Neonatal Intensive Care Outcomes Research and Evaluation (NICORE)

Neonatal Care in Northern Ireland, 2009

Neonatal Intensive Care Outcomes Research & Evaluation (NICORE)

Neonatal Care in Northern Ireland, 2009

Produced on behalf of the NICORE group by:

Ms E McCall
NICORE Project Manager

Dr S Craig
Consultant Neonatologist
NICORE Chairman

School of Nursing & Midwifery

Queen's University Belfast

Medical Biology Centre (MBC)

97 Lisburn Road, Belfast,

BT9 7BL

Northern Ireland.

Tel: 0044 (0) 2890 972993. Email: Nicore@qub.ac.uk

ISBN: 978-1-909131-00-2

Photographs reproduced with permission from TinyLife.

Published July 2012, NICORE. Printed by CDS, Belfast.

Contents		Page No.

Appendices

Foreword

Neonatal Care in Northern Ireland, 2009 is the eleventh annual report of the Neonatal Intensive Care, Outcomes, Research & Evaluation (NICORE) group. The report provides analyses of information for all infants admitted to any neonatal unit (NNU) in Northern Ireland (NI) who were born between 1st January 2009 and 31st December 2009. It is presented in a format which allows direct comparison with the **Neonatal Care in Northern Ireland, 2006** report.[1]

We have aimed to tailor this report to the data needs of neonatal health professionals throughout NI and have taken into consideration constructive feedback and suggestions. This revised report provides a more comprehensive breakdown of neonatal activity than in previous years and it is hoped that this will inform future service planning and development. Additionally, this report also presents more detailed analyses of important aspects of neonatal care including survival, morbidity, congenital malformations and key outcomes such as late onset sepsis, screening for retinopathy of prematurity (ROP) and core body temperature on admission. The report also provides national benchmarking against the 2009 National Neonatal Audit Programme (NNAP) key audit questions. This information should be valuable when making improvements in the quality of neonatal care.

There have been a number of significant developments since the last NICORE report. Firstly, a new parent information leaflet about the work of NICORE, which was produced in association with the Public Health Agency (PHA), has been introduced in all the NNUs. This is designed to promote transparency, in keeping with good practice, and to help parents to be better informed about the neonatal care of their infants. The leaflet has been well received.

Secondly, the BadgerNet™ neonatal data management system is now being integrated into the daily activity of all the NNUs. This has been a long and challenging process for all concerned but it now means that the existing paper-based data collection system can

be discontinued from 1st January 2013. From this time onwards, we will seek to download the NICORE dataset electronically from BadgerNet™ and we anticipate that this will substantially enhance the timeliness of the regional neonatal reporting by NICORE.

Thirdly, there is a changing context for the delivery of neonatal services in NI. A managed clinical neonatal network has been commissioned in response to the Regulatory Quality Improvement Authority (RQIA) enquiry into the recent pseudomonas outbreak in a number of NNUs in NI. It is expected that the role of NICORE will change and evolve in the coming months in the context of this new formalised network. It is hoped, however, that whatever the new arrangements may look like, neonatal professionals across the region will continue to work together to ensure that infants receive the right care, in the right way, at the right time, in a safe environment.

Finally, within the last year, NICORE has been re-housed within the School of Nursing & Midwifery, Queen's University Belfast (QUB) and we are now working closely with colleagues in this School and across other disciplines. Currently, there are collaborative ongoing projects with Prof Adele Marshall, School of Mathematics & Physics, QUB and Miss Eibhlin McLoone, Consultant Ophthalmologist, Royal Victoria Hospital.

Finally, we wish to record our thanks to colleagues who have retired since the publication of our last report namely: Dr John Jenkins, Prof Henry Halliday, Dr Des Brown, Prof Jim Dornan and Mrs Kyra Gorman. We thank the medical and nursing staff for completing NICORE data collection proformas and for their continued support for the work of NICORE. We also wish to thank Ms Pauline Armstrong for assuring the quality of Royal Maternity Hospital data and the Child Health System Bureau Service for the provision of population data.

Dr Stanley Craig MD MRCP (UK) FRCPCH

Consultant Neonatologist & NICORE Chairman

July 2012.

Executive summary

"Neonatal Care in Northern Ireland, 2009"

The report provides information and analyses for all infants who were born between 1st January 2009 and 31st December 2009 and admitted to a neonatal unit (NNU) in Northern Ireland (NI) for intensive care (IC), high dependency care (HDC) or special care (SC).

The aims are to: (1) give an overview of the care provided for all infants born in 2009 and admitted to a NNU across NI, (2) provide comparison data from previous NICORE reports where possible and (3) highlight areas for quality improvement and/or research and establish priorities for the future.

Key findings of "Neonatal Care in Northern Ireland, 2009"

1. There has been a 9.3% decrease in the absolute numbers of infants receiving neonatal care from 1951 in 2006 to 1769 in 2009. There has been a statistically significant decrease in the proportion of live born infants admitted to neonatal care in 2009 (1769 of 25506, 6.9%) when compared to 2006 (1951 of 23895, 8.2%). Pearson's Chi-Square test: χ^2 (1, N= 49401) = 26.8, $p<0.01$). These changes affected Antrim Area Hospital and Altnagelvin Area Hospital NNUs to a much greater extent than other NNUs.

2. The total number of neonatal care days has decreased by 4.1% from 32084 days in 2006 to 30757 in 2009 but the episodic-based length of stay (LOS) has increased from a median value of 7.0 to 8.0 days, between 2006 and 2009. This LOS varies widely between units ranging from four days to 12 days during 2009. The final infant-based median total length of stay (TLOS) for survivors of neonatal care has remained constant at 8.0 days, between 2006 and 2009.

3. There has been no statistically significant difference in the proportion of infants less than 26 weeks' gestation who were born and received the first episode of neonatal care outside the regional centre in 2009 (18 of 34, 52.9%) when compared to 2006 (15 of 37, 40.5%). Pearson's Chi-Square test: χ^2 (1, N=71) =1.095, p= 0.295).

4. There has been no statistically significant improvement in the survival rate for extremely low gestational age (less than 26 weeks' gestation) infants in 2009 (21 of 34, 61.8%) when compared to 2006 (25 of 37, 67.6%), Pearson's Chi-Square test: χ^2 (1, N=71) = 0.262 , p= 0.609).

5. Late onset sepsis (after day three of life) remains a major morbidity particularly due to coagulase negative staphylococcus (CoNS) species. There has been no statistically significant change in the proportion of infants with at least one proven episode of late sepsis (any pathogen) in 2009 (148 of 1320, 11.2%) when compared to 2006 (156 of 1510, 10.3%) Pearson's Chi-Square test: χ^2 (1, N=2836) = 0.627, p=0.429).

6. There has been a slight rise in the proportion of infants less than or equal to 32 weeks' gestation with chronic lung disease (CLD) (oxygen use at 36 weeks' corrected gestation) in 2009 (74 of 357, 20.7%) when compared to 2006 (64 of 370, 17.3%) Pearson's Chi-Square test: χ^2 (1, N=727) = 1.391, p=0.238) and in the use of steroids for CLD in 2009 (15 of 1764, 0.9%) when compared to 2006 (10 of 1947, 0.5%) Pearson's Chi-Square test: χ^2 (1, N=3711) = 1.568, p= 0.210). However, these were not statistically significant.

7. Therapeutic hypothermia for moderate to severe hypoxic ischaemic encephalopathy (HIE) is now in use in NI NNUs.

8. There has been no statistically significant improvement in the proportion of "at-risk" infants (surviving to screen due date) being screened for retinopathy of

prematurity (ROP) in 2009 (226 of 289, 78.2%) when compared to 2006 (218 of 288, 75.7 %) Pearson's Chi-Square test: χ^2 (1, N=577) = 0.511, p=0.475). More infants received treatment for ROP in 2009 however, there has been no statistically significant change in the proportion of infants undergoing retinal cryosurgery and/or laser surgery for ROP in 2009 (18 of 55, 32.7%) when compared to 2006 (11 of 49, 22.4%) Pearson's Chi-Square test: χ^2 (1, N=104) =1.361, p=0.243). It must be noted however that NICORE data does not include results of out-patient ROP screens.

9. There has been an increase in the number of infants with congenital malformations receiving neonatal care in NI during 2009 (162 of 1769, 9.2%) when compared to 2006 (151 of 1951, 7.7%), however the proportion of infants with congenital malformations receiving neonatal care does not show any statistically significant change during the two time periods (Pearson's Chi-Square test: χ^2 (1, N=3720) = 2.421, p=0.120). The number of care days associated with these infants in NI has increased from 2686 days in 2006 to 2821 days in 2009.

10. Longstanding, evidence-based NICORE quality standards indicate that there have been statistically significant improvements in initial thermal care (core body temperature greater than 36^{o}C on admission to NNU); particularly for the most vulnerable infants of less than or equal to 28 weeks' gestation in 2009 (86 of 112, 76.8%) when compared to 2006 (64 of 106, 60.4%) Pearson's Chi-Square test: χ^2 (1, N=218) = 6.831, p=0.009). High standards of antenatal steroid administration have been maintained with further improvement in 2009 as shown by a statistically significant increase in the proportion of mothers of who received at least a partial course of steroids prior to the delivery of an 'at risk' infant during 2009 (579 of 650, 89.1%) when compared to 2006 (596 of 725, 82.2%). Pearson's Chi-Square test: χ^2 (1, N=1375) = 13.014, p<0.001). In addition, the NICORE figures for "temperature on admission, use of antenatal steroids and screening for ROP" also compare favourably with the National Neonatal Audit Project figures for England & Wales.

11. Overall, for NI for those infants discharged home directly from NNU, 20.9% were exclusively breast fed with another 15.7% receiving breast milk and formula. Approximately 30% of infants of less than 33 weeks' gestation are feeding on some breast milk at the time of discharge (any destination) from neonatal care. However, only 12.1% are exclusively fed on breast milk.

Recommendations and the way forward

1. All NNUs should complete the integration of BadgerNet™ into their daily activity and move to electronic NICORE data collection as soon as it becomes available.

2. Collection of NICORE data should be an important priority for the newly established managed clinical network.

3. UK and international neonatal benchmarking should continue and be a key function of NICORE regardless of the new neonatal service structures.

4. The new managed clinical neonatal network should review the findings of this report and establish the clinical priorities accordingly.

5. The new managed clinical neonatal network should aim to increase the proportion of extremely low gestational age infants (less than 26 weeks' gestation) being born in the regional centre.

6. Concentrated efforts to reduce the burden of late onset (after day 3 of life) sepsis should remain a priority for each NNU and the new managed clinical neonatal network.

7. NNUs should monitor the trends in the development of chronic lung disease (CLD) in very preterm infants (less than or equal to 32 weeks' gestation) and should consider undertaking evidence-based quality improvement initiatives aimed at reducing the incidence of CLD.

8. NNUs should ensure that infants with moderate to severe hypoxic ischaemic encephalopathy (HIE) should have therapeutic hypothermia commenced within the evidence-based time frame.

9. NNUs should ensure that all at-risk infants are screened appropriately for retinopathy of prematurity (ROP) and findings documented in the newly agreed ROP screening record. Trend data in the number of infants receiving ROP treatment should be monitored by all NNUs who should also ensure adherence to evidence-based oxygen saturation targeting in those at risk of ROP.

10. NNUs should examine strategies to increase the proportion of infants receiving breast milk at the time of discharge.

11. NICORE should continue to benchmark with the National Neonatal Audit Programme (NNAP) in England & Wales and NNUs are encouraged to participate in this programme by routinely exporting their data to NNAP which is facilitated by BadgerNet™ platform.

Section 1.0 Introduction

1.1 Background

'Neonatal Care in Northern Ireland, 2009' provides information relating to all infants born and admitted to neonatal care in NI during the time period 1st January 2009 to 31st December 2009. This report provides a regional summary of neonatal care activities and for each NNU, outcomes in terms of mortality and morbidities and an assessment of performance against both NNAP key audit measures and NICORE evidence-based quality standards. Denominator data for live births in NI have been provided by the Child Health System Bureau Service database.[2]

The NICORE core dataset includes the Vermont Oxford Network (VON) dataset,[3] the British Association of Perinatal Medicine (BAPM) minimum dataset,[4] the EuroNeoStat (ENS) dataset[5] and NICORE specific data items. All infants are allocated to calendar year, (by date of birth) as with other perinatal datasets. This facilitates the provision of denominator data from other databases particularly the Child Health System Bureau Service database.[2]

1.2 Method

Each NNU routinely provided a range of socio-demographic, obstetric, neonatal and outcome data via the NICORE proforma where each record corresponded to one episode of care. Medical and/or nursing staff completed this proforma using the definitions provided. The data were then analysed centrally using the Predictive Analysis Software, PASW® Statistics 18 (SPSS Inc, Chicago, Illinois, USA).[6]

Each eligible infant was given a Baby Unique Identifier (BUI) on first admission to a NNU which enabled linkage of his/her data throughout the region if an inter-unit transfer occurred. The BUI number also enabled data to be analysed and presented on a regional

basis by the elimination of duplicate entries. All NICORE log books which linked the BUI to hospital numbers were retained within the NNU.

1.3 Limitations of the 2009 NICORE dataset

- Infants born in 2008 and admitted to NNU in 2009 have been excluded.
- Infants re-admitted to NNU from home have been excluded.
- Data pertaining to the provision of level 3 care (SC) on postnatal wards have been excluded from this report.

1.4 Location of the NICORE database

The NICORE 2009 database is held in the NICORE office, School of Nursing & Midwifery, Medical Biology Centre (MBC), Queen's University Belfast (QUB) and the content is covered by the QUB data protection registration.

1.5 Denominator data for all births in NI

Each of the four Child Health System Bureaus in NI provided a summary of relevant Child Health System (CHS) data for the time period 1st January 2009 to 31st December 2009.[2]

1.6 Report structure

This report concentrates on four main areas of neonatal care:

- Neonatal activity and workloads.
- Location of initial neonatal care and transfer patterns.
- Neonatal outcomes – mortality and key morbidities.
- Benchmarking: key audit questions and annual trends.

1.7 **Aims**

The aims of this report are:

- To give an overview of the care provided for all infants who were born in 2009 and admitted to a NNU across NI and to provide NICORE 2006 comparison data where appropriate.
- To highlight areas for future quality improvement and research.
- To establish priorities for the future.

Section 2.0 Neonatal activity and workloads

2.1 Introduction

In NI, provision of neonatal Services is shared by five Health and Social Care Trusts (HSCTs): Belfast, South Eastern, Northern, Southern and Western. There are currently seven neonatal facilities: one regional unit providing specialised services (Royal Maternity Hospital (RMH), four area units providing continuing IC/HDC (Ulster (ULST), Antrim (ANT), Craigavon (CAH), Altnagelvin (ALT) and two smaller units, Daisy Hill (DH) and Erne (EH), providing short-term IC/HDC. The current complement of cot levels, as defined by the British Association of Perinatal Medicine (BAPM),[7] for the region is: 21 level 1 (IC), 21 level 2 (HDC) and 64 level 3 (SC). In addition, the Royal Belfast Hospital for Sick Children (RBHSC), located in Belfast, provides surgical and specialist medical care. Infants are primarily transferred between NNUs according to clinical need.

2.2 Live births and admissions to neonatal care in NI

From 1st January 2009 to 31st December 2009, there were 25506 live born infants in NI hospitals, en route or at home (resident & non resident). During the same time period 2037 episodes of neonatal care were provided for 1769 infants. This equates to 6.9% of live births in NI.

- There has been a statistically significant decrease in the proportion of live born infants admitted to neonatal care in 2009 (1769 of 25506, 6.9%) when compared to 2006 (1951 of 23895, 8.2%). Pearson's Chi-Square test: χ^2 (1, N= 49401) = 26.8, $p<0.01$), (Table 1).

Table 1 compares the number of infants admitted to neonatal care to the total number of live infants born at each completed week of gestation in NI (resident and non resident) for the same time period. As expected there were some discrepancies in the recording of gestation across data sources and these are denoted with an asterisk.*

Table 1 Live born infants in NI & number of infants admitted to neonatal care by completed weeks' gestation during 2009 and 2006.

Gest (wks)	Live born infants NI 2009	Infants receiving neonatal care 2009	Live born infants NI 2006	Infants receiving neonatal care 2006
<22	13	0	Not available	0
22	7	0	4	0
23	5	4	11	2
24	17	12	12	11
***25**	14	18	23	24
***26**	27	26	21	24
***27**	30	33	33	30
28	30	22	31	31
***29**	40	36	45	46
30	48	46	57	55
***31**	74	73	58	60
***32**	87	89	90	92
33	135	135	170	168
34	223	164	222	186
35	394	163	323	163
36	652	117	553	148
37	1398	145	1147	127
≥38	22312	686	21095	784
Total	**25506**	**1769 (6.9%)**	**23895**	**1951 (8.2%)**

Regionally, during 2009 there were 2037 episodes of neonatal care provided for 1769 infants. In all, 1166 of 1769 (65.9%) infants received IC and/or HDC with additional SC. Six hundred and three infants of 1769 (34.1%) received SC only (Table 2). This equates to 4.6% of live births receiving IC and/or HDC and 2.4% receiving SC only.

These figures represent a 9.3% decrease in the absolute numbers of infants admitted to neonatal care from 1951 in 2006 to 1769 in 2009 as shown in Table 1 and Table 2.

- There has been no statistically significant change in the proportion of infants admitted to neonatal care receiving IC and/or HDC care in 2009 (1166 of 1769, 65.9%) when compared to 2006 (1226 of 1951, 62.8%). Pearson's Chi-Square test: χ^2 (1, N= 3720) = 3.82, p=0.05), (Table 2).

