Patient safety & hygiene practice

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Topic Expert Group

Patient safety and hygiene practice

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Topic Expert Group: Patient safety and hygiene practice

Overview

Infants admitted to a neonatal intensive care unit are extremely vulnerable and thus at a high risk of being harmed by lapses in quality or safety. Hygiene is an additional major issue in the NICU, as pathogen contamination of surfaces in neonatal wards and hand carriage of pathogens are associated with nosocomial infections. Continuous improvement of patient safety and hygiene is therefore an important component of high-quality care and requires an appropriate system of specific procedures, including identification of gaps, and reporting of these to facilitate learning from safety, hygiene, and quality issues. To ensure the highest possible level of hygiene and safety, the development of care bundles for common healthcare procedures, including cleaning guidelines, is essential. (1,2) Safety hazards emanating from human beings like staff and parents should be minimised by personal and hand hygiene guidelines. (3,4) Finally, patient screening for resistant bacteria as part of infection prevention should be a strategy to avoid risks emanating from the patients themselves. (5,6)

With regards to medical equipment (e.g. monitors, cannulas) knowledge in their use, interpretation of values, as well as cleaning procedures, are respective patient safety measures. (7) To prevent medication errors and potential adverse drug events, correct drug calculation and prescription should be achieved by electronic support during drug prescription and preparation. (8,9) To ensure a high quality of care and improve care where gaps are present, monitoring and reporting of errors regarding safety issues in a blame-free error culture is crucial to facilitate awareness. (10) The ratio of appropriately trained nurses needs to be present has to be defined, taking into account the level of care infants in this unit need. (11,12)

The Topic Expert Group on Patient safety and hygiene practice develops standards related to the prevention of healthcare-associated infections and thus antibiotic resistance by dealing with a holistic concept for patient safety and hygiene practice.

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Central venous catheter infection prevention

Helder O, Tissières P, Mader S, Thiele N, Borghesi A

Target group
Critically ill infants and parents

User group
Healthcare professionals, neonatal units, hospitals, and health services

Statement of standard
Each hospital has central venous catheters insertion and maintenance bundles, that are consistently applied to reduce the incidence of central line-associated bloodstream infections.

Rationale
Central venous catheters (CVC) are intravascular devices used in NICU settings. In addition to ensuring long-term intravenous access to preterm and critically ill infants, CVC are used for the administration of parenteral nutrition and medications that cannot be safely administered through a peripheral intravenous catheter. (1) CVC are important components of care, but their use is associated with an increased risk of central line-associated bloodstream infections (CLABSI). (2) CLABSI are in turn responsible for considerable mortality, morbidity, prolonged hospital stay, and additional costs for healthcare systems. (3)

Definitions of neonatal bloodstream infection vary across studies. (4–6) Bloodstream infection according to the Centers for Disease Control and Prevention (CDC), can be considered to be CVC-related if a catheter has been in place for at least 24 hours or if it was removed less than 48 hours before the infection. (7)

The prevalence of CLABSI is usually expressed as CLABSI per 1000 central line-days. (8) Reported incidence in neonatal units varies depending on several factors, including the hospital site and the gestational age group, and may be as high as >10.0 per 1000 central line-days. (9,10)

The Institute for Health Improvement (IHI) and the CDC, developed ‘care bundles’ that aim to reduce the incidence of CLABSI. Care bundles (defined as small, straightforward set of evidence-based practices, according to the IHI) can be divided into two subgroups: insertion bundles and maintenance bundles. (11,12)

Basic elements for the care bundles are maximal sterile barrier precautions during insertion, skin antisepsis, and hand hygiene. Care bundles have proven effective in reducing the incidence of CLABSI in neonatal units. (8)

Benefits

Short-term benefits
- Reduced risk of CLABSI (1–3,8–10,13)
- Reduced risk of comorbidity associated with bloodstream infections (consensus)
- Reduced mortality (consensus)
- Reduced stress for parents (consensus)

Long-term benefits

- Reduced risk of antibiotic resistant bacteria (consensus)
- Reduced risk of poor neurodevelopmental outcome (consensus)
- Reduced healthcare costs (8)
- Reduced length of hospital stay (8)

Components of the standard

Component	Grading of evidence	Indicator of meeting the standard
For parents and family		
1. Parents are informed and instructed by healthcare professionals about hand hygiene. (14,15) (see TEG Patient safety & hygiene practice)	A (High quality) B (High quality)	Patient information sheet
2. Parents are asked to instruct the own family and relatives to apply hand hygiene guidelines.	B (Moderate quality)	Patient information sheet
For healthcare professionals		
3. A unit guideline on central venous catheter (CVC) insertion and maintenance bundles is adhered to by all healthcare professionals. (3,14)	A (High quality) B (High quality)	Guideline
4. Training on insertion and maintenance bundle elements is attended by all responsible healthcare professionals.	B (High quality)	Training documentation
5. An insertion bundle is used: (8) • Antiseptic technique for healthcare provider's hand hygiene • Maximal sterile barrier precautions (caps, masks, sterile gowns, sterile gloves) • Patient's skin antisepsis with chlorhexidine • Full-drape	A (High quality)	Guideline
6. A maintenance bundle is used: (8) • Applying hand hygiene • Aseptic performance before catheter manipulation • Disinfection of CVC hubs	A (High quality)	Guideline

- Daily review of CVC dressing and site of insertion
- Prompt removal when the central line is no longer needed.

7. Insertion of a CVC: checklist is used before starting the intervention. (16)	A (High quality)	Guideline
For neonatal unit		
8. A unit guideline on CVC insertion and maintenance bundles is available and regularly updated.	B (High quality)	Guideline
9. The prevalence of bloodstream infections per 1000 central line-days is documented.	B (Moderate quality)	Audit report
10. Training on CVC insertion and maintenance bundle elements is ensured. (15)	B (High quality)	Training documentation
For hospital		
N/A		
For health service		
11. A national guideline on CVC insertion and maintenance bundles is available and regularly updated.	B (High quality)	Guideline
12. Central line-associated bloodstream infections rates are publicly available.	B (Moderate quality)	Audit report

Where to go – further development of care

Further development	**Grading of evidence**
For parents and family	
• Facilitate parents to use publicly available central line-associated bloodstream infections (CLABSI) rates to question variation between hospitals.	B (Moderate quality)
For healthcare professionals	
N/A	
For neonatal unit	
• Ensure an incidence <5 CLABSI per 1000 central line days. (17)	B (Moderate quality)
• Report all deviations from guideline practice as clinical incidents using the hospital reporting system (critical incidence reporting system).	B (Moderate quality)
For hospital	
• Prepare fluids and medication under optimal aseptic conditions.	B (High quality)

For health service	
• NICU benchmarking: report the prevalence of CLABSI per 1000 central line days.	B (Moderate quality)
• Provide benchmarking standards: excellent performance <3.5 CLABSI per 1000 central line days, moderate performance 3.6 to 5 CLABSI per 1000 central line days, and poor performance ≥5.1 CLABSI per 1000 central line days.	B (Moderate quality)

Getting started

Initial steps

For parents and family

- Parents and family are verbally informed by healthcare professionals about hand hygiene.

For healthcare professionals

- Attend training on insertion bundles.
- Attend training on maintenance bundles (for nurses).

For neonatal unit

- Develop and implement a unit guideline on central venous catheter (CVC) insertion and maintenance bundles.
- Develop information material on hand hygiene for parents.
- Document all bloodstream infections among admitted infants.
- Document the number of central line days.
- Provide appropriate equipment.

For hospital

- Support healthcare professionals to participate in training on CVC insertion and maintenance bundle elements.

For health service

- Develop and implement a national guideline on CVC insertion and maintenance bundles.
- Publish the incidence of central line-associated bloodstream infections per 1000 catheter days.

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Environmental hygiene in the NICU

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Target group
Infants, parents, and families

User group
Healthcare professionals, neonatal units, hospitals, and health services

Statement of standard
High standards of environmental hygiene and cleaning are ensured to reduce the occurrence of infection and complications.

Rationale
Neonatal late-onset sepsis is one of the most significant causes of morbidity and mortality mainly among very preterm infants. (1–12) Pathogen contamination of surfaces is a major source of pathogen contamination in neonatal wards. Personal materials such as mobile phones, jewellery are potential sources of contamination. (see TEG Patient safety & hygiene practice) Subsequent hand carriage of pathogens is associated with nosocomial infections.

