British Association of Perinatal Medicine

The British Association of Perinatal Medicine Neonatal Airway Safety Standard

A Framework for Practice

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Endorsed by

NPPG Neonatal & Paediatric Pharmacy Group

NTG Neonatal Transport Group

RCoA Royal College of Anaesthetists

Association of Paediatric Anaesthetists of Great Britain and Ireland

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Process

The scope and content of this document were determined by members of the working group. Development of the BAPM Neonatal Airway Capability Framework and BAPM Neonatal Airway Safety Standards were predominantly consensus based, due to lack of available evidence. Literature review, including use of existing national policies and guidelines, was undertaken in the key topic areas and where this was available it has been used to support recommendations in the framework. The group met by video conference to respond to points raised during the consultation as well as conducting meetings with members of national anaesthetic professional organisations prior to producing the revised framework.

Recognising that this standard will be challenging for many neonatal services, the working group has also provided links to existing materials and developed training and assessment resources to support the capability framework. Permission to use some training materials has kindly been provided by Dr Fiona Wood and the Resuscitation Council UK.

Glossary

Term/ Abbreviation	Meaning
NICU	Neonatal Intensive Care Unit
LNU	Local Neonatal Unit
SCU	Special Care Unit
Laryngeal Mask (LM)*	Laryngeal Mask Airway (LMA) or i-gel devices
CPAP	Continuous Positive Airway Pressure
nHFT	Nasal High Flow Therapy
LISA	Less Invasive Surfactant Administration
Difficult Airway	A clinical situation in which a trained practitioner experiences difficulty with face mask ventilation, difficulty with tracheal intubation, or both
Premedication	Drugs given prior to intubation to provide sedation, analgesia +/- muscle relaxation

**Throughout this document the term laryngeal mask (LM) is used as a general term to cover all supraglottic airway devices including Laryngeal Mask Airway (LMA) and i-gels, which is consistent with current Resuscitation Council UK terminology.*

Executive Summary

BAPM Neonatal Airway Safety Standards

This document sets out standards for safely managing the neonatal airway in neonatal services in the UK. The working group recognises that implementation of this standard will require additional resources for training and assessment and that meeting this standard may be challenging for many neonatal services. We nonetheless think this standard is important for delivering high quality safe neonatal care.

- Minimum capability levels required in neonatal units and transport services are outlined in Table 1.
- A capability framework outlining the skills and knowledge required by individuals to achieve these capability levels is shown in Table 2.
- Capability levels should be reviewed and reassessed at least once a year, and units should keep an up-to-date log of staff capabilities.
- Neonatal units should be appropriately resourced to undertake training and assessment of staff airway capability, and this is likely to require additional resources.
- It is recommended that units should audit their compliance with the capability standard as well as auditing success and adverse events rates for intubation and LISA.

Strategies for Successful Airway Management

- Skills and simulated training for the multidisciplinary team are important.
- Simulated training for Laryngeal Mask (LM) insertion translates well to clinical practice but simulated intubation has NOT been shown to translate successfully to clinical practice and therefore competency must be acquired and maintained through clinical exposure.
- Intubation failure is most commonly due to failure to recognise anatomical structures, and this should be a focus during training.
- For intubation the following are recommended:
    - Use of an intubation checklist (Appendix E).
    - Elective intubations are more successful than emergency intubations therefore aim to convert emergency intubations to more controlled intubations where possible.
    - Third or more attempt at intubation should be by experienced intubators (advanced/specialist).
    - Use of a videolaryngoscope is strongly recommended both for supervising inexperienced intubators and in routine clinical practice (Appendix B).
    - Nasal High Flow Therapy (nHFT) during oral intubation is strongly recommended as it improves the likelihood of successful first attempt intubation.
    - Premedication should be used for all non-emergency neonatal intubations.
    - Unintended extubation is a significant adverse event and should be reported and closely audited to identify modifiable factors.
- Continuous heart rate and saturation monitoring should be in place during airway management and exhaled CO2 colorimetric detectors or capnography should be used to confirm LM or tracheal tube placement.
- Units should give parents the choice to remain with their baby during elective or semi-elective intubation if they wish, as part of maintaining a family centred approach to care.
- Teaching and assessment tools to support the framework are included in the appendices.

