FRAME WORK FOR PRACTICE:

Holistic feeding and nutritional management for the near term/term neonate, following bowel surgery.

JUNE 2024

NATIONAL NEONATAL SURGICAL Interest Group

Endorsed by the NEONATAL NURSES ASSOCIATION

Endorsed by British Association of Perinatal Medicine

Endorsed by BRITISH ASSOCIATION OF PAEDIATRIC SURGEONS 1953

FRAMEWORK WORKING GROUP

NAMES	ORGANISATION	ROLE
Fiona Metcalfe	Leeds / NNSIG	Lead nurse, Chair NNSIG
Karen King	Cambridge University Hospitals	Advanced Neonatal dietitian / Lead Dietitian
Moriam Mustapha	London Neonatal ODN	Neonatal Network Dietitian / BAPM link
Vicki Thomas	Leeds	SLT / Lead SLT
Sarah Pedlow	Belfast trust	Paediatric nutrition Pharmacist
Ambereen Iqbal	GOSH	CNS- Neonatal Nutrition outreach
Anne Marie Masna	St George's Hospital	Nurse/ANP
Billie Large	Norfolk and Norwich	Neonatal surgical nurse specialist
Collette Donnelly	Belfast	ANNP
Chris Forster	Leeds	Neonatologist, nutrition lead
Hannah Day	GOSH	Dietitian
Jane Shaw	Sheffield	SLT
Janine Dolan	Belfast	Dietitian
Jessica Murray- Wicks	Chelsea and Westminster Hospital	Dietitian
Julia Falkner	Somerset	Dietitian, TOFS, EATS, Parent
Julia Olpin	Sheffield Children's Hospital	Nurse
Karen Hayes		
Kate Arnold	Kings College Hospital	Dietician
Kate Jones	KSS ODN & Brighton	Speech and language therapist, International Board-Certified Lactation Consultant (IBCLC)
Katie Green	Sheffield Children's Hospital	Dietitian
Katy Parnell	Birmingham women's and children's Hospital	Speech and language therapist
Kelly Watson	GOSH	Dietitian
Kirsty Krawczyk	Sheffield Children's Hospital	SLT
Kirsty O'Connor	GOSH	Speech and language therapist, IBCLC
Laura McDowell	Leeds	Dietitian

NAMES	ORGANISATION	ROLE
Liz Stoneman	GOSH	CNS nutrition (outreach)
Louise Harris	Cambridge University Hospitals	BFI lead, Nurse
Lynette Forsyte	Manchester/NWNODN	Dietitian
Maya Asir	Evelina Children's Hospital	SLT
Majella Moonhan	Belfast	Pharmacist
Moriam Mustapha	London Neonatal ODN	Neonatal Network Dietitian / BAPM link
Natalia Iglesias	Leeds	Advanced clinical pharmacist- paed/neonatal nutrition
Nicky Sedgwick	Sheffield	SLT
Nigel Hall	Southampton	Paediatric/Neonatal surgeon
Nikki Lyttle	Belfast	Dietitian
Penny Heap	Manchester	Neonatal surgical Nurse specialist
Rachael Rodley	Sheffield	Dietitian
Rosa Holden	Sheffield Children's hospital	SaLT
Ruth Paterson	Belfast	Parent representative
Stuart Paterson	Belfast	Parent representative
Sara Clarke	West Midlands ODN	Dietitian / Chair NDiG
Sarah Pedlow	Belfast	Nutritional Pharmacist
Sian Simpson	Sheffield	SLT
Sophie Woolger		Neonatal Nurse
Stephen Caldwell	Leicester	Colorectal Nurse, PSNG
Susie Harms	Leeds	Infant feeding advisor
Susie Regan	GOSH	Neonatal surgical nutrition CNS
Taylor Sturman	Sheffield	Nurse educator
Vici Thomas	Leeds	Highly specialised SLT
Zoe Gordon	Oxford	SLT- OA special interest