Table 2 Number of episodes of IC and/or HDC, SC and number of infants admitted to NNUs in NI during 2009 and 2006.

	Infants		Episodes	
	2009	**2006**	**2009**	**2006**
IC and/or HDC Level 1 and/or level 2 care	1166	1226	1309	1364
Additional SC Level 3 care	-	-	113	101
SC only Level 3 care only	603	725	615	734
Total	**1769**	**1951**	**2037**	**2199**

2.3 Neonatal activity by NNU

Table 3 and Table 4 summarise the neonatal care provided by the seven NNUs in NI. Levels of care have been allocated according to the British Association of Perinatal Medicine (BAPM) categories of neonatal care.[7] For the 1769 infants admitted to neonatal care, 1552 (87.7%) had a single admission, 176 (9.9%) had two admissions, 35 (2.0%) had three admissions, three (0.2%) had four admissions, two (0.1%) had five admissions and one infant (0.1%) had six admissions. As a consequence of this, the total infant-based figures displayed in Table 4 reflects multiple admissions of an infant across NNUs i.e. if an infant was admitted to two different NNUs this infant will be counted in each unit. If an infant is admitted to the same NNU a number of times the infant will be counted only once for this NNU.

In keeping with the reduction in the absolute numbers of infants receiving neonatal care, there has also been a 7.4% decrease in the total number of episodes of care provided since

2006 (Table 3). There have been proportionate reductions in the number of IC (8.0%) and HD (5.6%) care days but only a minor decrease in the proportion of SC (0.5%) days provided (Table 4). When comparing these changes on each of the individual NNUs, the greatest impact appears to have been on ANT and ALT NNUs, where there were 23.3% and 17.9% reductions in the number of care episodes respectively, compared with no change in CAH and a 2.9% decrease in RMH NNU. There was also a 12.5% increase in care episodes in EH (Table 3).

Table 3 Neonatal activity by NNU during 2009 and 2006.

	Total Infants		IC/HDC Episodes		SC Episodes		Total Episodes	
NNU	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**
ALT	240	299	163	164	83	138	246	302
ANT	263	344	208	223	59	125	267	348
CAH	349	356	218	190	146	174	364	364
DH	165	172	22	39	153	148	175	187
EH	141	125	29	39	115	89	144	128
RMH	507	521	448	482	61	42	509	524
ULST	322	335	221	227	111	119	332	346
Total	***1987**	***2152**	**1309**	**1364**	**728**	**835**	**2037**	**2199**

** One infant can have multiple admissions across NNUs.*

Table 4 Neonatal activity levels of care by NNU during 2009 and 2006.

	IC/ Level 1 days		HDC/ Level 2 days		SC/Level 3 days	
NNU	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**
ALT	700	757	818	888	2338	2517
ANT	513	1004	956	648	3148	3847
CAH	650	424	1028	991	3301	3351
DH	22	32	25	102	1651	1366
EH	45	97	30	39	1567	974
RMH	2678	2811	2873	3587	3102	3725
ULST	370	287	970	846	3434	2858
Total	**4978**	**5412**	**6700**	**7101**	**18541**	**18638**

2.4 Neonatal activity by gestational age group for NI and each NNU

The following infant classification according to duration of gestation (completed weeks) has been used to demonstrate neonatal activity: extremely preterm (less than 28 weeks' gestation), very preterm (28 to 31 weeks' gestation), moderately preterm (32 to 33 weeks' gestation), late preterm (34 to 36 weeks' gestation) and term (greater than or equal to 37 weeks' gestation) infants.[8] Table 5 demonstrates regional activity and workload in terms of infants, episodes and levels of care in NI and Table 6 to Table 12 give details for each NNU.

Table 5 Neonatal activity by gestational age group during 2009 and 2006.

	Infants		Episodes		IC/Level 1 days		HDC/Level 2 days		SC/Level 3 days	
Gest (wks)	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**
< 28	93	91	162	145	2254	2657	2420	2061	3009	2261
≥ 28 & ≤ 31	177	192	250	262	1093	1109	1780	1864	5246	5364
≥ 32 & ≤ 33	224	260	268	305	462	479	729	858	3641	3828
≥ 34 & ≤ 36	444	497	488	540	523	548	930	906	3712	3959
≥ 37	831	911	869	947	646	619	841	1412	2933	3259
Total	**1769**	**1951**	**2037**	**2199**	**4978**	**5412**	**6700**	**7101**	**18541**	**18671**

Table 6 Neonatal activity by gestational age group during 2009 and 2006 NNU: RMH.

	Infants		Episodes		IC/Level 1 days		HDC/Level 2 days		SC/Level 3 days	
Gest (wks)	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**
< 28	60	57	62	58	1581	1565	1345	1155	408	560
≥ 28 & ≤ 31	70	77	70	78	436	503	644	851	1125	1308
≥ 32 & ≤ 33	57	77	57	77	102	203	219	422	441	735
≥ 34 & ≤ 36	109	101	109	101	177	244	312	457	576	632
≥ 37	211	209	211	210	382	296	353	702	552	490
Total	**507**	**521**	**509**	**524**	**2678**	**2811**	**2873**	**3587**	**3102**	**3725**

Table 7 Neonatal activity by gestational age group during 2009 and 2006
NNU: ALT.

	Infants		Episodes		IC/Level 1 days		HDC/Level 2 days		SC/Level 3 days	
Gest (wks)	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**
< 28	13	17	15	18	233	563	258	303	259	396
≥ 28 & ≤ 31	24	27	27	27	213	69	286	285	610	729
≥ 32 & ≤ 33	40	22	39	22	78	16	75	43	566	347
≥ 34 & ≤ 36	67	81	68	81	107	18	151	135	581	504
≥ 37	96	152	97	154	69	91	48	122	322	541
Total	**240**	**299**	**246**	**302**	**700**	**757**	**818**	**888**	**2338**	**2517**

Table 8 Neonatal activity by gestational age group during 2009 and 2006
NNU: ANT.

	Infants		Episodes		IC/Level 1 days		HDC/Level 2 days		SC/Level 3 days	
Gest (wks)	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**
< 28	16	19	19	21	66	380	144	82	222	337
≥ 28 & ≤ 31	33	47	34	48	128	300	209	171	873	1087
≥ 32 & ≤ 33	49	64	50	64	145	132	233	160	756	936
≥ 34 & ≤ 36	75	102	74	102	101	126	225	121	764	958
≥ 37	90	112	90	113	73	66	145	114	533	529
Total	**263**	**344**	**267**	**348**	**513**	**1004**	**956**	**648**	**3148**	**3847**

Table 9 Neonatal activity by gestational age group during 2009 and 2006
NNU: CAH.

	Infants		Episodes		IC/Level 1 days		HDC/Level 2 days		SC/Level 3 days	
Gest (wks)	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**
< 28	32	15	38	17	272	90	508	385	1107	301
≥ 28 & ≤ 31	45	49	47	53	165	173	335	358	886	1115
≥ 32 & ≤ 33	43	65	42	65	70	52	43	83	502	812
≥ 34 & ≤ 36	87	88	91	88	74	51	70	43	486	628
≥ 37	142	139	146	141	69	58	72	122	320	495
Total	**349**	**356**	**364**	**364**	**650**	**424**	**1028**	**991**	**3301**	**3351**

Table 10 Neonatal activity by gestational age group during 2009 and 2006
NNU: ULST.

	Infants		Episodes		IC/Level 1 days		HDC/Level 2 days		SC/Level 3 days	
Gest (wks)	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**
< 28	14	15	16	17	98	19	158	69	618	468
≥ 28 & ≤ 31	41	30	41	33	135	57	293	185	996	635
≥ 32 & ≤ 33	52	50	54	50	54	52	149	141	702	567
≥ 34 & ≤ 36	66	87	67	91	47	72	158	126	537	625
≥ 37	149	153	154	155	36	87	212	325	581	563
Total	**322**	**335**	**332**	**346**	**370**	**287**	**970**	**846**	**3434**	**2858**

Table 11 Neonatal activity by gestational age group during 2009 and 2006
NNU: DH.

	Infants		Episodes		IC/Level 1 days		HDC/Level 2 days		SC/Level 3 days	
Gest (wks)	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**
< 28	6	5	7	9	2	3	0	62	211	112
≥ 28 & ≤ 31	23	17	25	21	3	3	11	5	517	442
≥ 32 & ≤ 33	9	15	9	16	1	4	0	7	169	229
≥ 34 & ≤ 36	41	42	45	47	6	11	7	15	406	296
≥ 37	86	93	89	94	10	11	7	13	348	320
Total	**165**	**172**	**175**	**187**	**22**	**32**	**25**	**102**	**1651**	**1399**

Table 12 Neonatal activity by gestational age group during 2009 and 2006
NNU: EH.

	Infants		Episodes		IC/Level 1 days		HDC/Level 2 days		SC/Level 3 days	
Gest (wks)	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**
< 28	4	5	5	5	2	37	7	5	184	87
≥ 28 & ≤ 31	6	2	6	2	13	4	2	9	239	48
≥ 32 & ≤ 33	17	10	17	11	12	20	10	2	505	202
≥ 34 & ≤ 36	33	29	34	30	11	26	7	9	362	316
≥ 37	81	79	82	80	7	10	4	14	277	321
Total	**141**	**125**	**144**	**128**	**45**	**97**	**30**	**39**	**1567**	**974**

2.5 Neonatal activity by birth weight group

Table 13a and 13b summarise neonatal activity by infant birth weight group as defined by BAPM.[9] Regionally (NI), using Pearson's Chi-Square there were no statistically significant differences in the proportion of infants admitted of low birth weight (LBW, less than 2500g), very low birth weight (VLBW, less than 1500g) or extremely low birth weight (ELBW, less than 1000g) between 2006 and 2009 (Table 13a).

Table 13a NI birth weight group for infants admitted to NNU during 2009 and 2006.

Birth Weight Group (g)	NI		
	2009	2006	Pearson's Chi-Square test
Low Birth Weight (LBW, < 2500g)	790 (44.7%)	916 (47.0%)	χ^2 (1, N=3720) =1.96 , p= 0.16)
Very Low Birth Weight (VLBW, < 1500g)	230 (13.0%)	240 (12.3%)	χ^2 (1, N=3710) =0.41 , p= 0.52)
Extremely Low Birth Weight (ELBW, <1,000g)	92 (5.2%)	92 (4.7%)	χ^2 (1, N=3720) = 0.46, p= 0.50)

2.6 Length of stay (LOS) in NNU

Despite a 9.3% reduction in the number of infants receiving care, there was only a 4.1% reduction in the total number of care days, from 32084 in 2006 to 30757 in 2009. For all episodes of care (2009), the median length of stay was 8.0 days which ranged from one day to 181 days (Table 14). This was an increase of one day compared with 2006. When comparing NNUs, the shortest and longest median LOS were 4.0 and 12.0 days in DH and ANT, respectively. Length of stay (LOS) was calculated as follows: (the date of discharge from the NNU minus the date of admission to the NNU) plus one day. This analysis includes both survivors and non-survivors.

Table 13b Infants by birth weight group for each NNU (excludes re-admissions to same unit) during 2009 and 2006.

Birth weight (g)	ALT		ANT		CAH		DH		EH		RMH		ULST		Total		NI	
	2009	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**
≤ 999	12	13	17	19	27	21	8	7	2	3	56	61	19	15	141	139	92	92
1000 - 1499	24	25	26	30	40	33	14	8	7	2	55	59	19	30	185	187	138	148
1500 - 2499	85	103	99	160	98	134	45	57	39	33	161	164	122	112	649	763	560	676
≥ 2500	119	158	121	135	184	168	98	100	93	87	235	237	162	178	1012	1063	979	1035
Total	**240**	**299**	**263**	**344**	**349**	**356**	**165**	**172**	**141**	**125**	**507**	**521**	**322**	**335**	**1987**	**2152**	**1769**	**1951**

Note: infants admitted to more than one NNU are counted in each hence ‘ Total’ is greater that the regional total for Northern Ireland ‘NI’

Table 14 Length of stay LOS (days) and descriptive statistics based on episodes of care during 2009 and 2006.

NNU	Mean LOS (days)		Median LOS (days)		Range		Sum (days)	
	2009	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**
ALT	16.2	14.5	9.0	6.0	1-135	1- 184	3984	4372
ANT	17.7	16.3	12.0	12.0	1-125	1-115	4729	5669
CAH	14.0	13.9	5.0	7.0	1-123	1-87	5103	5054
DH	9.8	8.6	4.0	4.0	1-70	1-63	1721	1600
EH	11.7	9.1	5.0	4.0	1-120	1-84	1682	1165
RMH	17.1	19.3	8.0	10.0	1-179	1-172	8703	10109
ULST	14.6	11.9	9.0	7.0	1-181	1-89	4835	4115
NI	**15.1**	**14.6**	**8.0**	**7.0**	**1-181**	**1-184**	**30757**	**32084**

Table 15 shows the median final total lengths of stay for all infants, those who died and the survivors by completed weeks' gestation at birth. This analysis is infant-based and uses the final total length of stay for each infant across all episodes of care until final discharge from neonatal care. 'Final total length of stay' (TLOS) was calculated as follows: (the final date of discharge from neonatal care minus the date of first admission to neonatal care) plus one day. If an infant was transferred to RBHSC or another NNU outside NI and then transferred back to neonatal care within NI without being discharged home then these days were accounted for in the 'Final total length of stay'. In all, during 2009, 53 infants died accounting for 758 neonatal care days, compared to 53 infants in 2006 accounting for 1205 days.

Table 15 **Final total length of stay TLOS (days) based of total length of stay for each infant across all episodes of care by completed weeks' gestation during 2009 and 2006.**

Gest (wks)	Infants		Median TLOS days		Total days		Survivors to discharge from NNU		Median TLOS Survivors days		Total days Survivors	
	2009	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**
23	4	2	1.5	2.5	152	5	1(25.0%)	0 (0.0%)	148.0	0.0	148	0
24	12	11	112.0	104.0	1083	898	6(50.0%)	5(45.5%)	137.0	125.0	899	644
25	18	24	104.0	101.0	1589	2387	14(77.8%)	20(83.3%)	117.0	104.0	1571	2023
26	26	24	92.5	80.5	2299	1608	21(80.8%)	20(83.3%)	106.0	94.0	2216	1598
27	33	30	70.0	75.0	2570	2122	29(87.9%)	28(93.3%)	74.0	76.5	2405	2116
28	22	31	72.5	65.0	1669	1882	21(95.5%)	29(93.5%)	74.0	65.0	1668	1856
29	36	46	49.5	54.5	1852	2517	35(97.2%)	44(95.7%)	50.0	55.0	1848	2512
30	46	55	44.5	39.0	2211	2146	45(97.8%)	51(92.7%)	44.0	40.0	2032	2125
31	73	60	32.0	31.0	2354	1880	72(98.6%)	59(98.3%)	32.0	31.0	2353	1852
32	89	92	23.0	23.0	2194	2258	89(100.0%)	92(100.0%)	23.0	23.0	2194	2258
33	135	168	17.0	18.0	2690	3098	132(97.8%)	166(98.8%)	17.0	18.0	2679	3092
34	164	186	14.0	15.0	2501	2673	160(97.6%)	184(98.9%)	14.0	15.0	2495	2638
35	163	163	10.0	9.0	1653	1619	161(98.8%)	161(98.8%)	10.0	9.0	1651	1605
36	117	148	7.0	6.0	1141	1325	114(97.4%)	144(97.3%)	7.0	6.0	1136	1153
37	145	127	4.0	5.0	896	837	141(97.2%)	127(100.0%)	4.0	5.0	847	837
≥38	686	784	3.0	4.0	3702	4819	675(98.4%)	768(98.0%)	3.0	4.0	3656	4560
NI	**1769**	**1951**	**8.0**	**8.0**	**30556**	**32074**	**1716 (97.0%)**	**1898 (97.3%)**	**8.0**	**8.0**	**29798**	**30869**

Section 3.0 Location of initial neonatal care and transfer patterns

3.1 Introduction

The following section details the transfers of infants into NNUs from their location of birth, both within and outside NI. The sending and receiving hospitals were categorised according to the following criteria: regional facility (RMH), facility offering continuing neonatal IC (ALT, ANT, CAH and ULST), facility offering short-term neonatal IC or stabilisation (DH and EH) and facilities with no neonatal IC services (Causeway Hospital (CWAY), Downe Hospital (DWH), Lagan Valley Hospital (LV), Mater Hospital (MAT), infants born at home/en route). The Royal Belfast Hospital for Sick Children (RBHSC) was given an individual category.

On occasion, due to neonatal staff confusing RMH and RBHSC on the NICORE proforma as a 'sending' or 'receiving' hospital' small discrepancies in Table 19 and Table 20 have arisen.

3.2 Birth details

Infants were comprised of 43.0% female (760 of 1769) and 57.0% male (1009 of 1769). The majority of infants 56.8% (997 of 1756) were delivered by caesarean section; information was unavailable for 13 infants. There were 1501 of 1763 (85.1%) infants from singleton births and 262 of 1763 (14.9%) from multiple births: (243 twins, nine triplets, four quadruplets and six sextuplets) admitted to neonatal care; information was unavailable for six infants.

3.3 Location of birth and initial neonatal care

Overall, for infants admitted to a NNU (2009), 442 of 1769 (25.0%) were born at the regional centre, 944 of 1769 (53.4%) were born at a hospital providing continuous neonatal care, 262 of 1769 (14.8%) at a hospital normally providing short-term neonatal IC only and 112 of 1769 (6.3%) born where no neonatal IC is provided. Nine infants were categorised as 'other' and of these three were born outside NI (Glasgow (one infant), Dublin (two infants); further information was unavailable for six infants. Those infants who were born in Royal Victoria Hospital main theatres were categorised as 'Regional centre' (three infants).