Aims

The purpose of this document is to:

- Set out standards for ensuring safe airway management for babies in Maternity and Neonatal Services in the UK.
- Outline the minimum expected departmental capabilities for airway management in different settings.
- Provide guidance on optimising airway management, including alternatives to intubation where airway management is more challenging.
- Provide supporting training and assessment materials as well as signposting other suitable training resources.
- Suggest areas for research and innovation to improve safe neonatal airway management.

This framework complements the existing BAPM Framework for Practice on Managing the Difficult Airway in the Neonate[1].

Background

Changes in exposure to neonatal intubation

Several changes to resuscitation and stabilisation guidance over the last two decades have reduced the number of babies who need intubation. These changes include no longer routinely intubating infants born through meconium-stained liquor; increased use of non-invasive breathing support from birth; increased use of less invasive surfactant administration and increased use of the laryngeal mask (LM) as an alternative to intubation for larger infants[2,3,4,5].

During this time there has also been a significant increase in the number of trainees and advanced neonatal nurse practitioners due to the implementation of the European Working Time Directive. Consequently, a smaller number of intubation opportunities are being spread across a wider pool of trainees. Unsurprisingly, recent surveys reveal a high proportion of trainees in the UK do not feel confident or competent at intubation[6,7]. In addition, many non-tertiary paediatricians working in LNUs and SCUs also intubate very infrequently and feel less confident and competent in this skill[8,9].

There is evidence both from the UK and internationally that neonatal intubation success rates are low and falling with overall first attempt success rates of 40-53%, and 22-23% requiring three or more attempts[10,11,12]. Rates of success are lower for trainees compared with consultants. Tracheal intubation associated adverse events (including prolonged hypoxaemia, bradycardia, airway and pharyngeal damage, air leak, mortality, and neuro-disability) are common and increase with multiple intubation attempts[13,14,15,16].

Changes to Paediatric Training

The RCPCH Progress+ curriculum[17] changes mean more flexible training pathways tailored to training needs. Core trainees will need to develop capabilities in a neonatal setting and to step up to tier 2 rotas from ST3 onwards but may not have as much neonatal exposure as previously. This will mean that tier 2 rotas will include some doctors in training who are less experienced in neonatal airway management, and many will not be competent at intubation. From 2022, the RCPCH has removed neonatal intubation from the mandatory list of assessments for core trainees (ST1-4). The new requirement is to demonstrate capability to maintain the neonatal airway up to the point of intubation (including the use of a LM). For Specialty level trainees (ST5-7) on a general paediatric pathway, it is still expected that they are supported to develop intubation skills and intubation is a key capability in the curriculum, although the emphasis is on safe airway management, recognition of the risks of repeated intubation attempts and working with colleagues to manage the difficult airway.

In light of these challenges, it is timely to outline the standards expected to support safe airway management in maternity and neonatal services.

BAPM Neonatal Airway Safety Standards

This BAPM safety standard focuses on unit capability and aims to ensure that a safe service is always available (Table 1). Delivery of these standards will rely on the skills and experience of individuals and an airway capabilities framework has therefore also been developed to support the safety standard (Table 2). Both the safety standards and capabilities framework have been developed by the BAPM Airway Standards Group.

Table 1: BAPM Neonatal Unit Minimum Airway Capability Safety Standards

Type of Unit	*Immediately Available	Available within 30 minutes	Difficult Airway Framework
NICUs	Advanced	Advanced	Extra support according to local protocols
LNUs	Intermediate	Advanced	
SCUs	Standard	Intermediate	
MLU/ Home Delivery	Basic	N/A	
	ICU Transfer	**Non-ICU Transfer**	Extra Support according to local protocol
Neonatal Transport Services	Advanced	Standard	

***on-site and available in an emergency within a few minutes.**

General Notes on Safety Standard

- Neonatal units should have at least one member of staff immediately available at all times, and an additional member of staff available within 30 minutes (may be off site), whose airway skills meet the **minimum capability level** suggested in table 1. Standards are also outlined for standalone maternity services.
- All neonatal staff undertaking responsibilities as first responder for neonatal resuscitation must have reached a minimum of basic capability prior to undertaking this role independently for babies ≥34 weeks. If the first responder is required to attend preterm deliveries<34 weeks without additional support, they should have reached standard capability as a minimum with additional "immediately available" support as needed, as outlined in table 1.
- In the event of a difficult airway, there should be local protocols in place to activate the difficult airway pathway.
- Competency requirements for ICU transfer should be assessed on an individual basis prior to transfer; some transfers will need Specialist capabilities.
- All staff undertaking transfers must have reached Standard capability as a minimum, even when transferring stable special care patients.

