East Midlands
Neonatal Operational Delivery Network

NETWORK GUIDELINE

Guideline:	**Necrotising Enterocolitis Care Bundle**
Version:	**1**
Date:	**April 2022**
Review Date:	**April 2024**
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Distribution:	**Neonatal Units within EMNODN**
Risk Managed:	**Guide good practice to improve outcomes for babies and families who are cared for in neonatal units in the regional and share experiences with other regions in the UK and other countries**

This document is a guideline. Its interpretation and application remains the responsibility of the individual clinician, particularly in view of its applicability across the different Trusts in the East Midlands Neonatal Operational Delivery Network. Please also consult any local policy/guideline document where appropriate and if in doubt contact a senior colleague.

Caution is advised when using guidelines after a review date.

REVIEW AND AMENDMENT LOG

Version	Type of Change	Date	Description of Change
1	-	27 April 2022	New

Contents

What is Necrotising Enterocolitis (NEC)?

Necrotising enterocolitis (NEC) is a serious inflammatory disease of the gut in newborn babies. It usually affects the immature gut in babies who are born early or preterm (i.e., before 37 completed weeks of gestation). Some babies who are born at full term but have other illnesses such as hypoxic ischaemic encephalopathy, cyanotic congenital heart disease can also get NEC.

NEC occurs in 5-6% of babies born at <32 weeks' gestation. Being small at birth also increases the risk of NEC. It is estimated that nearly 12% of infants born at <1500 g will develop NEC and 30% of these will die. Mortality is higher with severe disease: a large UK study revealed that 46.5% of the <32 weeks' gestational age babies who developed severe NEC died[1]. Survivors have increased risk of adverse neurodevelopmental outcome including an increased risk of cerebral palsy and cognitive impairment[2].

[1] Battersby et al., 'Incidence and Enteral Feed Antecedents of Severe Neonatal Necrotising Enterocolitis across Neonatal Networks in England, 2012-13'.
[2] Adams-Chapman, 'Necrotizing Enterocolitis and Neurodevelopmental Outcome'.

What is a care bundle?

A care bundle is a set of evidence-based interventions that is put together for a defined patient population and care setting that, when implemented together, will result in significantly better outcomes than when implemented individually.

This approach was developed by the Institute of Healthcare Development (IHI), Cambridge, Massachusetts in 2001[3]. The goal is to pull together a short list of interventions that are already recommended and accepted in practice as being good clinical care for most of the patients in the population that it targets. Therefore, the intent is not to create a comprehensive guideline, include elements that vary in their applicability to individual patients, or aim to create or test new or controversial interventions. The basic care bundle design guidelines as recommended by the IHI are given in Table 1.

Table 1. Institute of Healthcare Development guidelines on designing care bundles

Bundle Design Guidelines (recommendation of the Institute of Healthcare Development[4])
The bundle has three to five interventions (elements), with strong clinician agreement.
Each bundle element is relatively independent.
The bundle is used with a defined patient population in one location.
The multidisciplinary care team develops the bundle.
Bundle elements should be descriptive rather than prescriptive, to allow for local customization and appropriate clinical judgment.
Compliance with bundles is measured using all-or-none measurement, with a goal of 95 percent or greater.

Why do we need care bundles?

Research studies find the best ways to improve healthcare. Despite the best research evidence showing that healthcare can be improved with some interventions, real patient outcomes will improve only if those findings can be implemented in the right patients (

Figure 1). Care bundles are used in healthcare to enable implementation of evidence-based interventions. They challenge the assumption that evidence-based care is already being delivered and promote awareness that the entire team must work together in a system that is designed to look at all aspects of patient care in together. As they are not prescriptive, they promote the use of innovations where each team can consider local factors and adapt the bundle recommendations with the aim to improve care and reduce harm through improving the reliability of the local processes. Teams then test the impact and conduct iterative evaluations (such as Plan-Do-Study-Act cycles) to produce improved outcomes.

[3] Resar et al., 'Using Care Bundles to Improve Health Care Quality'.
[4] Resar et al.

