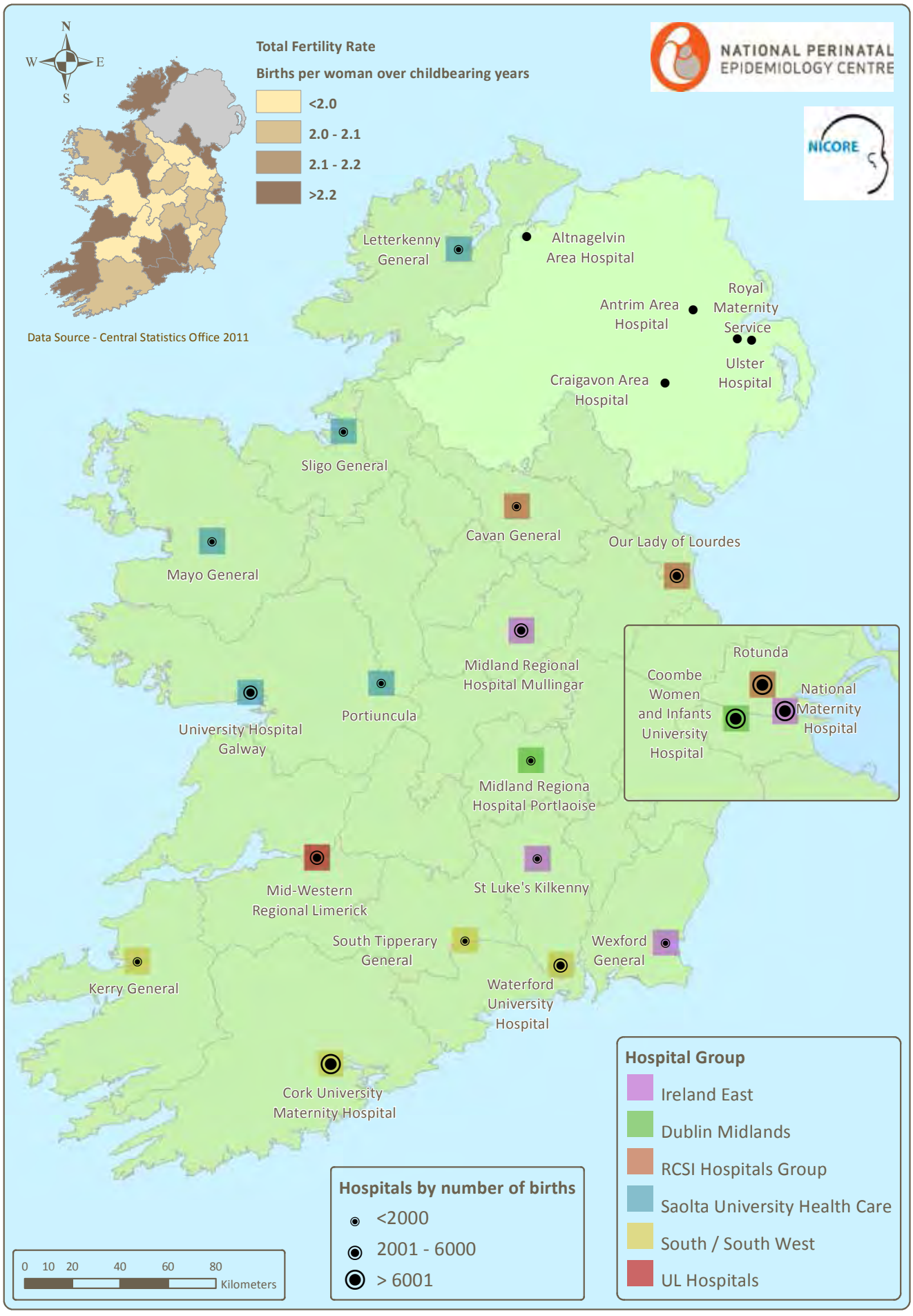


Figure 2: Neonatal centres in the Republic of Ireland and Northern Ireland participating in the Vermont Oxford Network. ROI centres are classified according to number of births weighing 500g or more in the associated obstetric centres in 2016

Methods

Data recording

In 2016, 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 2016 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 2016, VON forwarded a copy of the complete ROI dataset to the NPEC. The ROI data presented in this report are based on the ROI dataset. Throughout the report, ROI data are compared to VON data, comprising data from all centres across the Network. The Network data, referred to as VON data, are obtained from Nightingale, VON's on-line data reporting system.

Case ascertainment

The VON database allows the capture of a data record from the birth centre of all VLBW infants. It also allows the capture of a record from the first centre to which an infant was transferred, where applicable. In cases of infants who were treated in more than two centres, the VON database does not capture a record from the second transfer centre, and thus these infants have two records only, one from the birth centre and the other from the first transfer centre. On receipt of the ROI 2016 dataset from VON, the NPEC undertook a matching exercise in order to link data records associated with individual infants who were transferred to ensure that each infant was counted only once.

Secondly, in order to ensure the accuracy and completeness of the dataset, deaths which

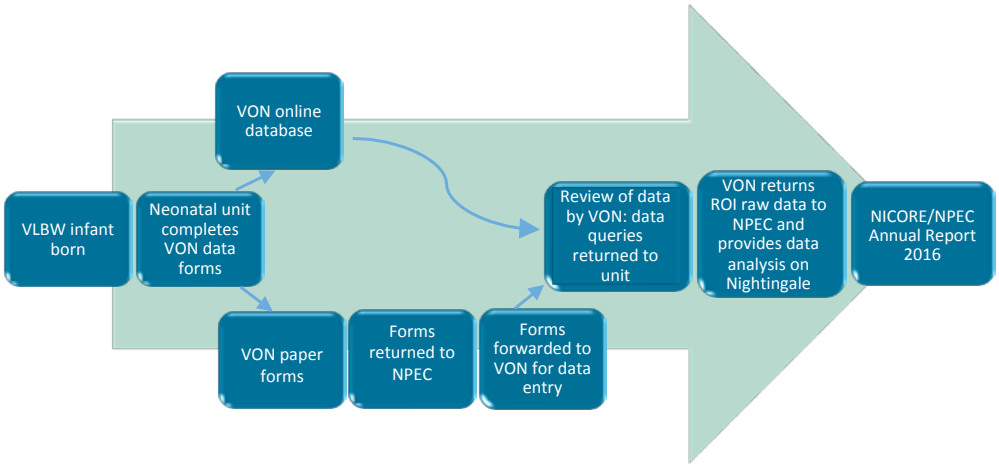


Figure 3: Flow of information in the VON data collection process

occurred in the delivery room were verified with early neonatal deaths reported to the NPEC's National Clinical Audit of Perinatal Mortality. In possible cases of early neonatal deaths which met the VON criteria and which were not captured in the VON dataset, the relevant neonatal centre was requested to check and submit a record if appropriate. The ROI dataset was subsequently updated.

Statistical analysis

Differences in proportions were assessed by the two-sample test of proportions. Pearson's chi-squared test (χ^2) was used to evaluate the association between outcomes and gestational age categories. Poisson regression was used to assess trend.

Reference to Very Low Birth Weight Infants in the Republic of Ireland Annual Report 2014 and 2015

Since publication of the 2014 and 2015 reports, the matching exercise described above was undertaken on the 2014 ROI dataset. This had the effect of reducing the number of VLBW infants born in the ROI in 2014 from 608, as described in the 2014 and 2015 reports, to 597. The current report utilises the most accurate values for 2014 ROI data and hence differs slightly from the values stated in the 2014 and 2015 reports. Values for 2015 data have not changed since publication of the 2015 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. It is correct to present rates which are based on rare outcomes and small numbers as this is what the data shows, but conclusions cannot be drawn from rates and outcomes based on small numbers.

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.

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 weeks 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.

Main findings

1. Overview

A total of 593 VLBW infants were reported to VON in 2016, 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 622 VLBW infants were reported in 2015 and 597 in 2014.

Table 1.1 outlines the gestational age of infants reported in 2016: 48 infants were born <24 weeks gestation, 134 were between 24 and 26 weeks gestation, 217 between 27 and 29 weeks gestation, 152 between 30 and 32 weeks gestation, and 42 infants were >32 weeks gestation. In total, 9% (54 out of 593) of VLBW infants born in 2016 had a major congenital anomaly (MCA) compared to a total of 7% (42 out of 622) in 2015 and 9% (55 out of 596) in 2014.

In terms of birth weight, 21 infants weighed ≤500g, of whom none were ≤401g (Table 1.2). A total of 104 infants had a birth weight in the 501-750g category, 125 in the 751-1000g category and 152 in the 1001-1250g category. Overall, 191 infants weighed more than 1250g, 25 of whom were ≥1500g but were ≤296/7 weeks gestation. Similar data for 2014 and 2015 is included in Table 1.2.

In all, 64,367 VLBW infants were reported to the Network in 2016.

Table 1.1: Number of cases reported to VON 2014 - 2016, according to gestational age

Gestational age	All cases			No. of cases excluding MCA		
	2014	2015	2016	2014	2015	2016
<24 weeks	41	48	48	40	48	45
24-26 weeks	114	114	134	105	103	122
27-29 weeks	235	235	217	216	221	197
30-32 weeks	159	170	152	139	160	137
>32 weeks	48	55	42	41	48	38
Total	**597**	**622**	**593**	**541**	**580**	**539**

Note: MCA=Major Congenital Anomaly. MCA was unknown for 1 infant in 2014.

Table 1.2: Number of cases reported to VON in 2014 - 2016, according to birth weight

Birth weight (g)	All cases			No. of cases excluding MCA		
	2014	2015	2016	2014	2015	2016
<501	26	23	21	25	23	20
501 – 750	85	100	104	81	95	90
751 – 1000	115	98	125	100	84	114
1001 – 1250	154	155	152	139	145	138
>1250	216	246	191	195	233	177
Total	**596**	**622**	**593**	**540**	**580**	**539**

Note: MCA=Major Congenital Anomaly; one infant in 2014 did not have a recorded birth weight and another infant in 2014 did not have a value for MCA.

2. Infant Characteristics

In 2016, ROI and VON populations were similar with respect to the proportion which received prenatal care; was administered antenatal magnesium sulphate; was exposed to maternal hypertension; delivered by Caesarean section; and was small for gestational age (Table 2.1).

Characteristics in which there were statistically significant differences between the two populations included the higher proportion of ROI infants which was exposed to chorioamnionitis (p=0.003); the higher proportion of ROI infants administered antenatal steroids (p<0.001); the higher proportion of multiple gestations amongst ROI cases (p<0.001); and the higher proportion of MCA amongst ROI cases (p<0.001).

In comparing characteristics across the three years, 2014 to 2016, the higher proportion of ROI infants receiving antenatal steroids and the higher number of multiple gestations amongst ROI infants was consistently highly significantly different between the populations each year (Table 2.2).

The proportion receiving prenatal care was higher amongst ROI infants than VON infants in 2014 and 2015, but there was a reduction in the number of ROI infants receiving prenatal care in 2016 so that there was not a significant difference from the VON (p<0.001 in 2014; p=0.005 in 2015; p=0.737 in 2016).

The proportion of VON infants born with MCA was stable at 5% across the three years: there was some variation amongst ROI infants, with 9% born with MCA in 2014 and 2016, and 7% in 2015. The difference in rates between both populations was highly statistically significant in 2014 and 2016 (p<0.001) and just reached statistical significance in 2015 (p=0.045; Table 2.2).

Table 2.1: Infant characteristics in the Republic of Ireland and VON, 2016. 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	311	593	52	64,332	51	0.481
Prenatal Care	568	590	96	64,049	96	0.737
Chorioamnionitis	99	579	17	63,378	13	0.003
Maternal Hypertension	171	589	29	63,925	31	0.302
Antenatal Steroids	521	586	89	63,981	83	<0.001
C-Section	406	593	69	64,325	71	0.174
Antenatal Magnesium Sulphate	352	584	60	62,519	57	0.110
Multiple Gestation	198	593	33	64,352	27	<0.001
Major Congenital Anomaly (MCA)	54	593	9	64,307	5	<0.001
Small for Gestational Age (SGA)	136	586	23	64,233	25	0.317

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

Table 2.2: Infant characteristics in the Republic of Ireland, 2014 - 2016. The P-value refers to the significance of the value of the difference between the ROI and VON populations.

Characteristic	2014 ROI %	2014 VON %	2014 P -value	2015 ROI %	2015 VON %	2015 P-value	2016 ROI %	2016 VON %	2016 P -value
Male	55	51	0.036	54	51	0.132	52	51	0.481
Prenatal Care	99	95	<0.001	98	96	0.005	96	96	0.737
Chorioamnionitis	17	13	0.013	14	13	0.354	17	13	0.003
Maternal Hypertension	26	30	0.020	26	31	0.012	29	32	0.302
Antenatal Steroids	86	80	<0.001	88	81	<0.001	89	83	<0.001
C-Section	70	71	0.501	70	72	0.185	69	72	0.174
Antenatal Mag. Sulphate	52	52	0.824	59	55	0.076	60	57	0.110
Multiple Gestation	33	28	0.004	36	27	<0.001	33	27	<0.001
Major Congenital Anomaly	9	5	<0.001	7	5	0.045	9	5	<0.001
Small for Gestational Age	26	24	0.390	24	24	0.946	23	25	0.317

3. Survival

In 2016, a total of 84% (n=496) of VLBW infants born in the ROI survived to discharge home or first birthday, one percentage below the VON rate (85%, n=54,410; Table 3.1). These figures reflect the 2015 survival rates, and in terms of the ROI, constitute an increase from the 2014 survival rate of 82% (n=487; Table 3.2). In 2016, as in 2015, the ROI survival rate was not statistically different from the VON rate (2016, p=0.36; 2015, p=0.68; Table 3.2).

The percentages of those who survived without specified morbidities i.e. the key morbidities of severe IVH, chronic lung disease in infants <33 weeks gestation, NEC, pneumothorax, any late infection or cystic PVL in 2016 was 56% (n=333) in the ROI and 57% (n=36,308) in VON, a difference which was not statistically significant (p=0.74; Table 3.1). The 2016 ROI survival without specified morbidities rate increased by 2% per annum since 2014 (Table 3.2), but this trend was not statistically significant (Annual rate ratio=1.04, 95% CI: 0.96-1.12; p=0.36).

Table 3.1: Survival of ROI and VON infants, including those with congenital anomalies, 2016. 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*	496	593	84	54,410	63,712	85	0.36
Survival without specified morbidities**	333	593	56	36,308	63,698	57	0.74

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 - 2016. The P-value refers to the significance of the value of the difference between the ROI and VON populations.

	2014			2015			2016		
Measure	**ROI %**	**VON %**	**P -value**	**ROI %**	**VON %**	**P -value**	**ROI %**	**VON %**	**P -value**
Survival*	82	86	0.01	84	85	0.68	84	85	0.36
Survival without specified morbidities**	52	57	0.02	54	57	0.16	56	57	0.74

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.

Survival to discharge of VLBW infants by gestational age and birth weight is reported in Tables 3.3 and 3.4 respectively for the years 2014 through to 2016.

Survival to discharge rose with increasing gestational age in 2016 until 30 weeks gestation, above which there was slight variation away from this pattern: this is consistent across the three years (Table 3.3). No infants born at less than 23 weeks gestation survived to discharge in any year. At 23 weeks gestation, 10 (n=27; 37%) infants survived to discharge in 2016, whilst nine (n=30; 30%) and four (n=21, 19%) survived in 2015 and 2014 respectively.

In terms of birth weight, there was a general trend of greater survival to discharge with increasing birth weight in 2016 and in the two preceding years (Table 3.4). In 2016, six (n=21; 29%) infants born less than 501g survived, whilst the analogous figures for 2015 were four (n=23, 17%) and two (n=26, 8%).