The implementation of policies covering environmental hygiene, incubator cleaning, cleaning of devices (e.g. monitors and probes) has been shown to decrease the risks of spreading bacteria. The widespread use of disposable (single use) devices and materials may further improve the hygiene standards and decrease the occurrence of microbial contamination. (1,3,10,13–18)

Benefits

Short-term benefits
- Reduced number of infections (2,3,6,11,19)
- Reduced length of NICU stay (20)
- Reduced healthcare costs (3,7,20)

Long-term benefits
- Earlier discharge and reduced stress for families (20)
- Reduced exposure to antibiotics (11,21,22)
- Improved neurodevelopmental outcome (3,19,21)
- Reduced healthcare costs (20)

Components of the standard

Component	Grading of evidence	Indicator of meeting the standard
For parents and family		
1. Parents and family are informed by healthcare professionals about the hygiene and personal items policy, why it is required and what is involved (e.g. jewellery, mobile phone). (3,7,23) (see TEG Patient safety & hygiene)	A (Moderate quality) B (High quality)	Patient information sheet
2. Parents are asked by healthcare professionals to instruct the own family and relatives to apply NICU hygiene guidelines. (see TEG Patient safety & hygiene)	B (Moderate quality)	Parent feedback
For healthcare professionals		
3. A unit guideline for hygiene including specified methods and schedules for cleaning of surface and equipment is adhered to by all staff.	B (High quality)	Guideline
4. Training on environmental hygiene policy and identification of poor practice is attended by all staff. (3,7)	A (Moderate quality) B (High quality)	Training documentation
5. Training on cleaning on yearly basis is attended by all responsible staff.	B (High quality)	Training documentation
For neonatal unit		
6. A unit guideline for hygiene including specified methods and schedules for cleaning of surface and equipment is available and regularly updated. (3,14–18,24–26)	A (Moderate quality) B (High quality)	Guideline
7. A schedule of cleaning procedures and their monitoring is continuously available. (3,15–17,25,26)	A (Moderate quality)	Audit report
8. An experienced person responsible for environmental hygiene and monitoring is identified.	B (Moderate quality)	Audit report
For hospital		
9. Training on environmental hygiene policy and identification of poor practice is ensured. (3,7,16,17,24)	B (High quality)	Training documentation

10. Training of staff responsible for cleaning is ensured on yearly basis.	B (High quality)	Training documentation
11. The hygiene department supervises and maintains environmental hygiene.	B (Moderate quality)	Audit report
For health service		
12. A national guideline for hygiene including specified methods and schedules for cleaning of surface and equipment is available and regularly updated.	B (High quality)	Guideline

Where to go – further development of care

Further development	**Grading of evidence**
For parents and family	
N/A	
For healthcare professionals	
N/A	
For neonatal unit	
• Provide a limited number of dedicated persons for the cleaning of the unit.	B (Moderate quality)
For hospital	
• Provide a limited number of dedicated persons for the cleaning of the unit.	B (Moderate quality)
For health service	
N/A	

Getting started

Initial steps
For parents and family
• Parents and family are verbally informed by healthcare professionals about the hygiene and personal items policy, why it is required and what is involved (e.g. jewellery, mobile phone).
For healthcare professionals
• Attend training on environmental hygiene policy and identification of poor practice.

For neonatal unit

- Develop and implement a unit guideline for environmental hygiene including instructions and schedules for the cleaning of specific items of equipment.
- Develop information material on hygiene and personal items policy for parents and family.
- Monitor nosocomial infection rates.

For hospital

- Support healthcare professionals to participate in training on environmental hygiene policy and identification of poor practice.

For health service

- Develop and implement a national guideline for hygiene including specified methods and schedules for cleaning of surface and equipment.
- Develop hygiene education programmes for healthcare professionals

Description

Additional information can be found online:
http://ecdc.europa.eu/en/healthtopics/Healthcare-associated_infections/guidance-infection-prevention-control/Pages/guidance-hand-hygiene-healthcare.aspx

https://www.cdc.gov/infectioncontrol/guidelines/environmental/index.html

https://ecdc.europa.eu/en/publications-data/directory-guidance-prevention-and-control/measures-in-hospitals

Source

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Hand hygiene

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Target group
Infants, parents, families, and everybody entering the neonatal unit

User group
Healthcare professionals, neonatal units, hospitals, and health services

Statement of standard
Hand hygiene is practiced consistently according to the guidelines in order to reduce the spread of hand carried pathogens.

Rationale
Newborn infants admitted to a neonatal unit especially very low birth weight infants (<1500 g) and infants subjected to intensive care are at risk for nosocomial or hospital acquired infections due to the immature host defence and invasive procedures. (1) The incidence of nosocomial bloodstream infections among these infants in neonatal intensive care units world-wide varies between 11 and 53%. (2) These infections are associated with increased mortality and morbidity, and prolonged hospital stay, compared to non-infected infants. (1,3–5)

Hand hygiene to reduce nosocomial bloodstream infections is recommended by the leading institutions like the World Health Organisation (WHO) and Centers of Disease and Infection Control (CDC), as well as the European Center of Disease and Infection Control (ECDC). The WHO's campaign 'my five moments for hand hygiene' is currently internationally regarded as standard of care. (6) High compliance with hand hygiene protocols among healthcare professionals is recognised as one of the most important means of prevention of hospital acquired infections. (2,7,8)

Benefits

Short-term benefits
- Reduced risk of nosocomial infection (2,7,8) (see TEG Medical care & clinical practice)
- Reduced risk of mortality and morbidity (intraventricular haemorrhage (IVH) (see TEG Medical care & clinical practice), necrotising enterocolitis (NEC) and retinopathy of prematurity (ROP)) (see TEG Medical care & clinical practice) (1,2,4)

Long-term benefits
- Reduced risk of antibiotic resistant bacteria (consensus)
- Reduced risk of chronic lung disease (2,4)
- Reduced risk of hearing loss (2,4)
- Reduced risk of cerebral palsy (2,4)
- Reduced risk of poor neurodevelopmental outcome (4)

Components of the standard

Component	Grading of evidence	Indicator of meeting the standard
For parents and family		
1. Parents are informed and instructed by healthcare professionals about hand hygiene according to the World Health Organisation's (WHO) 'my five moments of hand hygiene'. (6,9)	A (High quality) B (High quality)	Parent feedback, patient information sheet
2. Parents are asked to instruct the own family and relatives to apply hand hygiene guidelines.	B (Moderate quality)	Patient information sheet
3. Rings, watches, and bracelets are not to be worn in the neonatal unit.	B (Moderate quality)	Patient information sheet
For healthcare professionals		
4. A unit guideline on hand hygiene is adhered to by all healthcare professionals. (2)	A (High quality) B (High quality)	Guideline
5. Training on hand hygiene is attended by all responsible healthcare professionals. (2)	A (Moderate quality) B (High quality)	Training documentation
6. Hand hygiene according WHO's 'my five moments of hand hygiene' is applied. (6)	A (High quality)	Guideline
7. Single use non-sterile gloves are used where there is risk of body fluid contact. (10)	A (High quality)	Guideline
8. Single use non-sterile gloves, gown, and mask are used where there is risk of multi resistant bacteria. (11)	A (High quality)	Guideline
9. Artificial nails, rings, watches, bracelets, ties and long sleeves are not to be worn in the neonatal unit. (12)	A (Moderate quality)	Guideline
For neonatal unit		
10. A unit guideline on hand hygiene is available and regularly updated. (13,14)	A (High quality) B (High quality)	Guideline

11. Regular, and at least annually, audit and feedback on hand hygiene protocol adherence are conducted.	A (Low quality)	Audit report
12. A designated healthcare professional to promote hygiene is available.	B (Moderate quality)	Audit report
For hospital		
13. Training on hand hygiene is ensured.	B (High quality)	Training documentation
14. Hand hygiene facilities e.g. sinks and disinfection solutions are provided near the patient. (15)	A (Moderate quality)	Audit report
For health service		
15. A national guideline on hand hygiene is available and regularly updated. (13,14)	A (High quality) B (High quality)	Audit report, guideline

Where to go – further development of care

Further development	**Grading of evidence**
For parents and family	
• Report on hand hygiene adherence.	A (Low quality)
For healthcare professionals	
• Report on hand hygiene adherence.	A (Low quality)
For neonatal unit	
• Establish an integrated hand hygiene adherence system that electronically provides quality feedback on hand hygiene performance.	A (Moderate quality)
For hospital	
• Compare adherence with other neonatal units.	A (Low quality)
For health service	
• Report on hand hygiene adherence.	A (Low quality)

Getting started

Initial steps
For parents and family
• Parents and family are verbally informed and instructed by healthcare professionals about hand hygiene. • Family and relatives are informed about hand hygiene by parents.
For healthcare professionals
• Attend training on hand hygiene.

For neonatal unit

- Develop and implement a unit guideline on hand hygiene.
- Develop information material on hand hygiene for parents and family.
- Develop a formal education programme to cover all aspects of hand hygiene.
- Measure adherence to hand hygiene guideline on regular basis.
- Monitor nosocomial infection rate.

For hospital

- Support healthcare professionals to participate in training on hand hygiene.

For health service

- Develop and implement a national guideline on hand hygiene.

Source

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Monitoring errors

De Luca D, Tissiéres P, Helder O, Thiele, N, Perapoch J

Target group
Infants and parents

User group
Healthcare professionals, neonatal units, hospitals, health services, and technical staff

Statement of standard
Physiological monitoring is provided to any infant admitted to a NICU, which is tailored to the individual clinical situation.

Rationale
Neonatal intensive care allows the monitoring of several physiological parameters, with a range of technologies available. New techniques will expand the number of physiological parameters measurable in NICUs and will provide monitoring previously available for older patients. (1)

The increased range of monitoring parameters available produces challenges in their measurement and interpretation, due to the novelty and complexity of the monitoring technology, to a lack of understanding of some relatively new monitoring parameters or to technical errors in the monitoring itself or human error. (2,3) Neonatal quality-assurance procedures and protocols should be directed to the improving the accuracy and quality of monitoring. (4) Although monitoring errors are generally less frequent and severe than drug administration errors (2), improved evaluation of monitoring results will allow better clinical decisions.

