

BRITISH ASSOCIATION OF PERINATAL MEDICINE

**Optimal Arrangements for Neonatal Intensive Care Units
in the UK including guidance on their Medical Staffing**

A Framework for Practice

June 2014



Members of the working group

Chair: Dr Steve Jones, Consultant Neonatologist, Bath (appointed by BAPM's Executive Committee)

Members (self-nominated from BAPM membership and approved by Executive Committee):

Dr Eleri Adams, Consultant Neonatologist (Oxford), Dr Chris Day, Consultant Neonatologist (Bradford), Dr Grenville Fox, Consultant Neonatologist (London), Dr Jane Hawdon, Consultant Neonatologist (London), Dr Minesh Khashu, Consultant Neonatologist (Poole), Mrs Róisín McKeon-Carter, Advanced Neonatal Nurse Practitioner (Plymouth), Dr Imogen Morgan, Consultant Neonatologist (Birmingham), Dr Peter Reynolds, Consultant Neonatologist (Chertsey), Dr Steve Wardle, Consultant Neonatologist (Nottingham).

Organisations and representatives involved in the consultation process

Members of the British Association of Perinatal Medicine (BAPM), the Clinical Reference Group for Neonatal Critical Care (of the National Commissioning Board), the Royal College of Paediatrics and Child Health, the Royal College of Obstetrics and Gynaecology and the British Maternal and Fetal Medicine Society (BMFMS).

Executive summary

The findings of the Working Group recommend that:

- Neonatal Intensive Care Units (NICUs) in the UK should admit at least 100 very low birth weight (VLBW) babies per year
- NICUs in the UK should undertake at least 2000 days of respiratory support per year
- All UK NICUs should comply to existing standards of nurse to baby ratios and cot occupancy as well as those related to family and parent quality of experience
- Units with more than 7000 deliveries should augment their tier 1 medical support *
- NICUs undertaking more than 2500 Intensive care (IC) days [§] per annum should augment their tier 2 medical cover and provide two consultant led teams during normal hours*
- Neonatal consultant staff should be available on site in all NICUs for at least 12 hours a day and for units undertaking more than 4000 intensive care days [§] per annum* consideration should be given to 24 hour consultant presence.

* consensus

[§] defined by BAPM Categories of Care 2011

1. Introduction

1.1 Definitions

The aim of this document is to provide guidance on the optimal activity of Neonatal Intensive Care Units (NICUs) in the UK. Optimal is defined as providing a combination of the lowest mortality and morbidity, the best cost effectiveness and the best baby and parent experience. A NICU is defined as that described in the Department of Health (DH) Toolkit for Neonatal Services ⁽¹⁾ which equates to Level 3 Neonatal Intensive Care Units in accordance with the international classification. Medical staffing is defined as roles traditionally undertaken by medical practitioners but including those which can now also be undertaken by appropriately trained and experienced Advanced Neonatal Nurse Practitioners (ANNPs). Intensive Care days, High Dependency days and Special Care days are defined as described in the BAPM Categories of Care 2011 ⁽²⁷⁾.

1.2 Target Users

This document is aimed at individuals, organisations and government bodies involved in the planning, commissioning or provision of Neonatal Intensive Care.

1.3 Purpose of framework

This framework seeks to provide guidance on the optimal size and activity levels of NICUs in the UK.

This document does not seek to inform the referral threshold of infants into NICUs which in England is defined within the Neonatal Toolkit ⁽¹⁾ and the Service Specification for Neonatal Intensive Care ⁽²⁾ and in the devolved nations by guidance from the Welsh Assembly ⁽³⁾, the Scottish Parliament ⁽⁴⁾, and the Northern Ireland Assembly ⁽⁵⁾.

The recommendations in this document are not applicable to either paediatric or adult intensive care and evidence from these areas has not been sought.

BAPM recognises that the recommendations in this document do have implications for the obstetric and midwifery services working alongside NICUs and the impact on their capacity must be considered. BAPM also acknowledges that many of the recommendations are consensually agreed and implementation would be subject to local and/or national factors and constraints.