Table 3.3: Gestational age breakdown and survival to discharge of ROI infants reported to VON, including those with congenital anomalies, 2014 (N=597); 2015 (N=622); and 2016 (N=593).

Gestational Age	2014 Number of Survivors/ No. of liveborn infants (%)	2015 Number of Survivors/ No. of liveborn infants (%)	2016 Number of Survivors/ No. of liveborn infants (%)
<22 weeks	0/2 (0%)	0/2 (0%)	0/2 (0%)
22 weeks	0/18 (0%)	0/16 (0%)	0/19 (0%)
23 weeks	4/21 (19%)	9/30 (30%)	10/27 (37%)
24 weeks	18/36 (50%)	22/34 (65%)	25/45 (56%)
25 weeks	25/35 (71%)	33/43 (77%)	39/50 (78%)
26 weeks	28/43 (65%)	30/37 (81%)	34/39 (87%)
27 weeks	54/57 (95%)	40/46 (87%)	47/49 (96%)
28 weeks	75/83 (90%)	82/90 (91%)	77/83 (93%)
29 weeks	89/95 (94%)	94/99 (95%)	80/85 (94%)
30 weeks	68/71 (96%)	65/65 (100%)	62/66 (94%)
31 weeks	44/49 (90%)	64/68 (94%)	49/50 (98%)
32 weeks	36/39 (92%)	35/37 (95%)	34/36 (94%)
>32 weeks	46/48 (96%)	51/55 (93%)	39/42 (93%)
Total	**487/597 (82%)**	**525/622 (84%)**	**496/593 (84%)**

Note: One infant in 2014 did not have a recorded birth weight and therefore the denominator was 596.

Table 3.4: Birth weight and survival to discharge of ROI infants reported to VON, including those with congenital anomalies, 2014 (N=596); 2015 (N=622); and 2016 (N=593).

Gestational Age	2014 Number of Survivors/ No. of liveborn infants (%)	2015 Number of Survivors/ No. of liveborn infants (%)	2016 Number of Survivors/ No. of liveborn infants (%)
<501g	2/26 (8%)	4/23 (17%)	6/21 (29%)
501-600g	9/32 (28%)	19/37 (51%)	12/33 (36%)
601-700g	24/36 (67%)	29/45 (64%)	32/51 (63%)
701-800g	27/37 (73%)	26/37 (70%)	35/49 (71%)
801-900g	29/37 (78%)	33/40 (83%)	40/47 (85%)
901-1000g	51/58 (88%)	34/39 (87%)	45/49 (92%)
1001-1100g	47/54 (87%)	54/59 (92%)	51/54 (94%)
1101-1200g	60/64 (94%)	58/64 (91%)	62/67 (93%)
1201-1300g	77/81 (95%)	63/67 (94%)	61/63 (97%)
1301-1400g	67/72 (93%)	84/87 (97%)	62/64 (97%)
>1400g	94/99 (95%)	121/124 (98%)	90/95 (95%)
Total	**487/596 (82%)**	**525/622 (84%)**	**496/593 (84%)**

Note: One infant in 2014 did not have a recorded birth weight and therefore the denominator was 596.

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 2016, one of these four centres delivered between 4,000-5,000 births per annum; two centres delivered between 3,000-4,000 births per annum (one centre was just over the 3,000 mark having had 3,001 births); and the third 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 2016, 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 2016

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	3,000-4,000
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: Annual Clinical Reports of hospitals and hospital groups; and personal communication with individual.

Of 593 VLBW infants reported to VON in 2016, 577 infants had birth location data suitable for analysis of survival outcome based on the designated category of neonatal centre in which they were cared for at birth. Birth location data on the remaining 16 infants was either unavailable (14) or the infants were born before arrival (two).

Of the 577 infants with available birth location data, 421 (73%) were born in one of four tertiary neonatal centres; 115 (20%) were born in one of four regional neonatal centres and the remaining 41 infants (7%) were born in one of eleven peripheral centres (Table 4.2). This compares to proportions of 66% (n=400), 23% (n=138) and 11% (n=70) born in tertiary, regional and peripheral centres in 2015.[1] The gestational age breakdown of the infants born in each of the three locations is shown in Table 4.2.

Table 4.2: Number of infants born in each category of neonatal centre, and number transferred within 48 hours, according to gestational age, 2016, n=577

Gestational Age	Tertiary No. born (No. transferred within 48 hours)	Regional No. born (No. transferred within 48 hours)	Peripheral No. born (No. transferred within 48 hours)
<24 weeks	34 (0)	10 (1)	3 (2)
24-26 weeks	111 (0)	14 (5)	6 (6)
27-29 weeks	153 (1)	46 (1)	13 (13)
>30 weeks	123 (0)	45 (0)	19 (8)
Total	**421**	**115**	**41**

Of the 577 infants, 418 (72%) received intensive care/resuscitation in the delivery room (defined as the administration of face mask ventilation and/or endotracheal tube ventilation) (Table 4.3). Intensive care was provided to 78% of the infants born in tertiary centres, 53% of the infants born in regional centres and 66% of the infants born in peripheral centres.

Of the 418 infants who received resuscitation, 358 (86%) survived to discharge. The remaining 60 (14%) infants died, three of whom died in the delivery room (Figure 4.1). A total of 159 (28%) of the 577 infants did not receive intensive care/resuscitation in the delivery room, of whom 32 infants died in the delivery room and 127 survived to admission to a NICU/SCBU (Table 4.4 and Figure 4.1). These 127 infants were born in good enough condition so as not to require active resuscitation at birth: 81 of these infants were born at greater than 30 weeks gestation, 41 infants were in the 27-29 weeks gestational age range, and five infants were in the 24-26 weeks gestational age range.

Table 4.3: Survival of ROI Infants by category of neonatal centre, 2016, n=577

Survival	Tertiary Centres	Regional Centres	Peripheral Centres	Total
Number of liveborn infants	421	115	41	577
No. (%) who received resuscitation in the delivery room	330 (78%)	61 (53%)	27 (66%)	418 (72%)
No. (%) admitted to a NICU/SCBU	397 (94%)	106 (92%)	39 (95%)	542 (94%)
No. (%) transferred to another neonatal centre within 48 hours of birth	1 (0.2%)	7 (6%)	23 (56%)	31 (5%)
No. survived to discharge	350	99	34	483
% survival to discharge of liveborn infants	83%	86%	83%	84%

Table 4.4: Survival outcomes of infants not requiring intensive care/resuscitation in the delivery room by category of neonatal centre, 2016

Category Neonatal Centre	Resuscitation not required	Died in DR – Resuscitation not offered	Total
Tertiary	70	21	91
Regional	45	9	54
Peripheral	12	2	14
Total	**127**	**32**	**159**

Of the 577 infants with available birth location data, 542 (94%) were admitted to a NICU/SCBU, comprising 397 (94%) of the infants born at tertiary centres, 106 (94%) of those born at regional centres and 39 (95%) 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 31 (5%) of 577 infants were transferred and the majority of these (74%, n=23) were born in peripheral centres. One infant from a tertiary centre was transferred out within 48 hours of birth, to a paediatric hospital. Seven infants from regional centres were transferred out to tertiary neonatal centres.

The overall survival rate of 577 infants with available birth location data was 84% (n=483): tertiary and peripheral centres had the same survival rate of 83% whilst regional centres had a slightly higher rate of 86% (Table 4.3 and Figure 4.1). In 2015, regional centres had a survival rate of 91%, followed by tertiary centres with a rate of 86% and peripheral centres with a rate of 64%.[1]

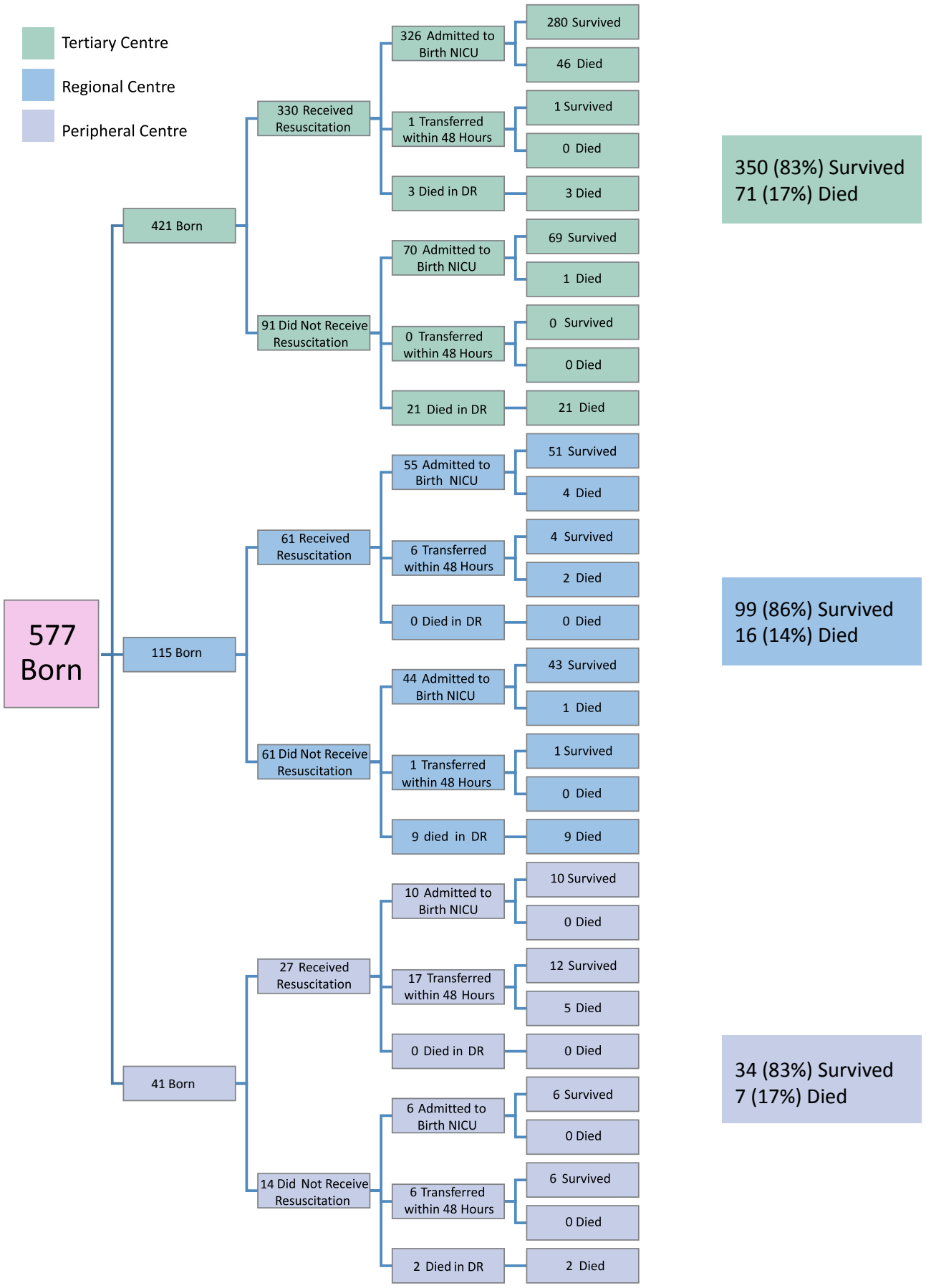


Figure 4.1: Flow chart illustrating survival outcomes of VLBW infants according to category of neonatal centre, 2016, n=577

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

Of 577 infants with available birth location data, 47 were infants born <24 weeks gestation. A total of 34 (72%) were born in one of the tertiary neonatal centres; 10 (21%) in one of the regional centres and the remaining three (6%) in one of the eleven peripheral centres (Table 4.5).

Twenty infants (43%) received intensive care/resuscitation in the delivery room (Table 4.5), including 16 (47%) of the infants born in tertiary centres, three (30%) of the infants born in regional centres and one (33%) infant born in a peripheral centre. Of the 20 infants who received intensive care/resuscitation in the delivery room, all survived to admission to a NICU/SCBU.

Of the 27 infants who did not receive intensive care/resuscitation in the delivery room, two were 21 weeks gestation, 18 were 22 weeks gestation and seven were 23 weeks (five of the whom were born between $23^{0/7}$-$23^{3/7}$ weeks and two between $23^{4/7}$-$23^{6/7}$ weeks). All of these infants died in the delivery room. Three had an MCA.

Of the 20 infants who survived to admission to a NICU/SCBU, two infants were transferred from their hospital of birth soon after birth. One was born in a peripheral centre and the other a regional centre and both were transferred to one of the four tertiary centres. Both were transferred on Day 2 (i.e. on the day after the date of birth irrespective of the time of birth) and both survived to discharge (Table 4.5 and Figure 4.2).

In total, ten infants born <24 weeks gestation in the ROI in 2016 survived to discharge, comprised of seven from tertiary centres, two from regional centres and one from a peripheral centre. The overall survival rate for was 21% (n=10/47) which compares to 19% (9/48) in 2015 and 10% (n=4/41) in 2014. The overall survival rate for infants of this gestational age increases to 50% if only infants who were actively resuscitated in the delivery room are included in the analysis (n=20) and also to 50% if only the infants who survived to admission to a NICU/SCBU are included in the analysis (n=20) (Table 4.5).

Table 4.5: 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	34	10	3	47
No. (%) who required resuscitation in the delivery room	16 (47%)	3 (30%)	1 (33%)	20 (43%)
No. (%) admitted to a NICU/SCBU	16 (47%)	3 (30%)	1 (33%)	20 (43%)
No. (%) transferred to another neonatal centre within 48 hours of birth	0 (0%)	1 (10%)	1 (33%)	2 (4%)
No. survived to discharge	7	2	1	10
% survival to discharge of liveborn infants	21%	20%	33%	21%
Survival to discharge of all liveborn infants offered resuscitation	44%(7/16)	67%(2/3)	100%(1/1)	50%(10/20)
% survival to discharge of all liveborn infants admitted to NICU/SCBU	44%(7/16)	67%(2/3)	100%(1/1)	50%(10/20)