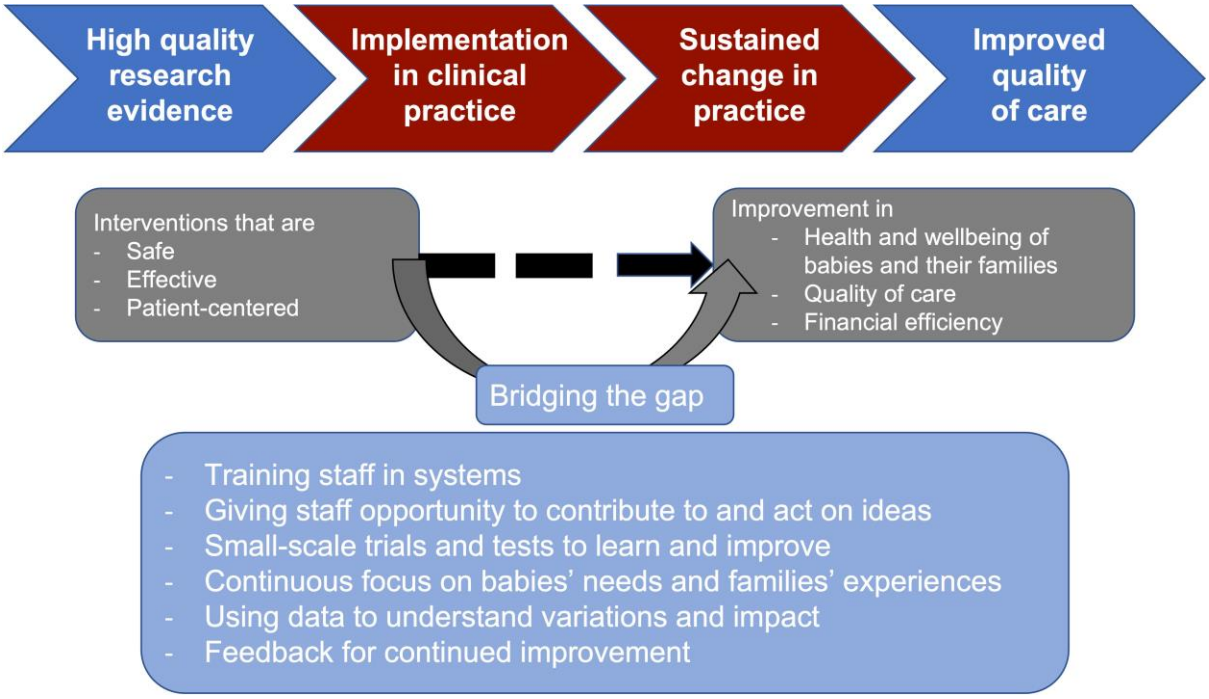


Figure 1. From research to improved quality of care

Who are the East Midlands Neonatal Operational Delivery Network?

The East Midlands Neonatal Operational Delivery Network (EMNODN) (***https://www.emnodn.nhs.uk***) is one of the 11 clinically managed Operational Delivery Networks (ODN) for neonatal services in England. ODNs were formed, in 2003, by the Department of Health, to ensure that babies and their families receive high quality care that is equitable and accessible to all.

The EMNODN has two hubs (North, led by Nottingham; and South, led by Leicester) and includes 11 neonatal units (Figure 2).