TABLE OF CONTENTS

Framework disclaimer: *This framework is designed to be used in conjunction with local policies and decision making as part of MDT input from the local clinical teams and AHPs. Advice and recommendations for nutritional care, needs to be considerate of the individual infant's history, clinical picture, parental and MDT agreement.*

SCOPE OF THIS FRAMEWORK

This framework for practice, covers the nutritional and feeding management specifically for the infant that is born term or near term i.e. ≥ 34 weeks gestation and required abdominal surgery for a congenital bowel abnormality or acquired problem e.g. necrotising enterocolitis (NEC), perforation, gastroschisis, exomphalos duodenal atresia, anorectal malformation, Hirschsprung's disease, meconium ileus, malrotation and volvulus.

- **We are NOT including the management for premature infants < 34 weeks gestation.**
- **We are NOT including the management of the extreme preterm infant needing abdominal surgery for NEC.**
- **Ex premature babies are included for ongoing nutritional care, if the surgical issue occurs once > 34 weeks CGA or they are now over > 34 weeks corrected gestational age (CGA) e.g., NEC, stricture following NEC needing surgery.**

There will be cross over to the nutritional management of the premature infant < 34 weeks, but some elements will not be included here. A multidisciplinary approach to care with families is paramount and will be considered throughout this document.

Specific nutritional management for extreme preterm infants and ex preterm infants < 34 weeks CGA, should be aligned with local preterm nutritional guidance with advice from local surgeons, parenteral nutrition/nutrition pharmacist and dietitian on nutritional care planning. It is important to have a personalised approach to nutritional care planning with the MDT and family.

The framework is for reference for tertiary centres and DGH neonatal or paediatric settings that care for surgical neonates up to 60 weeks post conception age – as per neonatal surgery service specification.

AIMS AND OBJECTIVES

AIM

- To develop a national framework for best practice, for the nutritional and feeding management of surgical neonates, using evidence base along with historical good practice. The framework is a collaboration with MDT input, FICare and developmental care best practice.
- To influence consistent national care standards for nutritional and feeding management.

OBJECTIVES

- To offer support and guidance on milk choice, feeding regimen, assessment of feed tolerance and managing fluid input and output for infants with abdominal surgical conditions.
- To support and provide guidance for introducingand sustaining a safe, positive journey to oral feeding.

BACKGROUND

There is currently no national framework for feeding and nutritional care of the surgical neonate. Practices can vary across different centres, between surgeons, neonatal or paediatric teams.

This framework has been produced to be adapted for use by centres caring for the surgical neonate.

A national expert, working group was established to review best practice. This collaboration has been co-produced and was represented by the national neonatal surgical interest group (NNSIG) - neonatal and surgical nurses and AHPs, the neonatal dietitian interest group (NDiG), Speech & Language Therapist interest group (RCSLT Neonatal CEN), pharmacists, neonatologists, paediatric surgeons, parents, infant feeding advisors, and neonatal nutrition Clinical Nurse Specialists (CNS).

This framework supports the recommendation that early intervention and an MDT approach is required to support the complex feeding needs of these infants (1–3).

Nutrition and growth have a profound impact on the quality of outcomes following neonatal surgery, particularly abdominal surgery. Breast milk is considered the best form of nutrition for infants.

Every effort should be made to actively support a parent to express and provide breast milk and breastfeed the surgical neonate. Operative stress, sepsis, prematurity, and co-morbidity can influence metabolism for these infants. Outcomes have improved with the use of parenteral nutrition.

For infants who experience gastrointestinal complications and require care on the neonatal unit, the feeding journey is likely be more challenging, with barriers to a positive, safe, nutritional and pain free feeding experience (1,4–8).

These infants are at higher risk of poor oral feeding outcomes due to the consequences and management of their gastrointestinal complication, e.g. history of vomiting, jejunal feeding, delays in achieving feeding milestones, prolonged periods of being nil orally, being on PN, delayed or interrupted initiation of oral feeding, prolonged period of bowel rest, pain and discomfort when feeding and multifactorial/multisystemic involvement resulting in disruption to typical feeding patterns and swallow function.

