



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

Revised April 2021

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Members of the Working Groups

September 2020 Revision

Chair: Dr Stephen Wardle (Neonatologist Nottingham, BAPM Honorary Secretary)

Helen Mactier (Consultant Neonatologist Glasgow, BAPM President)

Wendy Tyler (Consultant Neonatologist Shrewsbury, BAPM Honorary Treasurer)

Steve Jones (Consultant Neonatologist Bath)

Eleri Adams (Consultant Neonatologist Oxford)

Grenville Fox (Consultant Neonatologist St Thomas' London).

Original Framework 2014

Chair: Dr Steve Jones, Consultant Neonatologist, Bath

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).

Conflicts of interest

All working group members are employed by NHS Hospital Trusts in the UK and no conflicts of interest were declared.

Executive Summary

* consensus § defined by BAPM Categories of Care 2011 [1]

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
- All NICUs in the UK should undertake at least 2000 intensive care days (BAPM 2011 standards) per year
- Women who are threatening preterm labour or at high risk of delivering at <27+0 weeks' gestation in a singleton pregnancy or <28 weeks' gestation for multiple pregnancies and other women / fetuses outside of agreed pathways of care for Local Neonatal Units (LNUs) / Special Care Units (SCUs) should be transferred antenatally to maternity units with a co-located NICU. NICUs should develop perinatal capacity with maternity to accommodate their neonatal network's requirements for such transfer.
- All UK NICUs should comply to existing standards of nurse to baby staffing ratios and cot occupancy as well as those standards related to family and parent quality of experience
- Units with more than 7000 deliveries should have more than one tier 1 medical support to allow for a greater volume of activity*
- NICUs undertaking more than 2500 Intensive Care (IC) days § per annum should augment their tier 2 medical cover (more than one staff member per shift) 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 generally expected to include two ward rounds / handovers and for units undertaking more than 4000 intensive care days § per annum* consideration should be given to 24 hour consultant presence.
- Trusts that have more than one neonatal unit providing intensive or high dependency care should have separate cover at all levels of medical staffing appropriate for each level of unit

Introduction

Definitions

Optimal activity of Neonatal Intensive Care Units (NICUs).

- 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 [2] which equates to Level 3 Neonatal Intensive Care Units in accordance with the international classification.
- Intensive Care days, High Dependency days and Special Care days are defined as described in the BAPM Categories of Care 2011 [1].

Medical Staffing

- 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).

Target Users

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

Purpose of framework

This framework seeks to provide guidance on

- a) The optimal size and activity levels of NICUs in the UK.
- b) Medical staffing
- c) The referral threshold of infants into NICUs which in England is defined within the Neonatal Toolkit [2] and the Service Specification for Neonatal Intensive Care [3] and in the devolved nations by guidance from the Welsh Assembly [4], the Scottish Parliament [5], and the Northern Ireland Assembly [6].

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 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.

Background

Activity of units

Neonatal Intensive Care networks in England were developed following a DH review of Neonatal Intensive Care in 2003 [7]. 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 by partly centralising care for the smallest babies. 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 [7]. Neonatal networks are now well established in the UK.

Data from the National Neonatal Research Database (NNRD) published in 2012 showed that reorganisation of services into networks had allowed more babies of lower gestations to be delivered in units providing the highest volume of neonatal specialist care however there were still problems with many babies being transferred postnatally, often between units with equivalent level of specialist care [8]

There is now very good evidence of improved outcomes for preterm babies in the UK when they are born and cared for at tertiary units compared with units providing a lower level of care. Data from the EPICure 2 study collected in 2006 were analysed to look at designation of unit and size compared to neonatal outcomes for babies <27 weeks [9]. This confirmed that outcomes were not only better for babies cared for in neonatal units with a higher level of care but also that NICUs with higher levels of activity had significantly better outcomes than smaller ones. Of those babies born in hospitals with a NICU, 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 activity as more than 2000 respiratory care days (ventilation and CPAP combined) [9].

Another large UK study from the Neonatal Data Analysis Unit (NDAU) extracted data from the National Neonatal Research Database (NNRD) on all babies born before 33 weeks' gestation in 2009-2011 [10]. Infants born and admitted to a high-volume neonatal unit at the hospital of birth (defined as the highest quartile) were at reduced odds of neonatal mortality (IV regression odds ratio (OR) 0.70, 95% CI 0.53 to 0.92). The effect of volume on any in-hospital mortality was largest among infants born before 27 weeks' gestation (IV regression OR 0.51, 95% CI 0.33 to 0.79).

The UK data are also supported by French data from the Epipage study which confirm that larger NICUs have improved outcomes when compared to smaller ones [11]. Survival at discharge was lower in hospitals with lower volumes of neonatal activity (aOR 0.55, 95% CI 0.33-0.91). Survival without neuromotor and sensory disabilities at 2 years increased with hospital volume, from 75% to 80.7% in the highest volume units. After adjustment for other factors, survival without neuromotor or sensory disabilities was significantly lower in hospitals with a lower volume of neonatal activity (aOR 0.60, 95% CI 0.38-0.95) than in the highest quartile hospitals.