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

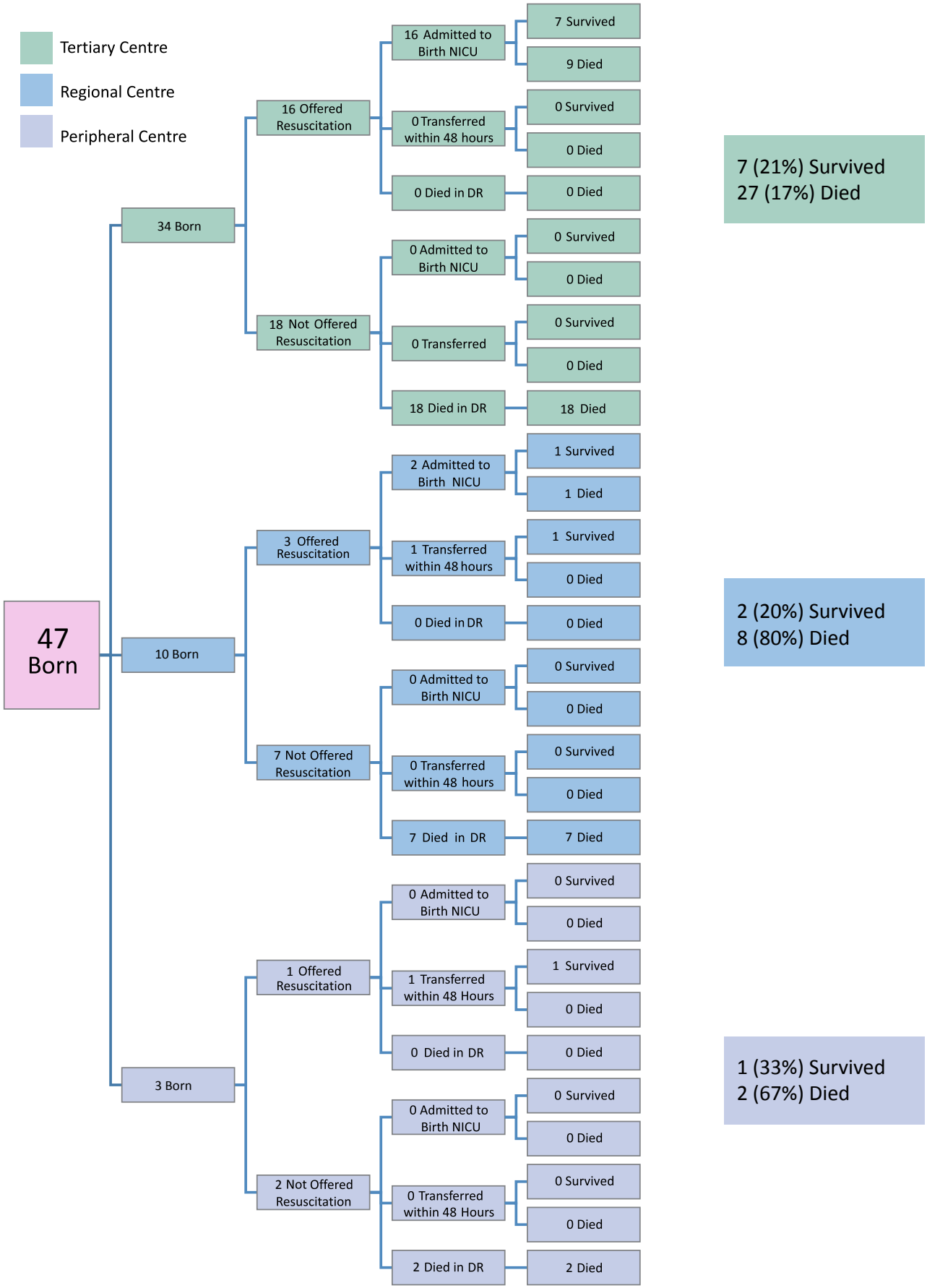


Figure 4.2: Flow chart illustrating survival outcomes of VLBW infants born <24 weeks gestation according to designated category of neonatal centre, 2016, n=47

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

Overall, there were 131 infants born at 24-26 weeks gestation for whom birth location data were available. Of these, 111 (85%) were born in one of the tertiary neonatal centres, 14 (11%) in one of the regional centres and 6 (5%) in one of the peripheral centres (Table 4.6).

Of the 131 infants born, 125 (95%) received intensive care/resuscitation in the delivery room, including 109 (98%) infants born in tertiary centres, 11 (79%) infants born in regional centres and five (83%) of the infants born in peripheral centres. Of the 125 infants offered intensive care/resuscitation, three infants died in the delivery room despite resuscitation, all three of which occurred in tertiary centres. The gestational age of one of these infants was $24^{0/7}$ weeks; one was $25^{0/7}$ weeks and the third was $25^{1/7}$ weeks: none had an MCA.

Six infants did not receive intensive care/resuscitation in the delivery room. One died in the delivery room and had an MCA. The other five infants all survived to discharge: their gestational ages were $24^{3/7}$, $25^{1/7}$, $26^{0/7}$, $26^{4/7}$ and $26^{6/7}$ weeks. Three were born in regional centres, one in a tertiary centre and one, the infant born at $24^{3/7}$, in a peripheral centre.

In all, four (2%) infants born at 24-26 weeks gestation died in the delivery room.

A total of 127 (97%) infants born at 24-26 weeks gestation survived to admission to a NICU/SCBU. Eleven of these (8% of those liveborn at 24-26 weeks gestation) were transferred from their hospital of birth soon after birth (Table 4.6). Five of these infants were born in regional centres, and a further six in peripheral centres (Figure 4.3). All were transferred to tertiary neonatal centres within 48 hours of birth. Five of these eleven infants who were transferred died prior to discharge.

In all, 97 (74%) infants born at 24-26 weeks gestation survived to discharge: 76% (n=84) of those born in tertiary centres, 71% (n=10) of those born in regional centres and half (n=3) of those born in peripheral centres (Table 4.6).

Table 4.6: Survival of ROI Infants born at 24–26 weeks gestation by category of neonatal centre, 2016, n=131

Survival	Tertiary Centres	Regional Centres	Peripheral Centres	Total
Number of liveborn infants	111	14	6	131
No. (%) who received resuscitation in the delivery room	109 (98%)	11 (79%)	5 (83%)	125 (95%)
No. (%) admitted to a NICU/SCBU	107 (96%)	14 (100%)	6 (100%)	127 (97%)
No. (%) transferred to another neonatal centre within 48 hours of birth	0 (0%)	5 (36%)	6 (100%)	11 (8%)
No. survived to discharge	84	10	3	97
% survival to discharge of liveborn infants	76%	71%	50%	74%

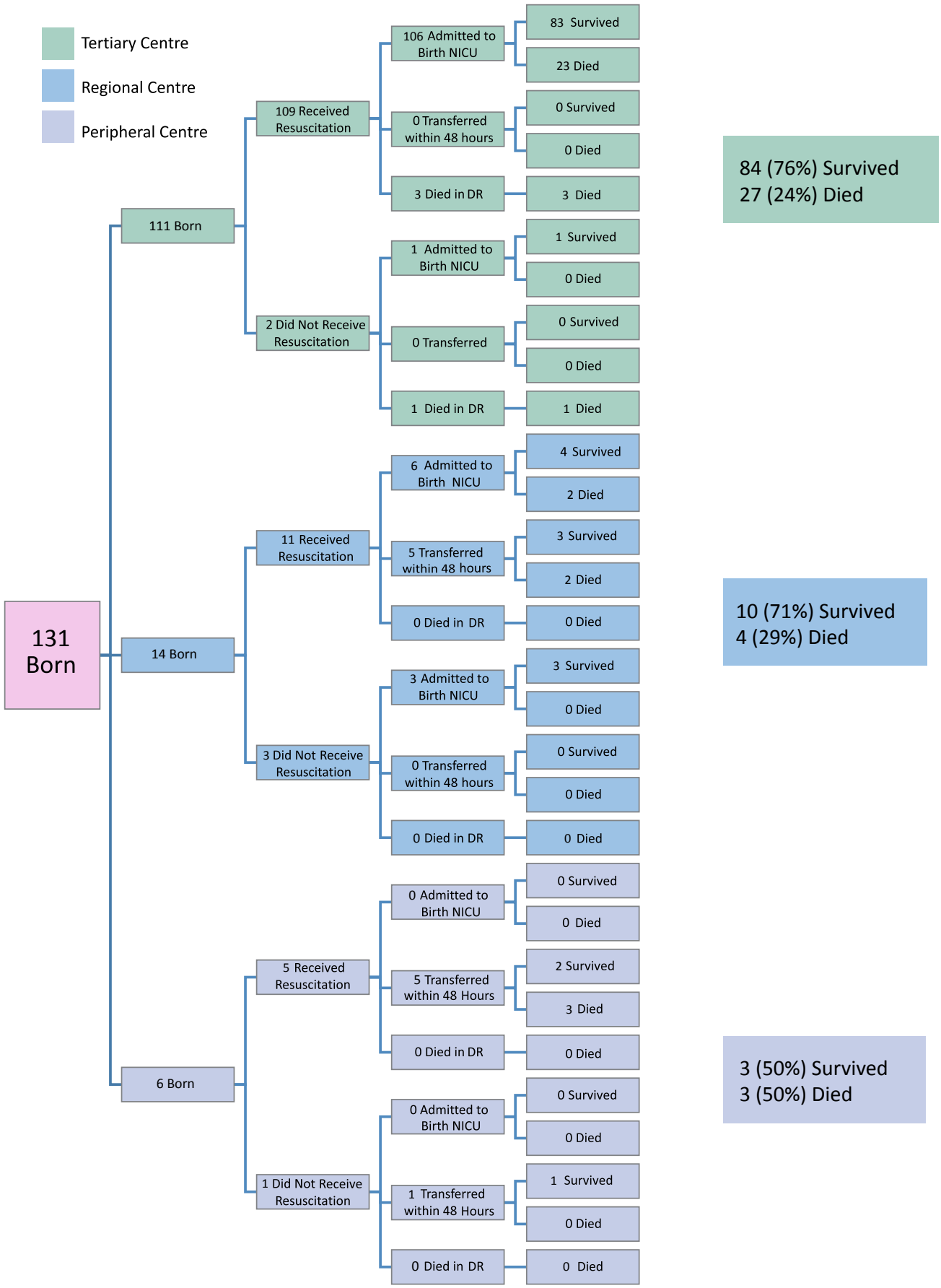


Figure 4.3: Flow chart illustrating survival outcomes of VLBW infants born at 24–26 weeks gestation according to category of neonatal centre, 2016, n=131

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

Overall, there were 212 infants born at 27-29 weeks gestation for whom birth location data were available. Of these, 153 (72%) were born in one of the tertiary neonatal centres, 46 (22%) in one of the regional centres and 13 (6%) in one of the peripheral centres (Table 4.7).

Of the 212 infants, 168 (79%) received intensive care/resuscitation in the delivery room, including 127 (83%) infants born in tertiary centres, 29 (63%) infants born in regional centres and 12 (92%) infants born in peripheral centres. All of these infants survived to admission to a NICU/SCBU (Figure 4.4).

A total of 44 infants did not receive resuscitation in the delivery room. Of these 44 infants, 41 were born in good condition, were subsequently admitted to a NICU/SCBU and survived to discharge. Three of these infants died in the delivery room, one of whom had a diagnosis of gastroschisis: two were born in tertiary centres and one in a regional centre (Figure 4.4).

A total of 209 (99%) infants born at 27-29 weeks gestation were admitted to a NICU/SCBU including 10 (5% of 212 born) infants who were subsequently transferred within 48 hours, eight from peripheral centres, one each from a regional centre and a tertiary centre. Of the 10 infants who transferred, nine survived and one died (Figure 4.4).

In all, 199 (94%) infants born at 27-29 weeks gestation survived to discharge: 144 (94%) of those born in tertiary centres, 43 (94%) of those born in regional centres and 12 (92%) of those born in peripheral centres (Table 4.7).

Table 4.7: Survival of ROI Infants born at 27-29 weeks gestation by category of neonatal centre, 2016, n=212

Survival	Tertiary Centres	Regional Centres	Peripheral Centres	Total
Number of liveborn infants	153	46	13	212
No. (%) who received resuscitation in the delivery room	127 (83%)	29 (63%)	12 (92%)	168 (79%)
No. (%) admitted to a NICU/SCBU	151 (99%)	45 (98%)	13 (100%)	209 (99%)
No. (%) transferred to another neonatal centre within 48 hours of birth	1 (1%)	1 (2%)	8 (62%)	10 (5%)
No. survived to discharge	144	43	12	199
% survival to discharge of liveborn infants	94%	94%	92%	94%

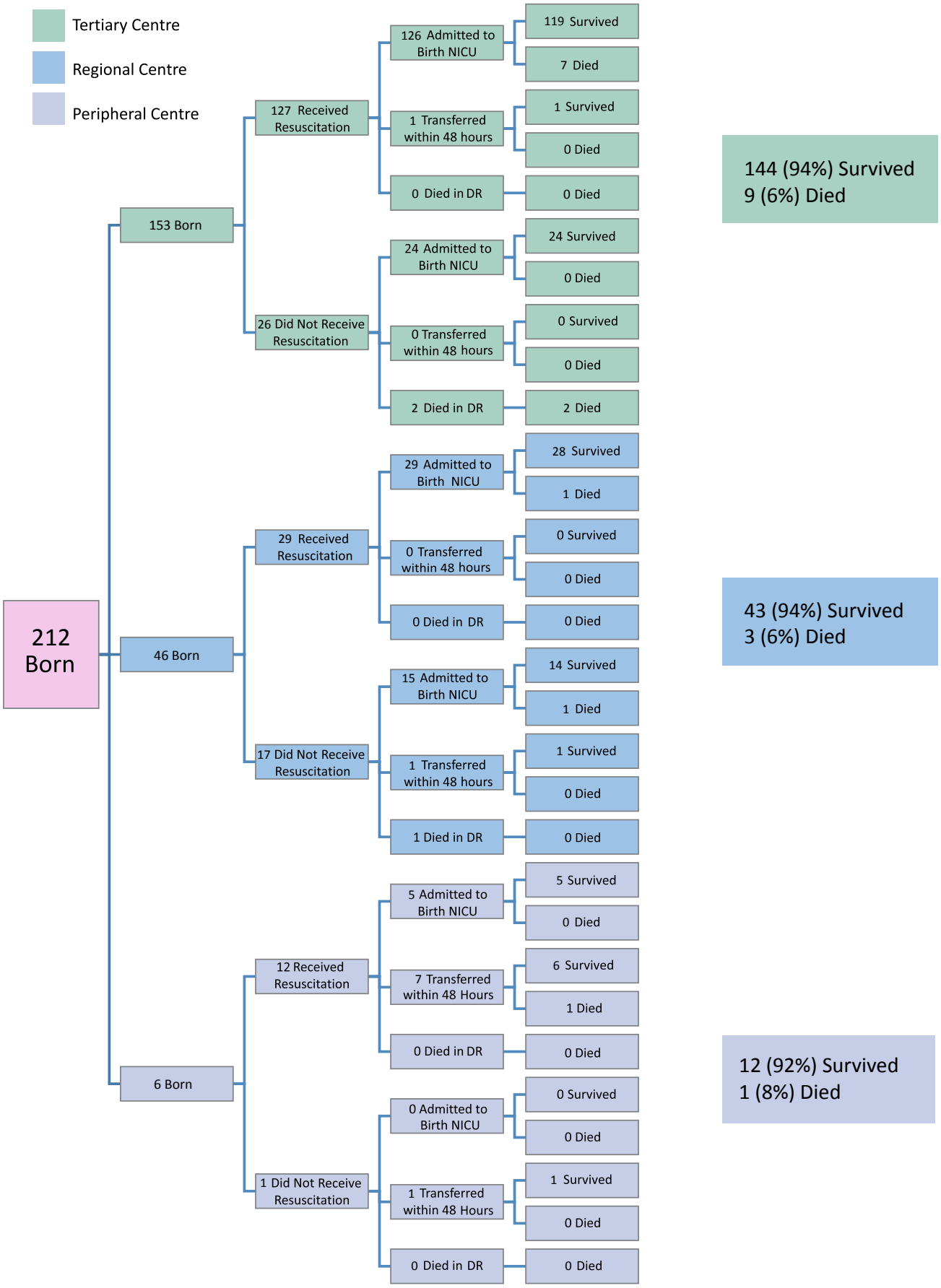


Figure 4.4: Flow chart illustrating survival outcomes of VLBW infants born at 27-29 weeks gestation according to designated category of neonatal centre, 2016, n=212

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

Overall, there were 187 infants born at >30 weeks gestation for whom birth location data were available. Of these, 123 (66%) were born in one of the tertiary neonatal centres, 45 (24%) in one of the regional neonatal centres and 19 (10%) in one of the peripheral centres (Table 4.8).