1.4 Background

1.4.1 Activity of units

Neonatal Intensive Care in the UK developed as a service provided in many local units in each region which is not the case in many other developed countries. Following the DH review of Neonatal Intensive Care in 2003 ^[6], there was a move to provide this service within regional networks. This decision was made because of the need to provide better services for babies

and families, improve outcomes and make the best use of available resources. Some evidence of the improved outcomes of larger units compared with smaller ones was considered in making this decision and this is presented in the supporting papers published with the report Neonatal Intensive Care Review: Strategy for Improvement, Department of Health, 2003 [6].

The most relevant UK evidence comes from the EPICure 2 study [10] which presents recent data from the UK. This confirms that outcomes are not only better for babies cared for in NICUs with a higher level of care but also that level 3 units with higher levels of activity have significantly better outcomes than smaller ones. Of those babies born in level 3 hospitals, the odds ratio of survival in hospitals with high versus medium activity levels was 2.71 (95% CI, 1.16 - 6.31) at 23 weeks and 2.29 (95%CI, 1.30 - 4.02) at 24 weeks gestation. The study defined high as more than 2000 Intensive Care days, with Intensive Care defined as the total of ventilator and CPAP days (31).

Other outcome data from the UK relating to the size or designation of units is relatively limited. However this is mainly due to the fact that major centralisation of neonatal services has not yet fully occurred in the UK and case mix was strongly influenced in the past by the hospital of birth and transfer (antenatal and postnatal), with larger hospitals more likely to have greater case complexity making risk-adjusted mortality more difficult to assess [7,8,9]. Data from a comparison of Australian and Scottish Neonatal Intensive Care systems suggests that better perinatal outcomes in Australia may be associated with the more centralised organisation of perinatal care, with the average number of births per NICU being 10,000 compared to only 4000 in Scotland [9].

Additional evidence is available from the USA. Studies published in the 1980s [14], 1990s [15] and 2000s [16, 17] strongly suggest that larger, regional neonatal units with higher levels of activity are associated with better outcomes [14-24, 28,29].

Despite other healthcare system differences, data from these studies are still likely to be of relevance in determining the optimal activity of NICUs. Phibbs defined a small unit as one with less than 15 occupied cots per day [15], and showed improved outcomes from units larger than this. A more recent study [17] also showed improved outcomes in units providing a higher level of care when compared with units providing a lower level, as well as demonstrating improved outcomes in units with a higher volume of patients (>100 very low birthweight {VLBW} infants per year).

At least one third of UK NICUs are small in the terms used in another recently published US study [16]. In this study, relative mortality is compared to that of regional NICUs. The criteria for transfer (<2000g birth weight) are set higher than that currently recommended in the DH Toolkit but it clearly shows that mortality is higher in smaller units compared to larger ones. In smaller community units, there is a 42% increase in the risk of death <2000g and a 51% increase in deaths <1500g compared to large regional units. At least one third of the DGHs in England and Wales would be classified as small community units (i.e. less than 15 cots in total and only 1-2 of those for Intensive Care).

Studies from Europe, in particular from Germany and the Netherlands, suggest that there are improved outcomes for preterm babies when women are transported for delivery to perinatal centres rather than being delivered in smaller units. They also demonstrate improved outcomes in units with higher volumes of VLBW infants [11- 13]. In these studies, small units are defined as those caring for <50 VLBW infants per year.

Warner et al [18] showed that the odds of death or major morbidity for VLBW infants born in non-subspecialty units was twice that of infants born in subspecialty perinatal centres despite controlling for demographic and practice characteristics. Interestingly, the effect of birth hospital type on death or major morbidity was greater for infants of 1000-1499g than for 500-999g, lending support to their conclusion that babies <32 weeks should only be delivered in perinatal centres.