Infants at high risk of requiring more advanced airway support

- Every effort should be made to ensure all babies at very high risk of requiring more advanced airway support (<27 weeks, <28-week twins, estimated fetal weight <800g and those with certain antenatally diagnosed conditions) are born in a maternity centre with a co-located NICU[18].
- Where high risk infants have not been transferred, the 30-minute responder should aim to be present for the delivery.
- Neonatal transport services are not set up to provide emergency response teams to support neonatal airway management to regional hospitals and local teams must ensure there are appropriate escalation processes.
- Most adult and paediatric anaesthetists/intensivists and ENT surgeons have other additional airway and ventilation skills that may help when managing a difficult airway.
- All units should have an agreed approach to managing the difficult airway, with suitable airway equipment available, supported by appropriate staff training.
- Where other teams such as anaesthetists, ENT surgeons or paediatric intensivists might be asked to support further airway management as part of the difficult airway framework, the neonatal airway lead should agree with the relevant departments the processes and actions to ensure appropriate equipment to support them is available in a timely fashion. These discussions must include laryngoscopes (including videolaryngoscopes), blades, and waveform capnography monitoring as well as more specialist equipment for ENT intubation and/or surgical airway.
- A BAPM Framework for Practice is available to support Managing the Difficult Airway in Neonates[19].

BAPM Neonatal Airway Capability Framework

Table 2 sets out capability levels for managing the neonatal airway, alongside the skills required to achieve and maintain each capability level and a description of how this should be assessed.

- To achieve any given capability level the practitioner must fulfil all skills within the domain.
- The number of intubations required to achieve Advanced capability will vary according to aptitude. We have not set a prescriptive standard, but the number of successful intubations is likely to be in the region of 10-40 including at least 5 in babies <28 weeks. Anaesthetic practice suggests approximately 40 intubations are required to achieve proficiency[20]. Figures from a recent US paper for neonatal trainees suggested a range of 8 to 46 intubations in those who reached a competency level of 80% success rate within 2 attempts[21]. Success rates within 2 attempts for senior clinicians in a large series was 86%[22]. Videolaryngoscopy may improve learning curves[23,24].
- Intermediate intubation skills have been set at a minimum of 5 successful intubations, considering the likely competency range for Advanced capability.
- The number of intubations required to maintain skills will be highly variable and this should be self-assessed, as well as maintaining an intubation log (Appendix G). Those whose highest capability is Intermediate are unlikely to maintain this over several years unless they had previously achieved Advanced capability. Attrition of intubation skills will be much slower in those who achieve and maintain Advanced or Specialist capabilities over several years.

Supporting Materials for this Capability Framework

- **Training Materials:**
  - BAPM Airway Skills and Simulations (Appendix A).
  - Tips for videolaryngoscopy (Appendix B).
  - A short guide to use of waveform capnography (Appendix C).

- **Practical Support Materials:**
  - Poster: Airway Equipment and Initial Respiratory Support Settings (Appendix D).
  - Intubation Checklist (Appendix E).
  - LISA Checklist (Appendix F).

- **Assessment Materials:**
  - Intubation/ LISA Log (Appendix G).
  - Individual Airway Competency Assessment form (Appendix H).
  - Neonatal Unit Staff Airway Assessment Log (Appendix I).