Table 4.8: Survival of ROI Infants born at >30 weeks gestation by category of neonatal centre, 2016, n=187

Survival	Tertiary Centres	Regional Centres	Peripheral Centres	Total
Number of liveborn infants	123	45	19	187
No. (%) who received resuscitation in the delivery room	78 (63%)	18 (40%)	9 (47%)	105 (56%)
No. (%) admitted to a NICU/SCBU	123 (100%)	44 (98%)	19 (100%)	186 (99%)
No. (%) transferred to another neonatal centre within 48 hours of birth	0 (0%)	0 (0%)	8 (42%)	8 (4%)
No. survived to discharge	115	44	18	177
% survival to discharge of liveborn infants	94%	98%	95%	95%

A total of 105 (56%) infants received intensive care/resuscitation in the delivery room, including 78 (63%) infants born in tertiary centres, 18 (40%) infants born in regional centres and 9 (47%) infants born in peripheral centres. All survived to admission to a NICU/SCBU but eight died prior to discharge (Figure 4.5). Eighty-two infants did not receive resuscitation in the delivery room, of whom one died in the delivery room. The remaining 81 infants who did not receive resuscitation were admitted to a NICU/SCBU and all but one survived to discharge.

In total, 186 (99%) infants born at >30 weeks gestation were admitted to a NICU/SCBU, of which eight transferred to another neonatal centre within 48 hours: all eight were born in peripheral centres, six of whom were transferred to one of the tertiary centres and two to regional centres. Seven of these infants survived to discharge (Table 4.8 and Figure 4.5).

In all, 177 (95%) infants born at >30 weeks gestation survived to discharge: 115 (94%) of those born in tertiary centres, 44 (98%) of those born in regional centres and 18 (95%) of those born in peripheral centres (Table 4.8).

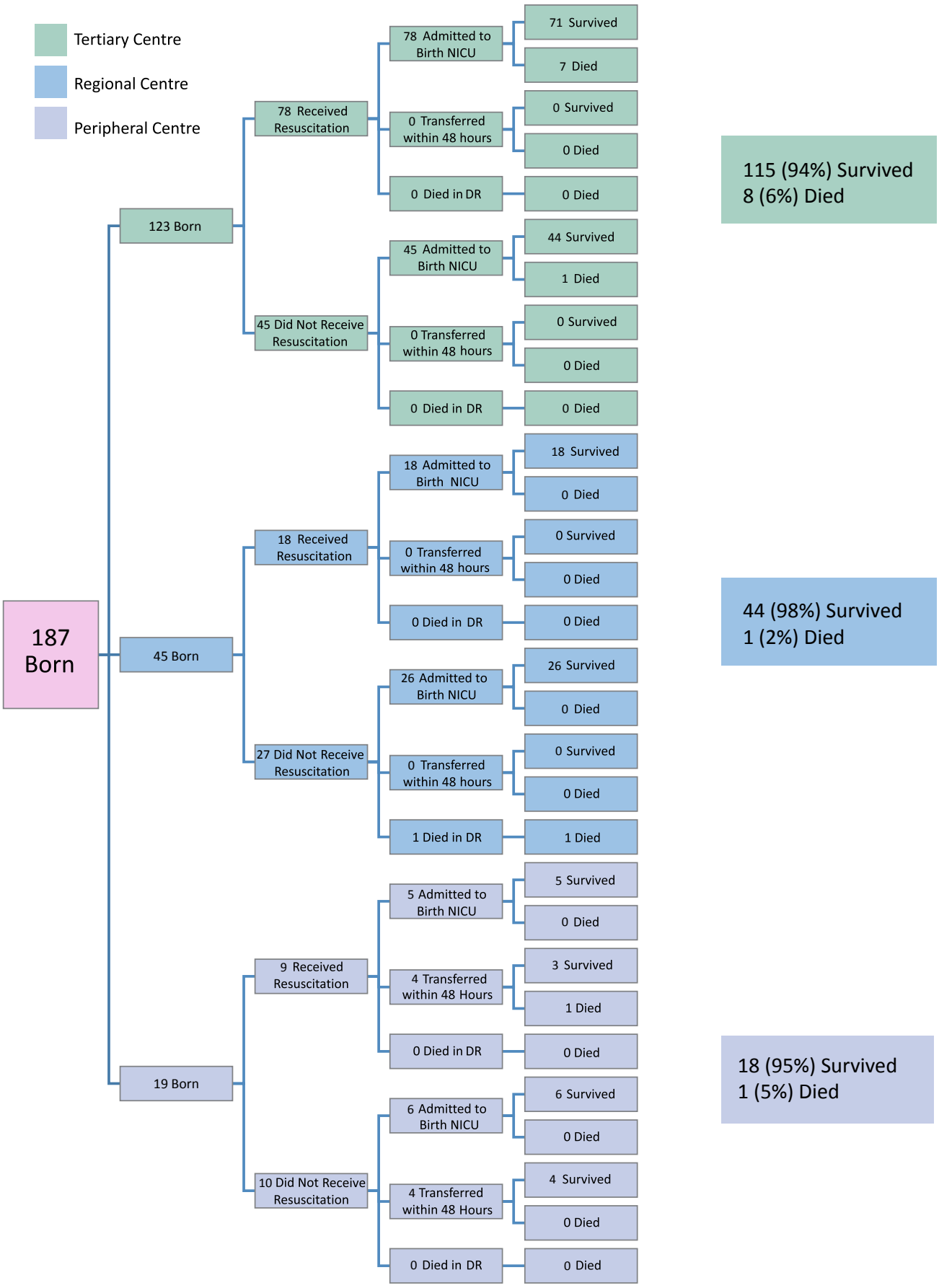


Figure 4.5: Flow chart illustrating survival outcomes of VLBW infants born > 30 weeks gestation according to category of neonatal centre, 2016, n=187

Summary survival outcomes of infants according to category of neonatal centre

In 2016, the three categories of neonatal centre had similar survival outcomes in terms of the 27-29 weeks and >30 weeks gestational age groups: 94%, 94% and 92% for tertiary, regional and peripheral centres respectively for 27-29 weeks gestation; and 94%, 98% and 95% for tertiary, regional and peripheral centres respectively for >30 weeks gestation (Table 4.9). These rates are also similar to VON rates for these gestational age groups in 2016. With regards to the <24 weeks and 24-26 weeks gestational age groups, rates are based on small numbers (numerators of 7, 2, 1 and 3 and denominators of 10, 3, 14 and 6) from which conclusions cannot be drawn.

In the context of all infants born, the peripheral centres showed an increase in survival rates from 2015 (64%, n=45/70) to 2016 (83%, n=34/41) (p=0.01). Survival rates for infants born at both tertiary and regional centres remained consistent between the years: tertiary centres, 86% survival in 2015 and 83% in 2016; regional centres, 91% survival in 2015 and 86% in 2016.[1]

Table 4.9: Survival rates for gestational age categories of VLBW infants born in the ROI according to category of neonatal centre, 2016, n=577

Survival By Gestational Age Group	Tertiary Centres	Regional Centres	Peripheral Centres	ROI Total	VON Total
<24 weeks	21% (7/34)	20% (2/10)	33% (1/3)	21% (10/47)	32%
24-26 weeks	76% (84/111)	71% (10/14)	50% (3/6)	74% (97/131)	76%
27-29 weeks	94% (144/153)	94% (43/46)	92% (12/13)	94% (199/212)	92%
>30 weeks	94% (115/123)	98% (44/45)	95% (18/19)	95% (177/187)	95%
Total	**83% (350/421)**	**86% (99/115)**	**83% (34/41)**	**84% (483/577)**	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 2016 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, 2016

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Mortality	76	69	1.10	(0.87, 1.34)	7	(-9, 23)
Mortality excluding early death	54	48	1.12	(0.84, 1.41)	6	(-8, 20)
Death or Morbidity	230	226	1.02	(0.89, 1.15)	4	(-26, 33)
Chronic Lung Disease	92	97	0.95	(0.75, 1.15)	-5	(-24, 14)
Pneumothorax	31	22	1.40	(0.98, 1.82)	9	(0, 18)
Late Bacterial Infection	45	40	1.12	(0.81, 1.43)	5	(-8, 17)
Coagulase Negative Infection	29	26	1.13	(0.74, 1.52)	3	(-7, 13)
Nosocomial Infection	68	58	1.17	(0.91, 1.43)	10	(-5, 25)
Fungal Infection	1	4	0.25	(-0.73, 1.24)	-3	(-7, 1)
Any Late Infection	68	60	1.13	(0.88, 1.39)	8	(-7, 23)
Intraventricular Haemorrhage	116	110	1.06	(0.87, 1.24)	6	(-14, 27)
Severe Intraventricular Haemorrhage	42	32	1.32	(0.98, 1.67)	10	(-1, 21)
Retinopathy of Prematurity	75	120	0.62	(0.45, 0.8)	-45	(-67, -24)
Severe Retinopathy of Prematurity	11	20	0.54	(0.1, 0.97)	-9	(-18, -1)
Cystic Periventricular Leukomalacia	7	13	0.56	(0, 1.11)	-6	(-12, 1)
Necrotising Enterocolitis	36	26	1.39	(1.01, 1.78)	10	(0, 20)

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)

SMRs for each KPI have been calculated for ROI infants with birth weights 501-1500g for three years, 2014 through to 2016: these SMRs facilitate an assessment of relative risks (RRs) i.e. whether the risk of a KPI changed from 2014 to 2015 or from 2015 to 2016. RRs were obtained by comparing the SMRs calculated for one year to those calculated for the preceding year using the methods described by Breslow and Day (1987).[2] 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) or by dividing the SMR for 2016 by the SMR for 2015 (RR=SMR 2016 / SMR 2015).

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 one year to the next 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 or from 2015 to 2016 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 or in 2016 than it was in 2015.

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, 2015 and 2016 and the relative risk comparing 2014 to 2015 and 2015 to 2016 and its 95% confidence interval.

Table 5.2: Risk Adjusted Standardised Mortality/Morbidity Ratios for Key Performance Indicators, Republic of Ireland, 2014-2016, and the relative risk in 2015 compared to 2014, and in 2016 compared to 2015.

Outcome	2014		2015		2016		2014-2015	2015-2016
	SMR	(95% CI)	SMR	(95% CI)	SMR	(95% CI)	RR (95% CI)	RR (95% CI)
Mortality	1.27	(1.03, 1.51)	1.15	(0.91, 1.39)	1.10	(0.87, 1.34)	0.90 (0.66, 1.24)	0.96 (0.69, 1.34)
Mortality excluding early death	1.23	(0.92, 1.54)	1.01	(0.70, 1.31)	1.12	(0.84, 1.41)	0.82 (0.53, 1.26)	1.12 (0.73, 1.72)
Death or Morbidity	1.14	(1.01, 1.27)	1.16	(1.03, 1.29)	1.02	(0.89, 1.15)	1.01 (0.85, 1.21)	0.88 (0.73, 1.05)
Chronic Lung Disease	1.08	(0.88, 1.28)	1.07	(0.87, 1.27)	0.95	(0.75, 1.15)	0.99 (0.75, 1.31)	0.89 (0.66, 1.19)
Pneumothorax	1.67	(1.25, 2.10)	1.80	(1.37, 2.24)	1.40	(0.98, 1.82)	1.08 (0.66, 1.76)	0.78 (0.47, 1.29)
Late Bacterial Infection	0.90	(0.58, 1.22)	0.97	(0.68, 1.26)	1.12	(0.81, 1.43)	1.08 (0.68, 1.74)	1.15 (0.74, 1.78)
Coagulase Negative Infection	1.84	(1.45, 2.23)	1.60	(1.22, 1.99)	1.13	(0.74, 1.52)	0.87 (0.56, 1.36)	0.71 (0.42, 1.16)
Nosocomial Infection	1.30	(1.04, 1.57)	1.43	(1.17, 1.69)	1.17	(0.91, 1.43)	1.10 (0.79, 1.54)	0.82 (0.58, 1.14)
Fungal Infection	0.55	(0, 1.57)	0.70	(0, 1.65)	0.25	(-0.73, 1.24)	1.28 (0.15, 15.35)	0.36 (0.01, 4.48)
Any Late Infection	1.26	(1.00, 1.52)	1.44	(1.18, 1.7)	1.13	(0.88, 1.39)	1.14 (0.82, 1.59)	0.79 (0.56, 1.10)
Intraventricular Haemorrhage	1.07	(0.88, 1.26)	1.24	(1.05, 1.43)	1.06	(0.87, 1.24)	1.16 (0.90, 1.51)	0.85 (0.66, 1.10)
Severe Intraventricular Haemorrhage	1.22	(0.85, 1.58)	1.15	(0.80, 1.51)	1.32	(0.98, 1.67)	0.95 (0.58, 1.55)	1.15 (0.72, 1.84)
Retinopathy of Prematurity	0.51	(0.33, 0.70)	0.71	(0.53, 0.89)	0.62	(0.45, 0.8)	1.39 (0.98, 1.98)	0.88 (0.63, 1.22)
Severe Retinopathy of Prematurity	0.83	(0.37, 1.29)	1.10	(0.66, 1.54)	0.54	(0.1, 0.97)	1.33 (0.66, 2.76)	0.49 (0.21, 1.05)
Cystic Periventricular Leukomalacia	0.32	(0, 0.87)	1.26	(0.71, 1.82)	0.56	(0, 1.11)	3.97 (1.28, 16.33)	0.44 (0.15, 1.13)
Necrotising Enterocolitis	1.21	(0.84, 1.59)	1.47	(1.08, 1.86)	1.39	(1.01, 1.78)	1.22 (0.74, 2.01)	0.95 (0.58, 1.54)

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.

Note: RR = relative risk in 2015 compared to 2014 and relative risk in 2016 compared to 2015; 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 2016, 16.4% (n=97) of VLBW babies born in the ROI died, 1.8% higher than the proportion of VON infants who died (14.6%, n=9,302). Nearly half of these ROI infants died either within the first 12 hours of life (5.9%, n=35) or within 12 hours of admission to the NICU (1.3%, n=8; Figure 5.1). After excluding early deaths, a further 9.1% (n=54) of ROI infants died. When early deaths are excluded, 10.5% (n=6,388) of VON VLBW infants died. This pattern of mortality in both the ROI and in VON is similar to that observed in 2014 and 2015.[1,3]

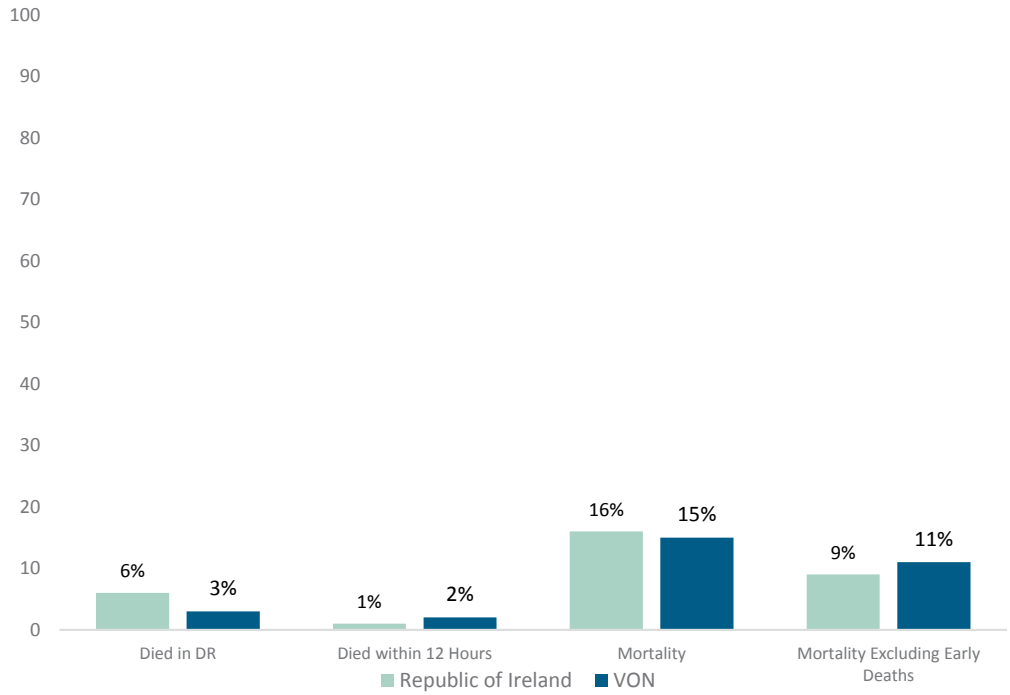


Figure 5.1: Distribution of mortality amongst ROI and VON infants, 2016

Deaths in the Delivery Room 2016

In 2016, a significantly higher proportion of ROI infants died in the delivery room (6%, n=35) compared to VON (3%, n=2,060; p<0.001; Table 5.3). Similar statistically significant findings was obtained in the preceding years: in 2015, 7% of ROI infants died in the delivery room compared to 4% of VON infants and in 2014, 8% of ROI infants died in the delivery room compared to 4% in VON. The decreasing trend in ROI delivery room deaths from 8% in 2014, through 7% in 2015 to 6% in 2016 was not statistically significant (Annual rate ratio=0.83, 95% CI: 0.70-1.03; p=0.09).