1.4.2 Medical staffing of neonatal intensive care units

The DH Toolkit for Neonatal Intensive Care and Clinical Reference Group Service Specification for England as well as the corresponding documents for the devolved nations (1), suggest the minimum resident level of medical staffing is a tier one - junior trainee ST1 -3 or Advanced Neonatal Nurse Practitioner (ANNP), and a second tier of senior trainee ST4-8 or appropriately trained speciality doctor or ANNP. This therefore forms the basic minimum level of care. As throughput increases in a NICU, the level of cover needs to increase accordingly. Augmentation at tier one is provided by extending nurse practice and/or a second junior doctor or ANNP. Augmentation at tier two is provided by a second trained doctor or suitably trained ANNP or resident consultant. Where the consultant is resident there must be a second consultant available on call to allow escalation. Continuity of senior clinician cover is also important and consultant working patterns need to reflect this aspect of care.

No strong evidence was found to suggest at what level these increases in staffing are necessary and it is the case that numbers of medical staff are often not proportional to current workload (26). The recommendations of the Working Group are therefore based on consensus.

2. Protocol

In the following section recommendations are either based on referenced published evidence, or are asterisked (*) when based on the consensus of the Working Group.

2.1 Search strategy

This included searches of MEDLINE, PubMed 1966 to December 2012, and hand searches of reference lists of relevant articles. Clinicians and researchers known to be working in the field were contacted directly and, where possible, unpublished data are included in the appendices.

2.2 Selection criteria, analysis and framework generation

Published studies were identified on the basis of searches looking at outcomes of Neonatal Intensive Care against some measure of throughput or size. All identified studies were circulated to Working Group members who independently, then subsequently as a group,

evaluated the relevance and applicability of the study to the structure of Neonatal Intensive Care services in the UK in 2013.

The framework was generated by a modified Delphi methodology where drafts were circulated, potential changes proposed by all group members, re-drafted by the chair and re-circulated at approximately 2 week intervals over a 10 week period, giving a total of four cycles. In general, changes to the framework throughout this process were based on the group's opinion of the strength, applicability and relevance of the evidence and thereby achieving consensus. The final proposed framework was agreed by the group in a face to face meeting, reviewed by the BAPM's Executive Committee prior to implementation of the consultation process including all BAPM members, the RCPCH, the RCOG and the BMFMS. Following consultation, responses were collated by the Chair and circulated to the group before drafting a final version to be endorsed by the BAPM.

3. Recommendations

3.1 Activity of Neonatal Intensive Care Units

3.1.1 Neonatal Intensive Care Units in the UK should have a throughput of at least 100 VLBW infants per year (VLBW = less than 1500g) (17).

3.1.2 Neonatal Networks that include NICUs admitting less than 50 VLBW should develop plans to amalgamate NICUs (or NICUs plus LNUs) to increase throughput. (11, 12, 13, 14, 15,16,17,18, 22, 23, 24,)

3.1.3 NICUs should undertake at least 2000 days of respiratory support per annum (endotracheal ventilation plus non-invasive ventilation which includes nasal CPAP, nasal High Flow and other non-invasive modalities but excludes low flow oxygen.) (10)

3.1.4 Where geography allows within networks, NICUs should be provided in centres that also deliver neonatal general surgery and if possible cardiac surgery (16,17).

3.1.5 Where possible all VLBW referrals into NICUs should be in utero. Where transfer is ex utero there must be case review at network level (7,8, 10).

3.1.6 All NICUs should have sufficient space to provide the footprints for each cot as defined in the BAPM standards.

3.1.7 All NICUs should adhere to the Bliss Baby Charter Standards and offer free accommodation on or near the unit and free car parking to parents. (1, 2, 30)

3.1.8 All NICUs should submit outcome and benchmarking data to a benchmarking organisation (28,29)

3.1.9 .All NICUs should implement quality improvement programmes to constantly monitor and improve their performance (28,29)

3.2 Medical staffing of NICUs

3.2.1 The minimum staffing of any NICU is outlined in the DoH toolkit, the Scottish Quality Framework, the Welsh and the Northern Irish Standards and the CRG neonatal service specification and for resident out of hours care should include a tier one clinician - ANNP or junior doctor ST1-3 and at tier 2 an experienced junior doctor ST 4-8 or appropriately trained specialty doctor or ANNP (1,2).