The standard of best clinical practice for infants born at less than 26 weeks' gestation, which is agreed and recommended by the NI Neonatal Network, is that the delivery should take place in the regional centre (RMH) where possible.

- There has been no statistically significant difference in the proportion of infants less than 26 weeks' gestation who were born and received the first episode of neonatal care outside the regional centre in 2009 (18 of 34, 52.9%) when compared to 2006 (15 of 37, 40.5%). Pearson's Chi-Square test: χ^2 (1, N=71) =1.095, p= 0.295), (Table 16).

Table 17 provides details of the location of initial neonatal care for each NNU for inborn and out born infants in the context of live born infants for each maternity unit. For example, this table demonstrates that during 2009 there were 5473 live born infants in RMH of which 436 (8.0%) were admitted to RMH NNU. An additional 38 out born infants were admitted directly to RMH NNU.

3.4 **Neonatal transfer patterns**

For NNU infant admissions during 2009, there was an associated transfer into NNU (after birth) in 379 of 2020 (18.8%) episodes of care; information was unavailable for 17 cases. At discharge, 390 of 2037 (19.1%) of infants were transferred to another NNU or hospital for continuing care (Table 20). Table 18 & 19 show how transfers were distributed throughout NI for those into and out of NNUs. On final discharge from neonatal care in NI 1402 of 1769 (79.3%) infants went home, 181 of 1769 (10.2%) went to the postnatal ward or another ward in the same hospital, 133 of 1769 (7.5%) went to another hospital or NNU and 53 infants (3.0%) died (Table 20).

Table 16 Provision of neonatal care at place of delivery by completed weeks' gestation during 2006 and 2009.

Gestation (wks)	Regional centre		Continuing care		Short- term care		No neonatal		Other		Total	
	2009	2006	2009	2006	2009	2006	2009	2006	2009	2006	2009	2006
23	0	2	4	0	0	0	0	0	0	0	4	2
24	5	4	5	6	0	0	2	1	0	0	12	11
25	11	16	1	7	2	1	1	0	3	0	18	24
26	19	13	6	7	0	0	1	2	0	2	26	24
27	14	13	17	13	1	2	1	2	0	0	33	30
28	7	13	15	12	0	0	0	4	0	2	22	31
29	16	20	17	21	1	4	1	0	1	1	36	46
30	19	19	23	34	4	0	0	2	0	0	46	55
31	20	16	48	39	3	3	2	2	0	0	73	60
32	22	33	59	53	6	4	2	2	0	0	89	92
33	30	41	88	110	13	12	2	5	2	0	135	168
34	41	39	98	112	22	26	3	9	0	0	164	186
35	33	31	95	103	27	19	8	9	0	1	163	163
36	23	28	68	90	17	22	9	8	0	0	117	148
37	28	28	82	64	28	28	6	7	1	0	145	127
38	49	43	81	103	29	30	13	13	0	0	172	189
39	45	51	102	114	38	48	16	14	0	0	201	227
≥40	60	62	135	209	71	61	45	36	2	0	313	368
Total	**442 (25.0%)**	**472 (24.2%)**	**944 (53.4%)**	**1079 (56.2%)**	**262 (14.8%)**	**260 (13.3%)**	**112 (6.3%)**	**116 (6.0%)**	**9 (0.5%)**	**6 (0.3%)**	**1769**	**1951**

Table 17 **Location of initial neonatal care (FIRST episode) and location of birth: inborn (IB) and out born (OB) during 2009 and 2006.**

NNU (Initial care)	Live Births		Inborn (IB)		Outborn (OB)		Total	
	2009	2006	2009	2006	2009	2006	2009	2006
ALT	2817	2612	218	279	6	7	224	286
ANT	2796	2554	208	270	22	41	230	311
CAH	3885	3475	291	288	3	25	294	313
DH	2170	1969	130	143	2	2	132	145
EH	1297	1281	132	116	4	3	136	119
RMH	5473	5272	436	468	38	24	474	492
ULST	3430	2662	227	261	52	24	279	285
Other	3638	4070	-	-	-	-	-	-
Total	**25506**	**23895**	**1642**	**1825**	**127**	**126**	**1769**	**1951**

Table 18 **Neonatal transfers after birth INTO each NNU by sending and receiving hospital (all care episodes) during 2009.**

	Receiving							
Sending	ALT	ANT	CAH	DH	EH	RMH	ULST	Total
ALT		1	3	0	4	4	2	14
ANT	3		5	0	0	9	6	23
CAH	5	0		29	0	7	2	43
CWAY	3	17	0	0	0	3	0	23
DH	0	0	11		0	2	0	13
EH	1	0	2	0		0	0	3
LV	0	0	2	0	0	0	34	36
MAT	0	5	1	0	0	21	13	40
RMH	10	31	35	10	2		41	129
ULST	1	5	2	2	0	12		22
At home /en route	0	0	0	1	1	2	1	5
RBHSC	2	0	5	0	0	1	3	11
Other	3	0	0	1	2	9	2	16
Total	28	59	66	43	9	70	104	379

Table 19 Neonatal transfers after birth OUT of each NNU by sending and receiving hospital (all care episodes) during 2009.

	Receiving										
Sending	**ALT**	**ANT**	**CAH**	**DH**	**EH**	**RMH**	**ULST**	**RBHSC**	**CWAY**	**Other**	**Total**
ALT		**1**	**3**	**0**	**4**	**3**	**2**	**9**	**3**	**0**	**25**
ANT	**3**		**5**	**0**	**0**	**9**	**6**	**16**	**17**	**0**	**56**
CAH	**5**	**0**		**29**	**0**	**4**	**2**	**15**	**0**	**2**	**57**
DH	**0**	**0**	**11**		**0**	**2**	**0**	**6**	**0**	**1**	**20**
EH	**1**	**0**	**2**	**0**		**0**	**0**	**7**	**0**		**10**
RMH	**12**	**32**	**37**	**10**	**2**		**37**	**47**	**7**	**2**	**186**
ULST	**1**	**5**	**2**	**2**	**0**	**11**		**15**	**0**	**0**	**36**
Total	**22**	**38**	**60**	**41**	**6**	**29**	**47**	**115**	**27**	**5**	**390**

Table 20 Destination on discharge from neonatal care during 2009.

Destination on Discharge	All care episodes	Final care episode
Home	1402(68.8%)	1402 (79.3%)
Postnatal ward/ other ward	192(9.4%)	181(10.2%)
Other hospital/neonatal unit	390(19.1%)	133 (7.5%)
Died	53(2.6%)	53(3.0%)
Total	**2037**	**1769**

Section 4.0 Neonatal outcomes: mortality and key morbidities

4.1 Introduction

This section provides an overview of mortality and key morbidity outcomes of neonatal care for infants born and admitted to NNU in 2009. Comparison data for infants born and admitted to NNU in 2006 are given where available.

4.2 Mortality and survival to discharge from NNU

During 2009, 53 of 1769 (3.0%) infants born and admitted to neonatal care died during an admission to NNU which equates to a mortality rate of 29.9 per 1,000 infants admitted to neonatal care in NI.

- There has been no statistically significant improvement in the survival rate for extremely low gestational age (less than 26 weeks' gestation) infants in 2009 (21 of 34, 61.8%) when compared to 2006 (25 of 37, 67.6%). Pearson's Chi-Square test: χ^2 (1, N=71) = 0.262 , p= 0.609), (Table 21).

Table 21 Mortality by completed weeks' gestation during 2009 and 2006.

Gest (wks)	Infants		Deaths		Survivors to discharge from neonatal care n (%)	
	2009	**2006**	**2009**	**2006**	**2009**	**2006**
23	4	2	3	2	1 (25.0%)	0 (0.0%)
24	12	11	6	6	6 (50.0%)	5 (45.5%)
25	18	24	4	4	14 (77.8%)	20 (83.3%)
26	26	24	5	4	21 (80.8%)	20 (83.3%)
27	33	30	4	2	29 (87.9%)	28 (93.3%)
28	22	31	1	2	21 (95.5%)	29 (93.5%)
29	36	46	1	2	35 (97.2%)	44 (95.7%)
30	46	55	1	4	45 (97.8%)	51 (92.7%)
31	73	60	1	1	72 (98.6%)	59 (98.3%)
32	89	92	0	0	89 (100.0%)	92 (100.0%)
33	135	168	3	2	132 (97.8%)	166 (98.8%)
34	164	186	4	2	160 (97.6%)	184 (98.9%)
35	163	163	2	2	161 (98.8%)	161 (98.8%)
36	117	148	3	4	114 (97.4%)	144 (97.3%)
37	145	127	4	0	141 (97.2%)	127 (100.0%)
≥38	686	784	11	16	675 (98.4%)	768 (98.0%)
NI	**1769**	**1951**	**53 (3.0%)**	**53 (2.7%)**	**1716 (97.0%)**	**1898 (97.3%)**

4.3 Mortality and survival to discharge from neonatal care and number of fetuses this pregnancy

Regionally (NI), during 2009 the majority of infants 1501 of 1763 (85.1%) were from singleton births and 262 of 1763 (14.9%) were from multiple births; information was unavailable in six cases.

- There has been no statistically significant change in the proportion of infants from multiple births for those infants admitted to neonatal care during 2009 (262 of 1763, 14.9 %) when compared to 2006 (291 of 1951, 14.9%). Pearson's Chi-Square test: $\chi^2(1, N=3714) = 0.02$, $p=0.963$), (Table 22).

- There has been a significant decrease in the proportion of infants from multiple births surviving to discharge in 2009 (252 of 262, 96.2%) when compared to 2006 (288 of 291, 99.0%). Pearson's Chi-Square test: χ^2 (1, N=553) = 4.661, p= 0.031), (Table 22).

Table 22 Survival to discharge from neonatal care for infants from singleton and multiple births by completed weeks' gestation during 2009 and 2006.

Gest (wks)	Singletons		Survival Singletons		Multiples		Survival Multiples	
	2009	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**
23	2	2	1(50.0%)	0	2	0	0	0
24	11	11	6(54.5%)	5(45.5%)	1	0	0	0
25	12	18	9(75.0%)	15(83.3%)	6	6	5(83.3%)	5(83.3%)
26	18	16	14(77.8%)	12(75.0%)	8	8	7(87.5%)	8(100.0%)
27	24	26	22(91.7%)	24(92.3%)	9	4	7(77.8%)	4(100.0%)
28	15	21	14(93.3%)	20(95.2%)	7	10	7(100.0%)	9(90.0%)
29	31	28	30(96.8%)	27(96.4%)	5	18	5(100.0%)	17(94.5%)
30	34	39	33(97.1%)	35(89.7%)	12	16	12(100.0%)	16(100.0%)
31	53	43	53(100.0%)	42(97.7%)	20	17	19(95.0%)	17(100.0%)
32	56	70	56(100.0%)	70(100.0%)	33	22	33(100.0%)	22(100.0%)
33	111	104	108(97.3%)	102(98.1%)	24	64	24(100.0%)	64(100.0%)
34	118	138	115(97.5%)	136(98.6%)	45	48	44(97.8%)	48(100.0%)
35	120	121	119(99.2%)	119(98.3%)	43	42	42(97.7%)	42(100.0%)
36	96	132	93(96.9%)	128(97.0%)	20	16	20(100.0%)	16(100.0%)
37	125	114	121(96.8%)	114(100.0%)	19	13	19(100.0%)	13(100.0%)
≥38	675	777	664(98.4%)	761(98.0%)	8	7	8(100.0%)	7(100.0%)
NI	**1501 (85.2%)**	**1660 (85.1%)**	**1458 (97.1%)**	**1610 (97.0%)**	**262 (14.9%)**	**291 (14.9%)**	**252 (96.2%)**	**288 (99.0%)**

4.4 NI survival for infants of 401 to 1500g birth weight 1999 to 2009

Table 23 illustrates survival for infants of 401 to 1500g birth weight by completed weeks' gestation over a ten – year period. These demonstrate good survival rates for infants born at greater than 27 completed weeks' gestation. The survival rates for infants born at 25 and 26 weeks are not as good as for those born at greater than or equal to 27 weeks but there have been positive trends in survival over the ten-year span. There are very few infants born at 23 and 24 completed weeks' gestation each year. Good improvements in

survival rates at 24 weeks are noted across the ten-year span but remain at approximately 50%. For infants born at 23 weeks, the outcome has remained very poor. The previous recommendation that infants born at less than 27 completed weeks' gestation should be cared for in the regional centre is still justified by these data.

Table 23 NI Survival for infants (401 to 1500g birth weight) born and admitted to Neonatal Care by completed weeks' gestation 1999/2000 to 2009 inclusive.

Gest (wks)	1999/ 2000	2000/ 2001	2001/ 2002	2004	2005	2006	2007	2008	2009	Overall All Years
22	-	-	0/1 (0.0%)	-	-	-	-	0/1 (0.0%)	-	**0/1 (0.0%)**
23	2/5 (40.0%)	2/11 (18.2%)	1/2 (50.0%)	2/7 (28.6%)	0/4 (0.0%)	0/2 (0.0%)	2/6 (33.3%)	3/8 (37.5%)	1/4 (25.0%)	**13/49 (26.5%)**
24	3/9 (33.3%)	4/13 (30.8%)	1/5 (20.0%)	4/16 (25.0%)	11/22 (50.0%)	5/11 (45.5%)	10/12 (83.3%)	5/9 (55.6%)	6/12 (50.0%)	**49/109 (45.0%)**
25	12/19 (63.2%)	9/14 (64.3%)	15/21 (71.4%)	10/12 (83.3%)	10/16 (62.5%)	20/24 (83.3%)	7/11 (63.6%)	16/19 (84.2%)	14/18 (77.8%)	**113/154 (73.4%)**
26	14/23 (60.9%)	16/23 (69.6%)	10/11 (90.9%)	18/22 (81.8%)	19/25 (76.0%)	20/24 (83.3%)	11/14 (78.6%)	19/19 (100.0%)	21/26 (80.8%)	**148/187 (79.1%)**
27	16/19 (84.2%)	22/31 (71.0%)	22/25 (88.0%)	30/34 (88.2%)	19/23 (82.6%)	28/30 (93.3%)	15/20 (75.0%)	26/29 (89.7%)	29/33 (87.9%)	**207/244 (84.8%)**
28	19/20 (95.0%)	17/18 (94.4%)	26/29 (89.7%)	28/28 (100.0%)	24/28 (85.7%)	29/31 (93.6%)	36/39 (92.3%)	33/35 (94.3%)	21/22 (95.5%)	**233/250 (93.2%)**
29	31/33 (93.9%)	29/31 (93.6%)	30/33 (90.9%)	33/34 (97.1%)	29/31 (93.6%)	40/42 (95.2%)	30/34 (88.2%)	50/52 (96.2%)	31/31 (100.0%)	**303/321 (94.4%)**
30	17/17 (100.0%)	22/22 (100.0%)	33/34 (97.1%)	26/27 (96.3%)	34/34 (100.0%)	34/35 (97.1%)	33/34 (97.1%)	15/19 (79.0%)	25/26 (96.2%)	**239/248 (96.4%)**
31+	39/40 (97.5%)	45/48 (93.8%)	45/48 (93.8%)	41/44 (93.2%)	56/57 (98.2%)	49/51 (96.1%)	51/52 (98.1%)	51/54 (94.4%)	63/64 (98.4%)	**440/458 (96.1%)**
NK	2/2	-	-	-	-	-	-	-	-	**2/2 (100.0%)**
NI	**155/187 (82.9%), 1nk**	**166/211 (78.7%)**	**183/209 (87.6%)**	**192/224 (85.7%)**	**202/240 (84.2%)**	**225/250 (90.0%)**	**195/222 (87.8%)**	**218/245 (89.0%)**	**211/236 (89.4%)**	**1747/2024 (86.3%)**

(Note: This data excludes those infants who died in the delivery room)

4.5 **Key morbidity: early sepsis**

Early sepsis was defined as being positive if ' a bacterial pathogen was recovered from a blood and/or cerebrospinal fluid culture obtained on day one, two or three of life where the date of birth counted as day one regardless of the time of birth.'[3]

- There has been a statistically significant decrease in the proportion of infants with early sepsis in 2009 (41 of 1730, 2.4%) when compared to 2006 (78 of 1099, 4.1%). Pearson's Chi –Square test: χ^2 (1, N=2829) = 37.274, p<0.001), (Table 24).

4.6 **Key morbidity: late sepsis**

For the purpose of these analyses, late sepsis was defined as being positive if "a bacterial pathogen or (if coagulase negative staphylococcus (CoNS) was recovered from a blood and/or cerebrospinal fluid culture obtained after day three of life where the date of birth is counted as day one regardless of the time of birth."[3]

- There has been no statistically significant change in the proportion of infants with at least one proven episode of late sepsis (any pathogen) in 2009 (148 of 1320, 11.2%) when compared to 2006 (156 of 1510, 10.3%). Pearson's Chi-Square test: χ^2 (1, N=2836) = 0.627, p=0.429), (Table 24).

Overall, during 2009 there were 236 reported proven episodes of late sepsis (any pathogen) for 148 infants. The majority of infants, 99 of 148 (66.9%) had one episode of late proven sepsis (Table 25).

There were 54 of 235 (23.0%) episodes of late sepsis where a pure growth of a bacterial pathogen other than CoNS was recovered, 177 of 235 (75.3%) episodes where a pure growth of CoNS was recovered and four of 235 (1.7%) episodes where a mixed growth

of CoNS and other pathogen was recovered from blood / cerebrospinal fluid; bacterial pathogen information was unavailable for one episode of late sepsis (Table 26).