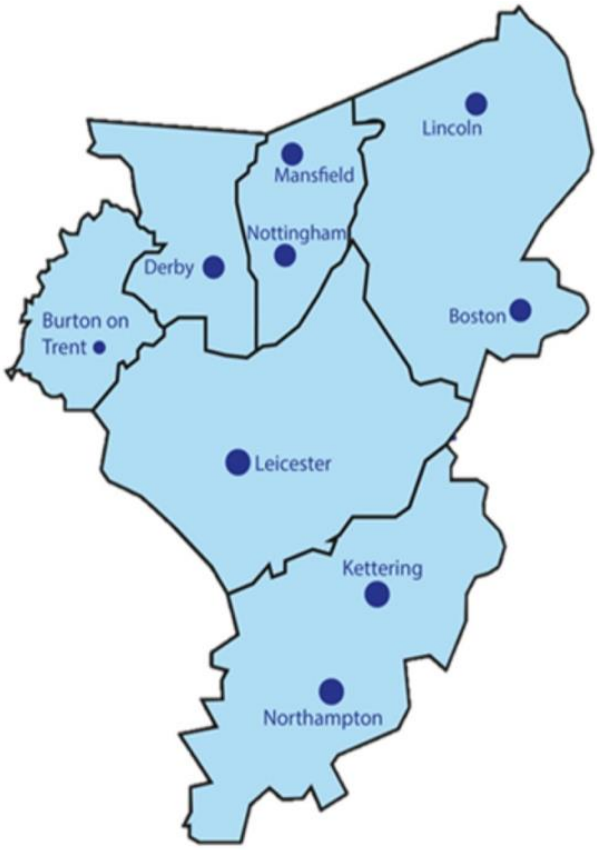


Figure 2. The East Midlands Neonatal Operational Delivery Network

Why is a NEC care bundle needed in the EMNODN?

In the UK, NEC rates are audited by the National Neonatal Audit Programme (NNAP). The NNAP is a national audit run by the Royal College of Paediatrics and Child Health, commissioned by the Healthcare Quality Improvement Partnership (***https://nnap.rcpch.ac.uk***). Despite continued efforts to improve care of preterm babies, NEC rates remain high. According to the NNAP report, in 2019, 5.5% of babies born at <32 weeks who survived to 48 hours had NEC.

In addition, NNAP reports show that the rates of NEC vary more than two-fold between neonatal networks. These differences are unlikely to be fully explained by differences in case mix. The rate of NEC in the EMNODN has remained above the national average since 2017 (when this measure was added to NNAP) and there are wide variabilities between the local units (Figure 3).

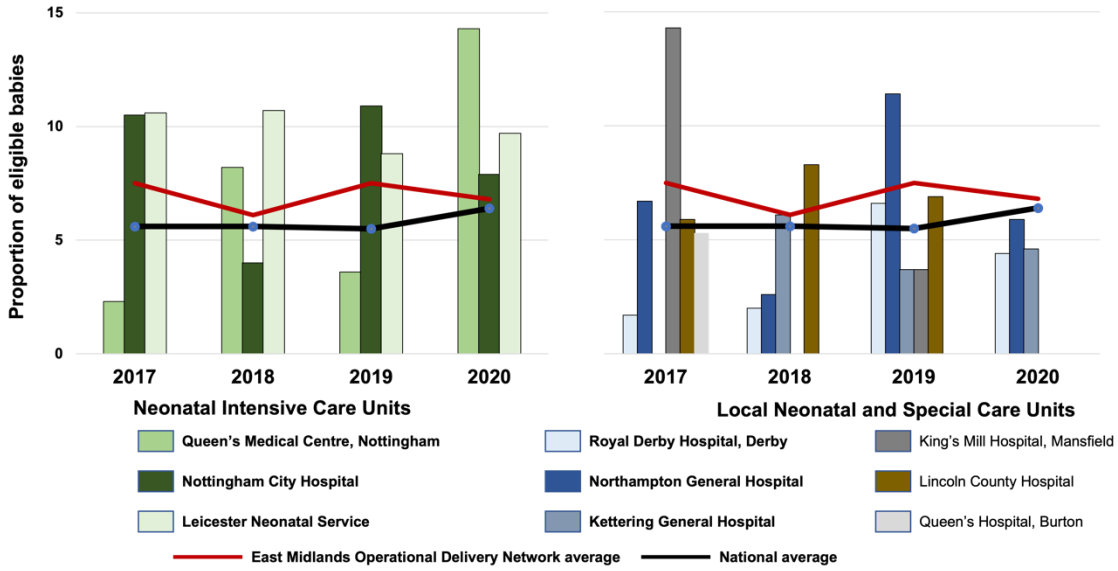


Figure 3. Proportion of babies admitted to an NNAP participating unit (born at <32 weeks GA and survived 48 hours) with NEC (2017-2019)

Given the high and variable rates of NEC in our region, extra local efforts and monitoring are required to ensure that services are geared to implement interventions that could reduce the risk of NEC, families receive adequate support to optimise infant feeding and the aim of reducing NEC rates are achieved.