Please see Appendices 1, 2, 3 for further details and evidence of oral feeding support and outcomes.

PARENTS AS PARTNERS IN CARE

Parents are the primary care provider for their child and therefore should be facilitated to collaborate with the clinical team to deliver as much cot-side care as is feasible, depending on their baby's need and their family circumstances (9).

'Family Integrated Care (FICare) is a model of neonatal care which promotes a culture of partnership between families and staff; enabling and empowering parents to become confident, knowledgeable, and independent primary caregivers' (10).

Parents providing consistent care during critical periods of early life, benefits the neurodevelopment of the baby, promotes long-term quality of life and parental empowerment and wellbeing. This can result in better bonding, increased breastfeeding rates, and reduced parental stress, all of which have long-term benefits for babies and families. Family integrated care results in improved communication and improved infection control rates.

Parental feeding intention should be agreed with parents and supported wherever possible. The loss of breastmilk/ breastfeeding experience not only impacts the well documented benefits for the infant, but can lead to significant parental grief, frustration, and increased rates of postpartum depression(11,12).

Support for all infants and their families should happen within the context of key quality improvement drivers in neonatal care, e.g. FiCare and developmental care frameworks, the UNICEF BFI standards and Bliss Baby Charter in the context of trauma informed care.

PARENTAL RECOMMENDATION IN RELATION TO NUTRITIONAL CARE

Feeding is a lifelong skill and essential for future development, social inclusion, positive experience. Food brings joy, community connections

Continuity of care was poor due to change over of surgeons causing gaps in care and progress. This was even more of an issue on the paediatric ward.

..disconnect about what was a priority for surgeons and parents from nutritional point

- Integrated support for mothers from maternity, neonates, paediatric wards and on-going to the community
- Parents involved in decision making and nutritional care planning.
- Make every effort to keep mother and baby together
- Breast feeding/expressing support essential throughout journey to include neonates and transition to paediatric wards. Involve parents in tracking/logging EBM supply with team.
- Ensure excellent nutrition and hydration provision, particularly for breast milk feeding mothers.
- Discharge/repatriation planning should be discussed from day 1.
- Develop a discharge criterion between MDT and parents to help manage expectations. Interim plans and goals are also helpful.
- Any parental training should be started asap.
- Proactively share details of the MDT involved in nutrition support with the family and ensure parents are involved in MDT discussions and updates- e.g. dietitian, speech therapist, specialist nutrition team, PN pharmacist, neonatologist, paediatric surgeon, infant feeding advisor, psychologist.
- A holistic, integrated approach to nutritional care is important.
- Need for excellent communication with parents/carers- Consider MDT meetings for long term infants or complex patients to include partners/fathers. Consider times outside working hours to facilitate involvement. Families have individual needs(9).
- Psychological support is important.
- Fathers/partners can be involved more if we proactively consider innovative and flexible models for communication.

HOLISTIC APPROACH TO INFANT FEEDING

Infants who experience gastrointestinal complications and require care in the neonatal unit, the feeding journey is likely to be more challenging, with barriers to a positive, safe, nutritional and pain free feeding experience (1,4–8).

Studies recommend early intervention, and an MDT approach is required to support the complex feeding needs of these infants. Approaches that involve parents to make informed decisions through the provision of timely information and education, and respect parental feeding intentions and hopes, working together to problem solve barriers to this where possible, should be promoted.

When the infant is ready for sucking feeds post-operatively, teams should be mindful of other non-surgical comorbidities e.g. neurological impairment, prematurity, respiratory needs that impact significantly on infant feeding readiness and outcomes, to communicate realistic feeding expectations and plans to families. Early positive oral experiences reduce negative and aversive feeding behaviours developing later in the oral feeding journey.