3.2.2 Consultant staff in NICUs should be on the General Medical Council specialist register for neonatal medicine or equivalent and have primary duties on the neonatal unit alone (1,2).

As units increase in size more staff would be required at all levels:

3.2.3 NICUs with more than 2500* intensive care days[§] per annum should double tier 2 cover at night by adding a second experienced junior doctor ST4-8 or appropriately trained specialty doctor or ANNP. A consultant present and immediately available on NICU in addition to tier 2 staff would be an alternative (* consensus)

3.2.4 NICUs co-located with a maternity service delivering more than 7000* deliveries per year should augment their tier 1 cover at night by adding a second junior doctor, an ANNP and/or by extending nurse practice. (* consensus)

3.2.5 It is recommended that all NICUs seek to extend consultant presence on the unit to at least 12 hours per day. (* consensus)

3.2.6 NICUs undertaking more than 4000* intensive care[§] days per annum with onerous on call duties should consider having a consultant present and immediately available 24 hours per day. (* consensus)

3.2.7 NICUs undertaking more than 2500* intensive care[§] days per annum should consider the presence of at least 2 consultant led teams during normal daytime hours. (* consensus)

3.2.8 NICUs undertaking more than 4000* intensive care[§] days per annum should consider the presence of three consultant led teams during normal daytime hours. (* consensus)

[§] Intensive care days are defined by BAPM's Categories of Care 2011 and it is acknowledged that there will be considerable HDU and SC days associated with this intensive care workload.

3.3 Nursing and Allied Health staffing of NICUs

3.3.1. All NICUs should have sufficient nursing staff to deliver BAPM's recommended nurse to patient ratios (1:1 NICU, 1:2 HDU, and 1:4 SC) (1, 2, 25)

3.3.2 All NICUs should deliver the recommended level of therapy and other Allied Health Professional support. (1,2)

Conflicts of interest – All working group members are employed by NHS Hospital Trusts in England and no conflicts of interest were declared.

References

1. DH Neonatal Toolkit 2009
2. Neonatal Service Specification from Neonatal Clinical Reference Group of the National Commissioning Board, DH England 2013
3. All Wales Neonatal Standards
<http://www.wales.nhs.uk/sites3/Documents/355/All%20Wales%20Neonatal%20Standards%20for%20Children%20and%20Young%20People%27s%20Specialised%20Healthcare%20Services-%20English.pdf>
4. Neonatal Care in Scotland: A Quality Framework (2013)
<http://www.scotland.gov.uk/Publications/2013/03/4910>
5. Position Paper on specialist services in Northern Ireland (2006) Northern Irish government
6. Neonatal Intensive Care Review: Strategy for Improvement, Department of Health, 2003
7. Field D, Hodges S, Mason E, Burton P. Survival and place of treatment after premature delivery. Archives of Disease in Childhood 1991; 66: 408-411
8. Field D, Draper ES. Survival and place of delivery following preterm birth: 1994 -96. Arch Dis Child Fetal Neonatal Ed 1999 80: F111-F114
9. International Neonatal Network, Scottish Neonatal Consultants, Nurses Collaborative Study Group. Risk adjusted and population based studies of the outcome for high risk infants in Scotland and Australia. Arch Dis Child Fetal Neonatal Ed 2000;82:F118–F123
10. Costeloe K, Hennessy EM, Stacey F, Draper ES. Survival of Extremely Preterm Infants by Hospital Designation. Presented at ESPR Meeting 2009 Hamburg, Germany (Abstract 943).
11. Poets CF, Bartels DB, Wallwiener D. Patient Volume and Facilities Measurements as Quality Indicators of Peri and Neonatal Care: A review of data from the last 4 years. Zeitschrift für Geburtshilfe und Neonatologie. 2004; 208(6):220
12. Kolle LA, Verloove-Vanhorick PP, Verwey RA, Brand R, Ruys JH. Maternal and neonatal transport: results of a national collaborative survey of preterm and very low birth weight infants in the Netherlands. Obstet Gynecol. 1988;72:729–732
13. Verloove-Vanhorick SP, Verwey RA, Ebeling MCA, Brand R, Ruys JH. Mortality in Very Preterm and Very Low Birth Weight Infants According to Place of Birth and Level of Care: Results of a National Collaborative Survey of Preterm and Very Low Birth Weight Infants in the Netherlands PEDIATRICS Vol. 81 No. 3 March 1988, pp. 404-411