Table 2: BAPM Neonatal Airway Capability Framework

	Definition of Capability	Skills Required to Achieve Capability *All skills required to be functioning at a given level*	Maintenance of Capability (Appendix A&B)	Assessment of capability (Appendix G,H, & I)
Beginner	Has not yet reached all skills required to achieve Basic capability	N/A	N/A	N/A
Basic	Can provide effective airway support and ventilation via facemask or laryngeal mask (LM) for babies ≥ 34 weeks with #normal anatomy.	• Familiar with equipment needed for airway management in babies ≥ 34 weeks. • Can demonstrate how to correctly size and apply facemask. • Can provide effective mask ventilation (including jaw thrust and 2-person technique). • Can determine *LM size required, insert LM, & provide effective ventilation via LM. • Can assess facemask/LM ventilation using colorimetric CO_2 detector and clinical assessment. • Familiar with local escalation plan for a baby requiring skills beyond Basic capability.	• Annual skills training to cover BAPM Basic airway skills. • BAPM Basic capability simulation training every 1-4 years. • Use of skills in clinical practice with feedback and assessment from more experienced practitioners.	• Annual self-assessment against BAPM capability levels. • Annual assessment to demonstrate all required BAPM Basic airway skills in a simulated or appropriate clinical setting or a combination of both. • BAPM Basic airway skills simulation assessment at least once every 4 years. See notes on assessment.
Standard	Can provide effective airway and ventilatory management for preterm and term infants with #normal anatomy using a wide range of airway adjuncts and non-invasive respiratory support (eg CPAP/nHFT). Has limited or no intubation experience.	• As for Basic capability AND • Can determine mask size and perform mask skills (positioning and ventilation) in preterm infants ≤33 weeks gestation. • Can demonstrate successful use of CPAP/nHFT (depending on local availability), *LM (where appropriate) and oro-pharyngeal airway to support the preterm infant airway and ventilation. • Can assess the effects of assisted ventilation on oximetry, heart rate, exhaled CO_2 responses and clinical examination. • Understands appropriate oxygen saturation targets and principles of oxygen therapy in preterm and term infants. • Can trouble-shoot airway and ventilation difficulties associated with non-invasive airway management (**DOPE, ventilation settings, need for surfactant). • Can deliver surfactant via LM if used locally. • Familiar with the local escalation plan for a baby requiring skills beyond Standard capability.	• Annual skills training to cover BAPM Standard Airway skills. • BAPM Standard capability simulation training every 1-4 years. • Use of skills in clinical practice with feedback and assessment from more experienced practitioners.	• Annual self-assessment against BAPM capability levels. • Annual assessment to demonstrate all required BAPM Standard airway skills in a simulated or appropriate clinical setting or a combination of both. • BAPM Standard airway skills simulation assessment at least once every 4 years. See notes on assessment.

Intermediate	As for standard capability and can intubate the trachea under optimal conditions but not able to consistently intubate in urgent/emergency settings and/or across all gestations.	• As for Standard capability AND • Has completed an intubation competency package to include understanding drugs, monitoring and equipment used during intubation. • Can correctly identify laryngeal structures when visualising the upper airway. • Can successfully intubate and ventilate a suitable term and preterm manikin. • Has successfully intubated at least 5 babies or infants or is already deemed competent (≥80% success in 2 attempts) to intubate older children or adults. • Is familiar with exhaled CO_2 monitoring used in the unit. • Understands capnography waveforms where these are used in the unit (Appendix C&D). • Can trouble-shoot common complications of intubation and ventilation (**DOPE, ventilation settings, need for surfactant). • Can deliver surfactant via tracheal tube (or LM) if this is locally preferred technique). • Understands that multiple or prolonged intubation attempts are harmful and is familiar with the local difficult airway escalation plan. • Recognises the features of a baby with a difficult airway and is familiar with equipment used to manage a difficult airway. • Familiar with the local escalation plan for a baby requiring skills beyond Intermediate capability.	• Annual skills training to cover BAPM Intermediate airway skills. • BAPM Intermediate simulation training every 1-4 years. • Use of skills in clinical practice with feedback and assessment from more experienced practitioners. • Comprehensive log of all intubation/LISA attempts (Appendix G).	• Annual self-assessment against BAPM capability levels. • Annual assessment to demonstrate all required BAPM Intermediate airway skills in a simulated or appropriate clinical setting or a combination of both. • BAPM Intermediate airway skills simulation assessment at least once every 4 years. • Annual Review of Intubation/LISA log. See notes on assessment.
Advanced	As for standard capability and can consistently intubate most babies with #normal anatomy including extreme preterm infants.	As for Standard capability AND • Can confidently intubate both term and preterm infants including the extremely premature with a first or second attempt success rate ≥80% for babies with #normal anatomy in elective and/or emergency settings. • Can administer surfactant using Less Invasive Surfactant Administration (LISA) system with a first or second attempt success rate ≥80%. • Familiar with the local escalation plan for a baby requiring skills beyond Advanced capability.	• Skills training as required to maintain BAPM Intermediate airway skills. • BAPM Intermediate simulation training every 1-4 years. • Comprehensive log of all intubation/LISA attempts (Appendix G).	• Annual self-assessment against BAPM capability levels. • BAPM Intermediate airway skills simulation assessment at least once every 4 years. • Annual Review of intubation/LISA log. See notes on assessment.
Specialist	As for advanced capability and can intubate or manage the neonatal airway in most situations including those presenting with a difficult airway.	As for Advanced capability AND • Has experience of managing more difficult airway situations successfully.		