PARENTERAL NUTRITION (PN) USE AND CONSIDERATIONS IN SURGICAL INFANTS

PN is often required by infants who undergo surgery while in the neonatal unit. NICE 2020 (13) guidance gives recommendations for surgical infants on the commencement of PN:

- Preterm or term infants who are unlikely to establish sufficient enteral feeding, for example babies with a congenital gut disorder or critical illness such as sepsis.
- Where enteral feeds have been stopped and it is unlikely that they will restart within 72 hours, 48 hours for premature infants.
- Where enteral feeds have been stopped for more than 48 hours (24 hours in preterm infants) and there is unlikely to be sufficient progress with enteral feeding within a further 48 hours.

Once the decision has been made to start PN it should commence as soon as possible and within 8 hours at the latest.

Special consideration should be given in critically unwell and post-surgical infants to start at the lower range of requirements and build up in a stepwise approach with close monitoring of biochemical tolerance of macronutrients (14). Follow local neonatal PN guidance for use and ongoing management.

PN should be given in adherence to the NICE guidance(13). Infants on longer term PN are at risk of developing intestinal failure associated liver disease (IFALD). Infants may benefit from these PN strategies:

- The use of composite lipid emulsion (13,15).
- Cycling of PN (16).
  This may only be possible when the infant has reached a certain weight or feed volume which can support their blood sugars during the period when the PN is off.
- Careful consideration to not overfeed with respect to lipid and carbohydrate composition.

BUCCAL COLOSTRUM

Buccal colostrum administration should be offered to all surgical neonates in the first hours of life, unless specifically contraindicated or as recommended by surgeon/ SALT advice. (17,18).

Aim to use only fresh colostrum as opposed to frozen colostrum. It can be administered into the mouth on the inside of both cheeks. 0.2ml administered over 1-2 minutes via a syringe or as part of mouth care. Do not use a gloved finger or gauze or via NGT. Can be repeated every 2-3 hours. When on more enteral feeds, give buccal colostrum orally then remaining feed NG if not feeding orally.

For babies diagnosed antenatally, this is an opportunity to provide antenatal counselling to support information sharing with parents and promote early expression to get colostrum postnatally or even antenatally.

Collection packs/kits need to be provided antenatally or immediately postnatally. Parents should be supported with early expressing to establish milk supply and administration of colostrum.

Buccal colostrum administration should be a standard of care for all surgical neonates even if 'Nil orally'.

Benefits of buccal colostrum:

- Providing early colostrum boost infants growth and development.
- Early expression and production of break milk reduces length of stay for breastfed infants.
- Colostrum protects infants from birth by providing concentrated nutrients and antibodies to fight infection-immune boost with 'liquid gold'.
- It strengthens an infant's immune system, establishing a healthy gut with the protection from building healthy microbiomes. Colostrum coats the intestine preventing harmful bacteria being absorbed (translocation of bacteria).
- Protects against NEC.

ASPIRATES AND STARTING ENTERAL FEEDS

Babies with surgical problems either from birth or acquired later in life, will have very individual challenges regarding commencing and advancing enteral feeds.

High volume aspirates are common following gastrointestinal surgery. Feeds will not be started until these have reduced in terms of volume and depth of colour – in general as tolerance improves, aspirates volume reduces and becomes clear. Surgeons will advise on this depending on the infant's condition and underlying condition. E.g., may consider starting feeds once gastric aspirates are < 30ml/kg/day and are becoming less bilious or clear in colour.

Nevertheless, early trophic feeding is beneficial. Support with expressing breast milk is essential at this time. Direct breast feeding should be considered and promoted early.