Table 5.3: Mortality amongst Republic of Ireland and VON infants, 2016. The P-value refers to the significance of the value of the difference between the ROI and VON populations.

	Republic of Ireland			VON		
	Cases	N	%	N	%	P-value
Died in DR	35	593	5.9	64,367	3.2	<0.001
Died within 12 Hours	8	593	1.3	62,321	1.6	0.916
Mortality Excl. Early Deaths	54	593	9.1	60,837	10.5	0.268
Total Mortality	**97**	**593**	**16.4**	**63,712**	**14.6**	**0.225**

Of the 35 infants who died in the delivery room in 2015, eight (23%) had a major congenital anomaly and 27 (77%) were born at less than 24 weeks gestation: three infants had both an MCA and were born at less than 24 weeks gestation (Table 5.4). In total, 32 of 35 (91%) infants who died in the delivery room in the ROI in 2016 had either an MCA or were less than 24 weeks gestation. This is similar to the analogous proportions of 89% (39 of 44 infants) in 2015 and 86% (43 of 50 infants) in 2014.[1,3]

In contrast to 2014 and 2015, when none of the infants less than 24 weeks gestation who died in the delivery room had an MCA, three infants had both in 2016.[1,3]

Table 5.4: Deaths in the delivery room, by gestational age category and presence of major congenital anomaly, 2016, n=35.

Gestational Age Category	Major Congenital Anomaly Present	Absent	Total
< 24 weeks	3	24	27
24-26 weeks	1	3	4
27-29 weeks	3	0	3
30-32 weeks	1	0	1
> 32 weeks	0	0	0
Total	**8**	**27**	**35**

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 76 deaths observed whereas the expected number based on the risk profile of the infants in the ROI population was 69 (Table 5.5). The SMR was 1.10 (95% CI: 0.87, 1.34), indicating that the number of observed cases was 1.10 times the expected number. In absolute numbers there were 7 more deaths than expected. This was not a statistically significant excess in mortality (95% CI: -9, 23).

Excluding early deaths, there were 54 observed deaths and 48 expected deaths based on the risk profile of infants in the ROI (SMR=1.12, 95% CI: 0.84, 1.41: Table 5.5). Thus, there was no difference in the observed and expected numbers of deaths excluding early death.

The relative risk for mortality, at 0.96, indicated that the risk was lower in 2016 than in 2015 but this reduction was not statistically significant (95% CI: 0.69, 1.34; Table 5.2). The relative risk for mortality excluding early death, at 1.12, indicated that the risk was higher in 2016 than in 2015 but again the difference was not statistically significant (95% CI: 0.73, 1.72; Table 5.2).

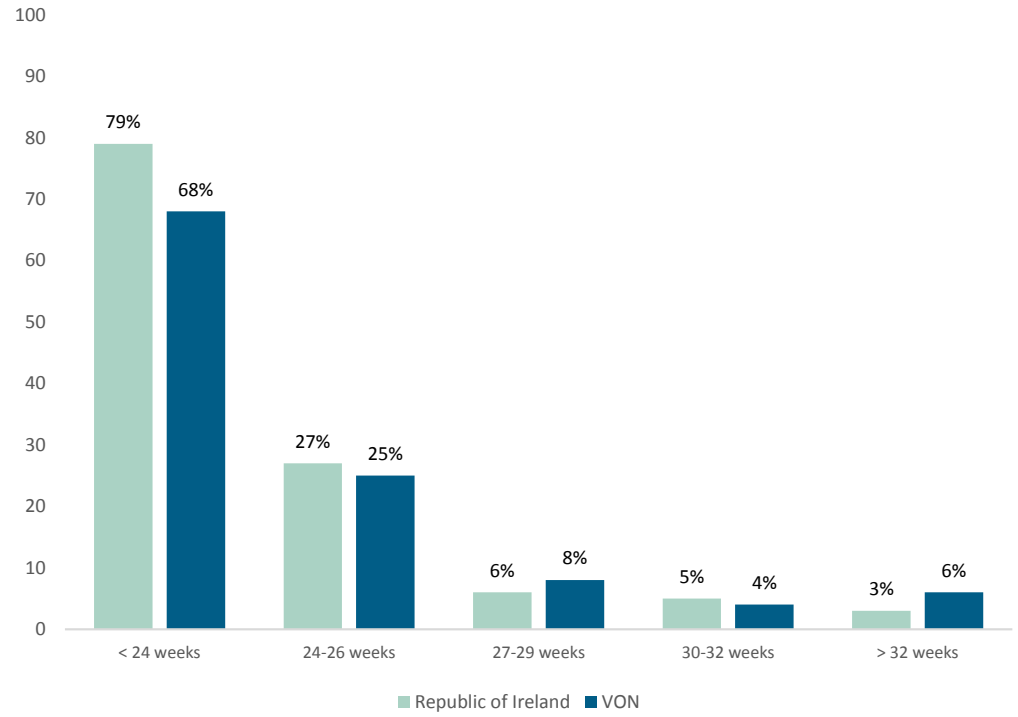


Figure 5.2: Distribution of mortality amongst infants by gestational age, 2016

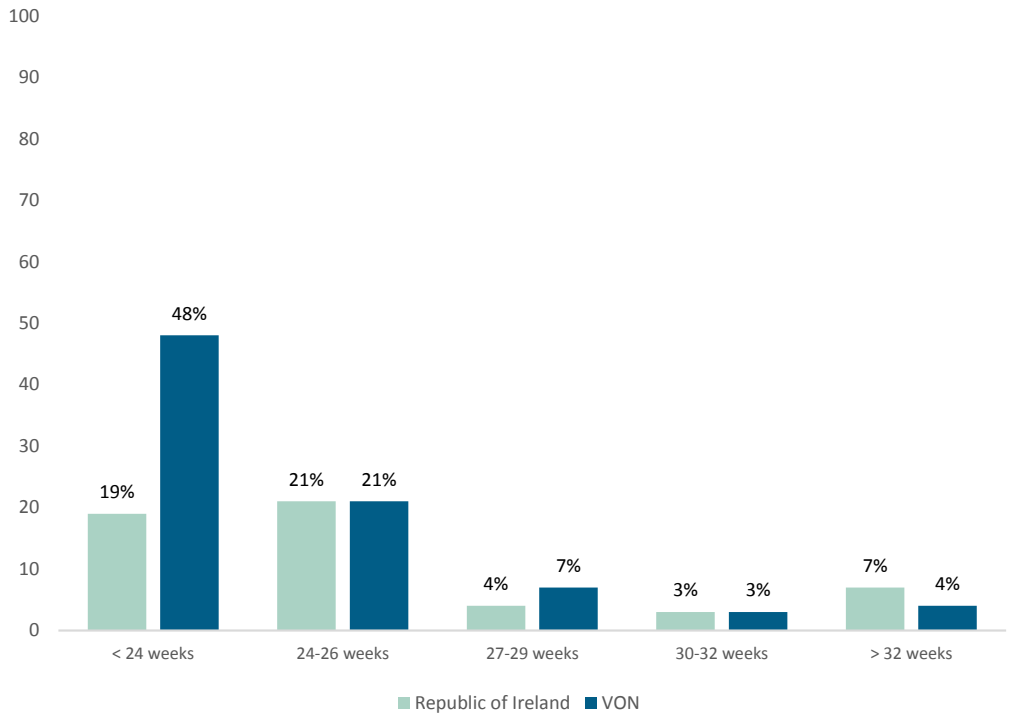


Figure 5.3: Distribution of mortality excluding early deaths amongst infants by gestational age, 2016

Table 5.5: Risk Adjusted Standardised Mortality Ratios for Key Performance Indicators - KPI 1: mortality and KPI 2: mortality excluding early death, ROI, 2016.

Outcome 2016	O	E	SMR	(95% CI)	O-E	(95% CI)
Mortality	76	69	1.10	(0.87, 1.34)	7	(-9, 23)
Mortality excluding early death	54	48	1.12	(0.84, 1.41)	6	(-8, 20)

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 2016, 44% of ROI infants (n=260) suffered death or morbidity. This compares to 43% (n=11,782) 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 230 observed cases of death or morbidity, whereas the expected number based on the risk profile of the infants in the Irish population was 226 (Table 5.6). The SMR was 1.02 (95% CI: 0.89, 1.15), indicating that the number of observed cases was approximately similar to the expected number. In absolute numbers there were 4 more cases of death or morbidity in the ROI than expected, a finding which was not statistically significant (95% CI: -26, 33).

The relative risk for death or morbidity, at 0.88 (95% CI: 0.73, 1.05), indicated that the risk in 2016 was less than that in 2015, although this did not represent a statistically significant reduction in risk between years (Table 5.2).

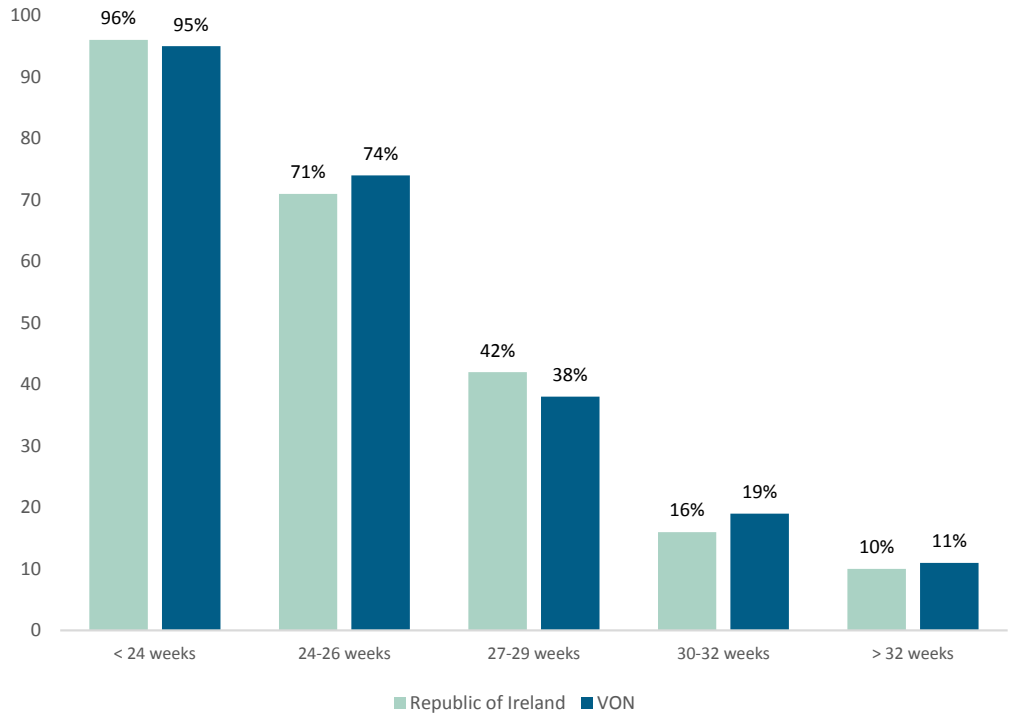


Figure 5.4: Distribution of death or morbidity amongst infants by gestational age, 2016

Table 5.6: Risk Adjusted Standardised Mortality Ratios for Key Performance Indicators - KPI 3: death or morbidity, ROI, 2016.

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Death or Morbidity	230	226	1.02	(0.89, 1.15)	4	(-26, 33)

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

KPI 4: CLD

In 2016, 20% of ROI infants (n=97 of 480) were classified as having CLD. This compares to 24% of VON infants (n=13,073). 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 92 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 5.7). The SMR was 0.95 (95% CI: 0.75, 1.15), indicating that the number of observed cases was 0.95 times the expected number. In absolute numbers there were five less cases of CLD than expected: this was not a statistically significant reduction (95% CI:-24, 14).

The relative risk for CLD, at 0.89 (95% CI: 0.66, 1.19), indicated that the risk in 2016 was lower than that in 2015, but this was not statistically significant (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=1.07 in 2015 vs. 0.95 in 2016; Table 5.2).

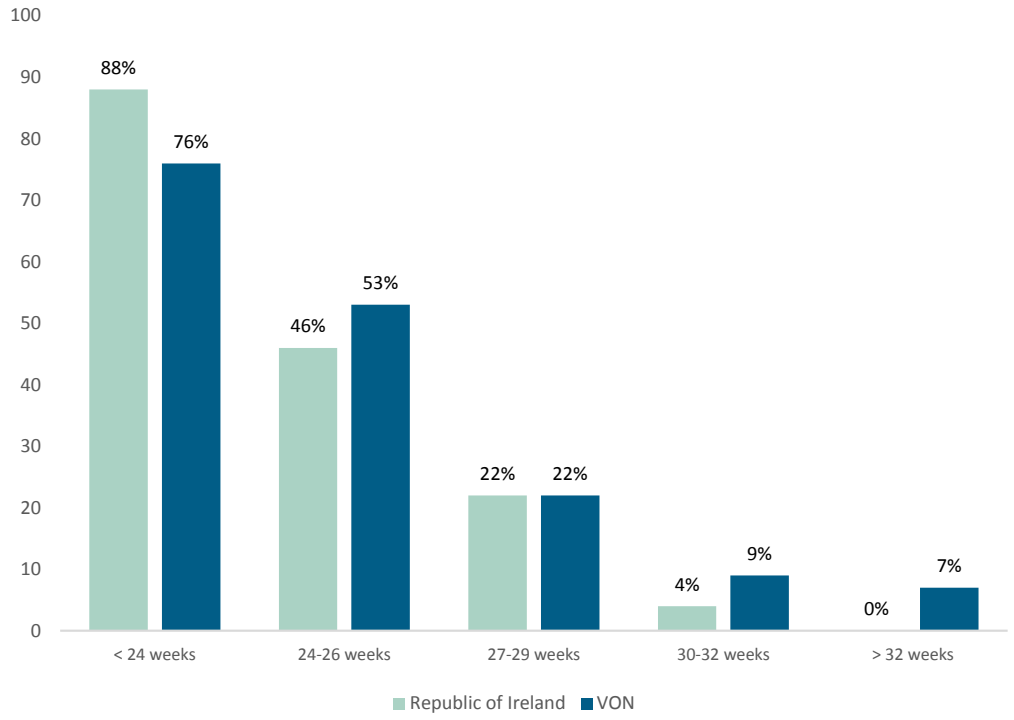


Figure 5.5: Distribution of chronic lung disease amongst infants by gestational age, 2016

Table 5.7: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 4: chronic lung disease, ROI, 2016.