#Normal anatomy = normal head, neck and upper airway anatomy.
*Laryngeal mask (LM) = supraglottic airway/Laryngeal Mask Airway (LMA) or i-gel devices.
DOPE= **Displaced tracheal tube or supraglottic airway, **O**bstructed airway – particulate matter or secretions, **P**neumothorax, **E**quipment failure.

Notes on Assessment

- Annual self-assessment is helpful to review what capability the practitioner has across all airway skills from Basic to Specialist, to support training needs.
- Capability can be assessed under simulated conditions and/or in clinical practice by a resuscitation officer or a neonatal practitioner who has reached at least the level of the competency being assessed.
- No specific training course is mandated but for information, Resuscitation Council UK Neonatal Life Support (NLS) provider certification provides all skills required for Basic capability and most skills required for Standard capability. The Resuscitation Council UK Advanced Resuscitation of the Newborn Infant (ARNI) certification provides most of the competencies required for Intermediate capability.
- New staff should provide the unit with a baseline self-assessment, their previously assessed capability level, date, and method used to assess this, and their current intubation skills log.
- Where capability has not been assessed previously using this framework, new staff should self-assess to determine a provisional capability level which should then be assessed over the next month.
- For existing staff, capability levels should be reviewed and reassessed at least once a year, or sooner if clinical situations suggest capability has improved or has not been maintained.
- Practitioners progressing beyond Standard capability can use a combination of self-assessment, their intubation log and further clinical assessment to support a change in capability level.

Implications for Training

- Expected capability ranges for neonatal and maternity staff are shown in table 3.
- Secure skills at Standard capability, across a wide range of staff should be a key focus in all neonatal units to enable maintenance of airway patency and provide adequate oxygenation and ventilatory support without intubation.
- Most neonatal airways can be successfully managed initially without the need for intubation. Although tracheal intubation is an important and necessary requirement for some patients, practitioners functioning at Basic or Standard capability should not attempt intubation without supervision and this should be done under optimal conditions.
- Networks should support training across the region with a particular focus on providing support to smaller LNUs and SCUs.

Table 3: Expected range of capability for maternity and neonatal staff groups

Capability	Basic	Standard	Intermediate	Advanced	Specialist
Staff Type	Can provide effective airway support and ventilation via facemask or LM for babies ≥ 34 weeks with #normal anatomy.	Effective airway and ventilatory management for preterm and term infants using a wide range of airway adjuncts and non-invasive respiratory support. Has limited or no intubation experience.	As for standard capability and can intubate the trachea under optimal conditions but not able to consistently intubate in urgent/emergency settings and/or across all gestations.	As for standard capability and can consistently intubate most babies with normal anatomy including extreme preterm infants.	As for advanced capability and can intubate or manage the neonatal airway in most situations including those presenting with a difficult airway.
Midwifery Staff					
Neonatal Special Care nurses					
Neonatal ICU/HDU nursing staff					
Tier 1 (ST1-3) medical staff and ENNPs					
Neonatal Transport nursing staff					
Tier 2 trainee ST3-4 (not neonatal SPIN or GRID)					
Tier 2 trainee ST5-7 (not neonatal or paediatric critical care SPIN or GRID)					
Junior ANNPs <3 years' NICU experience					
SCU Consultant					
ST 5-6 (neonatal SPIN or GRID) or equivalent					
LNU consultant					
Senior ANNPs >3years in NICU					
ST7 (neonatal SPIN or GRID) or equivalent/ Neonatal Transport Doctor/ANNP					
NICU Consultant					

Green= expected minimum capability level (for trainees, expected minimum by end of training level).
Grey shading: likely range of capabilities.