- Infants should be nil by mouth (NBM) and nil enterally for a minimal period of time in the post-operative period.
- During the NBM period it is safe for infants to be allowed to have buccal colostrum or mouth care with maternal breast milk (MBM) (19).
- Early expressing of breast milk should be supported, at least within 2 hours of birth (19).
- Early parental contact and skin to skin needs to be facilitated.
- Early enteral feeding is the most important strategy for the gastro-intestinal tract as it promotes motility, prevents atrophy, and supports the microbiome. It is also vital in preventing and limiting the development of IFALD.
- Due to the negative short- and long-term outcomes for infants with gastrointestinal complications, it is essential that positive feeding experiences, both non-oral and oral, are proactively supported in the early stages of the babies feeding journey, e.g. when the baby is on PN or having tube feeds. This is necessary to maximise feeding potential and to minimise adverse and negative feeding and neurodevelopmental outcomes.
- The decision to start feeds is an MDT decision. Liaising with an infant feeding advisor to support early expressing and breastfeeding is important.
- Regular communication and participation in decision making should occur with parents.
- "Oral/suck feeding is the preferred method of feeding where possible. An earlier introduction to oral feeds aims to reduce the risk of oral aversion and feeding difficulties developing Where oral feeds are introduced these should be cue-based and infant-led to promote the development of effective and typical neural pathways (Shonoff et al, 2000).

- In cases where surgical or feeding teams have a clear rationale to limit oral intake to a few mils only, opportunities for positioning practice at the breast and positive oral-sensory learning for the infant may be started by offering an expressed breast. When the infant is medically stable and there is no evidence-based rationale to limit breastmilk from a surgical or swallow perspective, a baby may be offered the breast without needing to express first.

Examples of these pre-oral feeding strategies:

- skin to skin
- mouth care, ideally with EBM.
- Opportunities for non-nutritive sucking- dummy/ finger/expressed breast
- Opportunities for dips/tastes of milk (as appropriate for infant)

- If it is not appropriate to introduce oral feeding, pre-oral feeding strategies above can be implemented that promote positive oral experience.
- It is also vital to maintain hygiene and minimise damage to the lips and skin of babies who are not receiving oral/suck feeds. This can be achieved through frequent/regular mouth care using expressed breast milk or sterile water.
- Early positive oral experiences reduce negative and aversive feeding behaviours developing later in the oral feeding journey. Please see Infographic Table in Appendix 2 for good practice pre-oral and oral feeding strategies for the surgical neonate.
- Referral to the speech and language therapy service should take place, should the infant and family require individualised support around pre-oral feeding skills, support with introduction of oral feeds or support with establishing oral feeds.

ADVANCEMENT OF ENTERAL FEEDS

'Trophic feeds' is poorly quantified in the literature, and ranges from 10-30ml/kg/day.

The decision about timing and volume of feeds is made in joint discussion with the MDT - neonatal, surgical team, dietitian, pharmacist, and parents. Feeds should be advanced according to standardised local guidance which supports decision making and practise across the local unit.

Feeds can be advanced in a stepwise manner using the suggested criteria below:

- Stoma losses within agreed threshold levels (20-30mls/ kg/day). This needs to be considered in relation to full enteral feeding.
- Stool losses <6-8 dirty nappies per day
- No skin excoriation around stoma site or the peri-anal area
- Appropriate weight gain
- Absence of clinical signs of dehydration e.g. urea and sodium within normal range
- Absence of vomiting

Feeds are included in the fluid volume once tolerating 20-40 ml/kg/day. From this point PN can be started to be weaned down against the increasing feeds alongside careful monitoring of growth.

Some infants will reach enteral autonomy at the first time of advancing feeds e.g. malrotation, duodenal atresia repair. While those infants with high stoma's, short bowel syndrome or dysmotility e.g. complex gastroschisis, are likely to reach a threshold level where feeds are unable to advance any further.

These infants will need to maintain a proportion of enteral and parenteral feeding to support growth. Feeds should always be challenged where able to optimise the functionality of the gut.

An MDT nutritional plan should occur to ensure consistent plans are in place and can be communicated to staff and parents. Titrations may be better to happen very slowly in some infants where tolerance is an issue e.g. only change 1-2 times per week .

NUTRITIONAL MANAGEMENTAND FEEDING

Choice of milk and feeding regimen - maternal feeding intention (e.g. breastfeeding, breastmilk via bottle, bottle feeding) should always be clarified and not assumed.