4.7 Key morbidity: late sepsis for VLBW infants

- There has been no statistically significant change in the proportion of VLBW infants with at least one proven episode of late sepsis (any pathogen) in 2009 (103 of 216, 47.7%) when compared to 2006 (97of 227, 42.7%). Pearson's Chi-Square test: χ^2 (1, N=443) = 1.097, p=0.295), (Table 24).

During 2009 there were 186 reported proven episodes of late sepsis (any pathogen) for 103 VLBW infants. The majority of these infants 58 of 103 (56.3%) had one episode of proven sepsis (Table 25).

For VLBW infants there were 39 of 185 (21.1%) episodes of proven late sepsis where a pure growth of a bacterial pathogen other than CoNS was recovered, 142 of 185 (76.8%) episodes where a pure growth of CoNS was recovered and four of 185 (2.2%) episodes where a mixed growth of CoNS and other pathogen were recovered from blood / cerebrospinal fluid; bacterial pathogen information was unavailable for one episode of late sepsis (Table 26).

Table 24 Key morbidity: early and late proven sepsis (infant - based) during 2009 and 2006.

Morbidity Outcomes	2009	2006
# Early sepsis	41/1730 (2.4%), 39 NK	78/1099 (4.1%), 51 NK
Late sepsis (any pathogen) proven **NA: Not in hospital after day 3 of life** **NK: Not Known**	148/1320 (11.2%), 1NK 448 NA	156/ 1510 (10.3%), 1NK 440 NA
Late sepsis (any pathogen) proven Very Low Birth Weight infants (VLBW, < 1500g) **NA: Not in hospital after day 3 of life** **NK: Not Known**	103/216 (47.7%) 14 NA	97/227 (42.7%), 1NK 12NA

 # Significant change (P< 0.05) Pearson's Chi-Square test

Table 25 Key morbidity: total episodes of late proven sepsis (infant – based) during 2009.

Episodes of late proven sepsis	All Infants	VLBW Infants
0	1620 (91.7%)	113 (52.3%)
1	99 (5.6%)	58 (26.9%)
2	27 (1.5%)	24 (11.1%)
3	11 (0.6%)	10 (4.6%)
4	7 (0.4%)	7 (3.2%)
5	2 (0.1%)	2 (0.9%)
6	2 (0.1%)	2 (0.9%)
Total	1768	216
Not known	**1**	**-**
Total	**1769**	216

Table 26 Bacterial pathogens for proven of late proven sepsis during 2009.

Number of episodes of late proven Sepsis	All infants	VLBW infants
Pure growth of a bacterial pathogen other than CoNS	54 (23.0%)	39 (21.1%)
Pure growth of CoNS	177 (75.3%)	142 (76.8%)
Mixed growth of bacterial pathogen and CoNS	4 (1.7%)	4 (2.2%)
Sub Total	**235**	**185**
Not known (NK)	1	1
Total	**236**	**186**

4.8 Key morbidity: late proven sepsis outcomes by NNU

Table 27 details the number of infants with at least one episode of proven late sepsis during the stay on each NNU.

Table 27 Key morbidity: late proven sepsis by NNU during 2009.

NNU	Total infants admitted	Total care episodes	Infants with at least ONE episode of proven late sepsis during stay on NNU	Total episodes of proven late sepsis during stay on NNU
ALT	240	246	16/183(8.7%) 56 NA, 1 NK	18
ANT	263	267	14/223(6.3%) 40 NA	20
CAH	349	364	24/234 (10.3%) 115 NA	37
DH	165	175	0/113 (0%) 52 NA	0
EH	141	144	0/93 (0%) 48 NA	0
RMH	507	509	85/395 (21.5%) 112 NA	133
ULST	322	332	26/267 (9.7%) 55 NA	28
NI	**1987**	**2037**	**148/1320 (11.2%) 448 NA, 1 NK**	**236**

NA: Infant not hospitalised after day 3 of life.

4.9 Key morbidity: respiratory system outcomes and treatment

Overall, there has been no change in the proportion of infants with pneumothorax (PTX), transient tachypnoea of the newborn (TTN) nor for those infants receiving steroids for chronic lung disease (CLD) and for those infants receiving supplemental oxygen at 36 weeks' corrected gestation. However, there has been a statistically significant increase in the proportion of infants with respiratory distress syndrome (RDS) during 2009 when compared to 2006 (Table 28).

- There has been a statistically significant increase in the proportion of infants with RDS in 2009 (496 of 1764, 28.1%) when compared to 2006 (485 of 1947, 24.9%). Pearson's Chi-Square test: χ^2 (1, N=3711) =4.897, p=0.027), (Table 28).

- There has been no statistically significant change in the proportion of infants with PTX in 2009 (71 of 1765, 4.0%) when compared to 2006 (56 of 1947, 2.9%). Pearson's Chi-Square test: χ^2 (1, N=3712) = 3.682, p= 0.055), (Table 28).

- There has been no statistically significant change in the proportion of infants with TTN in 2009 (320 of 1765, 18.1%) when compared to 2006 (364 of 1948, 18.7%). Pearson's Chi-Square test: χ^2 (1, N=3713) = 0.190, p=0.663), (Table 28).

- There has been no statistically significant change in the proportion of infants less than or equal to 32 week' gestation receiving oxygen at 36 weeks' corrected gestation in 2009 (74 of 357, 20.7%) when compared to 2006 (64 of 370, 17.3%). Pearson's Chi-Square test: χ^2 (1, N=727) = 1.391, p=0.238), (Table 28).

- There has been no statistically significant change in the proportion of infants receiving steroids for CLD in 2009 (15 of 1764, 0.9%) when compared to 2006 (10 of 1947, 0.5%). Pearson's Chi-Square test: χ^2 (1, N=3711) = 1.568, p= 0.210), (Table 28).

Table 28 Key morbidity: respiratory system outcomes and treatment during 2009 and 2006.

Respiratory system morbidity and treatment	2009	2006
#Respiratory distress syndrome (RDS)	496/1764 (28.1%), 5NK	485/1947 (24.9%), 4NK
Pneumothorax (PTX)	71/1765 (4.0%),4NK	56/1947 (2.9%), 4NK
Transient tachypnoea of the newborn (TTN)	320/1765 (18.1%), 4NK	364/1948(18.7%), 3NK
Supplemental oxygen at 36 weeks' corrected gestational age for infants ≤ 32 weeks' gestation	74/357 (20.7%), 2NK	64/370 (17.3%), 5NK
Steroids for chronic lung disease (CLD)	15/1764 (0.9%), 5NK	10/1947 (0.5%), 4NK

 # Significant change (P< 0.05) Pearson's Chi-Square test

Table 29 and Table 30 provide further analyses for each completed week of gestation for requirement of supplemental oxygen at 36 weeks' corrected gestation and for RDS, steroids for CLD, PTX and TTN during 2009.

Table 29 Key morbidity: CLD requirement for oxygen at 36 weeks' corrected gestational age by completed weeks' gestation during 2009.

Gest (wks)	Total Infants		Oxygen at 36 weeks		No oxygen at 36 weeks		Not hospitalised at 36 weeks		Not Known NK	
	2009	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**	**2009**	**2006**
23	4	2	1	0	0	0	3	2	0	0
24	12	11	7	6	0	0	5	5	0	0
25	18	24	11	13	1	6	6	5	0	0
26	26	24	19	11	2	4	5	8	0	1
27	33	30	16	10	8	10	9	10	0	0
28	22	31	9	9	9	14	3	8	1	0
29	36	46	5	10	18	26	13	10	0	0
30	46	55	4	3	26	22	16	28	0	2
31	73	60	1	1	36	32	36	26	0	1
32	89	92	1	1	52	36	35	54	1	1
Sub-total	**359**	**375**	**74**	**64**	**152**	**150**	**131**	**156**	**2**	**5**
≥ 33	1410	1576	46	29	338	404	1024	1130	2	13
Total	**1769**	**1951**	**120**	**93**	**490**	**554**	**1155**	**1286**	**4**	**18**

Table 30 Key morbidity: respiratory outcomes and treatment by completed weeks' gestation during 2009.

Gest (wks)	Total Infants		RDS at any time		Steroids for CLD		PTX at any time		TTN at any time	
	2009	2006	2009	2006	2009	2006	2009	2006	2009	2006
23	4	2	4/4 (100.0%)	2/2 (100.0%)	0	0	0/4 (0.0%)	0/2 (0.0%)	0/4 (0.0%)	0/2 (0.0%)
24	12	11	12/12 (100.0%)	11/11 (100.0%)	3	3	1/12 (8.3%)	1/11 9.1%)	0/12 (0.0%)	0/11 (0.0%)
25	18	24	18/18 (100.0%)	24/24 (100.0%)	5	3	1/18 (5.6%)	0/24 0.0%)	0/18 (0.0%)	0/24 (0.0%)
26	26	24	26/26 (100.0%)	23/24 (95.8%)	2	1	0/26 (0.0%)	3/24 (12.5%)	0/26 (0.0%)	0/24 (0.0%)
27	33	30	32/33 (97.0%)	30/30 (100.0%)	1	0	0/33(0.0%)	2/30 (6.7%)	1/33 (3.0%)	0/30 (0.0%)
28	22	31	22/22 (100.0%)	30/31(96.8%)	1	1	4/22 (18.2%)	0 /31 (0.0%)	0/22 (0.0%)	0/31 (0.0%)
29	36	46	34/36 (94.4%)	41/46 (89.1%)	0	1	1/36 (2.8%)	2/46 (4.4%)	0/36 (0.0%)	3/46 (6.5%)
30	46	55	38/46 (82.6%)	42/55 (76.4%)	1	0	1/46 (2.2%)	1/55 (1.8%)	3/45 (6.7%)	2/55 (3.6%)
31	73	60	51/73 (69.9%)	40/60 (66.7%)	0	0	1/73(1.4%)	3/60 (5.0%)	7/73 (9.6%)	8/60 (13.3%)
32	89	92	63/88 (71.6%)	44/92 (47.8%)	0	0	1/88 (1.1%)	1/92 (1.1%)	15/88 (17.1%)	13/92 (14.1%)
33	135	168	59/135(43.7%)	56/168 (33.3%)	1	0	2/134 (1.5%)	4/168 (2.4%)	19/135(14.1%)	36/168 (21.4%)
34	164	186	45/162 (27.8%)	48/186 (25.8%)	1	0	8/163(5.9%)	3/186 (1.6%)	20/163 (12.3%)	38/186 (20.4%)
35	163	163	28/163 (17.2%)	26/162 (16.1%)	0	0	11/163(6.8%)	2/163 (1.3%)	49/163 (30.1%)	39/163 (23.9%)
36	117	148	19/117 (16.2%)	19/148 (12.8%)	0	0	4/117 (3.4%)	2/148 (1.4%)	36/117(30.8%)	39/148 (26.4%)
37	135	127	12/145(8.3%)	15/127 (11.8%)	0	0	5/145(3.5%)	7/127 (5.5%)	44/145(30.3%)	34/127 (26.8%)
≥ 38	686	784	33/684 (4.8%)	34/781(4.4%)	0	1	31/685 4.5%)	25/780 (3.2%)	126/685 (18.4%)	152/781 (19.5%)
NI	**1769**	**1951**	**496/1764 (28.1%) 5NK**	**485/1947 (24.9%) 4NK**	**15/1764 (0.9%) 5NK**	**10/1947 (0.5%) 4NK**	**71/1765 (4.0%) 4NK**	**56/1947 (2.9%) 4 NK**	**320/1765 (18.1%) 4NK**	**364/1948 (18.7%), 3NK**

4.10 Key morbidity: cardiovascular system outcomes

Overall, there has been no change in the proportion of infants with patent ductus arteriosus (PDA) nor for those undergoing PDA surgery during 2009 compared with 2006 (Table 31).

- There has been no statistically significant change in the proportion of infants with PDA in 2009 (135 of 1765, 7.6%) when compared to 2006 (132 of 1948, 6.8%). Pearson's Chi-Square test: $\chi^2(1, N=3713) = 1.056$, $p=0.304$), (Table 31).

- There has been no statistically significant change in the proportion of infants undergoing PDA surgery in 2009 (7 of 1765, 0.4%) when compared to 2006 (9 of 1948, 0.5 %). Pearson's Chi-Square test: $\chi^2(1, N=3713) = 0.92$, $p=0.761$), (Table 31).

Table 31 Key morbidity: cardiovascular system outcomes during 2009 and 2006.

Cardiovascular system morbidity	2009	2006
Patent ductus arteriosus (PDA)	135/1765 (7.6%), 4NK	132/1948 (6.8%), 3NK
PDA surgery	7/1765 (0.4%), 4NK	9/1948 (0.5%), 3NK

 # Significant change (P< 0.05) Pearson's Chi-Square test

4.11 Key morbidity: gastrointestinal outcomes

Overall, there have been no statistically significant changes in the proportion of infants with NEC, infants undergoing surgery for NEC nor those with FGI perforation during 2009 when compared to 2006.

- For those infants of less than or equal to 34 weeks' gestation or less than 1500g birth weight there has been no statistically significant change in the proportion of infants with NEC in 2009 (20 of 657, 3.0%) when compared to 2006 (15 of 735, 2.0%). Pearson's Chi-Square test: χ^2 (1, N=1392) = 1.425, p= 0.233), (Table 32).

- For those infants of less than or equal to 34 weeks' gestation or less than 1500g birth weight there has been no statistically significant change in the proportion of infants undergoing NEC surgery in 2009 (5 of 657, 0.8%) when compared to 2006 (6 of 735, 0.8 %). Pearson's Chi-Square test: χ^2 (1, N=1392) = 0.14, p= 0.907), (Table 32).

- There has been no statistically significant change in the proportion of infants with FGI perforation in 2009 (8 of 1761, 0.5%) when compared to 2006 (6 of 1948, 0.3%). Pearson's Chi-Square test: χ^2 (1, N=3707) =1.030, p=0.310), (Table 32).

Table 32 Key morbidity: gastrointestinal system outcomes during 2009 and 2006.

Gastrointestinal system morbidity	2009	2006
Necrotizing Enterocolitis (NEC) (Infants ≤ 34 weeks' geststion or < 1500g birth weight).	20/657 (3.0%), 4NK	15/735 (2.0%)
NEC surgery (Infants ≤ 34 weeks' geststion or < 1500g birth weight).	5/657 (0.8%), 4NK	6/735 (0.8%)
Focal gastrointestinal perforation (FGI)	8/1761 (0.5%), 8NK	5/1946 (0.3%), 5NK

 # Significant change (P< 0.05) Pearson's Chi-Square test

4.12 **Key morbidity: central nervous system outcomes and treatment**

Overall, there have been no statistically significant changes in the proportion of infants with periventricular–intraventricular haemorrhage (P-IVH), cystic - periventricular leukomalacia (CPVL), hypoxic ischaemic encephalopathy (HIE) and seizures during 2009 when compared to 2006.

- For those infants undergoing cranial imaging on or before 28 days of life, there has been no statistically significant change in the proportion of infants with P-IVH in 2009 (91 of 515, 17.7%) when compared to 2006 (79 of 561, 14.1%). Pearson's Chi-Square test: χ^2 (1, N=1076) =2.598, p=0.107), (Table 33).

- For those infants undergoing cranial imaging on or before 28 days of life, with a diagnosed P-IVH there has been no statistically significant change in the proportion of infants with P-IVH of grade 3 or 4 in 2009 (21 of 90, 23.3%) when compared to 2006 (18 of 79, 22.8%). Pearson's Chi-Square test: χ^2 (1, N=169) =0.007, p=0.933), (Table 33).

- For those infants greater than or equal to 36 weeks' gestation there has been no statistically significant change in the proportion of infants with HIE in 2009 (50 of 946, 5.3%) when compared to 2006 (70 of 1056, 6.6%). Pearson's Chi-Square test: χ^2 (1, N=2002) = 1.598, p= 0.206), (Table 33).

- There has been no statistically significant change in the proportion of infants with clinical evidence of subtle seizures, focal or multifocal chronic or tonic seizures within three days after birth in 2009 (46 of 1702, 2.7 %) when compared to 2006 (60 of 1840, 3.3%). Pearson's Chi-Square test: χ^2 (1, N=3542) = 0.949, p= 0.330), (Table 33).

Table 33 Key morbidity: central nervous system outcomes and treatment during 2009 and 2006.

Central nervous system morbidity	2009	2006
Infants undergoing cranial imaging (CI) on or before day 28 of life.	521/1766 (29.5%), 3NK	587/1937 (30.3%), 14NK
Periventricular - intra-ventricular haemorrhage (P-IVH) present	91/515(17.7%), 6 NK	79/561 (14.1%), 26 NK
Worst Grade (P-IVH)	Grade 1: 46 Grade 2: 23 Grade 3: 12 Grade 4: 9 Grade Not known: 1	Grade 1: 34 Grade 2: 27 Grade 3: 9 Grade 4: 9
***Cystic - periventricular leukomalacia (CPVL)** ** Denominator unavailable*	11 infants	7 infants
Hypoxic ischaemic encephalopathy (HIE), for infants ≥ 36 weeks' gestation	50/946 (5.3%), 2NK	70/1056 (6.6%), 3NK
Severity of HIE (Sarnat Grading)[10]	Mild: 33/47 (70.2%) Mod: 8/47 (17.0%) Severe: 6/47 (12.8%) NK: 3	Mild: 36/66 (54.5%) Mod: 16/66 (24.2%) Severe: 14/66 (21.2%) NK: 4
***Therapeutic hypothermia** **Denominator unavailable*	8 infants (All whole body cooling) 5NK	Not available
Seizures within first 3 days after birth (all infants) **NA first admission to NNU after day 3.**	46/1702 (2.7%), 5NK 62 NA.	60/1840 (3.3%), 5NK 106 NA.