Standard monitoring technologies are used in NICUs (ECG, saturation, plethysmography), but advanced monitoring may be necessary and include double saturation and perfusion index, (5) near-infrared spectroscopy (NIRS) (6,7),electrical cardiometry (8,9), amplitude-integrated-EEG (10,11), heart rate variability (12), complex respiratory function monitoring (including electrical impedance tomography, respiratory inductance plethysmography and semi-quantitative lung ultrasound) (13–15), and metabolic monitoring. (16,17) All these technologies provide potential benefits for neonatal care and individual use is recommended only after healthcare professionals' education and training (see TEG Education & Training).

Benefits

Short-term benefits
- Improved understanding of the disease process (18)
- Targeted clinical decisions to the individual condition (18)

Long-term benefits
- Reduced mortality (19)
- Reduced risk of major morbidities (19)

Components of the standard

	Component	Grading of evidence	Indicator of meeting the standard
For parents and family			
1.	Parents are informed by healthcare professionals about different monitoring technologies used and commit to help reduce monitoring errors in the unit.	B (High quality)	Patient information sheet
For healthcare professionals			
2.	A unit guideline on the use of monitoring equipment, application and interpretation as well as management of monitoring errors is adhered to by all healthcare professionals.	B (High quality)	Guideline
3.	Training on the use of monitoring equipment, application and interpretation as well as different monitoring technologies is attended by all responsible healthcare professionals, targeted for each professional group.	B (High quality)	Training documentation
For neonatal unit			
4.	A unit guideline on the use of monitoring equipment, application and interpretation as well as management of monitoring errors is available and regularly updated.	B (High quality)	Guideline
5.	Regular, timely maintenance and calibration of available devices is conducted by appropriately trained technical staff.	B (High quality)	Guideline
For hospital			
6.	Training on the use of monitoring equipment, application and interpretation as well as different monitoring technologies is ensured.	B (High quality)	Training documentation
7.	Monitoring errors are evaluated and actions taken. (20)	B (Moderate quality)	Audit report
For health service			
8.	Monitoring errors are evaluated and actions taken. (20)	A (Very low quality) B (Moderate quality)	Audit report

Where to go – further development of care

Further development	Grading of evidence
For parents and family	
N/A	
For healthcare professionals	
N/A	
neonatal unit	
N/A	
For hospital	
N/A	
For health service	
• Develop new monitoring systems as appropriate.	B (High quality)

Getting started

Initial steps

For parents and family

- Parents are verbally informed by healthcare professionals about monitoring technologies used.

For healthcare professionals

- Attend training on the use of monitoring equipment, application and interpretation as well as different monitoring technologies and their physiological/clinical value.
- Attend training on technical details about the way to start monitoring, positioning electrodes, and calibration.

For neonatal unit

- Develop and implement a unit guideline on the use of monitoring equipment, application and interpretation as well as management of monitoring errors.
- Develop information material on monitoring for parents.
- Develop a protocol and flow chart for serial calibration and maintenance of monitoring devices.
- Develop an internal monitoring protocol, including reference values for evaluation and technical details for each device.

For hospital

- Support healthcare professionals to participate in training on the use of monitoring equipment, application and interpretation as well as different monitoring technologies and their physiological/clinical value.
- Support healthcare professionals to participate in training on technical details about the way to start monitoring, positioning electrodes, and calibration.

For health service

N/A

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Nurse staffing in neonatal intensive care

Poets CF, Helder O, Tissières P, Mader S, Härtel C, Rossi R

Target group
Infants requiring intensive care and parents

User group
Healthcare professionals, neonatal units, hospitals, and health services

Statement of standard
Nurse staffing levels reflect the needs of the infants they are caring for, which include one to one nursing during intensive care and one to two nursing during intermediate care.

Rationale
At present, nurse staffing levels vary widely between neonatal services. (1,2) There is evidence that insufficient nursing numbers are associated with increased mortality and increased infection rates. (3–9) Data indicate that provision of sufficient nursing staff will facilitate the timely delivery of neonatal care (3), allow for better prevention of nosocomial infections (10–12), result in better compliance with set oxygen saturation targets[5], and improved hand hygiene compliance. (13) There is also a relationship between the proportion of one to one nursing achieved and mortality. (14)

Evidence-based standards in this area include:

- an agreed proportion of nurses working in the NICU should have ≥3 years work experience in a NICU or completed post-registration education in intensive care (15,16)
- a nurse-to-infant ratio of one to one (15,16) (one nurse for one infant) for infants requiring intensive care, of one to two (15,16) (one nurse for two infants) for infants needing intermediate care, and a ratio of at least one to four for all infants requiring special care (15)
- in addition to nursing staff, support should be available from professionals with specific expertise in neonatal practice in the following areas: social work, psychology dietetics, physiotherapy, speech and language therapy, pharmacy, as well as nursing aids (15–20) (see TEG Infant-and family-centred developmental care)

Benefits

Short-term benefits

- Timely delivery of neonatal care (3)
- Reduced risk of nosocomial infections (10–12)
- Improved compliance with set oxygen saturation targets in infants (5)
- Improved hand hygiene compliance (13)
- Reduced neonatal mortality (8)

Long-term benefits

- Improved long-term outcomes (6)

Components of the standard

Component	Grading of evidence	Indicator of meeting the standard
For parents and family		
1. Parents are supported to be the primary caregiver.	B (High quality)	Parent feedback
For healthcare professionals		
2. Patient's care has priority over administrative and housekeeping tasks for nurses in clinical care.	B (High quality)	Guideline
For neonatal unit		
3. A unit guideline on nurse staffing requirements is available and regularly updated.	B (High quality)	Guideline
4. Sufficient nurse staffing numbers to provide appropriate levels of neonatal care is ensured: (15,16) • One nurse to one patient for intensive care (14) • One nurse to two patients for intermediate care • One nurse to four patients during special care • In addition, one nurse to provide shift coordination	A (High quality) C (Moderate quality)	Audit report
For hospital		
5. Sufficient nurse staffing numbers for care and continuing professional development and education of staff is ensured. (15,16) (see TEG Education & training)	A (Moderate quality)	Audit report, training documentation
For health service		
6. A national guideline on nurse staffing requirements is available and regularly updated.	B (High quality)	Guideline
7. The staffing required by a unit is defined according to the number of beds and the care level of the beds. (15,16)	A (Moderate quality) C (Moderate quality)	Audit report

8. Adequate national or regional training places on accredited educational courses are ensured. (see TEG Education & training)	A (Moderate quality) B (High quality	Audit report

Where to go – further development of care

Further development	**Grading of evidence**
For parents and family	
N/A	
For healthcare professionals	
N/A	
For neonatal unit	
N/A	
For hospital and health service	
• Develop initiatives to make neonatal nursing attractive as a career option.	B (High quality)
• Develop evidence-based standards for medical and allied professional staffing. (21)	A (High quality)
• Agree and implement a national or regional policy to ensure appropriate nurse staffing numbers. (15)	A (High quality)

Getting started

Initial steps
For parents and family
• National parent representatives contribute to national consensus meetings on neonatal staffing.
For healthcare professionals
N/A
For neonatal unit
• Develop and implement a unit guideline on nurse staffing requirements. • Inform health services and stakeholders about the importance of appropriate NICU staff numbers.
For hospital
• Develop and educate nursing workforce. • Facilitate development of neonatal expertise by allied professionals.
For health service
• Develop and implement a national guideline on nurse staffing requirements. • Organise expert stakeholder groups on a national level to reach consensus about nursing, medical and allied professional neonatal staffing requirements and their implementation.

Source

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Patient safety and quality awareness in neonatal intensive care

van der Starre C, Helder O, Tissières P, Thiele N, Ares S

Target group
Infants, parents, and families

User group
Healthcare professionals, neonatal units, hospitals, and health services

Statement of standard
Patient safety and quality improvement activities are fully integrated in clinical practice.

Rationale
Infants admitted to a neonatal intensive care unit (NICU) are at a high risk of being harmed by lapses in quality or safety. Improving patient safety is an important component of high quality care and requires the support of an appropriate system for the identification, investigation and development of learning from quality issues. Although there are several schemes for quality improvement, local leadership and implementation are critical to improving outcomes for ill infants. (1–6)

There are six potential domains in quality of healthcare: patient centeredness, patient safety, efficacy, efficiency, timeliness, and equitability (5), which should form the basis of any quality programme in neonatal care. These may be addressed using three major components: structure, data monitoring and culture. (7)

A Quality system needs to be championed at hospital board level but is led from within the neonatal team, supported by the quality improvement staff. Structural components also include a system capturing data to monitor key indicators as prioritised by the neonatal team. The system should develop a safety culture in which transparency, blame free reporting and the development of learning from clinical events reported within the system. Units should establish an advisory board to coordinate and direct quality improvement initiatives.