Use of EBM (Expressed Breast Milk):

- EBM is the preferred choice of milk for term and preterm infants and should be recommended.
- EBM contains growth factors, immunoglobulins, oligosaccharides, glutamine, and other components that promote bowel adaptation, digestion, and absorption post-surgery (20–24).
- Additional long-term benefits of EBM post stoma closure
- Standard term formulas contain whole protein which may be superior in stimulating adaptation however also contain lactose which may be poorly tolerated due to the loss of carbohydrate digestive enzymes and can be associated with osmotic diarrhoea, therefore may not be well tolerated post stoma formation (25).
- Specialist formulas may be recommended if poor tolerance to EBM/term formula.
- It is not advisable to offer water or oral rehydration solutions as first feeds.

Use of Donor human milk (DHM) with surgical infants if:

- If mother's own expressed breast milk is unavailable or insufficient to meet requirements, DHM may be considered as the milk of choice to establish full enteral feeds for the infant (26).

Consider use of DHM for surgical neonate if:

- Previous confirmed NEC.
- May be used as trophic feeds, caution regarding nutritional adequacy.
- DHM is used temporarily and ideally continued until mom's own milk is fully available. Discuss with dietitian if neither is available.
- Post medically or surgically managed NEC if EBM milk is not available.
- Infant with gastroschisis.
- Post-operative infants.
- Parental consent is required. As part of the consent process, parents should be counselled regarding the differences between. DHM and formula when compared to EBM, including benefits, risks and ongoing uncertainties.

There is insufficient evidence to make specific recommendations about duration of DBM use, fortification of DHM and use of DHM in moderate/late preterm and term babies' (26).

Infants who are on DHM may be transitioned to formula/ specialised formula. This should be done gradually over a number of days in small increments, as per local guidance and local MDT decision.

If mother's own expressed breast milk is unavailable or insufficient to meet requirements, DHM may be considered as the milk of choice to establish full enteral feeds for infant. Human milk fortifier (HMF) and use in infants with stomas:

- HMF is not contraindicated in infants who have a stoma although the underlying diagnosis and volume of stoma output should be considered before starting. Fortification, in some instances, can increase stoma output.

Recommend:

- Start slow introduction of breast milk fortifier with a slow increase
- Consider ½ strength for 24-48 hours and increase to full strength if no increase in stoma losses.
- Low threshold for reducing or stopping HMF if stoma output increases significantly or gastric tolerance is compromised. Discuss with clinical and dietetic teams.

EBM to hydrolysed formula to amino acid formulas

Specialist formulas may be recommended to improve absorption and can be adjusted to improve nutritional intake for growth. These should only be used and advised by the dietitian.

- Hydrolysed feeds are used if whole protein feeds are not tolerated.
- Medium chain triglyceride (MCT) based feeds may be beneficial in cases of ileal resection resulting in the inability to absorb bile acids. MCTs are water soluble and do not require bile acids for digestion. A combination of MCT and long chain triglyceride (LCT) is favourable because LCTs stimulate intestinal adaptation (27–29).
- Amino acid infant formulas are used if hydrolysed feeds are not tolerated. See table 1.
- Any change in type of milk should be graded gradually e.g. ¼ increments 24-48 hourly to prevent an increase in stoma losses and no other feed changes such as volumes/frequency, should be made at the same time.
- Formula concentration can be increased gradually as required to improve nutrient provision, monitoring for signs of increase in stoma losses.