 # Significant change (P< 0.05) Pearson's Chi-Square test

4.13 Key morbidity treatment: other major surgery outcomes

- There has been no statistically significant change in the proportion of infants undergoing 'other' major surgery in 2009 (53 of 1755, 3.0%) when compared to 2006 (58 of 1920, 3.0%). Pearson's Chi-Square test: χ^2 (1, N=3675) = 0.000, p= 0.999), (Table 34). This figure excludes infants transferred to RBHSC for surgery who were not re-admitted to neonatal care.

Table 34 Key morbidity treatment: other major surgery during 2009 and 2006.

Treatment Surgery	2009	2006
Other Major Surgery : excludes NEC, PDA, Congenital Heart Disease, ROP, Note: if infant is not re-admitted to neonatal care after surgery then 'other major surgery' not recorded in dataset.	53/1755 (3.0%), 14NK	58/1920 (3.0%), 31NK

 # Significant change (P< 0.05) Pearson's Chi-Square test

4. 14 Key morbidity: retinopathy of prematurity outcomes

Overall, there have been no statistically significant changes in the proportion of infants with retinopathy of prematurity (ROP) or for those undergoing retinal cryosurgery and/or laser surgery for ROP during 2009 when compared to 2006.

- For those infants eligible for ROP screening, surviving to screen due date and undergoing at least one screen prior to discharge from neonatal care; there has been no statistically significant change in the proportion of infants with ROP present in 2009 (58 of 224, 25.9%) when compared to 2006 (49 of 217, 22.6 %). Pearson's Chi-Square test: χ^2 (1, N=441) = 0.658, p=0.417), (Table 35).

- For those infants eligible for ROP screening, surviving to screen due date ,undergoing at least one screen prior to discharge from neonatal care and diagnosed with ROP; there has been no statistically significant change in the proportion of infants with ROP of grade 3 or 4 in 2009 (17 of 58, 29.3%) when

compared to 2006 (18 of 49, 36.7%). Pearson's Chi-Square test: χ^2 (1, N= 125) = 0.092, p=0.761), (Table 35).

- There has been no statistically significant change in the proportion of infants undergoing retinal cryosurgery and/or laser surgery for ROP in 2009 (18 of 55, 32.7%) when compared to 2006 (11 of 49, 22.4%). Pearson's Chi-Square test: χ^2 (1, N=104) =1.361, p=0.243), (Table 35).

Table 35 Key morbidity: retinopathy of prematurity outcomes during 2009 and 2006.

Key morbidity: Retinopathy of prematurity (ROP)	2009	2006
Infants Eligible for ROP screening	311/1769 (17.6%)	317/1951(16.2%)
Survivors to Screen due date	289/311(92.9%)	289/317(91.2%)
Screened prior to discharge from Neonatal care	226/289(78.2%)	218/288(75.7%), 1NK
ROP present	58/224 (25.9%), 2NK	49/217(22.6%), 1NK
Worst Grade ROP	Stage 1: 30 (51.7%) Stage 2: 11 (19.0%) Stage 3: 15 (25.9%) Stage 4: 2 (3.5%)	Stage 1: 20 (40.8%) Stage 2: 11 (22.5%) Stage 3: 15 (30.6%) Stage 4: 3 (6.1%)
Retinal cryosurgery and/or laser surgery for ROP	18/55 (32.7%), 3NK	11/49 (22.4%)

 # Significant change (P< 0.05) Pearson's Chi-Square test

Table 36 provides details of ROP screening and treatment for each completed week of gestation. The ROP 'screen due date' has been calculated in accordance with current available Royal College of Ophthalmology guidance at time of data collection (2006 and 2009). [11] [12] ROP grades have been categorised in accordance with the Vermont Oxford Network definitions. [3]

Table 36 Key morbidity: retinopathy of prematurity (ROP) screening outcomes and treatment during 2006 and 2009 by completed weeks' gestation.

Gest (wks)	Total eligible infants		Survivor to screen due date		Infants screened		ROP Not present		ROP Stage 1		ROP Stage 2		ROP Stage 3		ROP Stage 4	
	2009	2006	2009	2006	2009	2006	2009	2006	2009	2006	2009	2006	2009	2006	2009	2006
23	4	2	1	0	1	-	0	-	0	-	1	-	0	-	0	-
24	12	11	7	6	7	6	0	1	1	2	2	0	4	1	0	2
25	18	24	14	20	14	20	1	4	6	5	3	3	4	7	0	1
26	26	24	22	20	22	20	14	10	1	3	1	5	5	1	1	0
27	33	30	31	28	31	26	19	17	8	5	2	3	2	1	0	0
28	22	31	21	29	21	28	15	25	4	0	1	0	0	3	1	0
29	36	46	35	44	34	40	28	35	6	3	0	0	0	2	0	0
30	46	55	46	51	39	40	35	39	3	1	1	0	0	0	0	0
31	73	60	72	59	40	22	38	22	1	0	0	0	0	0	0	0
≥ 32	41	34	40	32	17	16	16	15	0	1	0	0	0	0	0	0
Total	**311**	**317**	**289**	**289**	**226/289 (78.2%)**	**218/288 (75.7%)**	**166/224 (74.1%)**	**168/217 (77.4%)**	**30/224 (13.4%)**	**20/217 (9.2%)**	**11/224 (4.9%)**	**11/217 (5.1%)**	**15/224 (6.7%)**	**15/217 (6.9%)**	**2/224 (0.9%)**	**3/217 (1.4%)**

4. 15 **Key morbidity: congenital malformations**

For ease of analyses, the NICORE congenital malformation data for 2009 and 2006 have been peer reviewed by the NICORE Chairman and the data have been categorised into broader groups as reported in Table 37. Further breakdown of congenital malformations are available from the NICORE office upon request.

- There has been no statistically significant change in the proportion of infants admitted to neonatal care with at least one congenital malformation during 2009 (162 of 1769, 9.2%) when compared to 2006 (151 of 1951, 7.7%). Pearson's Chi-Square test: χ^2 (1, N=3720) = 2.421, p=0.120), (Table 37). These infants received 2821 days of care in 2009 compared with 2686 days in 2006, which is 6.1% increase (Table 39).

Tables 38 provides a breakdown of infants with at least one congenital malformation as a proportion of total infants for each completed week gestational age for infants admitted to neonatal care during 2009 and 2006. Table 39 and Table 40 summarise survival to discharge from neonatal care, length of stay (LOS) and total neonatal care days for infants for each congenital malformation category.

- There has been no statistically significant change in the proportion of infants with at least one congenital malformation surviving to discharge from neonatal care during 2009 (143 of 162, 88.3 %) when compared to 2006 (126 of 151, 83.4%). Pearson's Chi-Square test: χ^2 (1, N=313) = 1.508, p=0.219), (Table 39).

Congenital malformation non – survivors to discharge from neonatal care

During 2009, 19 of 162 (11.7%) of infants admitted to neonatal care and diagnosed with a congenital malformation died during the stay in hospital. This represented 35.8% (19 of 53) of total deaths for 2009. These infants were categorised as follows: recognised

trisomy/chromosomal syndromes (two infants), respiratory system (three infants), cardiovascular system (two infants), central nervous system (two infants), gastrointestinal (two infants), recognised malformation syndromes (one infant), genitor-urinary (one infant), undiagnosed dysmorphic syndromes (four infants) and multiple malformations (two infants). Overall non-survivors had a mean (SD) length of stay (LOS) of 8.8 (17.2) days, median (IQR) of 2.0 (2.0) days and accounted for 167 neonatal care days.

Table 37 Key morbidity: categories of congenital malformations during 2009 and 2006.

Category of congenital malformation	Frequency	
	2009	**2006**
Recognised trisomy/chromosomal syndromes	39	31
Respiratory system (e.g. pulmonary hypoplasia, diaphragmatic hernia, other respiratory)	8	7
Cardiovascular system	42	35
Central nervous system (e.g. neural tube defect, other)	19	17
Gastrointestinal (e.g. gastroschisis, exompholos, other)	29	24
Recognised malformation syndromes (e.g. vater, CAA, potter's sequence)	9	5
Genito-urinary	7	17
Musculo-skeletal	8	8
Undiagnosed dysmorphic syndromes	10	5
Hydrops fetalis (non-immune, iso-immunisation)	0	2
Other CLP, IEM	8	6
Not Known (NK)	0	2
Total number of infants with at least one of the above congenital malformations NI.	**162 /1769 (9.2%)**	***151/1951 (7.7%)**

**Two infants were re-categorised as not having a congenital malformation upon re-coding by NICORE Chairman*

Table 38 Key morbidity: congenital malformations by completed weeks' gestation during 2009 and 2006.

Gestation (wks)	Infants with at least one Congenital Malformation (n)/total infants admitted to NNU at that gestational age	
	2009	**2006**
23	1/4 (25.0%)	0/2(0.0%)
24	0/12(0.0%)	0/11(0.0%)
25	2/18 (11.1%)	1/24(4.2%)
26	1/26 (3.8%)	0/24(0.0%)
27	2/33 (6.1%)	2/30(6.7%)
28	1/22(4.6%)	5/31(16.1%)
29	0/36(0.0%)	5/46(10.9%)
30	3/46(6.5%)	4/55(7.3%)
31	2/73(2.7%)	3/60(5.0%)
32	1/89(1.1%)	5/92(5.4%)
33	7/135(5.2%)	11/168(6.5%)
34	12/164(7.3%)	8/186(4.3%)
35	8/163(4.9%)	14/163(8.6%)
36	9/117(7.7%)	14/148(9.5%)
37	18/145(12.4%)	10/127(7.9%)
38	34/172(19.8%)	23/189(12.2%)
39	32/201(15.9%)	21/227(9.3%)
40	19/174(10.9%)	16/197(8.1%)
41	9/129(7.0%)	9/159(5.7%)
42	1/9(11.1%)	0/11(0.0%)
43	0/1(0.0%)	0/1(0.0%)
NI	**162/1769 (9.2%)**	**151/1951 (7.7%)**

Table 39 Key morbidity: survival to discharge from neonatal care by congenital malformation category during 2009 and 2006.

Category of congenital malformation	Infants		Survival	
	2009	2006	2009	2006
Recognised trisomy/chromosomal syndromes	39	31	37 (94.9%)	23(74.2%)
Respiratory system (e.g. pulmonary hypoplasia, diaphragmatic hernia, other respiratory)	8	7	3(37.5%)	3(42.9%)
Cardiovascular system	42	35	40(95.2%)	32(91.4%)
Central nervous system (neural tube defect, other)	19	17	17(89.5%)	16(94.1%)
Gastrointestinal (e.g. gastroschisis, exompholos, other)	29	24	27(93.1%)	21(87.5%)
Recognised malformation syndromes (e.g. vater, CAA, potter's sequence)	9	5	6(66.7%)	4(80.0%)
Genito-urinary	7	17	3(42.9%)	13(76.5%)
Musculo-skeletal	8	8	8(100.0%)	7(87.5%)
Undiagnosed dysmorphic syndromes	10	5	6(60.0%)	3(60.0%)
Hydrops fetalis (non immune, iso- immunisation)	-	2	-	2(100.0%)
Other CLP, IEM	8	6	8(100.0%)	6(100.0%)
Not recorded	-	2	-	2(100.0%)
NI	**162**	**151**	**143 (88.3%)**	**126 (83.4%)**
Median LOS, (IQR) days	5.00 (14.5)	6.00 (20.0)	6.00 (17.0)	8.50 (20.0)
Mean LOS (SD) days	17.41 (31.66)	17.79 (26.60)	18.56 (32.96)	17.79 (24.26)
Sum (total neonatal care days)	2821	2686	2654	2242

Table 40 Total Length of stay (TLOS) by category of congenital malformation during 2009.

Category of congenital malformation	Infants			Mean TLOS (SD) days			Median TLOS (IQR) days			Sum days		
	T	S	NS	T	S	NS	T	S	NS	T	S	NS
Recognised trisomy/chromosomal syndromes	39	37	2	17.5 (23.0)	18.4 (23.4)	2.5 (0.7)	7.0 (22.0)	8.0 (23.0)	2.5	684	679	5
Respiratory system	8	3	5	2.9 (3.6)	5.7 (5.0)	1.2 (0.5)	1.0 (3.3)	5.0	1.0 (0.5)	23	17	6
Cardiovascular system	42	40	2	21.6 (45.2)	22.6 (46.1)	2.5 (0.7)	4.0 (7.0)	4.0 (7.0)	2.5	909	904	5
Central nervous system	19	17	2	17.3 (29.1)	16.6 (30.0)	23.0 (28.3)	3.0 (21.0)	3.0 (19.0)	2.0 (23.0)	328	282	46
Gastrointestinal	29	27	2	13.1 (24.3)	11.4 (23.0)	(36.5) (40.3)	2.0 (14.0)	2.0 (13.0)	36.5 (57.0)	380	307	73
Recognised malformation syndromes	9	6	3	7.7 (6.0)	10.8 (4.7)	1.3 (0.6)	8.0 (10.0)	10.5 (6.5)	1.0 (1.0)	69	65	4
Genito-urinary	7	3	4	3.4 (2.8)	6.3 (1.2)	1.3 (0.5)	2.0 (6.0)	7.0 (2.0)	1.0 (0.8)	24	19	5
Musculo-skeletal	8	8	0	27.5 (47.0)	27.5 (47.0)	-	7.0 (28.5)	7.0 (28.5)	-	220	220	-
Undiagnosed dysmorphic syndromes	10	6	4	18.7 (22.9)	26.2 (26.3)	7.5 (11.7)	7.5 (31.5)	16.5 (56.0)	2.0 (18.0)	187	157	30
Hydrops Fetalis	-	-	-	-	-	-	-	-	-	-	-	-
Other CLP, IEM	8	8	0	15.8 (18.6)	15.8 (18.6)	-	8.0 (18.3)	8.0 (18.3)	-	126	126	-

T = total infants, S=survivor to discharge from neonatal care, NS = non survivor to discharge from neonatal care.

Section 5.0 Benchmarking: key audit questions and annual trends

5.1 Key audit questions: introduction

The following key evidence-based audit questions are those required by the National Neonatal Audit Programme (NNAP). These have facilitated national benchmarking of 2009 performance in NI with other NNUs in the United Kingdom (UK) during the same time period.[13] Further information including the clinical basis for these audit measures is available at the following web address:
http://www.rcpch.ac.uk/child-health/standards-care/clinical-audits/national-neonatal-audit-programme-nnap/national-neonatalhttp://

5.2 Key audit question one (AQ1)

AQ1. Do all babies less than or equal to 28 weeks' gestation have their temperature taken within the first hour after *admission to NICU?
Standard: 98-100%, UK Comparison data 2009 achievement: 63% (NNAP 1st hour after *birth) (27% missing data)

For NI FIRST admissions to neonatal care during 2009, 114 of 115 (99.1%) infants of less than or equal to 28 weeks' gestation had their temperature taken within the first hour (no missing data). For all admissions (within and across neonatal units) for infants of less than or equal to 28 weeks' gestation, the temperature was taken within the first hour after admission to NICU in 196 of 198 (99.0%) instances. Information was unavailable in one case.

5.3 Key audit question two (AQ2)

AQ2. Are all mothers who deliver between 24 and 34 weeks' gestation given any dose of antenatal steroids?
Standard: 85%, UK Comparison data NNAP 2009 achievement: 70% (7% missing data)

For NI during 2009 there were 654 infants between 24 and 34 weeks' gestation admitted to neonatal care with 575 of 646 (89.0%) of mothers receiving at least a partial course of antenatal steroids. Information was unavailable for eight infants (88.0% including missing data). Note: Mothers who deliver more than one infant are counted for each infant.

5.4 Key audit question three (AQ3)

AQ3. Do all babies less than 1501g or gestational age at birth less than 32 weeks and still an inpatient undergo 1st Retinopathy of Prematurity (ROP) screening as per the current guideline recommendations.
Standard: 100%, UK Comparison data NNAP 2009 achievement: 72% (on average)

For NI during 2009 there were 311 infants eligible for ROP screening. Of these, 289 survived to screen due date, as per current guideline recommendations, at the time of the study, with 226 of 289 (78.2%) undergoing an ROP screen prior to final discharge from neonatal care.

Those infants not receiving an eye screen prior to discharge from neonatal care tended to be the more mature infants with 23 of 63 (36.5%) greater than 31 weeks' gestation. Twenty – one of these infants were small for gestational age (less than 9th centile for gestation).

A full analysis of ROP data is being conducted as part of a further epidemiological study by Ms Eibhlin McLoone, Consultant Ophthalmologist, for the time period 2006 to 2010

inclusive. In addition a new 'ophthalmology discharge summary' has been integrated into the BadgerNet™ system which will allow ophthalmologists to provide a summary of the care provided including those screens carried out post NNU discharge.

5.5 Key audit question four (AQ4)

AQ4. What proportion of babies less than 33 weeks' gestation, at birth, are receiving their mother's milk when discharged from a neonatal unit?
No NNAP standard or UK comparison available for 2009 as audit question introduced for 2010 onwards.

For NI during 2009, there were 358 infants less than 33 weeks' gestation of whom 333 survived to discharge from neonatal care (any destination). Of these infants, 40 (12.1%) were exclusively receiving human milk, 55 (16.6%) human milk plus formula or fortifier and 233 (70.4%) exclusively formula. Three (0.9%) infants were recorded as receiving no enteral feeds and information was unavailable for an additional two infants.