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Chronic Lung Disease	92	97	0.95	(0.75, 1.15)	-5	(-24, 14)

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

KPI 5: Pneumothorax

In 2016, 6% of ROI infants (n=32 of 559) were classified as having pneumothorax. This compares to 4% (n=2,616) of VON infants.

Figure 5.6 outlines the proportion of pneumothorax in ROI and VON infants according to gestational age categories. In ROI infants. There was not a consistent increase or decrease in pneumothorax across the gestational age categories (p=0.434): it must be noted that the number of pneumothorax cases seen across gestational age categories in ROI infants was quite small.

There were 31 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 22 (Table 5.8). The SMR was 1.40 (95% CI: 0.98, 1.82), indicating that the number of observed cases was 1.40 times the expected number. In absolute numbers there were nine more cases of pneumothorax (95% CI: 0, 18) than expected, not quite statistically significant.

The relative risk for pneumothorax, at 0.78, indicated that the risk was lower in 2016 than in 2015, but this reduction was not statistically significant (95% CI: 0.47, 1.29; Table 5.2).

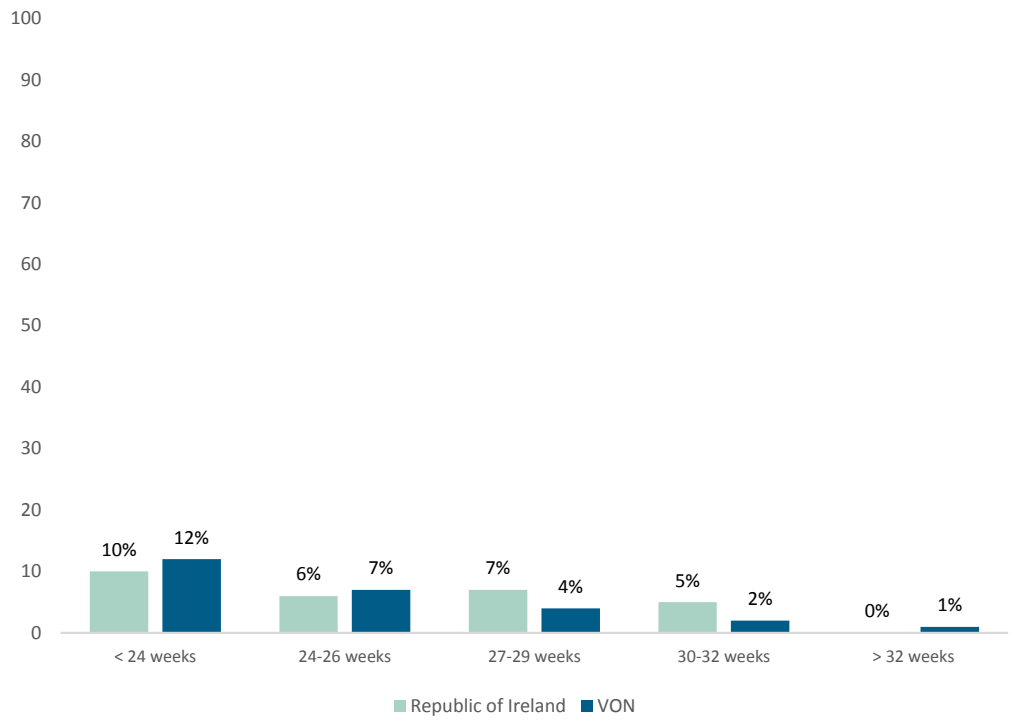


Figure 5.6: Distribution of pneumothorax amongst infants by gestational age, 2016

Table 5.8: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 5: pneumothorax, ROI, 2016

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Pneumothorax	31	22	1.40	(0.98, 1.82)	9	(0, 18)

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 illustrates the proportions 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=0.99; coagulase negative infection: p=0.51; nosocomial infection: p=0.28; fungal infection: p=0.06; any late infection: p=0.73). This is consistent with analogous findings in 2014 and 2015.[1,3]

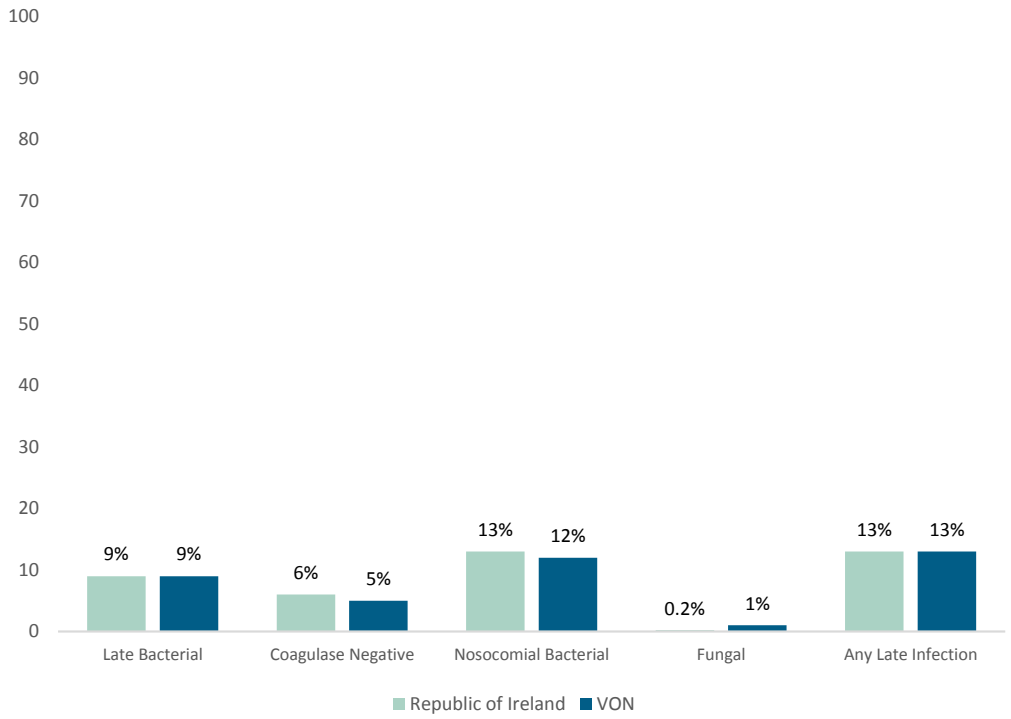


Figure 5.7: Distribution of infections in ROI and VON infants, 2016

KPI 6: Late Bacterial Infection

The proportion of late bacterial infection in ROI infants was 9% in both the ROI (n=48 of 533) and VON populations (n=5,347). 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 40 cases (Table 5.9). Thus, the observed number was 1.12 times the expected number (SMR=1.12, 95% CI: 0.681, 1.43). In absolute numbers there were five more cases of late bacterial infection than expected, which was not statistically significant (95% CI: -8, 17).

The relative risk for late bacterial infection, at 1.15, indicated that the risk was slightly higher in 2016 than in 2015, but this increase was not statistically significant (95% CI: 0.74, 1.78; Table 5.2).

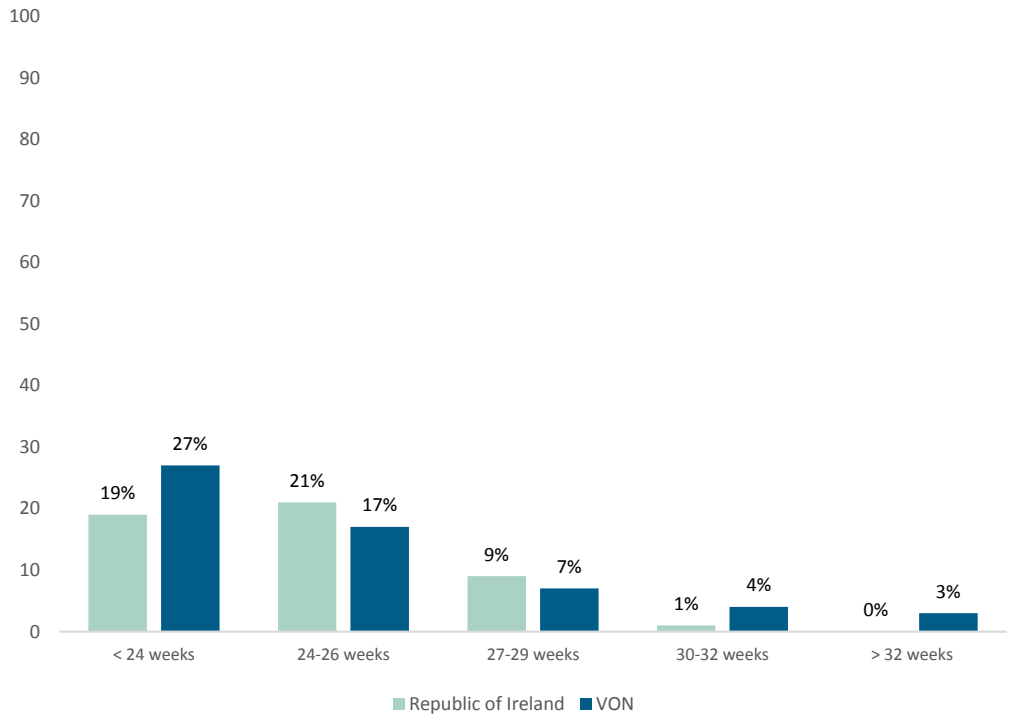


Figure 5.8: Distribution of late bacterial infection amongst infants by gestational age, 2016

Table 5.9: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 6: late bacterial infection, ROI, 2016.

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Late Bacterial Infection	45	40	1.12	(0.81, 1.43)	5	(-8, 17)

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

KPI 7: Coagulase Negative Infection

Coagulase negative infection was observed in 6% (n=30 of 533) of ROI infants and 5% of VON infants (n=2,970). 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=0.014). Adjusting for the risk profile of ROI infants born weighing 501-1500g, there were 29 observed cases of coagulase negative infection compared to an expected number of 26 cases (Table 5.10). Thus, the observed number was 1.13 times the expected number (SMR=1.13, 95% CI: 0.74, 1.52). In absolute numbers there were 3 more cases of coagulase negative infection than expected, which was not a statistically significant excess (95% CI: -7, 13).

The relative risk for coagulase negative infection, at 0.71, indicated that the risk was lower in 2016 than in 2015 but this reduction was not statistically significant (95% CI: 0.42, 1.16; Table 5.2).

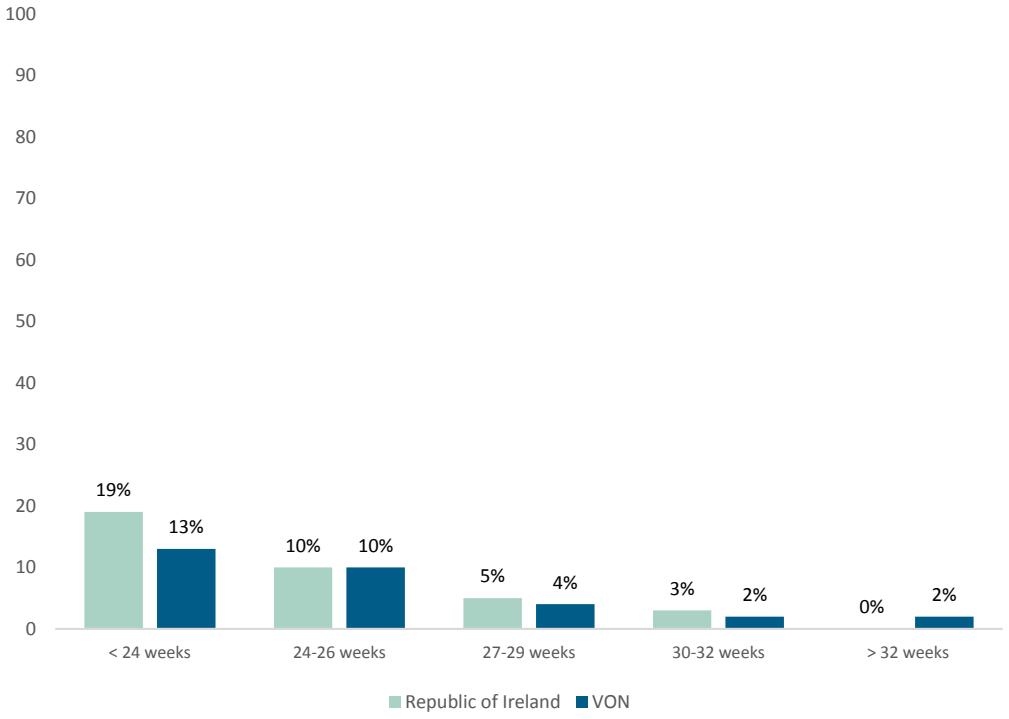


Figure 5.9: Distribution of coagulase negative infection amongst infants by gestational age, 2016

Table 5.10: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 7: coagulase negative infection, ROI, 2016.

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Coagulase Negative Infection	29	26	1.13	(0.74, 1.52)	3	(-7, 13)

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

KPI 8: Nosocomial Infection

Nosocomial infection was reported in 13% (n=72 of 533) of the ROI infant population and 12% (n=7,128) 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 68 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 58 cases (Table 5.11). Thus, there were 1.17 times more cases observed than expected (SMR=1.17, 95% CI: 0.91, 1.43). In absolute numbers this equated to an excess of 10 cases, which was not a statistically significant difference (95% CI: -5, 25).

At 0.82, the relative risk indicated that the risk for nosocomial infection decreased from 2015 to 2016, but this was not a statistically significant reduction (95% CI: 0.58, 1.14; Table 5.2).

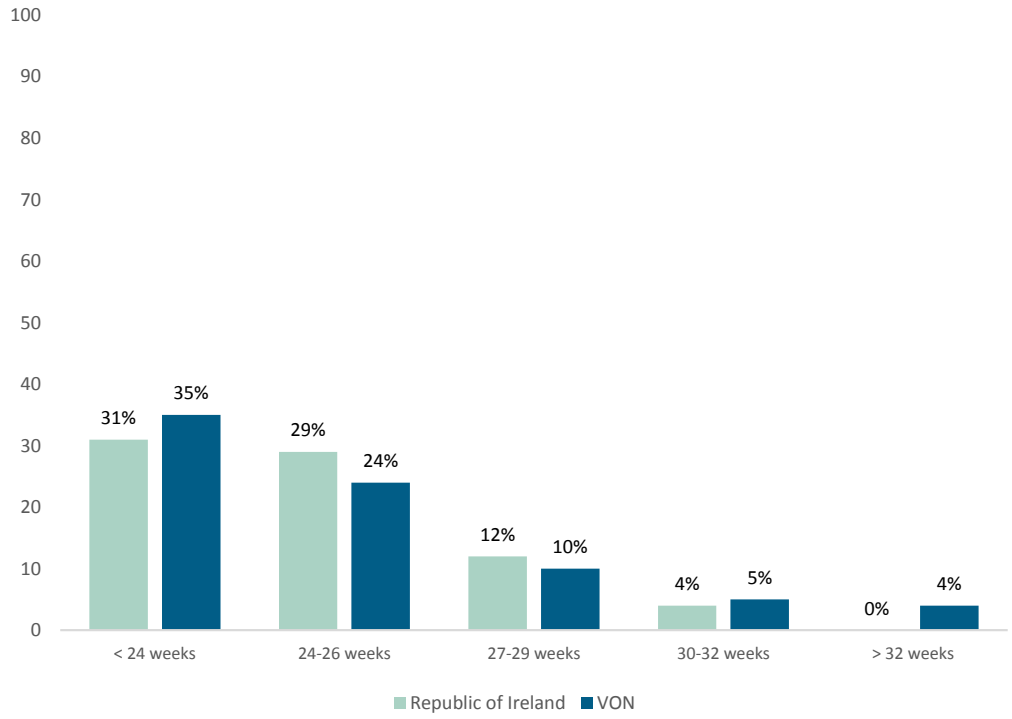


Figure 5.10: Distribution of nosocomial infection amongst infants by gestational age, 2016

Table 5.11: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 8: nosocomial infection, ROI, 2016.