An overview of the NEC care bundle

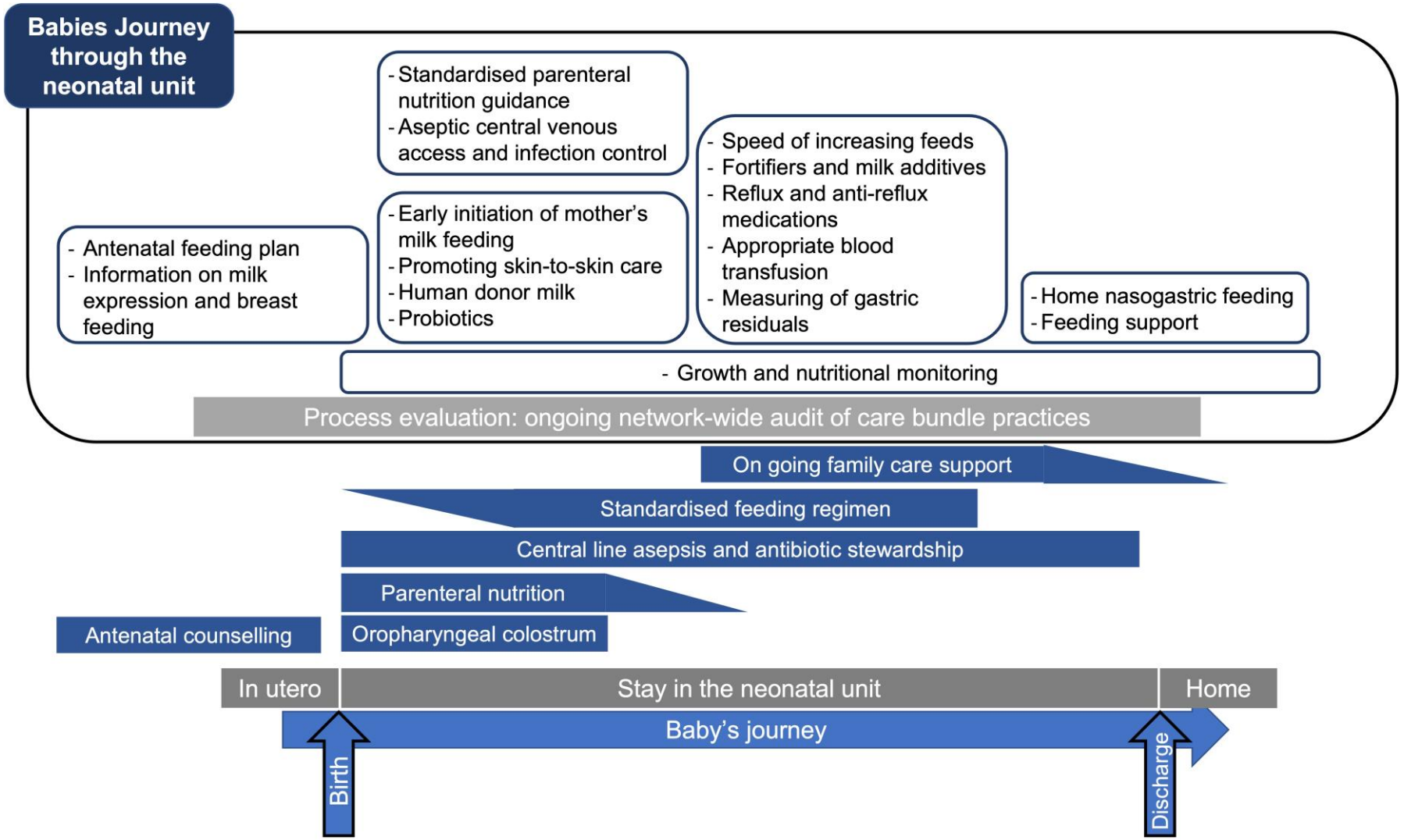


Figure 4. An overview of babies' journeys through neonatal care and opportunities to reduce risk of NEC

Current guidelines and facilities in EMNODN neonatal units

We collected information from the neonatal units in the EMNODN to find out how the units support appropriate feeding and reducing the risk of NEC.