Overall, for all infants discharged home directly from neonatal care 20.9% (292 of 1397) were being exclusively breast fed, 15.7% (219 of 1397) were receiving both breast milk and formula, the majority of infants 63.3% (884 of 1397) were receiving formula milk only. Two infants were recorded as receiving no enteral feeds and information was unavailable in five cases. Note: NICORE data does not differentiate between mother's milk and donor milk.

5.6 Key audit question five (AQ5)

AQ5. How many babies, born between 32 to 36 and greater than or equal to 37 weeks' gestation, receive care on neonatal units?
Standard: Benchmarking, UK Comparison data NNAP 2009 achievement: 6% for greater than or equal to 37 weeks' gestation, 55% 32 to 36 weeks' gestation.

For NI, during 2009, 3.5% (831 of 23710) live born term infants (greater than or equal to 37 weeks' gestation) received neonatal care and 44.8% (668 of 1491) live born infants of 32 to 36 weeks' gestation, received neonatal care (Table 1). NICORE admission rates are based on 'live born' infants as opposed to 'Total Births'. However, admission rates are still below the national average. The denominator data used by NNAP needs to be clarified and appropriate changes need to be made to NICORE denominator data to allow for better comparisons.

5. 7 Annual trends: introduction

The following short section directly compares NI performance against pre-set NICORE quality standards (NQS) for 2009 and 2006. Future NICORE reports will only provide regional performance using the NNAP audit measures and direct submission of NNU data to NNAP will also be facilitated by the BadgerNet™ platform should NNUs wish to participate in this national benchmarking.

5.8 NICORE quality standard one (NQS1)

NQS1. 80% of mothers should have received at least a partial course of steroids prior to the delivery of an 'at risk' (less than or equal 34 weeks' gestation) infant.[14]

This standard is based on the European consensus guidelines on the management of neonatal respiratory distress syndrome. This guideline states that 'clinicians should offer a single course of prenatal Betamethasone to all women at risk of preterm delivery

(before 35 weeks' gestation) including threatened preterm labour, antepartum haemorrhage, preterm rupture of membranes or any condition requiring elective preterm delivery since this treatment is associated with significant reductions in the rates of respiratory distress syndrome, neonatal death, intra-ventricular haemorrhage and necrotizing enterocolitis'.[14]

- There has been a statistically significant increase in the proportion of mothers of who received at least a partial course of steroids prior to the delivery of an "at risk" infant during 2009 (579 of 650, 89.1%) when compared to 2006 (596 of 725, 82.2%). Pearson's Chi-Square test: χ^2 (1, N=1375) = 13.014, p<0.001),(Table 44).

5.9 NICORE quality standard two (NQS2)

NQS2. Core body admission temperature of all infants should be greater than 36^{o}C.[15 16 17]

Hypothermia is a recognised risk factor for increased neonatal mortality. Since our last NICORE report plastic wraps have now been introduced in most units for infants less than 29 weeks' gestation as part of routine thermal care in an attempt to reduce heat loss immediately after delivery.

- There has been a statistically significant increase in the proportion of infants admitted to neonatal care with a core body temperature greater than 36^{o}C during 2009 (1817 of 1998, 90.9 %) when compared to 2006 (1647 of 1909, 86.3%). Pearson's Chi-Square test: χ^2 (1, N=3907) =21.137, p< 0.001), (Table 44).

- There has been a statistically significant increase in the proportion of inborn infants (first admission) admitted to neonatal care with a core body temperature greater than 36^{o}C during 2009 (1454 of 1613, 90.1%) when compared to 2006 (1536 of 1786, 86.0 %). Pearson's Chi-Square test: χ^2 (1, N=3399) = 13.726, p<0.001), (Table 42, 44).

- There has been a statistically significant increase in the proportion of inborn infants less than or equal to 28 weeks' gestation (first admission) admitted to neonatal care with a core body temperature greater than 36^{o}C during 2009 (86 of 112, 76.8%) when compared to 2006 (64 of 106, 60.4%). Pearson's Chi-Square test: χ^2 (1, N=218) = 6.831, p=0.009), (Table 41, 44).

Table 41 details NI performance against NQS2 for first admissions to neonatal care and all associated episodes of care for infants less than or equal to 28 weeks' gestation since these infants are most vulnerable to cold stress immediately after birth. Performance for first admission ranged from 0% to 100% across NNUs.

Table 41 Core body temperature within one hour of admission to neonatal care by NNU for infants of ≤ 28 weeks' gestation during 2009.

NNU	Core body temperature > 36 ^{0}C (1st Admissions)	Core body temperature > 36 ^{0}C (All Admissions)
ALT	8/11 (72.7%)	14/19 (73.7%)
ANT	7/12 (58.3%)	15/21 (71.4%)
CAH	19/19 (100.0%), 1NK	47/48 (97.9%), 1nk
DH	0/2 (0%)	7/9 (77.8%)
EH	0/2(0%)	3/5 (60.0%)
RMH	46/57 (80.7%), 1NK	55/68 (80.9%), 2NK
ULST	6/9 (66.7%)	20/23 (87.0%)
Total	**86/112 (76.8%), 2NK**	**161/193 (83.4%), 3NK**

Table 42 provides further analyses of core body temperature on FIRST admission to neonatal care for IB and OB infants for each completed week gestation for 2009 and 2006. Figure one illustrates the percentage achievement of the admission temperature standard by gestation groups for both inborn and out born first admissions to NNU, 2009.

Table 43 demonstrates categories of core body temperature on first admission to neonatal care for inborn infants 2009 and compared with 2006 in accordance with the World Health Organisation (WHO) definitions of hypothermia.[18]

Table: 42 Core body admission temperatures greater than 36^0C by gestation and location of birth for first admission to NNU during 2006 and 2009.

Gest (wks)	Inborn						Out born						Total	
	>36 °C		≤36 °C		Missing		>36 °C		≤36 °C		Missing			
	2009	2006	2009	2006	2009	2006	2009	2006	2009	2006	2009	2006	2009	2006
23	2	0	2	1	0	1	0	0	0	0	0	0	4	2
24	8	2	2	8	0	0	0	0	2	1	0	0	12	11
25	12	10	2	13	0	1	3	0	1	0	0	0	18	24
26	21	9	4	11	0	0	1	4	0	0	0	0	26	24
27	20	22	10	5	2	1	0	2	1	0	0	0	33	30
28	20	21	2	4	0	0	0	4	0	1	0	1	22	31
29	27	32	5	10	1	3	1	1	1	0	1	0	36	46
30	39	37	7	16	0	0	0	0	0	2	0	0	46	55
31	58	52	12	6	1	0	1	2	1	0	0	0	73	60
32	77	72	9	18	1	0	2	2	0	0	0	0	89	92
33	114	142	15	19	2	1	4	5	0	1	0	0	135	168
34	139	150	18	24	2	1	5	9	0	2	0	0	164	186
35	143	129	9	17	2	6	9	11	0	0	0	0	163	163
36	97	119	10	12	1	9	7	8	2	0	0	0	117	148
37	123	104	13	14	2	2	7	6	0	1	0	0	145	127
>37	553	637	40	72	15	14	75	55	1	4	2	2	686	784
Total	**1453**	**1538**	**160**	**250**	**29**	**39**	**115**	**109**	**9**	**12**	**3**	**3**	**1769**	**1951**

Note: For the purpose of this analyses first admission temperatures include those taken within and greater than one hour of admission.

Figure 1 **Achievement of admission temperature standard >36^{0}C by gestation groups for inborn and out born infants for first admissions to NNU, 2009.**

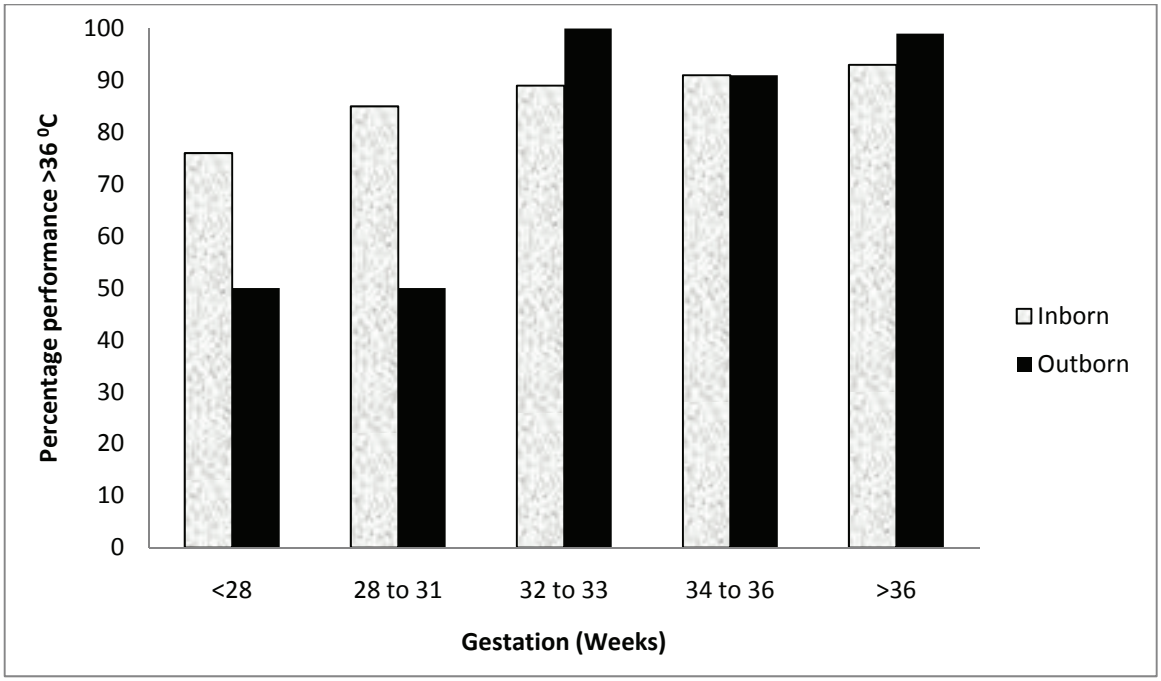

Table 43 **Core body admission temperatures (inborn, first admissions) according to World Health Organisation (WHO) definitions during 2009 and 2006.**

Core body temperature on admission to NNU	2009	2006
>37.5^{0}C (Hyperthermia)	110(6.8%)	91(5.1%)
36.5^{0}C to 37.5 ^{0}C (Normothermia)	1094(67.8%)	1131(63.3%)
36.0^{0}C to 36.4 ^{0}C (Mild Hypothermia)	314 (19.5%)	381(21.3%)
32.0^{0}C to 35.9^{0}C (Moderate Hypothermia)	95 (5.9%)	177 (9.9%)
< 32.0^{0}C (Severe Hypothermia)	0 (0.0%)	6(0.3%)
Total	1613	1786
Not known (NK)	29	39

.

5.10 NICORE quality standard three (NQS3)

NQS3. All infants who are less than 32 weeks' gestation OR less than 1501g birth weight should undergo an ophthalmic examination in order to screen for Retinopathy of Prematurity (ROP). [11] [12]

The Royal College of Paediatrics and Child Health, Royal College of Ophthalmologists, British Association of Perinatal Medicine (BAPM) & BLISS UK Retinopathy of Prematurity Guideline published in 2008 recommended good practice point states that all infants of less than 32 weeks' gestation or less than 1501g birth weight should be screened for ROP. [12]

- For those infants eligible for ROP screening and surviving to screen due date there has been no statistically significant change in the proportion of infants undergoing eye screening in 2009 (226 of 289, 78.2%) when compared to 2006 (218 of 288, 75.7 %). Pearson's Chi-Square test: χ^2 (1, N=577) = 0.511, p=0.475), (Table 44).

5.11 NICORE quality standard four (NQS4)

NQS4. 100% of infants discharged home from neonatal care will undergo newborn hearing screening prior to discharge.[19]

The UK National Screening Committee has recommended that all newborn infants are offered hearing screening. In October 2005 the hearing screening programme for all newborn babies was introduced in NI. It is recognised that early detection of a hearing loss and the provision of hearing aids result in better outcomes for speech and language development in later life.

- For those infants discharged home directly from an NNU there has been no statistically significant change in the proportion of infants undergoing newborn hearing screening in 2009 (1260 of 1392, 90.5%) when compared to 2006 (1510 of 1676, 90.1 %). Pearson's Chi-Square test: χ^2 (1, N=3068) = 0.154, p=0.695), (Table 44).

Table 44 Summary NI performance against NICORE Quality Standards for 2009 and 2006.

NICORE Quality Standard (NQS)	Performance 2009	Performance 2006
# 1. Antenatal steroids administration for 'at risk' mothers (≤ 34 wks' gestation)	579/650 (89.1%), NK 8	596/725 (82.2%), NK 18
# 2a Core body NNU admission temperature >36^0 C for all episodes of care.	1817/1998 (90.9%), 39 NK	1647/1909 (86.3%), 42NK
# 2b. Core body NNU admission temperature >36^0 C inborn first admissions	1454/1613 (90.1%), 29 NK	1536/1786 (86.0%), 36NK
# 2c. Core body NNU admission temperature >36^0 C inborn first admissions ≤ 28 wks' gestation	86/112 (76.8%), 2 NK	64/106 (60.4%), 3NK
3. Screening for ROP for infants <32 weeks' gestation or ≤1500g birth weight (Survivors to screen due date)	226/289 (78.2%)	218/288 (75.7%), 1NK
4. Hearing Screening for infants discharged HOME directly from NNU.	1260/1392 (90.5%), 10NK	1510/1676 (90.1%), 99NK

Pearson's Chi-Square test p<0.05.

Section 6.0 Conclusions and the way forward

6.1 Conclusions

1. This report has provided data which show that there has been a 9.3% decrease in the absolute numbers of infants receiving neonatal care from 1951 in 2006 to 1769 in 2009. This also represents a statistically significant decrease in the proportion of live born infants admitted to neonatal care in 2009 (1769 of 25506, 6.9%) when compared to 2006 (1951 of 23895, 8.2%). These changes affected ANT and ALT NNUs to a much greater extent than other NNUs with a 23.3% and 17.9% decrease respectively.

2. The total number of neonatal care days decreased by 4.1% from 32084 to 30757 days but the average episodic-based length of stay (LOS) in NI has increased from a median of 7.0 to 8.0 days, between 2006 and 2009. The range of median LOS varied widely between NNUs; the shortest median LOS was in DH at four days and the longest median LOS in ANT at 12 days. The final infant-based median total length of stay (TLOS) for survivors of neonatal care has remained constant at 8.0 days, between 2006 and 2009.

3. There has been a slight increase in the proportion of infants less than 26 weeks' gestation who were born and received their first episode of neonatal care outside the regional centre in 2009 (18 of 34, 52.9%) when compared to 2006 (15 of 37, 40.5%) but this was not statistically significant.

4. There has been no statistically significant improvement in the survival rates for extremely low gestational age infants (less than 26 weeks' gestation).

5. Late onset sepsis (after day three of life) remains a major morbidity particularly due to coagulase negative staphylococcus (CoNS) species.

6. There has been a small rise in the proportion of very premature infants (less than or equal to 32 weeks' gestation) with CLD (oxygen use at 36 weeks' corrected gestation) from 17.3 to 20.7% since 2006 and in the use of steroids for CLD from 0.5% to 0.9%. However, these were not statistically significant.

7. Therapeutic hypothermia for moderate to severe hypoxic ischaemic encephalopathy (HIE) is now in use in NI NNUs.

8. There has been a small improvement in the proportion of "at-risk" infants being screened for ROP, from 75.7 % to 78.2%, although not statistically significant. More infants received treatment for ROP but it is likely that this represents a change in the threshold for treatment following the new ROP treatment guideline produced in 2008.[12]

9. There has been an increase in the number of infants with congenital malformations receiving neonatal care, although not statistically significant and in the number of care days associated with these infants in NI, between 2006 and 2009.

10. There have been statistically significant improvements in initial thermal care and antenatal steroid use as measured by longstanding evidence-based NICORE standards. The NICORE figures for "temperature on admission", use of antenatal steroids and screening for Retinopathy of Prematurity" compare favourably with the National Neonatal Audit Project (NNAP) figures for England & Wales.

11. Overall, for NI for those infants discharged home directly from NNU 20.9% were exclusively breast fed with another 15.7% receiving breast milk and formula. Approximately 30% of infants of less than 33 weeks' gestation are feeding on some breast milk at the time of discharge (any destination) from neonatal care. However, only 12.1% are exclusively fed on breast milk.

6.2 The way forward

1. All NNUs should complete the integration of BadgerNet™ into their daily activity and move to electronic NICORE data collection as soon as it becomes available.

2. Collection of NICORE data should be an important priority for the newly established managed clinical network.

3. UK and international neonatal benchmarking should continue and be a key function of NICORE regardless of the new neonatal service structures.

4. The new managed clinical neonatal network should review the findings of this report and establish the clinical priorities accordingly.

5. The new managed clinical network should aim to increase the proportion of extremely low gestational age infants (less than 26 weeks' gestation) being born in the regional centre.

6. Concentrated efforts to reduce the burden of late onset sepsis (after day three of life) should remain a priority for each NNU and the new managed clinical neonatal network.

7. NNUs should monitor the trends in the development of CLD in very preterm infants and consider undertaking evidence-based quality improvement initiatives aimed at reducing the incidence of CLD.

8. Since therapeutic hypothermia for moderate to severe HIE is now available for use in NI, NNUs should ensure that infants with moderate to severe HIE should have therapeutic hypothermia commenced within the evidence-based timeframe.