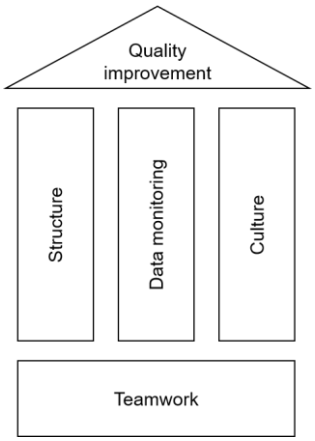

Figure 1 adapted from Haraden & Staines, 2015

Benefits

- Reduced clinical errors and patient harm (1–6)
- Improved safety climate (1,3,4)
- Improved incident reporting (2,3,5)
- Uncovered processes of care prone to errors/prone to cause patient harm (3,5)
- Reduced length of hospital stay (3,4)
- Improved patient outcome (1–6)
- Prioritisation of improvement projects (2–5)
- Improved teamwork (1–3)
- Improved well-being of frontline staff (2,3,5)
- Improved patient/family satisfaction (2,3)
- Provided insight in relevant data for quality management (3,4,6)

Components of the standard

Component	Grading of evidence	Indicator of meeting the standard
For parents and family		
1. Parents and family are informed by healthcare professionals about patient safety and quality awareness in neonatal intensive care.	B (Moderate quality)	Patient information sheet
2. Parents are invited to provide feedback during and after the NICU stay.	B (Moderate quality)	Parent feedback
3. Parent representatives are invited to provide input and feedback in training and educating staff.	B (Moderate quality)	Training documentation
4. Parents are encouraged to report incidents and receive confidential timely feedback.	B (Moderate quality)	Parent feedback
5. Parents are members of the NICU quality improvement board.	B (Moderate quality)	Guideline
For healthcare professionals		
6. A unit guideline on patient safety and quality awareness is adhered to by all healthcare professionals.	B (Moderate quality)	Guideline
7. Training on patient safety and quality improvement including participation in simulation where appropriate is attended by all staff.	B (Moderate quality)	Training documentation

8. All healthcare professionals are actively engaged in quality improvement projects and training.	B (Moderate quality)	Audit report, guideline, training documentation
9. Healthcare professionals report all incidents.	B (Moderate quality)	Audit report, clinical records
10. A blame-free culture is established.	B (Moderate quality)	Staff feedback
For neonatal unit		
11. A unit guideline on patient safety and quality awareness is available and regularly updated.	B (Moderate quality)	Guideline
12. Clear roles and responsibilities in patient safety and quality improvement are allocated, including a clinical lead for patient safety.	B (Moderate quality)	Audit report, guideline
13. A clinical incident reporting system is provided.	B (Moderate quality)	Audit report, guideline
14. Regular patient safety and quality improvement meetings are held and actions are taken.	B (Moderate quality)	Audit report, guideline
15. Individual participation with quality improvement/patient safety initiatives is included in yearly performance reviews.	B (Moderate quality)	Audit report, training documentation
For hospital		
16. Training on patient safety and quality improvement including participation in simulation where appropriate is ensured.	B (Moderate quality)	Training documentation
17. A clear policy and structure for the no-blame reporting of incidents is available.	B (Moderate quality)	Guideline, audit report
18. Quality monitoring is given priority by the whole hospital management team and regularly monitored.	B (Moderate quality)	Guideline, audit report
19. Neonatal quality improvement activity is supported by the hospital quality management team.	B (Moderate quality)	Audit report

20. Benchmarking against other neonatal services is facilitated.	B (Moderate quality)	Audit report
For health service		
21. A national guideline on patient safety and quality awareness is available and regularly updated.	B (Moderate quality)	Guideline
22. Quality indicators and learning points from patient safety initiatives are shared across the health system.	B (Moderate quality)	Audit reports

Where to go – further development of care

Further development	**Grading of evidence**
For parents and family	
N/A	
For healthcare professionals	
N/A	
For neonatal unit	
N/A	
For hospital	
N/A	
For health service	
• Establish regular international benchmarking.	B (Moderate quality)

Getting started

Initial steps
For parents and family
• Parents are verbally informed by healthcare professionals about patient safety and quality awareness in neonatal intensive care. • Parents are encouraged to report incidents.
For healthcare professionals
• Attend training on patient safety and quality improvement including participation in simulation where appropriate. • Report incidents using available hospital structures. • Collate incidents and develop practice improvements.
For neonatal unit
• Develop and implement a unit guideline on patient safety and quality awareness. • Develop information material on patient safety and quality awareness in neonatal intensive care for parents. • Foster a patient safety culture by starting with team training.

For hospital

- Support healthcare professionals to participate in training on patient safety/quality improvement including participation in simulation where appropriate.
- Facilitate learning from mistakes and from other departments.
- Designate a quality improvement manager.

For health service

- Develop and implement a national guideline on patient safety and quality awareness.
- Establish a national peer review programme.

Description

It may seem quite logical and even to be expected that a lot of attention has been given to improvement of quality of care in neonatal care. The extremely vulnerable and seriously ill patients in a neonatal intensive care unit (NICU) are at a high risk of being harmed by lapses in quality or safety. Nevertheless, improving healthcare quality has proven to be a challenging undertaking, that foremost requires long term dedication. It has become clear that the science of improvement, human factors and implementation are indispensable in increasing quality and patient safety. This standard of care attempts to highlight the most relevant topics and tools that NICUs can apply in their quality management.

The Institute of Medicine has defined six domains in quality of healthcare: patient centeredness, patient safety, efficacy, efficiency, timeliness, and equitability. Quality and safety management should encompass all these topics. Obviously that poses a very daunting task for NICUs, which nonetheless needs to be addressed. The first thing that needs to be clarified, is that no single quality management system will fit all NICUs; customisation is in order, as each NICU may need to have to address different priorities in quality and patient safety. Also, the instrument that works well in one NICU will likely be less or not successful in another NICU; for instance, the applicability of a programme to increase flow of patients and reduce length of stay would be very variable among different settings.

Patient centeredness has been viewed as an evident requirement for neonatal care and the “family unit” as the “patient” is a widespread point of view. The implementation of rooming in facilities for mothers, mother and child suites, and shared care programmes are some of the most apparent developments. The increasing use of individualised neonatal care programmes is another example of application of patient-centred care that directly benefits both patients and parents. The challenges for the future in infant- and family-centred care lie in creating shared decision-making. Together with parents, we will need to examine what is needed for all stakeholders, such as parents, healthcare workers, hospitals etc., to implement and maintain shared decision-making. By involving parents in the care for their children, not only can we improve that care, but also advance knowledge and experience of quality and safety in a broader way.

Since the publication of the landmark report “To err is human” (5), the quality and patient safety movement, which had taken off with a slow start, has gained more and more momentum. Numerous initiatives and organisations dedicated to quality improvement have been created, such as the Institute for Healthcare Improvement in the USA and the Health Foundation in the UK. Research in the fields of quality,

patient safety, implementation, innovation and human factors, has exploded. As the research and knowledge of safety and quality has increasingly been shared, it became evident that a number of basic requirements for improvement are necessary for all healthcare settings.

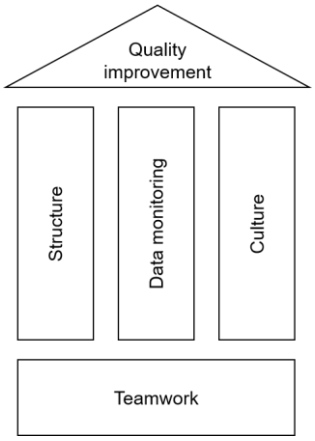

Figure 1 adapted from Haraden & Staines, 2015

First of all, a system or structure for Quality and Patient Safety Management (QPSM) needs to be in place. Roles, tasks and responsibilities have to be defined. It needs to be clear who is doing what, and who is accountable for which components of the management system. This needs to be facilitated and supported actively by boards, directors, and (middle) management; quality management will undoubtedly fail when it is simply added to the everyday tasks and activities of the engaged frontline staff. Another necessity relates to improvement skills. Frontline staff and middle management involved in quality improvement need to collaborate with co-workers schooled in change management, as healthcare professionals usually are not trained in the skills for developing and implementing new processes, procedures etc.
Next to this, each NICU needs to determine what data to monitor and in what way. In order to be able to prioritise, implement, monitor, adapt and create a success of any improvement initiative, data need to be collected relevant to the problem that needs to be tackled (see TEG data collection & documentation).