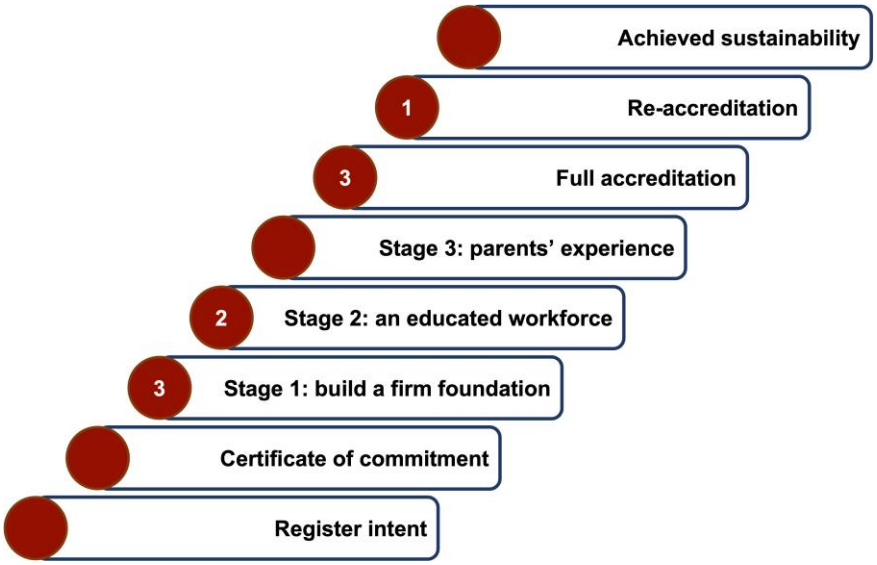


Figure 5. Journey to becoming "baby-friendly"
(numbers show the number of units that have achieved the level of accreditation)

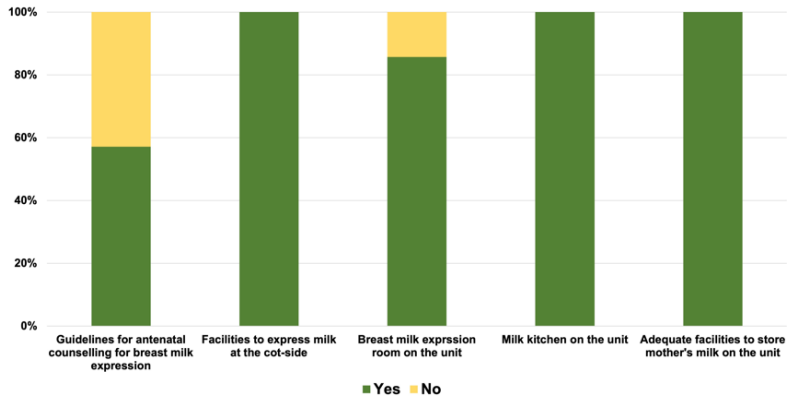
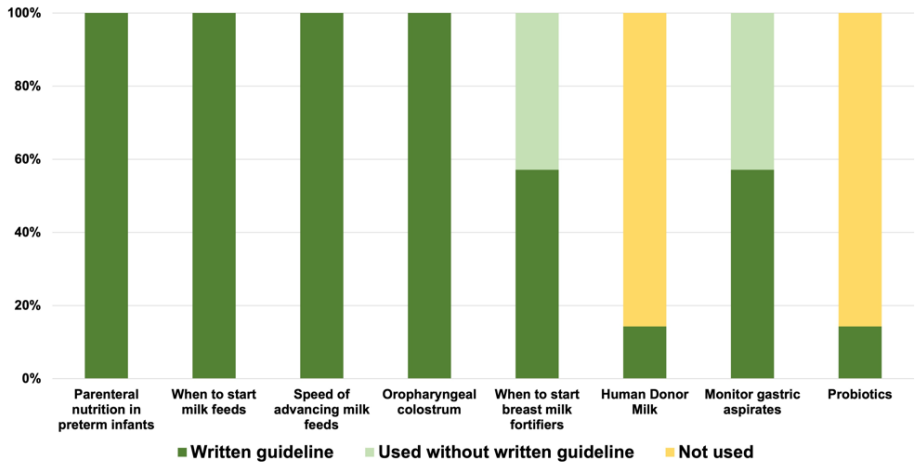