14. Paneth N, Kiely JL, Wallenstein S, Marcus M, Pakter J, Susser M. Newborn intensive care and neonatal mortality in low birthweight infants: a population study. *N Engl J Med*.1982;307:149–155
15. Phibbs CS, Bronstein JM, Buxton E, Phibbs RH. The effect of patient volume and level of care at the hospital of birth on neonatal mortality. *JAMA* 1996;276:1054-9.
16. Cifuentes J, Bronstein J, Phibbs CS, Phibbs RH, Schmitt SK, Carlo WA. Mortality in low birth weight infants according to level of neonatal care at hospital of birth. *Pediatrics* 2002;109:745-51.
17. Phibbs CS, Baker LB, Caughey AB, Danielsen B, Schmitt SK, Phibbs RH. Level and Volume of Neonatal Intensive Care and Mortality in Very-Low-Birth-Weight Infants. *N Engl J Med* 2007;356:2165-75.
18. Warner B, Musial MJ, Chenier T, Donovan E. The effect of birth hospital type on the outcome of very low birth weight infants. *Pediatrics*. 2004;113:35–41
19. Mayfield JA, Rosenblatt RA, Baldwin LM, Chu J, Logerfo JP. The relation of obstetrical volume and nursery level to Perinatal mortality. *Am J Public Health* 1990;80:819-23.
20. Mandell MB. The Effect of Regionalization On Infant and Early Neonatal Mortality. An Interrupted Time-Series Analysis. *Evaluation Review*, Vol. 10, No. 6, 806-829 (1986)
21. Lubchenco LO, Butterfield LJ, Delaney-Black V, Goldson E, Koops BL, Lazotte DC. Outcome of very-low-birth-weight infants: does antepartum versus neonatal referral have a better impact on mortality, morbidity, or long-term outcome? *Am J Obstet Gynecol*. 1989;160:539–545
22. Modanlou HD, Dorchester W, Freeman R, Rommal C. Perinatal transport to a regional perinatal center in a metropolitan area: maternal versus neonatal transport. *Am J Obstet Gynecol*. 1980;138:1157–1164
23. Mondalou HD, Dorchester WL, Thorosian A, Freeman RK. Antenatal versus neonatal transport to a regional Perinatal center: a comparison between matched pairs. *Obstet Gynecol*. 1979;53:725–729
24. Ozminkowski RJ, Wortman PM, Roloff DW. Inborn/outborn status and neonatal survival: a meta-analysis of non randomised studies. *Stat Med*. 1988;7:1207–1221
25. Tarnow-Mordi WO, Tucker JS, McCabe CJ, Nicolson P, Parry GJ, The UK neonatal staffing study: A prospective evaluation of neonatal intensive care in the UK. *Semin Neonat* 1997; 2; 171–179
26. Fox GF, Hannam S. Data on staffing of London level 3 neonatal units, collected for the Thames Regional Perinatal Group 2010
27. BAPM Categories of care (August 2011) :

<http://www.bapm.org/publications/documents/guidelines/CatsofcarereportAug11.pdf>

28. Rogowski JA, Horbar JD, Staiger DO, Kenny M, Carpenter J, Geppert J. Indirect vs direct hospital quality indicators for very low birth weight Infants. JAMA 2004; 291; 202-209
29. Rogowski JA, StaigerDO, Horbar JD. Variations in the quality of care for very low birthweight infants : Implications for policy. Health Affairs 2004; 23(5);88-97
30. Bliss baby charter
31. Marlow N, Bennett C, Draper ES, et al. Arch Dis Child Fetal Neonatal Ed published online March6, 2014 doi: 10.1136/archdischild-2013-305555