9. NNUs should ensure that all “at-risk” infants are screened appropriately for ROP and documented in the newly agreed ROP screening record on BadgerNet™. Trend data in the number of infants receiving ROP treatment should be monitored by all NNUs who should ensure adherence to evidence-based oxygen saturation targeting in those at risk of ROP.

10. NNUs should examine how to increase the proportion of infants receiving breast milk at the time of discharge.

11. NICORE should continue to benchmark with the National Neonatal Audit Programme (NNAP) in England & Wales and NNUs are encouraged to participate in the National Neonatal Audit Programme which will be facilitated by BadgerNet™.

References

1. McCall, E. and Craig, S., on behalf of the NICORE group. (2009) *Neonatal Care in Northern Ireland 2006*. Belfast: NICORE. ISBN: 9780853899594.

2. Department of Health, Social Services and Public Safety Northern Ireland DHSSPS (NI), Child Health System Bureau Service Database.

3. Vermont Oxford Network. (2008) *Vermont Oxford Network Database Manual of Operations For Infants born in 2009. Release13.2.* Vermont: Vermont Oxford Network [Online]. Available at: http://www.vtoxford.org/tools/2009ManualofOperationswithindex12_2.pdf. (Accessed: June 2012).

4. British Association of Perinatal Medicine. (2004) *The BAPM Neonatal Dataset for the Annual reporting of data by neonatal intensive care units*. London: British Association of Perinatal Medicine [Online]. Available at: http://www.bapm.org/publications/documents/general/dataset_fullreview_20040300.pdf. (Accessed: June 2012).

5. http://www.euroneostat.org/paginas/publicas/euroneo/euroNeoStat/index.html (Accessed: June 2012).

6. http://www.spss.com (Accessed: June 2012).

7. British Association of Perinatal Medicine. (2001) *Standards for Hospitals Providing Neonatal Intensive and High Dependency Care and categories of babies requiring neonatal care.* 2nd ed. London: British Association of Perinatal Medicine [Online]. Available at: http://www.bapm.org/publications/documents/guidelines/hosp_standards.pdf (Accessed: July 2012).

8. March of Dimes, PMNCH, Save the Children, WHO. (2012) *Born Too Soon: The Global Action Report on Preterm Birth.* Eds CP Howson, MV Kinney, JE Lawn. Geneva: World Health Organization [Online]. Available at: http://www.who.int/pmnch/media/news/2012/preterm_birth_report/en/index.html (Accessed: July 2012).

9. British Association of Perinatal Medicine. (2010) *Service Standards for Hospitals Providing Neonatal Care.* 3rd ed. London: British Association of Perinatal Medicine [Online]. Available at: http://www.bapm.org/publications/documents/guidelines/BAPM_Standards_Final_Aug2010.pdf (Accessed: July 2012).

10. Sarnat, H. and Sarnat, S. (1976) 'Neonatal encephalopathy following foetal distress', *Archives of Neurology,* 33, pp. 696-705.

11. Royal College of Ophthalmologists and British, Association of Perinatal Medicine. (1996) 'Retinopathy of Prematurity: guidelines for screening and treatment. The report of a joint Working Party of The Royal College of Ophthalmologists and the British Association of Perinatal Medicine', *Early Human Development,* 46 (3), pp. 239-258.

12. Royal College of Paediatrics and Child Health, Royal College of Ophthalmologists, British Association of Perinatal Medicine & BLISS. (2008) *UK Retinopathy of*

Prematurity Guideline, London: Royal College of Paediatrics and Child Health [Online]. Available at:
http://www.bapm.org/publications/documents/guidelines/ROP_Guideline%20_Jul08_%20final.pdf
(Accessed: July 2012).

13. Watkinson, M., Davis, K., and Neonatal Data Analysis Unit (NDAU). (2009) *Annual Report National Neonatal Audit Programme 2009*, London: Royal College of Paediatrics and Child Health Science and Research Department [Online]. Available at:
http://www1.imperial.ac.uk/resources/5858D61E-49BE-4550-9326-634295ECB5DE/nnap_annual_report_extended_web_version.pdf
(Accessed: July 2012).

14. Sweet, D., Bevilacqua, G., Carnielli, V., Greisen, G., Plavka, R., Saugstad, O.D., Simeoni, U., Speer, C.P., Valls-I-Soler, A., Halliday, H., Working Group on Prematuity of the World Association of Perinatal Medicine and European Association of Perinatal Medicine. (2007) 'European consensus guidelines on the management of neonatal respiratory distress syndrome', *Journal of Perinatal Medicine* 35(3), pp. 175-186. [Online] DOI: 10.1515/JPM.2007.048 Available at:
http://www.blackwellpublishing.com/medicine/bmj/nnf5/pdfs/uk_guidelines/SURFACTANT-EU_guideline.pdf
(Accessed: July 2012).

15. British Association of Perinatal Medicine and Royal College of Physicians. (1992) 'Development of audit measures and guidelines for good practice in the management of respiratory distress syndrome. Report of a joint working group of the British Association of Perinatal Medicine and the Research Unit of the Royal College of Physicians', *Archives of Disease in Childhood,* 67(10 Spec No), pp 1221-1227. [Online]. Available at:
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1590463/pdf/archdisch00887-0089.pdf
(Accessed: July 2012).

16. McCall, E.M., Alderdice, F.A., Halliday, H.L., Jenkins, J.G. and Vohra, S. (2010) 'Interventions to prevent hypothermia at birth in preterm and/or low birth weight babies', *Cochrane Database of Systematic Reviews*, Issue 3. Art. No.: CD004210. [Online] DOI: 10.1002/14651858.CD004210.pub4.2010. (Accessed: June 2012).

17. Acolet, D., Elbourne, D., McIntosh, N., Weindling, M., Korkodilos, M., Haviland, J and Macintosh, M. (2005) ' Project 27/28: Inquiry Into Quality of Neonatal Care and Its Effect on the Survival of Infants Who Were Born at 27 and 28 Weeks in England, Wales and Northern Ireland', *Pediatrics,* 116, pp. 1457-1465. [Online] DOI: 10.1542/peds.2004-2691. Available at: http://pediatrics.aappublications.org/content/116/6/1457.full.html (Accessed: July 2012).

18. Department of Reproductive Health and Research (RHR). World Health Organisation. (1997) *Thermal protection of the newborn: a practical guide* (WHO/RHT/MSM/97.2). Geneva: World Health Organisation [Online]. Available at: http://www.who.int/reproductivehealth/publications/maternal_perinatal_health/MSM_97_2/en/index.html (Accessed: July 2012).

19. http://www.screening.nhs.uk/newbornhearing-northernireland (Accessed: July 2012).

Appendix One: NICORE steering group membership.

Name	Title
Prof F. Alderdice	Director of Research, School of Nursing & Midwifery - QUB
Dr B. Aljarad	Consultant Paediatrician – SHSCT (Daisy Hill)
Dr S. Bali	Consultant Paediatrician – NHSCT (Antrim)
Dr C. Bailie	Consultant Obstetrician – BHSCT
Dr C. Beattie	Consultant in Public Health –PHA
Sr M. Campbell	Neonatal Ward Manager – SEHSCT (Ulster)
Dr S. Craig (Chairman)	**Consultant Neonatologist – BHSCT (RMH)**
Sr J. Cunningham	Ward Manager – WHSCT (Erne)
Prof J. Dornan	Consultant Obstetrician & Gynaecologist – Belfast Trust
Sr B. Devine	Neonatal Sister – WHSCT (Altnagelvin)
Sr P. Farrell	Clinical Midwifery Manager – BHSCT (RMH)
Dr M. Hogan	Consultant Paediatrician - SHSCT & N Ireland Neonatal Network Chair
ANNP A. Hughes	Advanced Neonatal Nurse Practitioner – WHSCT (Altnagelvin)
Prof L. Johnston	Head of School, Nursing and Midwifery - QUB
Dr M. Ledwidge	Consultant Paediatrician – WHSCT (Altnagelvin)
Dr N. Lipscomb	Consultant Paediatrician – WHSCT (Erne)
Dr J. Little	Assistant Director, Service Development Screening – PHA
Sr J. Lynch	Ward Manager – SHSCT (Daisy Hill)
Dr C. Mayes	Consultant Neonatologist, Royal Maternity Hospital
SN C MacDonald	Staff Nurse – WHSCT (Altnagelvin)
Ms A. McAuley	Health Services Researcher – PHA
Ms E. McCall	NICORE Project Manager – QUB
Dr S. McKee	Consultant Clinical Geneticist – BHSCT
Miss E. McLoone	Consultant Ophthalmologist – BHSCT
Dr R. McMillen	Consultant Obstetrician & Gynaecologist NHSCT (Antrim)
Sr L. McParland	Neonatal Sister & Neonatal Benchmarking Group – SHSCT
Dr D. Millar	Consultant Neonatologist, Royal Maternity Hospital
Dr P. Quinn	Consultant Paediatrician – SHSCT (Craigavon)
Sr S. Rankin	Neonatal Ward Manager – NHSCT (Antrim)
Ms H. Reid	Consultant in Public Health – PHA
Dr N. Saxena	Consultant Neonatologist – SEHSCT (Ulster)
Sr U. Toland	Neonatal Ward Manager – SHSCT (Craigavon)
Dr R. Tubman	Consultant Neonatologist – BHSCT (RMH)

Appendix Two: NICORE requests.

Requestor	Nature of Request	Progress
1. Dr Sarinda Millar/Dr John Jenkins, Paediatrics, Antrim Area Hospital	Service evaluation of Antrim Area Hospital nurse practitioner led neonatal service as part of an MSc Thesis. Activity, morbidity and mortality data for Antrim Area Hospital with comparisons to similar sized units.	Ongoing
2. Dr Nichola McCullough, Research Fellow, EUROCAT Project, University of Ulster	Congenital malformations, survival and length of stay in the neonatal population. NICORE data will contribute to an overall scoping project for the prevention and causes of congenital malformations. Funded by R&D Office.	Completed: 01/05/2012
3. Dr Heather Livingston, DHSSPSNI.	Survival data for Northern Ireland by gestational age (401 to 1500g birth weight infants).	Completed: 31/05/2012
4. Dr Sanjeev Bali, Antrim Area Hospital	2011 Neonatal unit activity data for Antrim Area Hospital for presentation at NHSCT regional perinatal meeting.	Completed: 16/04/2012
5. Julie Neill, Health Intelligence Officer, Public Health Agency.	PHA breastfeeding working group : enteral feeding at discharge from neonatal care (Update). Confirmation of preliminary figures.	Completed: 05/04/2012
6. Prof Linda Johnston, Head of School, School of Nursing and Midwifery, QUB.	2006 and 2009 datasets for PhD chapter in Thesis: Surgical correction for congenital malformations in infant ≥ 34 weeks' gestation.	Completed: 23/03/2012
7. Ms Heather Reid, Public Health Specialist, PHA	Confirmed pseudomonas (late sepsis) infections 2009.	Completed: 31/01/2012
8. Miss Eibhlin McLoone, Consultant Ophthalmologist, BHSCT.	Key variables associated with infants eligible for screening for ROP 2006 to 2010 inclusive for an epidemiology study of ROP in N. Ireland.	Completed: 15/11/2011
9. Dr Frances Stewart , Obstetrics & Gynaecology, Antrim Area Hospital	Hypoxic ischaemic encephalopathy in Northern HSC Trust 2006 and 2009. (Assembly Question).	Completed: 30/09/2011
10. Prof Adele Marshall, Centre for Statistical Science and Operational Research CenSSOR, QUB.	Key variables from 2006 and 2009 datasets for data modelling length of stay in neonatal care. As part of a PhD Thesis (Kieran Payne).	Completed: 23/08/2011
11. Assembly Question / DHSSPSNI.	Group B Streptococcus (*Streptococcus agalactiae*, GBS) confirmed blood stream/cerebrospinal fluid infections. For infants (1769) born in Northern Ireland & admitted to neonatal care (1st January 2009 to 31st December 2009).	Completed: 18/08/2011
12. Dr Mike Smith, Clinical Director Paediatrics, Craigavon Area Hospital.	Neonatal workloads across units in Northern Ireland.	Completed: 15/08/2011

Appendix Three: NICORE publications.

Peer Reviewed Papers

Doran, J., McGowan, J., Alderdice, F., McCall, E., Craig, S. and Jenkins, J. (2012) 'Regional follow up of late preterm neonatal intensive care graduates', *Nurse Researcher,* 19(4), pp. 36-42. [In Press].

McGowan, J.E., Alderdice, F.A, Doran, J., Holmes,V., Jenkins, J., Craig, S. and Johnston, L. (2012) 'Impact of Neonatal Intensive Care on Late Preterm Infants: Developmental Outcomes at Three Years', *Pediatrics* [In Press].

Marshall, A.H., Payne, K., Cairns, K.J, Craig, S. and McCall, E. (2012) 'Modelling the development of late onset sepsis and length of stay using discrete conditional survival models with a classification tree component', *The 25th IEEE International Symposium on Computer-Based Medical Systems (CBMS).* [Online]. Available at: http://www.cbms2012.org/ (Accessed June 2012).

McGowan, J.E., Alderdice, F.A., Holmes, V. and Johnston, L. (2011) 'Early Childhood Development of Late Preterm Infants: A Systematic Review', *Pediatrics,* 127(6), pp. 1111-1124. [Online] DOI: 10.1542/peds.2010-2257 (Accessed June 2012).

McCall, E.M., Alderdice, F.A., Halliday, H.L., Jenkins, J.G. and Vohra, S. (2010) 'Interventions to prevent hypothermia at birth in preterm and/or low birth weight babies', *Cochrane Database of Systematic Reviews*, Issue 3. Art. No.: CD004210. [Online] DOI: 10.1002/14651858.CD004210.pub4.2010. (Accessed June 2012).

Rogers, E., Alderdice, F., McCall, E., Jenkins, J. and Craig, S. (2010) 'Reducing nosocomial infections in neonatal intensive care', *Journal of Maternal - Fetal and Neonatal Medicine*, 23(9), pp. 1039-1046. [Online] DOI: 10.10.3109/14767050903387029 (Accessed: June 2012).

Murphy, B.P., Armstrong, K., Ryan, C.A. and Jenkins, J.G. (2010) 'Benchmarking care for very low birth weight infants in Ireland and Northern Ireland', *Archives of Disease in Chilhood Fetal & Neonatal Edition*, 95(1), pp. F30-F35. [Online] DOI: 10.1136/adc.2009.160002 (Accessed: June 2012).

Craig, S., McCall, E., Bell, A. and Tubman, R. (2009) 'Improving survival for infants of <26 weeks' gestation, 1995–2005', *Archives of Disease in Childhood Fetal & Neonatal Edition*, 94(3), pp. F229-F230. [Online] DOI: 10.1136/ads.2008.138701 (Accessed: June 2012).

Jenkins, J., Gardner, E., McCall, E., Casson, K. and Dolk, H. (2009) 'Socioeconomic inequalities in neonatal intensive care admission rates', *Archives of Disease in Childhood Fetal & Neonatal Edition,* 94(6), pp. F423-F428. [Online] DOI: 10.1136/adc.2008.146464 (Accessed: June 2012).

Hughes, J.L, McCall, E., Alderdice, F. and Jenkins, J. (for the members of the Neonatal Intensive Care Outcome Research and Evaluation Group). (2006) 'More and earlier surfactant for preterm infants', *Archives of Disease in Childhood Fetal & Neonatal Edition*, 91(2), pp. F125-F126. [Online] DOI: 10.1136/adc.2005.073148 (Accessed: June 2012).

Jenkins, J., Alderdice, F., McCall, E. and on behalf of the Neonatal Intensive Care Outcomes Research & Evaluation (NICORE) Group. (2005) 'Improvement in neonatal intensive care in Northern Ireland through sharing of audit data', *Quality & Safety in Health Care,* 14(3), pp. 202 –206. [Online] DOI: 10.1136/qshc.2004.010371.

Alderdice, F., Bailie, C., Dornan, J. and Jenkins, J. (2005) 'Timing of elective caesarean section at term: barriers to guidelines in practice', *Journal of Maternal – Fetal and Neonatal Medicine,* 17 (2), pp. 137-138. [Online] DOI:10.1080/jmf.17.2.137.138.

Alderdice, F., McCall, E., Bailie, C., Craig, S., Dornan, J., McMillen, R. and Jenkins, J. (2005)' Admission to neonatal intensive care with respiratory morbidity following 'term' elective caesarean section', *Irish Medical Journal,* 98(6), pp. 170-172.

Jenkins, J., Alderdice, F., McCall, E. and the Neonatal Intensive Care Outcomes Research & Evaluation Group. (2003) 'Making information available for quality improvement and service planning in neonatal care', *Irish Medical Journal*, 96(6), pp. 171-174.

NICORE REPORTS

McCall, E. and Craig, S., on behalf of the NICORE group. (2011) *Tenth Annual Report on Very Low Birth Weight Infants born in Northern Ireland in 2007 & 2008*. Belfast: NICORE. ISBN: 9780853899853.

McCall, E. and Craig, S., on behalf of the NICORE group. (2009) *Neonatal Care in Northern Ireland 2006*. Belfast: NICORE. ISBN: 9780853899594.

McCall, E., Craig, S., Jenkins, J. and Alderdice, F., on behalf of the NICORE group. (2005) *Eighth Annual Report on Very Low Birth Weight Infants born in Northern Ireland in 2005*. Belfast: NICORE. ISBN: 9780853899174.

McCall, E., Craig, S., Alderdice, F. and Jenkins, J., on behalf of the NICORE group. (2006) *Seventh Annual Report Very Low Birth Weight Infants.* Belfast: NICORE. ISBN: 0853899002.