Figure 6. Facilities to support mothers' expressing breast milk

Figure 7. Do units in the EMONDN have guidelines for interventions that support preterm nutrition and may reduce the risk of NEC in preterm infants



Defining Necrotising Enterocolitis

The first classification criteria of NEC were proposed by Bell in 1978 and later modified (modified Bell staging) in 1986. Bell developed these criteria to stage the severity of NEC after a baby was diagnosed with NEC but they are frequently used for establishing diagnosis. Recently its use has been questioned due to lack of sensitivity and/or specificity of its components and the inclusion of spontaneous intestinal perforation. Several different diagnostic definitions have been proposed and are in use.[5] UK studies have reported NEC prevalence based on very restrictive definitions[6] as NEC confirmed by laparotomy, histology, or autopsy, or, if no tissue evidence was available, the reported primary cause of death on the death certificate. Infants with a diagnosis of SIP at the time of laparotomy were excluded. Less stringent criteria are used in clinical practice.

Reporting NEC to the NNAP

A major challenge in measuring and reporting rates of NEC is the lack of validated data on how many babies had NEC.

The NNAP reports NEC in babies born at less than 32 weeks' gestation who survive for at least 48 hours after birth if they meet the NNAP surveillance definition for NEC on one or more occasions. It recommends using a combination of clinical and radiological features and if at least one of each is present, the baby is said to have a NEC (Table 2). This information is entered in the "Discharge Detail" form that appears on the babies' electronic patient records on Badger.net. In 2019, 65% of the neonatal units included in NNAP provided assurance of the accuracy of their data for NEC. The lack of reliable data entry and inability to assure accuracy of data that feeds in to NNAP makes regional and national comparisons unreliable. An essential part of any quality improvement effort that could impact NEC rates is to ensure that neonatal units ensure accurate recording of NEC diagnoses.

Table 2. NEC in NNAP

Population included	– Babies who experienced their final neonatal discharge in the calendar year of analysis. – Babies born at less than 32 weeks gestational age and survived to at least 48 hours after birth	
Criteria for diagnosis	NEC may be diagnosed at surgery, post-mortem or based on the following clinical and radiographic signs:	
	Clinical feature	Bilious gastric aspirate or emesis
		Abdominal distention
		Occult or gross blood in stool (no fissure)
	Radiographic feature	Pneumatosis
		Hepato-biliary gas
		Pneumoperitoneum
	Exclude	Spontaneous intestinal perforation
Attribution	– to their location of care at 48 hours of life – if in transit – attributed to the transferring hospital – if multiple admission locations at 48 hours – attributed to the earliest associated admission time	
Data source	Field "Was NEC diagnosed during this admission?" on the *Discharge details* form	

[5] Patel et al., 'Defining Necrotizing Enterocolitis'.
[6] Battersby et al., 'Incidence and Enteral Feed Antecedents of Severe Neonatal Necrotising Enterocolitis across Neonatal Networks in England, 2012-13'.

What do we want to achieve with the EMNDON NEC care bundle?

Aim

The aim of the EMNODN NEC care bundle is to reduce the incidence of NEC in the East Midlands.

To achieve this aim, the components of the care bundle will be implemented across all eleven neonatal units in the East Midlands.

The care bundle aims to achieve this aim by focusing on two components of neonatal care that could impact risk of NEC in preterm infants

1. Promotion of own mother's milk feeding
2. Optimal delivery of parenteral and enteral nutrition

Promotion of own mother's milk feeding

Why do we need to focus on own mother's milk feeding?

Feeding preterm babies' own mother's milk reduces the risk of NEC, improves growth and gives babies the best chance to achieve optimal long term neurodevelopmental, and metabolic outcomes.

According to the NNAP, the proportion of babies born in the East Midlands who receive any own mother's milk discharge remains below the national average and is not improving (Figure 8).