Arrangements to support the Neonatal Airway Safety Standard

- Neonatal units should be appropriately resourced to undertake training and assessment of staff airway capability.
- All units should have a neonatal airway lead with funded supporting programmed activities (PAs), as well as a resuscitation officer and/or nursing lead with funded time to support training and assessment. Whilst some training can be done as part of a neonatal resuscitation course, BAPM recognises that implementation of this framework is likely to require additional resource for training and assessment.
- Units should keep an up-to-date log of the capability of all staff whose role requires them to act as immediate responder or secondary responder (within 30 minutes) and all staff undertaking transfer of infants both within the hospital setting (intrahospital transfers) and between hospitals (interhospital transfers).
- New staff must have a provisional assessment before starting (see notes on assessment) and should be formally assessed within 1 month.
- All unit rotas should clearly delineate the name and contact details for the immediate responder and the second responder (available within 30 minutes). For large units, there may be more than one responder in each category, with primary responsibility for different parts of the unit.

Governance and Audit

- Secure airway management of neonates is a significant safety concern due to the potential for major harm.
- It is recommended that units should audit their compliance with the capability standard and escalate significant deviations from the standard through their trust and network governance processes. Additional resource and/or training may be required to support improvements in safety.
- Units should audit success rates for intubation and LISA and rates of adverse events related to airway management to improve practice and refine training.
- Units should also review difficult airway cases in morbidity and mortality meetings with discussion at network level where appropriate.

Strategies for Successful Airway Management

Skills and Simulated Training

- Skills and simulated training for the multidisciplinary team are important for team communication, familiarity with equipment and learning or reinforcing the process steps involved in airway management, airway escalation planning, and human factors training including safety culture.
- Airway skills training, and simulation exemplars can be found in Appendix A.
- Managing the neonatal airway without intubation is a key skill for all staff to reduce the risks of unnecessary intubation, with its associated adverse events and complications.
- Training for LM insertion can be quickly and successfully learned in a simulated environment and translates well to clinical practice[25].
- Learning intubation skills in a simulated environment has **NOT** been shown to translate successfully to intubating in real life[26,27]. Practitioners must therefore acquire and maintain competency through clinical exposure.
- Intubation failure is most commonly due to failure to recognise anatomical structures, and this should be a focus during training[28]. Video recordings of successful and unsuccessful intubations are included in Appendix A and interactive discussion of the structures seen during these videos may be helpful to support trainee familiarisation with laryngoscopy views.
- Intubators should be aware that age related presbyopia (long-sightedness) can impact the ability to perform direct intubation before this becomes apparent on the standard eye test due to the very short distance between the eye and vocal cords. Videolaryngoscopy is one option to overcome this issue[29].

Planning and Preparation

- Pre-delivery planning should take place where delivery of a baby who may need more complex additional airway support is imminently anticipated.
- Suggested sizes for a variety of neonatal airway equipment and initial ventilator settings are shown in Appendix D.
- Where intubation is needed:
    - Using a checklist has been shown to reduce tracheal intubation related adverse events such as significant hypoxia, bradycardia, airway and pharyngeal damage in neonates[30,31]. An example intubation checklist is included in Appendix E.
    - Elective intubations are more successful than emergency intubations therefore aim to convert emergency intubations to more controlled intubations where possible by using airway adjuncts or non-invasive respiratory support.
    - Aim to match the experience of the intubator with the perceived level of difficulty of intubation.
    - Whenever possible, unsupervised intubations should be performed by advanced intubators.
    - Unsupervised intubation should not be undertaken by those at standard competence or below.
    - Third or more attempt at intubation should be by experienced intubators (Advanced or Specialist) as risk of adverse events is almost 10 times more likely with ≥3 intubation attempts[32].
    - The following are not considered suitable for practitioners below Intermediate capability and Advanced capability is highly desirable:
        - Extremely premature babies <27 weeks gestation <4 days old.
        - Unstable babies requiring emergency intubation.

- Babies with congenital anomalies affecting airway anatomy.

Use of videolaryngoscopy for intubation

- Use of a videolaryngoscope (VL) is strongly recommended both for supervising inexperienced intubators and in routine clinical practice.
- Use of VL compared with direct laryngoscopy without VL has a lower risk of tracheal intubation associated adverse events[33,34,35,36].
- VL should be used to facilitate training in direct laryngoscopy to ensure clinicians are able to intubate where a VL is not readily available.
- VL may increase the success of intubation on the first attempt and may result in fewer intubation attempts but may not reduce time required for successful intubation[37].
- Use of VL as a teaching tool, where the view obtained is shared in real-time with a more experienced clinician who can advise on how to improve the view, increases the chance of success when compared with direct laryngoscopy for inexperienced operators[38,39]. See Appendix B.
- All staff need to be aware of the differences in shape between direct laryngoscopy and some VL blades and the potential need for adaptations of intubation technique (see Appendix B). These differences in blade size/shape are reducing with availability of newer VL technology[40,41].