The last pillar of the QPSM is culture. How is the safety climate in a NICU, a hospital, a country? Is there a “just culture” where openly discussing errors and mistakes is not only possible without fear for repercussions, but in fact welcomed as an opportunity to learn? In this respect, leading by example is one of the most powerful modes of improving the safety culture in any setting. Directors and heads of departments that welcome feedback on their (lack of) adhering to hand hygiene rules, will likely see an increase in commitment from frontline staff and patients/parents. Next to leadership in setting the standard for the desired work-related behaviours, they also need to facilitate teamwork and teamwork training. Teamwork is more and more recognised as the foundation of healthcare and thus it needs to be addressed. As has been proven numerous times, expert teamwork is not created by simply putting a number of experts together, but requires training, both in acute care settings such as the NICU, as well as other settings such as for instance an outpatient department. Healthcare frontline staff are well trained professionals in their field of expertise, however, the non-technical skills that are required for teamwork quite often have not received the attention they require. Communication,

stress management, leadership, decision-making, risk management, developing a shared understanding of the situation are topics of training, education, and discussion that can and should be addressed. Especially interdisciplinary training is an upcoming phenomenon in healthcare, that addresses these non-technical skills. Teamwork and culture also relate to the notion that patients and family should be welcomed as members of the team. Obviously, healthcare in itself means partnering up with patients, as without them, there would be no need for healthcare providers. However, integrating parents in the NICU team can be quite challenging and there may be a number of barriers. For instance, the events surrounding the birth of a preterm child can be extremely stressing for parents, thus decreasing their ability in shared decision-making. Or the frontline staff feel they cannot properly discuss the decisions during the rounds if the parents are present. These potential issues obviously need to be explored and dealt with before teaming up with the parents can reach its full potential. A large number of initiatives have been launched worldwide, so what remains is learning from each other, and from the parents/families, in how to best achieve safe, patient centred and reliable care for the most vulnerable, the NICU patients.

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EFCNI, van der Starre C, Helder O et al., European Standards of Care for Newborn Health: Patient safety and quality awareness in neonatal intensive care. 2018.

Patient screening for resistant bacteria

Giannoni E, Tissières P Helder O, Mader S, Thiele N, Borghesi A

Target group
Infants, parents, and families

User group
Healthcare professionals, neonatal units, hospitals, and health services

Statement of standard
Patient screening for multidrug-resistant bacteria in neonatal intensive care units (NICUs) is part of infection prevention and control programmes.

Rationale
The goal is to reduce the incidence of infections caused by multidrug-resistant bacteria in NICUs. Active surveillance consists of performing screening cultures to identify asymptomatic infants colonised with multidrug-resistant organisms (MDRO), including methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant *Enterococci*, and Gram-negative pathogens expressing extended spectrum β-lactamases and carbapenemases. Identification of patients colonised by MDRO allows the adoption of contact precautions and cohorting of patients and decontamination, in order to minimise the likelihood of progression from colonisation to invasive infection and the spread to other patients. The benefit of active surveillance and associated interventions is well documented in the adult ICUs (1), and during outbreaks. (2) However, the benefit of screening all NICU patients for MDRO is more controversial. While some studies have shown a reduction in colonisation by MDRO (3,4), there was significant variation in timing of screening, anatomic sites sampled, isolation protocols, and decolonisation strategies. (5,6) Furthermore, cost effectiveness of active surveillance is questionable (7), treatments used for decontamination may not be totally harmless in newborns (8), and other infection prevention strategies focusing on hand hygiene and promotion of feeding with breast milk may be more efficient. (9,10) The impact of screening all infants admitted to the NICU for MDRO is likely to depend on the local epidemiology of nosocomial infections and resistance patterns, on NICU organisation and implementation of basic infection prevention practices. Therefore, a uniform approach for screening MDRO may not be applicable to all European NICUs, and policies regarding screening should be part of infection prevention and control programmes developed by each institution.

Benefits

Short-term benefits
- Reduced risk and containment of outbreaks due to multi-resistant bacteria (2,9,10)

Long-term benefits
- Reduced mortality and improved neurodevelopmental outcome (2,11)

Components of the standard

Component	Grading of evidence	Indicator of meeting the standard
For parents and family		
1. Parents and family are informed by healthcare professionals about practices to reduce the incidence of nosocomial infections. (9,10)	A (Moderate quality) B (High quality)	Patient information sheet
For healthcare professionals		
2. A unit guideline on screening for multi-resistant bacteria and regarding measures that need to be taken in the event of a positive screening is adhered to by all healthcare professionals.	B (High quality)	Guideline
3. Training on infection prevention practices are attended by all responsible healthcare professionals. (2,9,10)	A (High quality) B (High quality)	Training documentation
4. Frequent contact with dedicated infection control teams to discuss specific cases is ensured.	B (High quality)	Guideline
For neonatal unit		
5. A unit guideline on screening for multi-resistant bacteria and regarding measures that need to be taken in the event of a positive screening is available and regularly updated. (2,9,10)	A (Moderate quality) B (High quality)	Guideline
For hospital		
6. Training on infection prevention practices and frequent contact with dedicated infection control teams to discuss specific cases is ensured.	B (High quality)	Guideline, training documentation
7. Resources for infection prevention and control are available, including microbiology laboratories with ability to perform identification, susceptibility testing and rapid notification of results to clinicians, ability to monitor local epidemiology of nosocomial infections, and strategies for management of outbreak. (2,9,10)	A (High quality)	Guideline, audit report

For health service		
8. A national guideline on screening for multi-resistant bacteria, and regarding measures that need to be taken in the event of a positive screening is available and regularly updated.	B (High quality)	Guideline
9. Initiatives to contain antibiotic-resistant pathogens are supported. (9,10)	A (Moderate quality)	Audit report

Where to go – further development of care

Further development	**Grading of evidence**
For parents and family	
N/A	
For healthcare professionals	
N/A	
For neonatal unit and hospital	
• Update policies based on changes in the local epidemiology of nosocomial infections and new evidence from the literature.	B (Moderate quality)
For health service	
N/A	

Getting started

Initial steps
For parents and family
• Parents and family are verbally informed by healthcare professionals about infection prevention practices.
For healthcare professionals
N/A
For neonatal unit
• Develop and implement a guideline on screening for multi-resistant bacteria, and regarding measures that need to be taken in the event of a positive screening. • Develop information material on infection prevention and control for parents.
For hospital
N/A
For health service
• Develop and implement a national guideline on screening for multi-resistant bacteria, and regarding measures that need to be taken in the event of a positive screening.

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Lifecycle

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Personal hygiene

Lausten-Thomsen U, Helder O, Tissières P, Mader S, Thiele N, Ares S

Target group
Infants, parents, families, and healthcare professionals

User group
Healthcare professionals, neonatal units, hospitals, and health services

Statement of standard
High personal hygiene standard is ensured to reduce the risk of nosocomial infections.

Rationale
Personal carriage of pathogens places infants at risk for nosocomial infections. The risk is increased because of immature host defences and frequent invasive procedures, which in turn increases the risk of mortality, morbidity, and prolonged hospital stay. (1–4) Apart from hand carried contamination (5,6), several other potential sources for personally carried pathogens among healthcare professionals, parents and families have been identified, including clothing/textiles (7,8), personal jewellery (9,10), artificial fingernails (11), personal electronic devices (10,12), and contagious diseases, e.g. human respiratory syncytial virus. (13) Implementation of standardised hygiene protocols reduces the bacterial burden in the NICU environment, and subsequently the risk of sepsis. (14) (see TEG Patient safety & hygiene practices)

Benefits

Short-term benefits
- Generally reduced risk of infection (consensus)
- Facilitated parental presence and kangaroo care (consensus)

Long-term benefits
N/A

Components of the standard

Component	Grading of evidence	Indicator of meeting the standard
For parents and family		
1. Parents and family are informed and instructed by healthcare professionals about personal hygiene, personal clothing, and use of electronic personal devices to reduce the risk of nosocomial infections.	B (Moderate quality)	Patient information sheet, training documentation

2. Parents are asked to instruct the own family and relatives to apply NICU hygiene guidelines.	B (Moderate quality)	Parent feedback
3. Fingernails are kept clean and short and artificial nails are not used. (11)	A (Moderate quality)	Guideline
4. Strict adherence to local infections control politics (such as proper hand hygiene) practices are followed when electronic devices are handled. (10,12) (see TEG Patient safety & hygiene practices)	A (Moderate quality)	Guideline
For healthcare professionals		
5. Healthcare professionals are informed and instructed about personal hygiene, personal clothing, and use of electronic personal devices to reduce the risk of nosocomial infections.	B (Moderate quality)	Guideline
6. A unit guideline on personal hygiene is adhered to by all healthcare professionals.	B (Moderate quality)	Guideline
7. Healthcare professionals are encouraged to identify poor practice.	B (Moderate quality)	Audit report, training documentation
8. Fingernails are kept clean and short and artificial nails are not used. (11)	A (Moderate quality)	Guideline
9. Strict adherence to local infections control politics (such as proper hand hygiene) practices are followed when electronic devices are handled. (10,12) (see TEG Patient safety & hygiene practices)	A (Moderate quality)	Guideline
10. Single use of non-sterile gloves, gown, and mask is ensured: • in case of infectious diseases • non-sterile gloves are worn when in contact with blood, mucous membranes, non-intact skin or other potentially infectious materials. Gloves are worn and changed according to the WHO “5 moments of handy hygiene”. (15) (see TEG Patient safety & hygiene practices)	B (Moderate quality)	Guideline

For neonatal unit		
11. A unit guideline on personal hygiene, uniforms, jewellery and use of personal electronic devices is available and regularly updated. (9,10)	A (Moderate quality) B (High quality)	Guideline
12. Local uniform regulations are applied (indoor washable shoes, short sleeved uniform changed daily and when soiled, hair short or kept away from the patient). (8,16)	A (Moderate quality) B (Moderate quality)	Guideline
For hospital		
13. The NICU is incorporated alongside each individual hospital's infection control guidelines and the products they choose to use.	A (Moderate quality) B (Moderate quality)	Guideline
14. Access to showers in the NICU is ensured for parents, family, and staff. (see TEG NICU design)	B (Moderate quality)	Audit report
For health service		
15. A national guideline on personal hygiene including hand hygiene, washing and shower facilities, uniforms is available and regularly updated. (see TEG Patient safety & hygiene practices)	B (Moderate quality)	Guideline

Where to go – further development of care

Further development	**Grading of evidence**
For parents and family	
N/A	
For healthcare professionals	
N/A.	
For neonatal unit	
• Focus future interventions on newborn infants ≤1000 g birth weight, in whom infection rates are higher. (17)	A (Moderate quality)
• Report compliance to personal hygiene guideline.	B (Moderate quality)
For hospital	
• Audit adherence to protocol regularly including a combination of staff education, promotion hand hygiene, and performance monitoring with regular feedback in order to promote/maintain a high level of hygiene.	A (Low quality) B (Low quality)
For health service	
N/A	

Getting started

Initial steps

For parents and family

- Parents and family are informed and instructed by healthcare professionals about personal hygiene, personal clothing, and use of electronic personal devices to reduce the risk of nosocomial infections.