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Nosocomial Infection	68	58	1.17	(0.91, 1.43)	10	(-5, 25)

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

KPI 9: Fungal Infection

In 2016, one (0.2%) ROI infant experienced fungal infection, compared to 594 (1%) infants in VON. This infant was born at 24-26 weeks gestation. Graphs are not included.

The observed case of fungal infection was amongst the infants born weighing 501-1500g. Based on the risk profile of ROI infants, there was an expected number of four cases (Table 5.12). Three less cases of fungal infection than expected did not constitute a statistically significant reduction in fungal infection cases (95% CI: -7, 1).

The relative risk for fungal infection in 2016, at 0.36 represents a statistically significant reduction in risk from 2015 to 2016 (95% CI: 0.01, 4.48; Table 5.2).

Table 5.12: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 9: fungal infection, ROI, 2016.

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Fungal Infection	1	4	0.25	(-0.73, 1.24)	-3	(-7, 1)

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

KPI 10: Any Late Infection

Any late infection was reported for 13% of ROI infants (n=72 of 533) and 13% of VON infants (n=7,723). 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 68 observed cases with any late infection compared to an expected number of 60 cases (Table 5.13). Thus, the observed number equated to 1.13 times the expected number (SMR=1.13, 95% CI: 0.88, 1.39) and the excess of 8 cases was not statistically significant (95% CI: -7, 23).

The relative risk for any late infection in 2016 was 0.79 times the risk in 2015: this reduction however was not statistically significant (95% CI: 0.56, 1.10; Table 5.2).

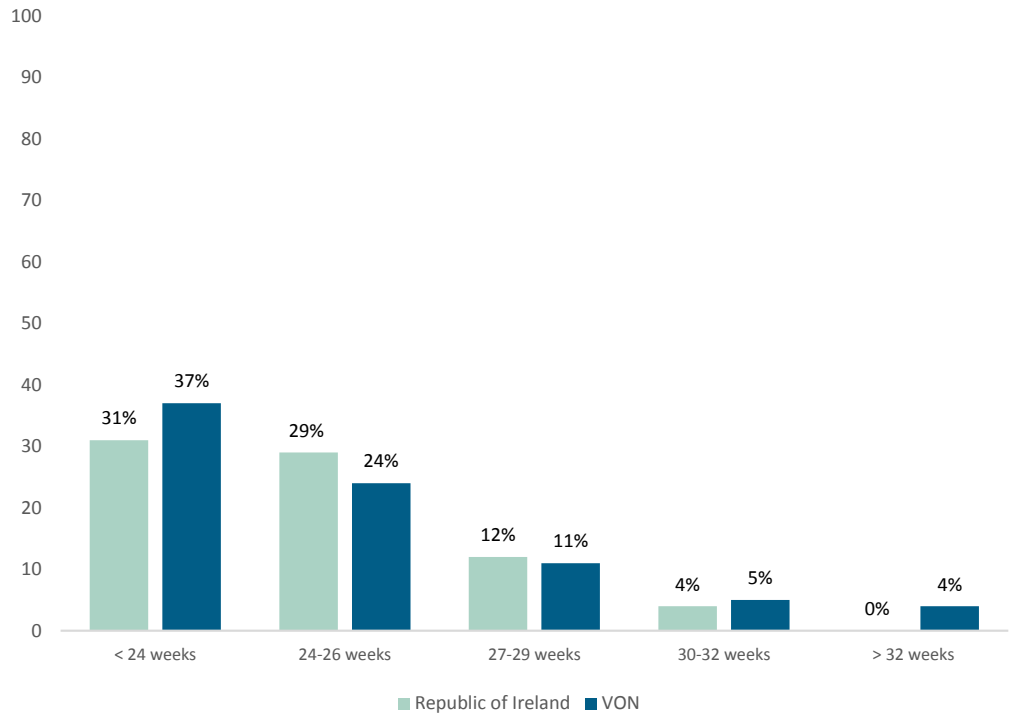


Figure 5.11: Distribution of any late infection amongst infants by gestational age, 2016

Table 5.13: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 10: any late infection, ROI, 2016.

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Any Late Infection	68	60	1.13	(0.88, 1.39)	8	(-7, 23)

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

KPI 11: Any IVH and KPI 12: Severe IVH

Overall, 23% (n=119) of ROI infants experienced IVH compared to 25% (n=14,193) of VON infants. Of these, 9% (n=44) of ROI infants had severe IVH, i.e. Grade 3 or 4, compared to 8% (n=4,414) 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 116 ROI infants weighing 501-1500g at birth whereas the number of cases expected based on the infants' risk profile was 110 (SMR=1.06, 95% CI: 0.87, 1.24: Table 5.14). In absolute numbers, there were 6 more cases than expected, which was not statistically significant (95% CI: -14, 27). The relative risk for IVH, at 0.85, indicated that the risk for IVH was lower in 2016 than in the previous year, but this finding was not statistically significant (95% CI: 0.66, 1.10; Table 5.2).

In cases of severe IVH, there were 42 observed cases compared to an expected number of 32 cases (SMR=1.32, 95% CI: 0.98, 1.67): this excess of 10 cases was not statistically significant (95% CI: -1, 21; Table 5.14). The relative risk for severe IVH in 2016 was 0.85 times the risk in 2015: this reduction in risk was not statistically significant (95% CI: 0.66, 1.10; Table 5.2).

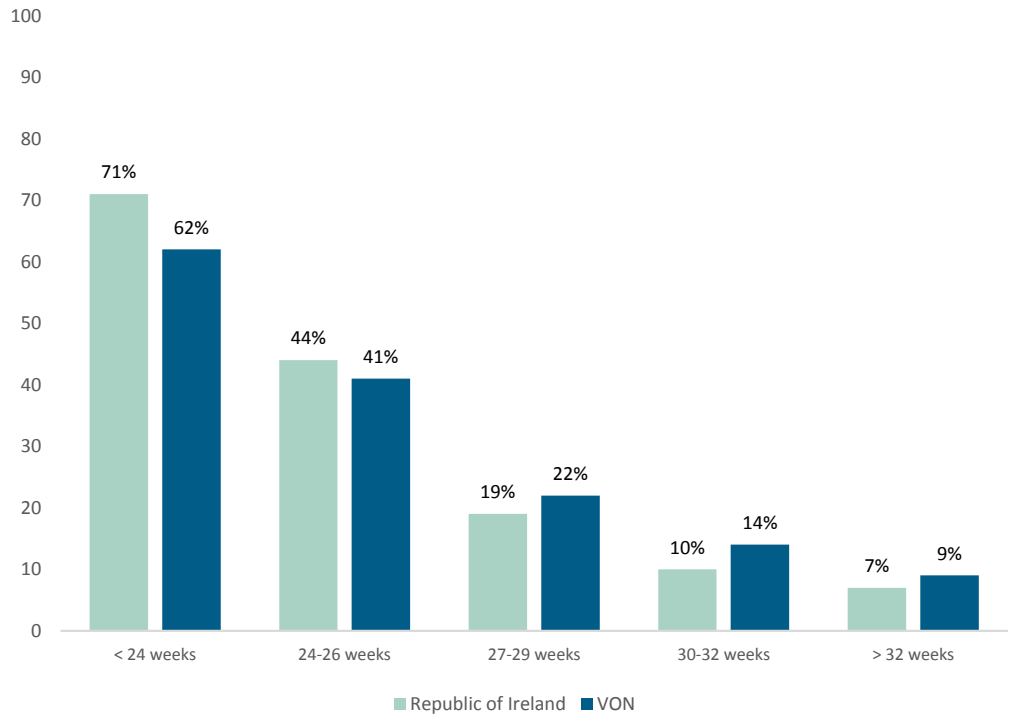


Figure 5.12: Distribution of any IVH amongst infants by gestational age, 2016

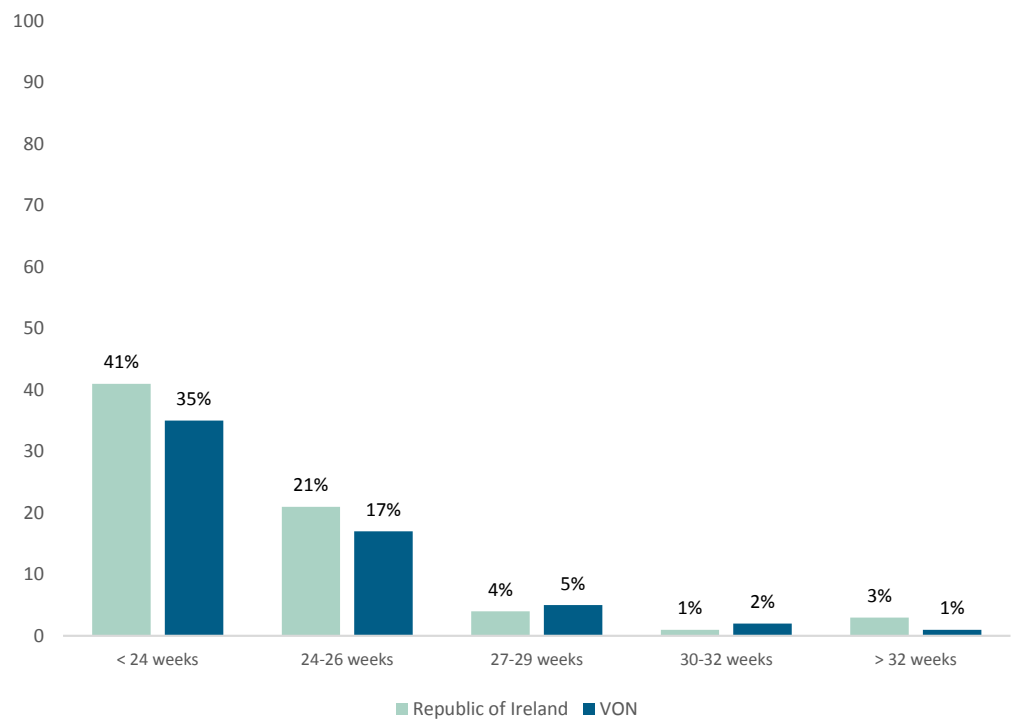


Figure 5.13: Distribution of severe IVH amongst infants by gestational age, 2016

Table 5.14: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 11: intraventricular haemorrhage and KPI 12: severe intraventricular haemorrhage, ROI, 2016.

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Intraventricular Haemorrhage	116	110	1.06	(0.87, 1.24)	6	(-14, 27)
Severe Intraventricular Haemorrhage	42	32	1.32	(0.98, 1.67)	10	(-1, 21)

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

KPI 13: ROP and KPI 14: Severe ROP

ROP was reported in 18% (n=80 of 451) of ROI infants and 31% (n=14,087) of VON infants. Severe ROP (stage 3, 4 or 5) was reported for 6% (n=13 of 451) of ROI infants and 6% (n=2,854) 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 75 observed cases of ROP compared to an expected number of 120 cases (Table 5.15). Thus, the observed number equated to 62% of the expected number, which constituted a statistically significant difference (SMR=0.62, 95% CI: 0.45, 0.80). In absolute numbers, there were 45 fewer cases of ROP than expected, which was a statistically significant reduction (95% CI: -67, -24).

The relative risk for ROP, at 0.88, indicated that the risk for ROP was lower in 2016 than in 2015, but this decrease was not statistically significant (95% CI: 0.63, 1.22; Table 5.2).

With regard to severe ROP, there were 11 observed cases compared to 20 cases which would be expected based on the risk profile of infants in the ROI population (SMR=0.54, 95% CI: 0.10, 0.97), a statistically significant difference. In absolute terms, the nine fewer cases of severe ROP was statistically significant (95% CI: -18, -1; Table 5.15).

The relative risk for severe ROP, at 0.49, indicates that the risk was lower in 2016 than in 2015, but this difference was not statistically significant (95% CI: 0.21, 1.05; Table 5.2).

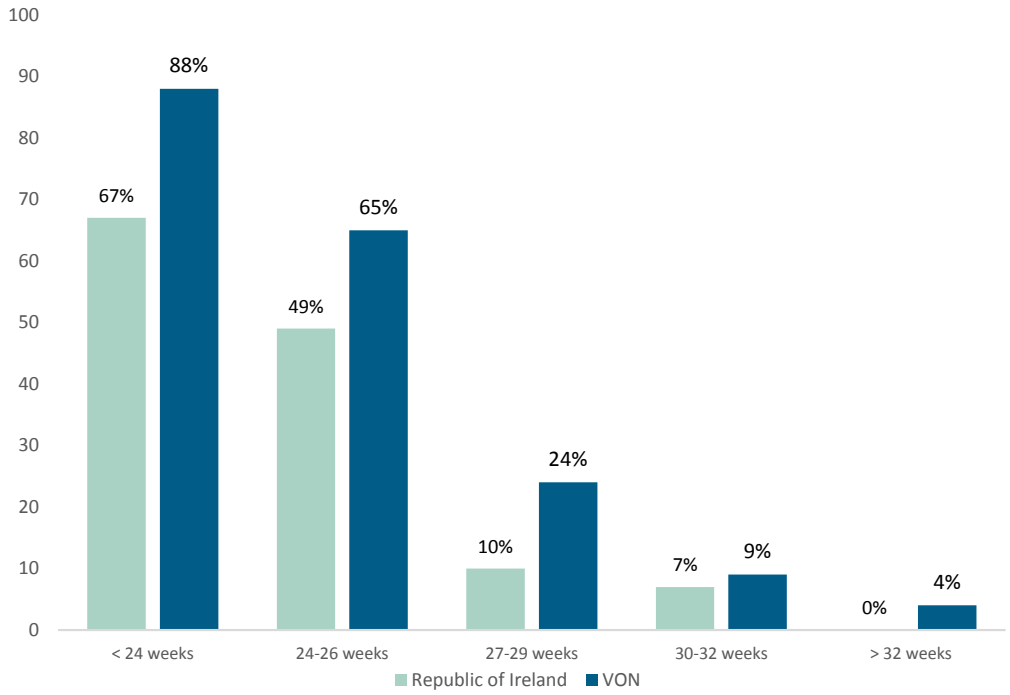


Figure 5.14: Distribution of ROP amongst infants by gestational age, 2016

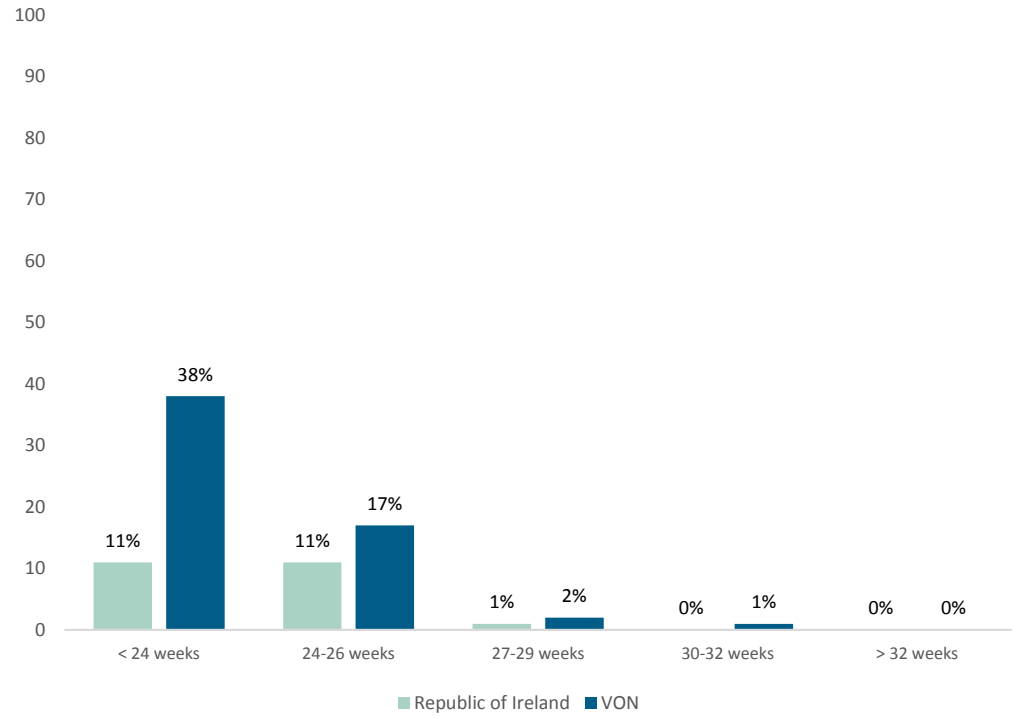


Figure 5.15: Distribution of severe ROP amongst infants by gestational age, 2016

Table 5.15: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 13: retinopathy of prematurity and KPI 14: severe retinopathy of prematurity, ROI, 2016.