Patient Preparation and Stabilisation

- Resuscitation and stabilisation during transition should follow national guidance and a facemask should be used initially for ventilatory support[2].
- Most neonatal airways can be successfully managed initially without the need for intubation.
- The use of optimal airway positioning, CPAP/nHFT, facemask/ LM ventilation and appropriate oxygen therapy should be the main focus for initial management.
- Non-invasive respiratory support: In preterm infants who are breathing, first line respiratory support at birth should be CPAP 6-8cm H_2O (nasal mask/nasal prong delivery is superior to T-piece resuscitator and facemask[42]) or nHFT 6-8L/min and caffeine administration should be optimised[43,44,45,46] . Non-invasive respiratory support should also be considered for older infants who are breathing. Further details in Appendix D.
- LMs: use of LM may often safely avoid the need for emergency intubation [47] [48] . Whilst manufacturers guidance advises use of size 1 LMs in babies >2kg and/or ≥34weeks, short-term use can be considered for babies >1kg (~27 weeks) who require ventilatory support where advanced intubation skills are not immediately available or where intubation has failed, with consideration given to use in babies from 800g (~25 weeks) when the baby is in extremis[49,50,51,52,53,54,55] (Appendix D). Smaller size LMs are now starting to be manufactured which require evaluation.
- Oxygen therapy: In view of the high incidence of desaturation during intubation, oxygen therapy should be used to keep saturations as near the upper end of the normal preterm infant target range as possible ie 95%[56]. Higher saturations can be targeted for term infants and/or where a difficult airway is anticipated.
- Intubation will be needed to provide optimal support for some babies. Emergency intubation is associated with notably higher rates of intubation failure and complications compared with elective intubation and every effort should be made to optimise the baby's condition prior to attempting intubation.
- Where intubation is required:
    - Nasal High Flow Therapy during oral intubation improves the likelihood of successful intubation on the first attempt without physiological instability (NNT 6) and this

intervention is strongly recommended during intubation for all neonates[57].
    - Drugs used to support intubation (commonly termed premedication in neonatology) should be used for all non-emergency neonatal intubations as this is a distressing and painful invasive procedure.
        - Premedication consisting of a vagolytic to prevent bradycardia, an analgesic for pain and reflex control, and a neuromuscular blocking agent for paralysis improves intubating conditions, decreases the number of intubation attempts and minimises adverse physiological responses[58,59].
        - All intubators should have a good working knowledge of the pharmacological properties and side-effects of commonly used premedication drugs (BAPM HEE e-learning package is available to support this at https://learninghub.nhs.uk/catalogue/Neonatal-airway).
        - Where available, pre-filled syringes of premedication drugs should be used.
        - Local drug calculators and some e-Prescribing systems enable doses of pre-medication drugs to be calculated well in advance of intubation to improve safety around prescribing and administration of these drugs.
- Surfactant should be administered according to local/network guidelines which should also conform with international consensus[60].
- Less Invasive Surfactant Administration (LISA) is the preferred route for surfactant administration in babies who do not have severe respiratory distress and have established respiration [61].
    - This technique requires a similar skill level to a confident intubator. It is expected that practitioners would start learning the technique at Intermediate capability and becoming competent (≥80% success in 2 attempts) at Advanced capability.
    - LISA should be done via VL where possible to confirm correct catheter positioning. Multiple LISA attempts should be avoided to reduce risks of adverse events.
    - All networks should have practical guidelines and educational support for LISA technique. A LISA checklist example is included in Appendix F.
- LM surfactant administration is a newer method for surfactant administration and has been shown to be effective in reducing rates of intubation and ventilation[62]. It is a less invasive technique which does not require premedication. A recent study confirmed non-inferiority to INSURE (INtubation-SURfactant-Extubation) technique in preterm infants down to 800g [63] and there are currently trials comparing LISA with LM surfactant administration for preterm babies from 1.25kg[64]. European Consensus guidelines on respiratory distress syndrome 2022 makes a weak recommendation that surfactant could be administered via LM in babies >1kg.
    - BAPM suggests that a decision to administer surfactant via an LM should be made at a local level where LISA is not possible. Where units decide to use this technique, they should have practical guidelines, training, and educational support to ensure this is carried out safely. An example of a guideline for this procedure can be found here: GGC LMA Surfactant.
    - Babies receiving LM surfactant should be discussed with the tertiary centre if oxygen requirement and work of breathing do not improve significantly.