For healthcare professionals

- Healthcare professionals are informed and instructed about personal hygiene, personal clothing, and use of electronic personal devices to reduce the risk of nosocomial infections.
- Monitor nosocomial infection rates.

For neonatal unit

- Develop and implement a unit guideline on personal hygiene.
- Develop information material on personal hygiene for parents and family.
- Promote adherence to hand hygiene protocols to prevent healthcare-associated infections.
- Measure compliance on regular base.
- Educate healthcare personnel about the importance of hand hygiene for infection prevention, reminders, and adherence surveillance with feedback of results to frontline providers in hand hygiene adherence programmes.
- Develop inter-professional awareness by educating all healthcare professionals and family on preventing personal carried contamination/transmission of nosocomial agents: include medical, nursing, laboratory, and maintenance personnel, students, volunteer staff, visitors, and families.

For hospital

- Promote adherence to hand hygiene to prevent healthcare-associated infections.

For health service

- Develop and implement a national guideline on personal hygiene.

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Prevention of medication errors in NICU patients

Van der Sijs H, Helder O, Tissières P, Mader S, Thiele N, Perapoch J

Target group
Infants and parents

User group
Healthcare professionals, neonatal units, hospitals, and health services

Statement of standard
Medication errors are monitored and evaluated to reduce the exposure of infants to avoidable therapeutic risks.

Rationale
The risk of drug administration errors is high in infants for a range of reasons, including different types of errors and reduced compensatory ability. (1,2) The majority of prescriptions for infants are for off-label and unlicensed medications, which are more often associated with medication errors and potential adverse drug events. (3–5)

There is a high risk of calculation errors because doses are based on bodyweight, which may vary 10-fold (from 0.5-5kg), and changes with growth during the first months. Electronic prescribing reduces the frequency of missing, illegible and incomplete orders. Absence of electronic clinical decision support may result in dose (calculation) errors. (6,7) Errors and inaccuracy in drug preparation occur because use of adult dosage formulations require measurement of small volumes, and/or calculation of dilution steps. (8,9) Patient identification may be problematic, as infants cannot confirm their identity and may be part of a multiple pregnancy with similar names and birth dates. (10) Infants often have both intra-venous and intra-arterial catheters and nasogastric tubes increasing the risk of administration by the wrong route. (11)

Benefits

Short-term benefits
- Easily understandable information about drug doses, preparation, and administration (12)
- Reduced risk of calculation errors (7)
- Reduced risk of administration by incorrect route (13)
- Reduced risk of illegible and incomplete drug prescriptions (7)

Long-term benefits
- Evidence-based drug information specific to newborn infants (14)
- Improved availability of neonatal formulations (14)
- Improved accuracy of drug doses (9)
- Improved drug safety alerting (15)

Components of the standard

Component	Grading of evidence	Indicator of meeting the standard
For parents and family		
1. Parents are informed by healthcare professionals about any medication errors.	B (High quality)	Clinical records
2. Parents are encouraged to speak up when they believe a mistake has been made with the prescription, dosage or administration of medicines to their infant.	B (Moderate quality)	Parent feedback
For healthcare professionals		
3. A guideline for compounding, dosage, and administration of all dispensed parenteral and oral drugs in neonatal care is adhered to by all healthcare professionals.	B (High quality)	Guideline
4. Training on medication compounding and in the use of electronic calculation support and electronic prescribing is attended by all responsible healthcare professionals.	B (High quality)	Training documentation
5. Electronic calculation support is used. (1,7,15)	A (Moderate quality) B (Moderate quality)	Guideline
6. Healthcare professionals are not interrupted during medication compounding. (1,16)	A (Moderate quality) B (Moderate quality)	Guideline
7. Medication is compounded and administered using double checks at each stage. (1)	A (Moderate quality) B (Moderate quality)	Guideline
8. Generated drug safety alerts are handled carefully weighing benefits and risks. (1,15)	A (Moderate quality) B (Moderate quality)	Guideline
9. Medication errors are recorded in clinical records, explained to parents and reported within the hospital. (1)	A (Moderate quality) B (Moderate quality)	Audit report, guideline
10. Adverse drug reactions are reported to the national authorities. (17)	A (Moderate quality) B (Moderate quality) C (High quality)	Audit report

For neonatal unit and hospital		
11. A guideline for compounding, dosage, and administration of all dispensed parenteral and oral drugs in neonatal care is available and regularly updated.	B (High quality)	Guideline
12. Training on medication compounding and in the use of electronic calculation support and electronic prescribing is ensured.	B (High quality)	Training documentation
13. An electronic prescribing system for all medication orders is provided. (1,7)	A (Moderate quality) B (Moderate quality)	Guideline
14. Different connecting systems for oral and intravenous administration are available. (11,13,17)	A (Moderate quality) B (Moderate quality) C (High quality)	Training documentation
15. A system for reporting and analysis of medication errors is available. (1,17)	A (Moderate quality) B (Moderate quality) C (High quality)	Audit report
16. A hospital pharmacist trained and experienced in neonatal practice is available. (8)	A (Moderate quality) B (Moderate quality)	Audit report
For health service		
17. A national guideline on compounding, dosage, and administration of all dispensed parenteral and oral drugs in neonatal care is available and regularly updated.	B (High quality)	Guideline
18. A national system for analysis of medication errors is available. (17)	A (Moderate quality) B (Low quality) C (High quality)	Audit report

Where to go – further development of care

Further development	Grading of evidence
For parents and family	
N/A	
For healthcare professionals	
N/A	
For neonatal unit	
N/A	
For hospital	
• Implement an electronic prescribing system with integral clinical decision support (checks for dose, drug-drug interactions, duplicate therapy, allergy and contraindications).	B (Moderate quality)
• Provide satellite pharmacies or central pharmacy compounding individualised doses for infants.	B (Moderate quality)
• Implement smart infusion pumps.	A (Low quality
• Implement bar code assisted medication administration.	B (Moderate quality)
For health service	
• Provide national neonatal/paediatric drug formulary with evidence based (or expert based) dose recommendations.	B (Moderate quality)
• Support the development of paediatric investigation plans. (14)	A (Moderate quality) B (Moderate quality) C (High quality)

Getting started

Initial steps
For parents and family
• Parents are verbally informed by healthcare professionals about prescribed medication and medication errors.
For healthcare professionals
• Attend training on medication compounding and in the use of electronic calculation support and electronic prescribing.
• Perform double checks for compounding and administration of drugs.
• Report and document medication errors.
• Use calculation aids for calculation of doses.
For neonatal unit and hospital
• Develop and implement a guideline for compounding and administration of drugs.
• Develop and implement a guideline specifying which handbook/formulary is to be used.
• Develop information material on drug information and medication errors for parents.
• Support healthcare professionals to participate in training on medication compounding and in the use of electronic calculation support and electronic prescribing.
• Ensure a hospital pharmacist is trained and experienced in neonatal practice.
For health service
• Develop and implement a national guideline on compounding, dosage and administration of all dispensed parenteral and oral drugs in neonatal care.
• Establish a national service for medication error reporting.

Source

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Prevention of necrotising enterocolitis (NEC)

Manzoni P, Tissières P, Helder O, Borghesi A

Target group
Very preterm infants and parents

User group
Healthcare professionals, neonatal units, hospitals, and health services

Statement of standard
Neonatal services implement bundles of care designed to prevent necrotising enterocolitis (NEC).

Rationale
Necrotising enterocolitis (NEC) is a devastating bowel disease affecting approximately 7% of very preterm infants. It is associated with increased mortality, serious neonatal morbidity, prolonged NICU stay, high costs, late neurodevelopmental impairment, and decreased quality of life in survivors. (1–5)

The pathogenesis of NEC is multifactorial, including gut immaturity, infection, enteric colonisation by pathogens, and local vascular injury, in the presence of milk. (1–4) Risk factors include absence or limited exposure to human milk, either donor or maternal (6,7), exposure to inhibitors of gastric acidity (8,9), and exposure to cow-milk derived proteins provided as fortifier (6), or as formula milk (7). Changes in the daily increase in the amount of enteral feeding or packed red blood cells transfusion have not been directly related to the onset of NEC. (10,11)

A limited number of strategies have proven effective in reducing the prevalence of the most severe stages of NEC (5), including human milk (7), and potentially probiotics (12–14) and bovine Lactoferrin (15). It is likely that only multifaceted, comprehensive strategies will consistently lead to the prevention of NEC.