Infants who are transferred postnatally also have a higher risk of death or severe brain injury compared to those born and cared for in tertiary units [12]. Antenatal transfer of these infants to maternity units with NICUs on site is clearly the best approach for women with threatened preterm labour or at high risk of preterm labour. As a result of this the antenatal transfer and delivery of all babies <27+0 weeks in a maternity unit with a co-located NICU is now recommended [23]. Canadian data have also confirmed the benefit of antenatal compared to postnatal transfer with postnatally transferred babies <29 weeks'

gestation having a higher odds of death (aOR 2.1 (1.5-3.0)) and cerebral palsy (aOR 1.9 (1.1-3.3)) [13].

Older international data from the US, Australia and Europe also support the UK data [14-23]. The Neonatal Transformation Review published in 2019 [24] highlighted the fact that over a third of NICUs in England perform fewer than 2000 intensive care days per annum. It also highlighted the fact that several of the units with low volumes of activity were in close proximity and recommended reconfiguration of some of these services to lead to economies of scale, better staffing and less variation in admission rates, albeit at a cost of increased antenatal transfers.

Medical staffing of neonatal intensive care units

The Neonatal Service Standard and 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 [2,3], 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. As throughput increases in a NICU, the level of cover needs to increase accordingly. Augmentation at tier one can be 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 and included in tier 2 numbers 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 [25]. The recommendations of the Working Group are therefore based on consensus.

Each NICU should have dedicated staffing at every level without commitments to other areas. Trusts with more than one neonatal unit should provide separate cover at each level of staffing to each unit without cross cover.

Protocol

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

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.

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. This document has been reviewed and the reference list and applicability to Neonatal Intensive Care services in the UK in 2020 has been assessed.

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 weekly 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 and 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.

Recommendations

Activity of Neonatal Intensive Care Units

- Neonatal Intensive Care Units in the UK should have a throughput of at least 100 new VLBW admissions per year (VLBW = less than 1.5Kg) [19].
- NICUs should undertake at least 2000 days of intensive care per annum (BAPM 2011 standards) [9,10, 24].
- Neonatal Networks should have robust pathways for the appropriate transfer of babies. Neonatal networks that include NICUs admitting less than 100 VLBW or carrying out <2000 intensive care days should develop plans to amalgamate NICUs (or NICUs plus LNUs) to increase throughput or change designation. [9, 10, 24]
- Where geography allows within networks, NICUs should be provided in centres that also deliver neonatal general surgery and if possible cardiac surgery [2,3,24].
- Women threatening preterm labour or at high risk of delivering before 27+0 weeks' gestation should be transferred to a hospital with a NICU whenever possible [9,10,12,13,24].
- Where possible all VLBW referrals into NICUs should be in utero. Where transfer is ex utero there should be a case review at network level [11,12,24]. Early postnatal transfers of babies <29 weeks' gestation for capacity reasons should be avoided where possible.
- All NICUs should have sufficient space to provide the footprints for each cot as defined in the DOH standards [27].
- All NICUs should adhere to the Bliss Baby Charter Standards and offer accommodation on or near the unit without charge as well as free car parking to both parents. [2,3,24,26]
- All NICUs should submit outcome and benchmarking data to a benchmarking organisation [2,3]
- All NICUs should implement quality improvement programmes to constantly monitor and improve their performance [2,3]

Medical staffing of NICUs

- 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 generally an experienced junior doctor ST 4-8 or appropriately trained specialty doctor or ANNP [2,3].

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- 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 [2,3].
- As units increase in size more staff would be required at all levels:
- 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)
- 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)
- It is recommended that all NICUs implement consultant presence on the unit for at least 12 hours per day (generally expected to include two ward rounds / handovers), or more as resources allow and depending on patient numbers and intensity. (* consensus)
- NICUs undertaking more than 4000* intensive care[§] days per annum with onerous on call duties should consider having a consultant present in addition to tier 2 staff and immediately available 24 hours per day. (* consensus)
- 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)
- NICUs undertaking more than 4000* intensive care[§] days per annum should consider the presence of three consultant led teams during normal daytime hours. (* consensus)
- Staff at each level should only have responsibility for the NICU and Trusts with more than one neonatal unit should have completely separate cover at each level of staff during office hours and out of hours.

[§] 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.

Summary of NICU Medical Staffing Recommendations (in addition to standard cover at each level)

	>2000 IC days	>2500 IC days	>4000 IC days	>7000 deliveries
Tier 1 (ST1-3 / ANNP)	✓	✓	✓	Augment cover (>1) out of hours
Tier 2 (ST4-8 / ANNP)	✓	Double cover out of hours	✓	✓
Tier 3 (Consultant)	≥12 hours	≥12 hours Consider increasing to 2 consultant led teams during daytime hours	≥12 hours Consider increasing to 3 consultant led teams during daytime hours	✓

Nursing and Allied Health staffing of NICUs

- All NICUs should have sufficient nursing staff to deliver BAPM’s standard of nurse to patient ratios (1:1 NICU, 1:2 HDU, and 1:4 SC) and a co-ordinator [1,2,3,24]
- 3.3.2 All NICUs should deliver the recommended level of therapy and other Allied Health Professional support. [28-32]

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