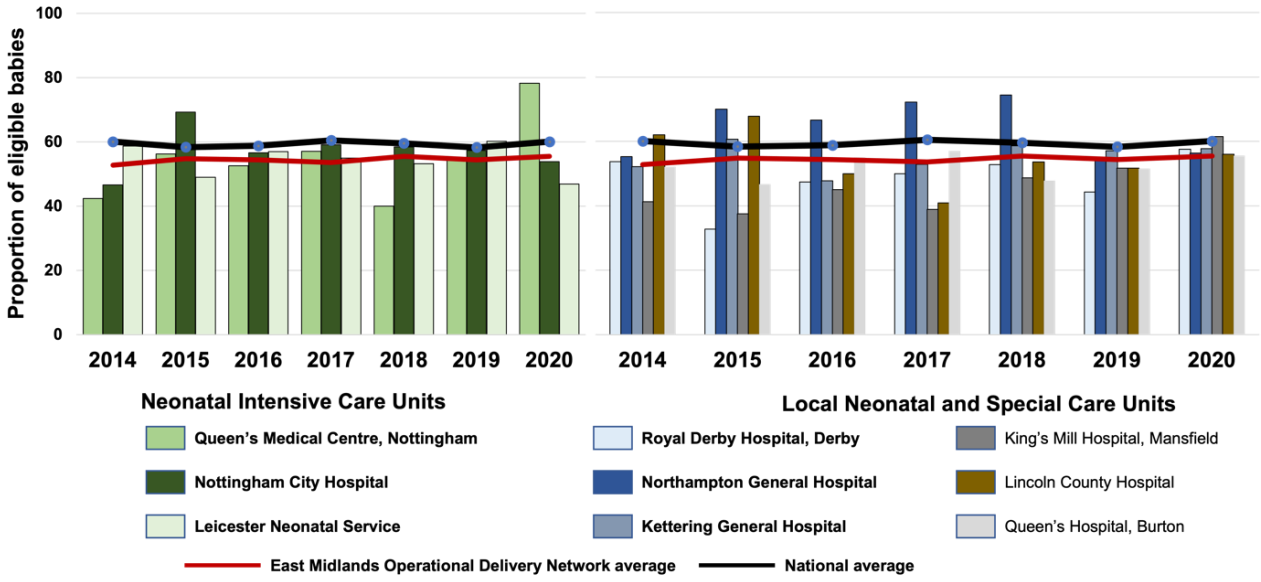


Figure 8. Proportion of babies admitted to an NNAP participating unit (born at <33 weeks GA, received care in one neonatal unit, and survived to discharge) who received any breast milk at discharge

Supporting own mother's milk feeding

Objectives	Recommendations
To inform all mothers about the benefits of own mother's milk feeding in preterm babies	Breast feeding leaflets should be available and given to all mothers
	Early expression of breast milk and its benefits should be discussed with mothers at the antenatal and first postnatal consultation
Support ongoing own mother's milk feeding on the neonatal unit	Own mother's breast feeding (or breast milk feeding) and milk expression should be discussed on daily parent updates and on ward rounds
	Adequate facilities (colostrum packs, breast pumps, breast milk pumping space) should be available on the neonatal unit and be accessible to all mothers

Optimal delivery of parenteral and enteral nutrition

Objectives	Recommendations
Optimise delivery of parenteral nutrition to all eligible infants	All infants born at ≤30 weeks' gestation should have parenteral nutrition as soon after birth as possible, 8 hours at the latest
	Preterm infants born at >30 weeks' gestation should have parenteral nutrition if sufficient progress is not made with enteral feeding in the first 72 hours after birth
	All infants who are unlikely to establish sufficient milk feeding (e.g., gut disorder or critical illness) should have parenteral nutrition
Administer oro-pharyngeal colostrum	All preterm infants should receive oropharyngeal colostrum within 48 hours of birth
	All preterm infants should receive oropharyngeal colostrum for at least 5 days after birth
Promotion of skin-to-skin care	All parents should have the opportunity to have skin-to-skin care with their baby
	Adequate cot-side facilities should be available for skin-to-skin care
Optimise delivery of enteral (milk) feeds	All infants should be started on milk feeds with own mother's milk within 48 hours of birth
	All units should have standardised guidance on speed of increasing milk feeds
Support establishing breastfeeding	All infants and mothers must be supported to establish breastfeeding prior to discharge
	Adequate cot-side and rooming-in facilities should be available to support a breastfeeding mother

Other interventions and practices that may support own mother's milk feeding, enhance nutrition, and prevent risk of NEC

Breast milk fortifiers

Own mothers' breast milk may not provide sufficient nutrients to meet the high demands of the rapidly growing preterm infant. Multi-nutrient human milk fortifiers can be added to meet these demands[7].