Benefits

Short-term benefit
- Reduced risk of NEC and comorbidity (6,7,13)
- Reduced mortality (16)

Long-term benefits
- Reduced risk of poor neurodevelopmental outcome (16,17)
- Reduced risk of poor nutritional outcome including impaired growth and dependence on nutritional devices (consensus)
- Reduced healthcare costs (consensus)

Components of the standard

Component	Grading of evidence	Indicator of meeting the standard
For parents and family		
1. Parents are informed by healthcare professionals about the benefits of human milk feeding. (7)	A (High quality) B (High quality)	Patient information sheet
2. Mothers are instructed about how to early initiate expressing breast milk. (18) (see TEG Nutrition)	A (High quality)	Parent feedback
3. Parents are instructed by healthcare professionals about the need for hand hygiene to reduce the risk of nosocomial infections. (see TEG Patient safety & hygiene practice)	B (Moderate quality)	Patient information sheet, training documentation
For healthcare professionals		
4. A unit guideline on the implementation of bundles of care designed to prevent necrotising enterocolitis (NEC) is adhered to by all healthcare professionals.	B (High quality)	Guideline
5. Own mother´s milk is used where available, donor milk is substituted if necessary. (3,7)	A (High quality)	Clinical records, guideline
6. Probiotics are recommended. (12,13)	A (High quality)	Guideline
7. Inhibitors of gastric acidity (H2-blockers, proton pump inhibitors, etc.) are avoided. (8,9)	A (High quality)	Guideline
For neonatal unit		
8. A unit guideline on the implementation of bundles of care designed to prevent NEC is available and regularly updated.	B (High quality)	Guideline
9. The proportion of very preterm infants who develop NEC is audited.	B (High quality)	Audit report
For health service		
10. A national guideline on the implementation of bundles of care designed to prevent NEC is available and regularly updated.	B (High quality)	Guideline
11. Human milk banks are available. (19)	A (High quality)	Audit report

Where to go – further development of care

Further development	Grading of evidence
For parents and family	
N/A	
For healthcare professionals and neonatal unit	
• Define the optimal probiotic to be used in the NICU.	B (Low quality)
For hospital	
• Ensure availability of own mother´s milk and donor milk. (19)	A (High quality)
For health service	
N/A	

Getting started

Initial steps

For parents and family

- Parents are verbally instructed by healthcare professionals about the importance of the use of own mother´s milk where available and in the benefits of donor milk as a substitute.

For healthcare professionals

- Monitor the proportion of very preterm infants who develop necrotising enterocolitis (NEC).

For neonatal unit

- Develop and implement a unit guideline on bundles for prevention practices for NEC.
- Develop information material about the benefits of human milk feeding and the need for hand hygiene for parents.

For hospital

- Provide donor milk supply. (see TEG Nutrition)

For health service

- Develop and implement a national guideline on the implementation of bundles of care designed to prevent NEC.

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Prevention of ventilator associated pneumonia

Dubois C, Tissières P, Helder O, Mader S, Borghesi A

Target group
Infants receiving mechanical ventilation and parents

User group
Healthcare professionals, neonatal units, hospitals, and health services

Statement of standard
The risk of ventilator associated pneumonia (VAP) is minimised by systematic application of care bundles.

Rationale
Ventilator associated pneumonia (VAP) may occur in between eight and 50% of ventilated infants (1,2), with a prevalence of up to 37 cases per 1000 ventilator-days (2–8). Criteria used to define VAP vary and affect incidence reporting. Despite formal definition in older infants, a specific definition for newborn infants is lacking. (1)

The risk of nosocomial infection is increased because of immature host defences and frequent invasive procedures. VAP arises when there is bacterial invasion of the pulmonary parenchyma in a patient who receives ventilation for more than 48 hours. (1) VAP arises following colonisation of the aerodigestive tract, aspiration of oral secretions and contaminated equipment. (2) Identification of causative microorganisms is not necessary to establish a diagnosis, but microbiological tests are essential to narrow the spectrum of antibiotic therapy.

Risk factors for VAP include low birth weight, prematurity, prolonged mechanical ventilation, reintubation, frequent endotracheal suctioning, presence of invasive devices, transfusions, inotropic drugs, and a history of bloodstream infection. (4,6,8–14) VAPs are associated with increased mortality, morbidity, prolonged hospital stay, and additional costs. (3,4,6,10,15) Multiple interventions are required to minimise the frequency of VAP. VAP may be reduced by careful attention to care practices. (11,16)

Benefits

Short-term benefits

- Reduced occurrence of VAP (11,16)
- Reduced risk of systemic sepsis (9,10,17)
- Reduced mortality and morbidity (6,12,18)
- Reduced duration of mechanical ventilation (3,6,8–10,13,14)
- Reduced length of hospital stay

Long-term benefits

- Reduced exposure to antibiotics (consensus)
- Reduced risk of chronic lung disease (4,12)
- Improved neuro-developmental outcome (19)
- Reduced healthcare costs (15,18,20)

Components of the standard

Component	Grading of evidence	Indicator of meeting the standard
For parents and family		
1. Parents are informed and instructed by healthcare professionals about ventilator associated pneumonia (VAP) and prevention using proper hand hygiene. (2,21,22) (see TEG Patient safety & hygiene practice)	A (Moderate quality) B (High quality)	Patient information sheet
2. Parents are encouraged to report incidents where they believe an error has been made in hygiene, and receive confidential timely feedback. (23) (see TEG Patient safety & hygiene practice)	A (Moderate quality) B (High quality)	Parent feedback
For healthcare professionals		
3. A unit guideline for screening, documentation, prevention, and treatment for VAP is adhered to by all healthcare professionals. (2,5,11,12,15,16,18,24–32)	A (Moderate quality) B (High quality)	Guideline
4. Head of bed is elevated at least 30°. (5,21)	A (Moderate quality) B (High quality)	Guideline
5. Training on screening, documentation, and treatment for VAP is attended by all responsible healthcare professionals.	B (High quality)	Training documentation
6. Hand hygiene according WHO's 'my five moments of hand hygiene' is applied including after handling respiratory equipment and supplies. (2,15,33,34)	A (High quality) B (High quality)	Guideline
7. A daily evaluation for readiness for extubation is undertaken. (2,11)	A (High quality) B (High quality)	Clinical records

For neonatal unit and hospital		
8. A unit guideline for screening, documentation, prevention, and treatment for VAP is available and regularly updated. (2,5,11,12,15,16,18,24–32)	A (Moderate quality) B (High quality)	Guideline
9. A unit guideline including criteria for intubation and extubation, and intubation procedures is available. (2,11,16,35)	A (High quality) B (High quality)	Guideline
10. Training on screening, documentation, treatment and prevention for neonatal VAP is ensured. (31,32)	A (High quality) B (High quality)	Training documentation
For health service		
11. The frequency of neonatal VAP is monitored between neonatal services using a common definition and expressed as infections per 1000 ventilator-days.	B (Moderate quality)	Audit report

Where to go – further development of care

Further development	**Grading of evidence**
For parents and family	
N/A	
For healthcare professionals	
N/A	
For neonatal unit	
• Develop checklists for monitoring care of intubated patients.	B (Moderate quality)
For hospital	
N/A	
For health service	
• Refine and implement VAP care bundles. (11,16)	A (Moderate quality)
• Develop a European definition of VAP for newborn infants.	B (High quality)

Getting started

Initial steps
For parents and family
• Parents are verbally informed and educated by healthcare professionals about hand hygiene, nosocomial infections, and intubation.
For healthcare professionals
• Attend training on screening, documentation, and treatment for VAP. • Develop strategies for non-invasive ventilation when appropriate.
For neonatal unit and hospital
• Develop and implement a unit guideline on screening, documentation, prevention, and treatment for VAP. • Develop information material on VAP and prevention using proper hand hygiene for parents. • Support healthcare professionals to participate in training on screening, documentation, and treatment for VAP. • Develop written protocols for ventilator care and audit compliance. • Document and monitor the frequency of VAP.
For health service
• Develop a national guideline for screening, documentation, prevention, and treatment for VAP.

Description

A care bundle for the prevention of VAP includes:

- A clear pragmatic definition of neonatal VAP.
- A unit specific guideline covering ventilation strategy aimed at the use of ventilation strategies to minimise duration of endotracheal intubation.
- Development of objective criteria for intubation and extubation and use non-invasive respiratory support whenever possible.
- A daily assessment of readiness for extubation to be recorded in the clinical record.
- Careful attention to hand hygiene before and after contact with the infant for oral care and handling respiratory equipment and supplies.
- Procedures for minimising contamination of endotracheal tubes during insertion.
- Adoption of full sterile precautions for suctioning.
- Use of closed endotracheal suction devices.
- Regular oropharyngeal suction before ET manipulation, changing infant position, extubation and reintubation.
- Head of bed elevated at least 30°.
- Oral care provided 3-4 hourly.
- Minimisation of ventilator circuit changes (e.g. only on visible soiling, malfunction).
- Regular audits of adherence to the protocol.
- Monitoring and reporting the occurrence of VAP (rate per 1000 ventilator days).
- Regular training sessions for staff on prevention of VAP care bundle.