McCall, E., Jenkins, J. and Alderdice, F., on behalf of the NICORE group. (2004) *Sixth Annual Report.* Belfast: NICORE. ISBN: 0853898669.

McCall, E., Jenkins, J. and Alderdice, F., on behalf of the NICORE group. (2002) *Fifth Annual Report.* Belfast: NICORE. ISBN: 0853898170.

McCall, E., Jenkins, J. and Alderdice, F., on behalf of the NICORE group. (2000) *Fourth Annual Report.* Belfast: NICORE.

Appendix Four: International benchmarking groups.

1. Vermont Oxford Network (VON)

World Wide Web address: http://www.vtoxford.org/

Background

The Vermont Oxford Network was established in 1988 and a non-profit voluntary organisation dedicated to the provision of high quality care to newborn infants and their families. The Network is today comprised of over 800 neonatal intensive care units around the world and maintains a VLBW Database for infants 401 to 1500 grams or gestational age between 22 weeks 0 days and 29 weeks 6 days who are born at participating hospitals or admitted to them within 28 days of birth. Further information, datasets and definitions are available from the website above.

Participation

Altnagelvin, Antrim, Craigavon, Royal Maternity and Ulster Neonatal Units have been sending anonymised data to VON since 2004 and have been receiving detailed unit reports from VON.

Benchmarking reports available to participating neonatal units

- All Ireland Group Reports.
- Northern Ireland Group Reports.
- UK Group Reports.
- International Network Reports.

2. EuroNeoStat (ENS)

World Wide Web address:

http://www.euroneostat.org/paginas/publicas/euroneo/euroNeoStat/index.html

EuroNeoStat is a European information system to monitor short and long-term morbidity outcomes to improve quality of care and patient-safety for Very-Low-Birth-Weight (VLBW) infants. This network is funded by the European Commission (DG. SANCO funded project Nº116/2006).

The central office is located in Bilbao, Spain, and is led by Prof. Adolf Valls i Soler and Dr. José Ignacio Pijan.

EuroNeoStat aims to develop an information system to assess the quality of care provided for infants of less than 1501g birth weight or less than 32 weeks' gestation born in Europe, in order to contribute to the improvement of the health status of those high-risk infants, and to detect any outcome inequalities that might exist. In 2006, sixteen neonatal units sent data to EuroNeoStat providing a sample size of 1753 infants. Further information, datasets and definitions are available from the website above.

Participation

Royal Maternity neonatal unit has been sending anonymised data to EuroNeoStat since 2006. Prior to this Royal Maternity participated in the EuroNeoNet project. Altnagelvin, Antrim, Craigavon, Royal Maternity and Ulster Neonatal Units have been sending anonymised data to VON since 1st January 2009.

Benchmarking reports available to participating neonatal units

EuroNeoStat. EurNeoStat Annual Report for VLGAI & Individual Report for Each Unit Participating in the EuroNeoStat Project 2006.

Appendix Five: NICORE data collection proforma.

Neonatal Intensive Care Outcomes Research & Evaluation 2009

One NICORE proforma to be completed for each ADMISSION to your unit regardless of the level of care that the infant receives. Record information for THIS ADMISSION only unless otherwise stated. READ DEFINITION MANUAL

DO NOT REMOVE THIS FORM FROM YOUR UNIT

BUI Number:

Patient Identifiers:

1. Hospital/Medical Number:
2. Health & Care Number:
3. Surname:
4. Forename:

A. ADMISSION DETAILS:

5a. Date of admission: DD MM YY

5b. Time: (24 Hrs)

6. Source of admission:
- delivery suite
- theatre
- postnatal ward
- maternity unit – other hospital
- neonatal unit – other hospital
- Unknown

7. Age of infant on admission to this unit: *Note: Day of birth = day 1*

Days:
Hours:

8. Sex: female male indeterminate

9. Reason for admission:

10. Place of delivery: **Inborn** ☐ **Outborn** ☐

Specify if out born:

11. Planned place of delivery at booking:

this hospital	☐
another hospital	☐
home birth	☐
not booked – no antenatal care	☐
other	☐
unknown	☐

12a. Did a transfer take place? **Yes** ☐ **No** ☐

12b. If yes, specify timing of transfer:

before labour for medical reasons	☐
during labour	☐
before birth, labour status not known	☐
after birth	☐
unknown	☐

12c. if yes, specify sending hospital: ☐

12d. If yes, date of transfer:

DD	MM	YY

13. Consultant: ☐ **(optional)**

14 a. Temperature within 1 hr of this NICU admission: **Yes** ☐ **No** ☐ **NA** ☐

14 b. Admission temperature: ☐ **^{0} C**

15. Blood sugar in first 4 hours:

yes	☐	**value mMol/L** ☐
no	☐	
unknown	☐	
not applicable	☐	

B. PREGNANCY AND DELIVERY:

Antenatal risk factors:

16.	**Smoking**	**yes**	☐	**no**	☐	**unknown**	☐					
17.	**Diabetes**	**yes**	☐	**no**	☐	**unknown**	☐	**Type1**	☐	**Type2**	☐	**Gestational** ☐
18.	**Rhesus**	**yes**	☐	**no**	☐	**unknown**	☐					
19.	**Hypertension**	**yes**	☐	**no**	☐	**Unknown**	☐					
20	**Other risk factors**	**yes**	☐	**no**	☐	**unknown**	☐					

If yes,

21.	**Other risk factor 1**	
22.	**Other risk factor 2**	
23.	**Other risk factor 3**	
24.	**Other risk factor 4**	
25.	**Other risk factor 5**	

26. Prenatal care: **yes** ☐ **no** ☐ **unknown** ☐

27. Antenatal steroids given:

none given	☐		
incomplete course	☐		
complete course	☐		
other	☐	**specify**	
unknown	☐		

28. Number of courses of antenatal steroids: ☐

29. Chorioamnionitis: **yes** ☐ **no** ☐ **unknown** ☐

30. Duration of ruptured membranes:

less than 24 hours	☐
1 – 7 days	☐
more than 7 days	☐
unknown	☐

31. Reason for delivery:

spontaneous ☐
elective ☐
emergency ☐
unknown ☐

32. Mode of delivery:

vaginal ☐
caesarean section ☐
unknown ☐

33a. Date of birth: DD MM YY ☐☐☐ **33b.Time:** HH : MM ☐☐ **(24 Hrs)**

34a. Number of fetuses this pregnancy: ☐

34b. Number of infants delivered: ☐ **34c. If > 1 state birth order** ☐

35. Apgar scores: **a. 1 min** ☐ **b. 5 mins** ☐ **c. 10 mins** ☐

36. Time to first breath:

not applicable ☐
less than 1 minute ☐
1 to 5 minutes ☐
6 to 10 minutes ☐
11 to 15 minutes ☐
more than 15 ☐
not established ☐
unknown ☐

37. Gestation: ☐ **a. wks** ☐ **b. days**

38. Birthweight: ☐ **grams**
39. Length at birth: ☐ **cms**
40. Head circumference at birth: ☐ **cms (nearest 10th)**

41. Meconium Aspiration Syndrome: yes ☐ **no** ☐ **unknown** ☐

42. Resuscitation:

no resuscitation ☐
oxygen ☐
Face Mask Ventilation ☐
intubation & ventilation ☐
tracheal suction for meconium ☐
epinephrine (adrenaline) ☐
cardiac compression ☐

43. Cord arterial pH:

done ☐ **pH** ☐
not done ☐
unknown ☐

44. Cord venous pH:

done ☐ **pH** ☐
not done ☐
unknown ☐

45. Admission notes (optional)

Crib Score:

46. Worst base excess in first 12 hours: ☐

(Crib score and probability of mortality will be automatically generated)

C. PARENTS DETAILS:

Mother's details:

47. Age (yrs):

48. Postcode:

49. Northern Ireland resident at time of delivery:

Yes ☐ **No** ☐

50. Marital status:

- ☐ single (never married)
- ☐ married (first marriage)
- ☐ separated (still legally married)
- ☐ divorced
- ☐ widowed
- ☐ unknown

51. Ethnicity:

- ☐ white
- ☐ Irish traveller
- ☐ mixed — specify
- ☐ Indian
- ☐ Pakistani
- ☐ Bangladeshi
- ☐ Asian - other
- ☐ Black Carribean
- ☐ Black African
- ☐ Black - other
- ☐ Chinese
- ☐ other — specify

D. EARLY OUTCOMES NOTED WITHIN 28 DAYS:

Date of day 28 where date of birth = day 1

52a. Early <u>proven bacterial sepsis</u> (first 72 hours):

yes ☐
no ☐
unknown ☐
not applicable ☐

52b. List bacterial pathogen/s:

53a. Cranial imaging (US/CT/MRI) on or before 28 days of life:

Yes ☐ **No** ☐

53b. If yes, state location where cranial imaging took place:

this hospital ☐ **other hospital** ☐ **Both** ☐

53c. If yes, state max grade IVH

53d. State where IVH FIRST occurred:

this hospital ☐ **other hospital** ☐ **NA** ☐

54. Oxygen at 28 days:

yes ☐
no ☐
not applicable ☐

55. Died within 12 hours: **yes** ☐ **no** ☐
(of admission to NICU)

E. DISCHARGE DETAILS:

56. Date of discharge from NNU: DD MM YY

57a. Date of death/discharge from hospital: DD MM YY **57b.Time:** (24 Hrs)

58. Discharge destination:

- home
- postnatal ward / other ward
- died
- *other hospital — name:
- still in hospital at 1 year
- unknown

59. Reason for transfer:

- not transferred
- growth and discharge planning
- medical diagnostic services
- surgery
- chronic care
- ECMO
- Other — Specify:

60. Discharge weight: grams

61. Discharge head circumference: cms

62. Discharge length: cms

63. Feeding at discharge:

- none
- breast milk only
- formula milk only
- breast milk plus formula or fortifier
- unknown

64. Tube feeding at discharge home: yes no na unknown

65. Treatment at discharge:

- none
- oxygen
- apnoea/cardio respiratory monitor
- other — specify

If Died:

66. Cause of death:

withdrawal of care	☐		
respiratory failure	☐		
sepsis	☐		
neurological	☐		
congenital malformation	☐		
Other	☐	**specify:**	

67. Postmortem:

done	☐
not requested	☐
requested but consent refused	☐
requested but not available	☐

Levels of Care:

68 Level 1 care		**days**
69. Level 2 care		**days**
70. Level 3 care		**days**
71. Normal care		**days**

F. INTERVENTIONS / TREATMENTS/DIAGNOSES DURING THIS ADMISSION:

72. Oxygen after leaving delivery room : yes ☐ no ☐

If yes: (not mutually exclusive)

73a. Oxygen > 21% ☐ days

73b. Oxygen > 60% ☐ days

74. Adjusted gestational age – week 36 ☐ date

75. Oxygen at 36 weeks: yes ☐ no ☐ na ☐

76. Date of final added oxygen therapy: ☐

77. Conventional ventilation : yes ☐ no ☐

78. HFOV: yes ☐ no ☐

79. High Flow Nasal Cannula (> 1L/min) yes ☐ no ☐

80. Nasal IMV, IPPV or SIMV yes ☐ no ☐

81. Nasal CPAP: yes ☐ no ☐

82. Days of Nasal CPAP ☐

83. Nasal CPAP before ventilation: yes ☐ no ☐

84. Duration of (assisted) ventilation (hfov or conv ventilation):

less than 4 hrs ☐☐

4 – 24 hrs ☐☐

more than 24 hrs ☐☐

85. Total Duration of assisted ventilation if more than 24 hrs: Days:

86. Days where an ET tube in situ: Days:

87. Surfactant given in delivery room: yes ☐ no ☐

88. Surfactant given at any time: yes ☐ no ☐

	DD	MM	YY	HH : MM				type:	B	P	S
89. Surfactant 1st dose (mg):							24 (hrs)	type:			
90.Surfactant 2nd dose (mg):							24 (hrs)	type:			
91. Surfactant 3rd dose (mg):							24 (hrs)	type:			

B = Bovine P = Porcine S = Synthetic

92a. Inhaled Nitric Oxide: Yes ☐ No ☐

92b. If yes, location: this hospital ☐ other hospital ☐ both ☐

93a. ECMO: Yes ☐ No ☐

93b. If yes, location: this hospital ☐ other hospital ☐ both ☐

94. Respiratory Distress Syndrome:	yes	☐	no	☐			
95. Transient Tachypnoea of the Newborn:	yes	☐	no	☐			
96. Steroids for chronic lung disease (this admission):	yes	☐	no	☐			
97a. Pneumothorax :	yes	☐	no	☐			
yes – chest drain inserted	yes	☐	no	☐			
97b. If yes, where occurred:	this hospital	☐	other hospital	☐	both	☐	
98. Patent Ductus Arteriosus:	yes	☐	no	☐			
99. Shunt for post haemorrhagic hydrocephalus:	yes	☐	no	☐			
100. PDA surgery:	yes	☐	no	☐			
101. Indomethacin (any reason):	Prophylactic	☐	Therapeutic	☐	None	☐	
102. Ibuprofen (for PDA):	Prophylactic	☐	Therapeutic	☐	None	☐	
103. Etamprilale (therapeutic):	yes	☐	no	☐			
104a. Necrotising enterocolitis:	yes	☐	no	☐			
104b. If yes, where occurred:	this hospital	☐	other hospital	☐	both	☐	
105. Nec surgery:	yes	☐	no	☐			
106a. Focal GI perforation :	yes	☐	no	☐			
106b. If yes, where occurred:	this hospital	☐	other hospital	☐	both	☐	
107. Seizures:	yes	☐	no	☐	na	☐	
108a. Hypoxic ischaemic encephalopathy:	yes	☐	no	☐	na	☐	
108b. If yes, did infant receive controlled hypothermia	yes	☐	no	☐	na	☐	
108c. If yes, which treatment :	whole body	☐	selective head cooling	☐	na	☐	
108d. Severity of HIE:	mild	☐	moderate	☐	severe	☐	

109. Cystic PVL:

no ☐
yes ☐
not applicable ☐
unknown ☐

Date of diagnosis: DD ☐☐ MM ☐☐ YY ☐☐

110a. Major surgery as listed in manual: yes ☐ no ☐ na ☐

110b. State surgery:

110c. State location where surgery performed:

this hospital ☐ **other hospital** ☐

EYE SCREENING: Retinopathy of prematurity:

111a. During this admission did the infant undergo Ophthalmology screening:
Yes ☐ **No** ☐

111b. If screened state date of first eye screening in this unit:

DD	MM	YY

111c. If not screened, state reason:

not appropriate for screening	☐
discharged other hospital prior to screen due	☐
died	☐
discharged home with OPD appt	☐
discharged home with no OPD appt	☐
done in another hospital	☐
reason not given	☐

111d. If screened worst stage (max changes) in this admission:

	Lft	Rt
Stage 0 (no evidence of ROP)		
stage 1 (presence of demarcation line (+/- vascularization)		
stage 2 (presence of intra retinal ridge)		
stage 3 (presence of a ridge with extra retinal fibrovascular proliferation)		
stage 4 (partial retinal detachment)		
stage 5 (retinal detachment)		
Aggressive posterior ROP		

111e. If ROP present, state which zone was the most advanced ROP in this admission:

	Lft	Rt
Zone 1:		
Zone 2:		
Zone 3:		

111f. ROP pre plus or plus disease present in this admission:

	Lft	Rt
present: pre –plus		
present : plus disease		
not present		
unknown		

111g. ROP retinal cryo and/or laser surgery this admission: Yes ☐ **No** ☐

111h. If yes, (111f) state eye/s: Lft only ☐ **Rt only** ☐ **Both** ☐

HEARING SCREENING:

112a. Hearing screening during this admission:

Yes ☐ **No** ☐

112b. Results of hearing screening:

Follow up required ☐ **no further testing required** ☐

112c. Reason for hearing not screened this hospital:

discharged other hospital	☐
died	☐
discharged home OPD appt	☐
discharged home no OPD appt	☐
done in another hospital	☐
reason not given	☐

LATE SEPSIS – THIS ADMISSION ONLY

113a. Septicaemia (proven, late after day 3): Yes ☐ **no** ☐ **na** ☐

113b. Total episodes of PROVEN BACTERIAL sepsis: ☐

113c. Bacterial Pathogen/s 1st episode:
(list all pathogens including Coag Neg Staph)

113d. Bacterial Pathogen/s 2nd episode:
(list all pathogens including Coag Neg Staph)

113e. Bacterial Pathogen/s 3rd episode:
(list all pathogens including Coag Neg Staph)

113f. Bacterial Pathogen/s 4th episode:
(list all pathogens including Coag Neg Staph)

113g. Bacterial Pathogen/s 5th episode:
(list all pathogens including Coag Neg Staph)

113h. Bacterial Pathogen/s 6th episode:
(list all pathogens including Coag Neg Staph)

114a. Total episodes of PROVEN FUNGAL sepsis

114b. Fungal Pathogen/s 1st episode:

114c. Fungal Pathogen/s 2nd episode:

114d Fungal Pathogen/s 3rd episode:

114e Fungal Pathogen/s 4th episode:

114f Fungal Pathogen/s 5th episode:

114g Fungal Pathogen/s 6th episode:

115a Birth defect/s present: **Yes** ☐ **No** ☐

115b If yes, list (refer to manual):

School of Nursing and Midwifery

Queen's University Belfast

Medical Biology Centre
97 Lisburn Road
Belfast BT9 7BL

Tel: 0044 (0) 28 9097 2993
Email: Nicore@qub.ac.uk

HSC Health and Social Care

DHSSPS
Department of Health, Social Services and Public Safety
www.dhsspsni.gov.uk

Queen's University Belfast

NICORE

08/12