[7] Arslanoglu et al., 'Fortification of Human Milk for Preterm Infants'.

Preterm infants fed fortified breast milk put on weight and grow in length and head size more quickly than those not receiving fortifiers without an increase in the risk of NEC[8]. Effects of feeding fortified milk on long term outcomes such as growth and development in later childhood are not known.

Current evidence does not support the use of human-milk derived fortifiers: when compared to fortifiers made from cow's milk, there is insufficient evidence to conclude that there is any benefit including no reduction in risk of NEC[9].

Use of human donor milk

Where sufficient volumes of own mother's milk is not available, preterm infants may require supplementation. This can be achieved with specialised preterm formula milk or human donor milk. Feeding with human donor milk compared with specialised preterm formula can reduce the risk of NEC[10]. However, infants fed preterm formula have increased rates of weight gain, linear growth, and head growth when compared to those fed human donor milk[11].

Some units in the EMNODN, offer supplementation with human donor milk.

Probiotics

Combining studies that used different probiotics shows that in giving very preterm and very low birth weight infants probiotic supplements may reduce the risk of NEC and reduce the risk of death and serious infections[12].

Probiotic formulations may be given to infants <32 weeks' gestation and <1500 g at birth. The formulation must be handled and administered with strict adherence to aseptic non-touch techniques and local blood culture results must be closely monitored for positive results for the bacteria contained in the probiotic formulation.

Some units do not use probiotic formulations due to lack of evidence to support which formulation to use.

Measuring gastric residuals

Routine measurement of gastric residuals hinders advancement of enteral feeds but is often used to ensure early indicators of NEC are not missed. There is insufficient evidence to determine whether routine gastric residual measurements reduce the incidence of NEC[13].

Practice among EMNODN neonatal units varies; some routinely measure gastric residuals while other do not.

Enteral feeding during blood transfusion

Effects of feeding an infant during a packed red cell transfusion are currently unclear[14] and practice varies between neonatal units and among clinicians.

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[8] Brown et al., 'Multi-Nutrient Fortification of Human Milk for Preterm Infants'.
[9] Premkumar, Pammi, and Suresh, 'Human Milk-Derived Fortifier versus Bovine Milk-Derived Fortifier for Prevention of Mortality and Morbidity in Preterm Neonates'.
[10] Quigley, Embleton, and McGuire, 'Formula versus Donor Breast Milk for Feeding Preterm or Low Birth Weight Infants'.
[11] Quigley, Embleton, and McGuire.
[12] Sharif et al., 'Probiotics to Prevent Necrotising Enterocolitis in Very Preterm or Very Low Birth Weight Infants'.
[13] Abiramalatha, Thanigainathan, and Ninan, 'Routine Monitoring of Gastric Residual for Prevention of Necrotising Enterocolitis in Preterm Infants'.
[14] Yeo et al., 'Stopping Enteral Feeds for Prevention of Transfusion-Associated Necrotising Enterocolitis in Preterm Infants'.

Summary of recommendations

1. All units should work towards achieving sustainability with full baby-friendly accreditation.

2. All units should have written policy for supporting own mother's milk feeding and providing optimal nutrition to preterm infants, including guidelines for

    a) Antenatal and postnatal support for mothers to express breast milk
    b) Promotion of skin-to-skin care
    c) Administration of oropharyngeal colostrum
    d) Early and optimal administration of parenteral nutrition
    e) Starting and advancing enteral (milk) feeds
    f) Supporting mothers to establish breastfeeding prior to discharge

3. All units should have adequate facilities for breast milk expression, storage, and preparation.

4. All units should have updated policies on other interventions that may support provision of optimal nutrition and/or impact the risk of NEC.

5. All units must ensure accurate recording of NEC in electronic patient records and ensure data entry for cases of NEC in to NNAP are validated.