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Retinopathy of Prematurity	75	120	0.62	(0.45, 0.8)	-45	(-67, -24)
Severe Retinopathy of Prematurity	11	20	0.54	(0.1, 0.97)	-9	(-18, -1)

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

KPI 15: Cystic PVL

Cystic PVL were observed in 1.5% (8 of 536) of ROI infants and 3% (n=1,648) of VON infants in 2016. 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=0.523) 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 7 observed cases of cystic PVL whereas the number expected based on their risk profile was 13 (Table 5.16). Thus, the observed number equated to approximately half of the expected number (SMR=0.56, 95% CI: 0, 1.11). In absolute numbers the six fewer cases observed did not represent a statistically significant difference from the expected number (95% CI: -12, 1).

At 0.44, the relative risk for cystic PVL in 2016 was not statistically significantly less than the risk in 2015 (95% CI: 0.15, 1.13; Table 5.2). However, the small number of cases in both years (three in 2015 and seven in 2016) preclude definitive conclusions being drawn.

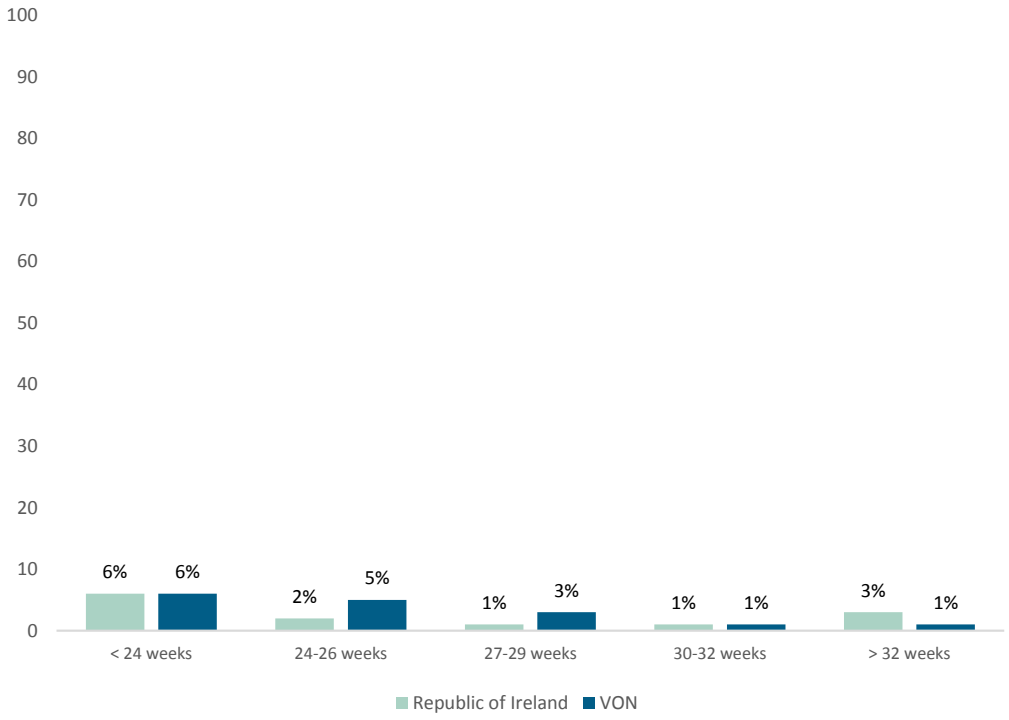


Figure 5.16: Distribution of cystic PVL amongst infants by gestational age, 2016

Table 5.16: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 15: cystic periventricular leukomalacia, ROI, 2016.

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Cystic Periventricular Leukomalacia	7	13	0.56	(0, 1.11)	-6	(-12, 1)

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

KPI 16: Necrotising Enterocolitis (NEC)

NEC was observed in 7% (n=38 of 558) of ROI infants and 5% (n=3,113) of VON infants in 2016. 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 36 observed cases of NEC and an expected number of 26 cases (SMR=1.39, 95% CI: 1.01, 1.78; Table 5.17). This was a statistically significant excess of 10 cases of NEC (95% CI: 0, 20).

The relative risk for NEC, at 0.95, indicated that the risk was lower in 2016 than in 2015, but this decrease was not statistically significant (95% CI: 0.58, 1.54; Table 5.2).

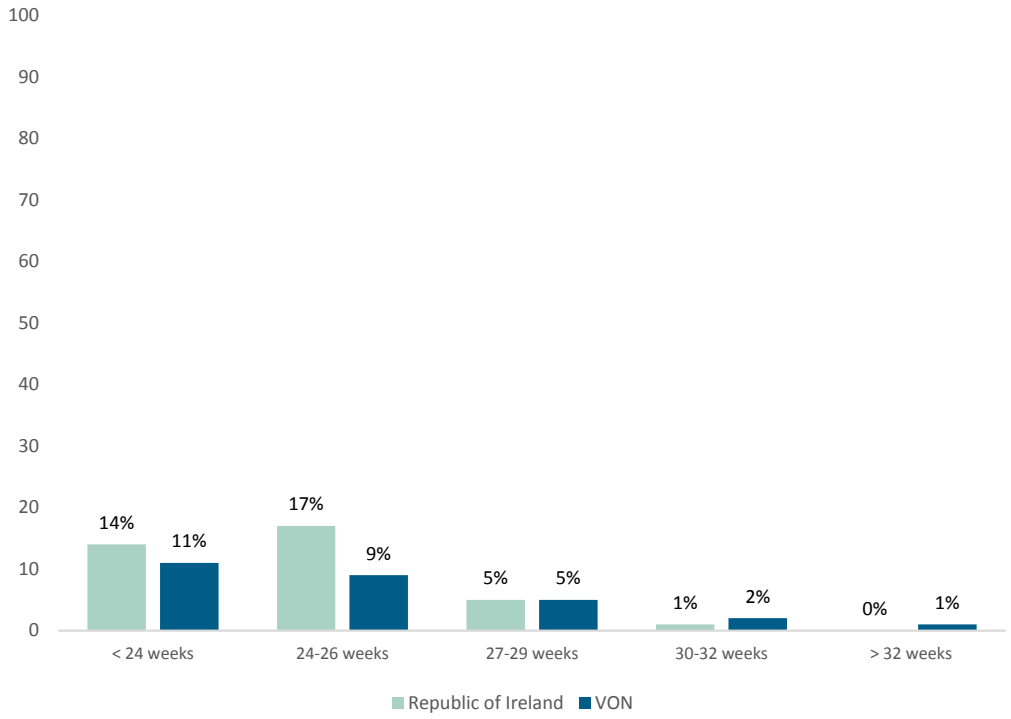


Figure 5.17: Distribution of NEC amongst infants by gestational age, 2016.

Table 5.17: Risk Adjusted Standardised Morbidity Ratios for Key Performance Indicators - KPI 16: necrotising enterocolitis, ROI, 2016.

Outcome	O	E	SMR	(95% CI)	O-E	(95% CI)
Necrotising Enterocolitis	36	26	1.39	(1.01, 1.78)	10	(0, 20)

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

8th March 2018

Re: Very Low Birth Weight Infants in the Republic of Ireland - Annual Report 2016

Dear Dr Murphy,

We thank you for the presentation by yourself and Dr Paul Corcoran to the NOCA Governance Board on Thursday the 15th of February.

On behalf of the NOCA Governance Board and our Executive Team, I wish to congratulate you and your co-chair, 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 Governance Board looks forward to the aggregated three year report due to be published later this year, which will include recommendations. As discussed with the Governance Board, we also look forward to the development of more hospital level reporting and the increased use of this information to drive improvement locally.

Please accept this letter as formal endorsement from the NOCA Governance Board of the Very Low Birth Weight Infants in the Republic of Ireland - Annual Report 2016

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, Block B
111 St Stephen's Green
Dublin 2, D02 VN51
Tel: + (353) 1 402 8577
Email: auditinfo@noca.ie

Appendix B: NICORE Group Members, 2016

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 Rizwan Khan, *Consultant Paediatrician,* University Maternity Hospital Limerick

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 Akhtar Khan, *Consultant Paediatrician,* University Hospital Kerry

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 2016

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

Contents:

Page 1: Patient Identification Worksheet
Page 2: Length of Stay Calculation Worksheet
Page 3: 28 Day Form
Pages 4 & 5: Discharge Form (2 pages)
Page 6: Transfer and Readmission Form (only infants who transfer to another hospital)
Page 7: Supplemental Data Form (Expanded Database only)

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

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

LENGTH OF STAY CALCULATION WORKSHEET FOR INFANTS BORN IN 2016

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 2016-2017 (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 / 2016** ☐57 **Day #**

Subtract Date of Admission: **01 / 13 / 2016** − ☐13 **Day #**

☐44

Add 1: + 1

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

Explanation: Date of 02/26/2016 is Day Number 57. Date of 01/13/2016 is Day Number 13. The day numbers for each date are found in the 2016-2017 Day Number Chart on the Network web site, www.vtoxford.org.

PLEASE DO NOT SUBMIT THIS WORKSHEET

Protected Health Care Information

Vermont Oxford NETWORK

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28 DAY FORM - *For Infants Born in 2016*

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	

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DISCHARGE FORM - *For Infants Born in 2016* - PAGE 1

VON Vermont Oxford NETWORK

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

INTERVENTIONS

22. Respiratory Support (at any time after leaving the delivery room/initial resuscitation area):
- a) **Oxygen after Initial Resuscitation:** ☐ Yes ☐ No
- b) **Conventional Ventilation after Initial Resuscitation:** ☐ Yes ☐ No
- c) **High Frequency Ventilation after Initial Resuscitation:** ☐ Yes ☐ No
- d) **High Flow Nasal Cannula after Initial Resuscitation:** ☐ Yes ☐ No
- e) **Nasal IMV or Nasal SIMV after Initial Resuscitation:** ☐ Yes ☐ No

23. a) **Nasal CPAP after Initial Resuscitation:** ☐ Yes ☐ No
b) **NCPAP before or without ever having received ETT Vent:** ☐ Yes ☐ No ☐ N/A

24. a) **Surfactant during Initial Resuscitation:** ☐ Yes ☐ No
b) **Surfactant at Any Time:** ☐ Yes ☐ No (Item 24.b must be ***Yes*** if Item 24.a is ***Yes***)
***If Yes*, Age at First Dose:** c) Hours _____ d) Minutes (0-59) _____

25. a) **Inhaled Nitric Oxide:** ☐ Yes ☐ No
b) ***If Yes*, where given:** ☐ Your Hospital ☐ Other Hospital ☐ Both

26. Respiratory Support at 36 Weeks (See Manual for N/A criteria):
- a) **Oxygen at 36 Weeks:** ☐ Yes ☐ No ☐ N/A
- b) **Conventional Ventilation at 36 Weeks:** ☐ Yes ☐ No ☐ N/A
- c) **High Frequency Ventilation at 36 Weeks:** ☐ Yes ☐ No ☐ N/A
- d) **High Flow Nasal Cannula at 36 Weeks:** ☐ Yes ☐ No ☐ N/A
- e) **Nasal IMV or SIMV at 36 Weeks:** ☐ Yes ☐ No ☐ N/A
- f) **Nasal CPAP at 36 Weeks:** ☐ Yes ☐ No ☐ N/A

27. a) **Steroids for CLD:** ☐ Yes ☐ No
b) ***If Yes*, Where Given:** ☐ Your Hospital ☐ Other Hospital ☐ Both

28. Indomethacin for Any Reason: ☐ Yes ☐ No

29. Ibuprofen for PDA: ☐ Yes ☐ No

30. Probiotics: ☐ Yes ☐ No

31. Treatment of ROP with Anti-VEGF Drug: ☐ Yes ☐ No

32. a) **ROP Surgery:** ☐ Yes ☐ No
b) ***If Yes*, Where Done:** ☐ Your Hospital ☐ Other Hospital ☐ Both

33. a) **PDA Ligation:** ☐ Yes ☐ No
b) ***If Yes*, Where Done:** ☐ Your Hospital ☐ Other Hospital ☐ Both

34. Surgery for NEC, Suspected NEC, or Bowel Perforation: ☐ Yes ☐ No (If ***Yes***, a Surgery Code is Required in item **36a**)

35. Other Surgery: ☐ Yes ☐ No (If ***Yes***, a Surgery Code is Required in item **36a**)

36a. If *Yes* to NEC Surgery or Other Surgery, Surgical Codes (See Appendix D): If NEC Surgery, one or more of the following codes is required: S302, S303, S307, S308, S309, S333. Indicate location of surgery for each surgery code.

Surgery Code 1: _____	☐ Your Hospital	☐ Other Hospital	☐ Both
Surgery Code 2: _____	☐ Your Hospital	☐ Other Hospital	☐ Both
Surgery Code 3: _____	☐ Your Hospital	☐ Other Hospital	☐ Both
Surgery Code 4: _____	☐ Your Hospital	☐ Other Hospital	☐ Both
Surgery Code 5: _____	☐ Your Hospital	☐ Other Hospital	☐ Both
Surgery Code 6: _____	☐ Your Hospital	☐ Other Hospital	☐ Both
Surgery Code 7: _____	☐ Your Hospital	☐ Other Hospital	☐ Both
Surgery Code 8: _____	☐ Your Hospital	☐ Other Hospital	☐ Both
Surgery Code 9: _____	☐ Your Hospital	☐ Other Hospital	☐ Both
Surgery Code 10: _____	☐ Your Hospital	☐ Other Hospital	☐ Both

36b. Include description for codes S100, S200, S300, S400, S500, S600, S700, S800, S900, S1000 & S1001:

_____

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DISCHARGE FORM - *For Infants Born in 2016* - 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)

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TRANSFER & READMISSION FORM - *For Infants Born in 2016*

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)

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

VERMONT OXFORD NETWORK
DELIVERY ROOM DEATH BOOKLET FOR INFANTS BORN IN 2016

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 Vermont Oxford Network. Vermont Oxford Network does not accept protected health care information.

Contents:

Page 1: Patient Identification Worksheet
Page 2: Delivery Room Death Form

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

VON Vermont Oxford NETWORK

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DELIVERY ROOM DEATH FORM – *For Infants Born in 2016*

VON 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**

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References

1. Twomey A, Drummond L, Murphy BP, Corcoran P, Greene RA, on behalf of NICORE Republic of Ireland. Very Low Birth Weight Infants in the Republic of Ireland Annual Report 2015. Cork: National Perinatal Epidemiology Centre, 2017.

2. 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.

2. 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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