Patient Safety During Airway Management

- Patient monitoring:
    - Continuous Heart rate and saturation monitoring should be in place.
    - Exhaled Carbon Dioxide should be monitored using exhaled CO_2 colorimetric detectors or capnography.
        - Exhaled CO_2 colorimetric detectors, most commonly Pedi-Cap® (Nellcor/Medtronic, Minneapolis MN) (1-15kg) and Neo-StatCO_2® (Mercury

Medical, Clearwater FL) (250g -6kg) can be used with both LMs or tracheal tubes. If the tube is obstructed and there is no exhaled CO_2 there will be no colour change as the lungs are not ventilated. In a low cardiac output state, the colour change device may be too insensitive to change colour – other means of confirming tube position must be used eg. VL, lung ultrasound. Out of date devices and soiling from gastric contents can lead to false positive results.

- Capnography (continuous CO_2 waveform measurement over time) is the gold standard for CO_2 monitoring in older children and adults[65]. Technological difficulties have limited use in neonates until recently[66] . It is likely that this more sensitive form of monitoring will become more prevalent in neonatology over the next few years. Capnography traces can be found in Appendix D and a separate more detailed short guide to use of waveform capnography during intubation is included in Appendix C for those starting to use this technology.

- CO_2 detection is the primary method for confirming a LM/tracheal tube is in the airway and achieving lung ventilation, supported by stable appropriate heart rate and oxygen saturations and auscultation. If there are concerns about ventilation via the LM or tracheal tube, there should be a low threshold for removing and reinserting.
- Where prolonged LM/tracheal tube ventilation is required, changing colorimetric monitoring to waveform capnography should be considered.
- Confirmation of correct depth of tube insertion is by chest Xray (or lung ultrasound in experienced hands)[67].
- Airway fixation should be secure and according to local guidelines. Re-confirm target insertion depth has been maintained following fixation.
- Unintended extubation is a significant adverse event and should be reported and closely audited to identify modifiable factors.

Parent Presence During Airway Management

- Families should be informed that their baby requires intubation/ reintubation whenever practically possible including before birth if intubation is anticipated straight after delivery.
- Family presence during neonatal intubation has not been shown to influence the success of intubation or the incidence of adverse events occurring during intubation[68]. Parental presence however, may increase anxiety for junior intubators[69].
- More broadly, there is evidence that parental presence and involvement during painful procedures on the neonatal unit can help to provide comfort to babies, as well as enable parents to feel more empowered and reduce their anxiety[70,71,72]. More information for health care professionals in supporting parents involvement during painful procedures can be found here.
- Units should give parents the choice to remain with their baby during elective or semi-elective intubation if they wish, as part of maintaining a family centred approach to care. Where parents choose to remain, they should be supported by a member of staff who is not involved in the procedure itself, and shown how they can best support their baby during the procedure.
- Communication with parents about whether they would like to remain with their baby should be done in a clear and factual way, giving parents information about what will happen during the procedure and how they could comfort their baby, to inform their choice about what is right for them at the time.
- Units should audit parent information, choices and parental presence during intubation including collection of parent and staff feedback.

New Horizons and Areas for Further Research

- Development and safety testing of laryngeal masks or other supraglottic airway devices that can be used to ventilate babies <1kg.
- Improved laryngoscope blades and VLs to support intubation of the smallest infants.
- More realistic simulation manikins for neonatal intubation.
- Definitive studies on whether LM surfactant administration is non-inferior to LISA, allowing a gentler approach to surfactant administration in many babies (trial currently underway).
- Improved technology, research, and use of capnography in NICUs.
- Further studies on optimal non-invasive respiratory care in the delivery suite.
- Studies to further clarify who and when to treat with surfactant, eg lung ultrasound v FiO_2, delivery room surfactant via LISA v early rescue.
- Further development and research into the value of Teleneonatology and AI to support safer remote neonatal airway management[73].
- Optimising fixation and monitoring of tracheal tubes to reduce adverse events.

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