Source

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Safe equipment use

Härtel C, Tissières P, Helder O, Mader S, Trips T

Target group
Infants and parents

User group
Healthcare professionals, neonatal units, hospitals, and health services

Statement of standard
Safe use of equipment in neonatal care is ensured using standardised operating procedures and systematic monitoring and reporting of incidents.

Rationale
The goal is to assure safe equipment use in the complex environment of neonatal intensive care units (NICU). It is important to understand factors that contribute to failures in patient safety. (1–4) In NICUs a large variety of different technological devices is used, and their inappropriate use may lead to unplanned, critical events. Despite built-in safety systems, the occurrence of device related errors and their consequences for patient outcomes are still not well-defined. (1–12) In a recent prospective study using random safety audits, the rate of appropriate use of NICU equipment was only 34%, while critical incidents were reported in 2.3%. (13) Besides individual human aspects (inexperience, fatigue (14)), system factors (e.g. staffing, crowding, team process, complexity of clinical workload, obsolete equipment) play an important role for the risk of adverse events.(4) Adverse events occur at 74 events/100 infants in NICUs, e.g. hospital-acquired infections, dislocation of catheters and accidental extubations. (15) Considering the high rate of short term morbidity and long-term complications of extreme prematurity and the potential impact of equipment use, a patient safety culture is essential in the NICU environment and should be embedded in the organisation's efforts to enhance resilience and to assure patient- and family-satisfaction. (15–19)

Benefits

Short-term benefits
- Better informed parents on the benefits and risks of the use of equipment (consensus)
- Facilitated systematic reporting of inappropriate equipment use (1,4,19)

Long-term benefits
- Reduced morbidities as a consequence of inappropriate exposure to medical equipment (consensus)
- Improved healthcare professional training and understanding of the use of health technologies (1)
- Improved care by implementation of a "safety culture" (transparency, disclosure, feedback) (6,19) (see TEG Patient safety & hygiene practice)

Components of the standard

Component	Grading of evidence	Indicator of meeting the standard
For parents and family		
1. Parents are informed by healthcare professionals about equipment used. (1,3,6)	A (Moderate quality) B (High quality)	Patient information sheet
2. In situations where parents will use and interpret information from medical equipment and their possible side effects they are educated and updated regularly by healthcare professionals in its use. (16)	A (High quality) B (High quality)	Training documentation
3. Appropriate equipment use is included in discharge planning (see TEG Follow-up & continuing care and TEG Infant- and family-centred developmental care).	B (Moderate quality)	Guideline
For healthcare professionals		
4. A guideline for all intensive care equipment including checklists for development, implementation and regular updates is adhered to by all healthcare professionals.	A (High quality) B (High quality)	Guideline
5. Training on reporting and learning from adverse events and inappropriate use of equipment is attended by all responsible healthcare professionals. (1,6,19)	A (Moderate quality) B (High quality)	Training documentation
For neonatal unit and or hospital		
6. A guideline for all intensive care equipment including checklists for development, implementation is available and regularly updated.	B (High quality)	Guideline
7. Training on reporting and learning from adverse events and inappropriate use of equipment is ensured to optimise the use of equipment, including simulation of clinical team working. (20)	A (Moderate quality) B (High quality)	Training documentation
8. Equipment maintenance is specified and audited regularly. (7)	A (Moderate quality)	Audit report

9. Adverse events and inappropriate use of equipment are audited and feedback is given on a regular basis. (19)	A (Moderate quality) B (Moderate quality)	Audit report
For health service		
10. Local safety investigations are collated nationally, monitored and reported. (3,6,19,21)	B (Moderate quality)	Audit report

Where to go – further development of care

Further development	**Grading of evidence**
For parents and family	
• Parents are involved in the design and delivery of education about medical equipment.	B (Moderate quality)
For healthcare professionals	
• Healthcare professionals are involved in the design and delivery of education about medical equipment.	B (Moderate quality)
For neonatal unit	
• Develop a structure of critical incident root-cause analysis and feedback and communicate learning. (22)	A (Moderate quality)
For hospital	
• Provide dedicated medical technical support for neonatal equipment.	B (Moderate quality)
For health service	
• Develop a national network for benchmarking of safe equipment use including parent organisations, healthcare providers, industry, and other stakeholders.	B (Moderate quality)

Getting started

Initial steps
For parents and family
• Parents are verbally informed by healthcare professionals about safe equipment use.
For healthcare professionals
• Attend training on reporting and learning from adverse events and inappropriate use of equipment. • Report critical incidences.
For neonatal unit
• Develop and implement a guideline for all intensive care equipment including checklists for development, implementation and regular updates. • Develop information material on safe equipment use for parents. • Implement a formal system to record errors/adverse events.

For hospital

- Support healthcare professionals to participate in training on safe equipment use.
- Provide time and resources for effective safety management and support.

For health service

- Develop service wide sharing of information on equipment use.

Source

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Vascular access

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Target group
Infants and parents

User group
Healthcare professionals, neonatal units, hospitals, and health services

Statement of standard
Vascular access is achieved in a competent, skillful and safe manner.

Rationale
Intravenous (IV) cannulation is among the most common and widespread medical procedures performed on critically ill infants in the NICU. (1) Treatment frequently depends on the use of peripheral or central vascular access devices (VADs) to administer fluids, nutrients, and medication. (2–4) There are several types of VADs, which are inserted into either a vein or an artery. Factors such as body weight, fluid characteristics, availability of venous access sites, and anticipated length of access needed are taken into account when siting a VAD. The frequency of complications, including infiltration/extravasation, leaking, occlusion, thrombosis, and infections, has remained relatively constant over the past 30 years. (5–15)

Benefits

Short-term benefits
- Reduced number of skin breaking and painful procedures (16,17)
- Reduced occurrence of complications e.g. infections (18)

Long-term benefits
- Reduced late consequences of early exposure to antibiotics (consensus)
- Reduced risk of long-term consequences of painful procedures for infants and parents (19)

Components of the standard

Component	Grading of evidence	Indicator of meeting the standard
For parents and family		
1. Parents are informed by healthcare professionals about the need and procedure for achieving vascular access.	B (High quality)	Patient information sheet

2. Parents are encouraged and guided to comfort the infant if feasible by healthcare professionals. (20) (see TEG Care procedures)	B (High quality)	Patient information sheet
For healthcare professionals		
3. A unit guideline on the aseptic insertion and maintenance of vascular access devices (VADs) is adhered to by all healthcare professionals. (21)	A (High quality) B (High quality)	Guideline
4. The necessity for ongoing vascular access is identified.	B (High quality)	Guideline
5. The procedure is approached in a developmentally supportive manner using (none)-pharmacological pain relieving treatment. (10,22–26) (see TEG Infant-and family-centred developmental care)	A (Moderate quality) B (Moderate quality)	Guideline
6. Training on the insertion of VADs is attended by all responsible healthcare professionals.	B (High quality)	Training documentation
For neonatal unit		
7. A unit guideline on the aseptic insertion and maintenance of VADs is available and regularly updated.	B (High quality)	Guideline
For hospital		
8. Training on the aseptic insertion of VADs is ensured.	B (High quality)	Training documentation
9. Equipment to administer and monitor infusion therapy is suitable for a neonatal population.	B (High quality)	Audit report
For health service		
10. A national guideline on the aseptic insertion and maintenance of VADs is available and regularly updated.	B (High quality)	Guideline

Where to go – further development of care

Further development	**Grading of evidence**
For parents and family	
N/A	
For healthcare professionals	
N/A	
For neonatal unit and hospital	
• Optimise the use of specially trained vascular access professionals.	A (Low quality) B (Moderate quality)
For health service	
• Develop a European Vascular Access Certification programme for all healthcare professionals in the field.	B (Moderate quality)

Getting started

Initial steps
For parents and family
• Parents are verbally informed by healthcare professionals about the need and procedure for achieving vascular access. • If present, parents are invited to support their infant before, during and after the insertion of vascular access devices (VADs).
For healthcare professionals
• Attend training on the aseptic insertion and maintenance of VADs.
For neonatal unit
• Develop and implement a unit guideline on the aseptic insertion and maintenance of VADs. • Provide a flow chart that guarantees most appropriate Vascular Access Device to meet each infant's current and anticipated needs. (23) • Provide a vascular visualisation devise for vascular assessment and insertion support if required. • Conduct data collection and compliance monitoring. • Develop information material for parents on the need and procedure for achieving vascular access. (10,24,25)
For hospital
• Support healthcare professionals to participate in training on peripheral and central venous/arterial access. • Provide a vascular visualisation device for vascular assessment and insertion support if required.
For health service
• Develop and implement a national guideline on the aseptic insertion and maintenance of VADs including indication for insertion, type of device, access visualisation, and management of access and complications.

Source

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