PROBIOTICS

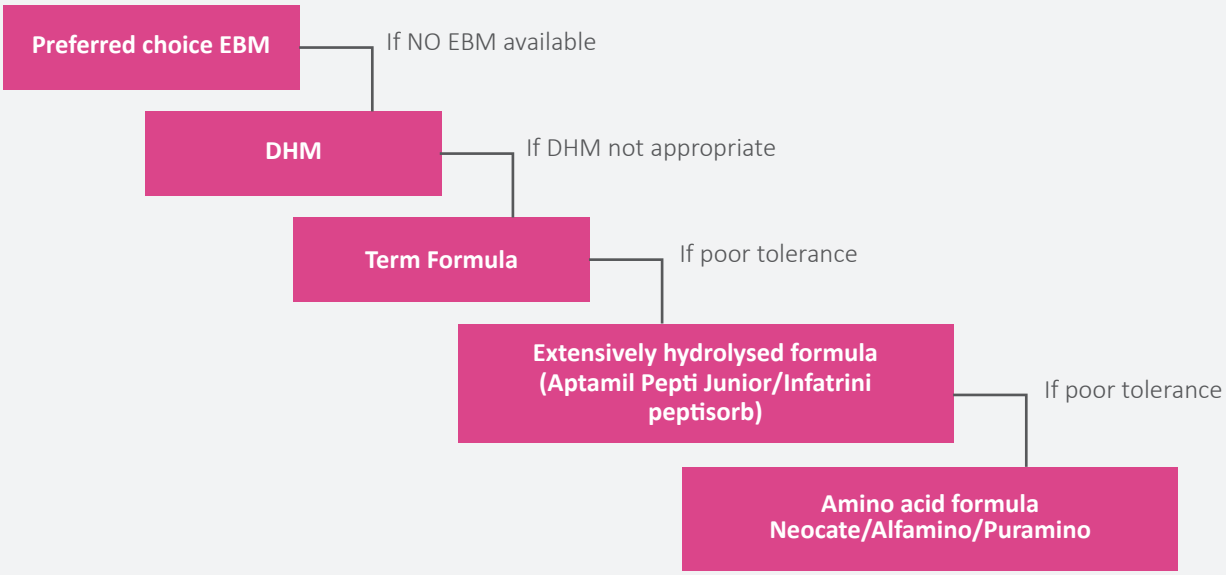
The use of probiotics in preterm neonates is well documented and recommended (30). There is however little evidence or recommendations on probiotic use in the near term/term neonate requiring abdominal surgery.

There is only one small RCT looking at probiotic use in neonates > 35weeks gestation following abdominal surgery (31) – they found that probiotic use had no effect to sepsis rates, time to receiving feeds, mortality but did increase 'good' bacteria in gut. However, the clinical implications are unknown. Larger RCTs are needed. Probiotic use is therefore not a routine recommended practice at this point.

Table 1: Pros & cons of specialist term infant formulas

	PROS	CONS
Extensively hydrolysed formulas with additional MCT (e.g. Aptamil Pepti Jr. Infatrini Peptisorb)	• Hydrolysed protein to support absorption • High MCT to support digestion • Low osmolarity to support improved gut absorption • Infatrini Peptisorb	• Term formula – will not meet preterm requirements • Will require additional vitamins and minerals
Amino acid based formulas (e.g. Neocate LCP, Puramino, Alfamino)	• Amino acid formula may improve absorption	• Term formula – will not meet preterm requirements • Will require additional vitamins and minerals • High osmolarity may worsen absorption

Choice of milk post stoma formation



SUPPLEMENTATION OF VITAMINS AND MINERALS IN MID TO LATE PRETERM POST BOWEL RESECTION

Babies with intestinal failure are at greater risk of micronutrient deficiencies due to bowel resections. Length of time on P.N, area of bowel resected, loss of Ileo-caecal valve and malabsorption issues all impact on micronutrient deficiencies (32). Those with less than 50 % expected bowel length are at increased risk of micronutrient deficiencies (32).

Infants will usually receive their full macro- and micronutrients while on full parenteral support, but during the transition to enteral nutrition and once receiving full enteral nutrition, patients must receive and absorb adequate micronutrients enterally to avoid deficiency (33). During the transition period and once on full enteral nutrition if not supplemented, the prevalence of micronutrient deficiencies can be high, with the most common deficiencies found in fat soluble vitamins (A, D, E, K), iron, copper, selenium, and zinc (33).

The ileum is the main site of absorption of bile salts, vitamin B12, electrolytes and fluid. Sufficient bile acids are needed for fat and fat-soluble vitamin absorption and therefore

significant ileal resection and resection of the ileocecal valve may result in fat soluble vitamin and vitamin B12 deficiencies (32). Nutritional requirements for late and moderately late preterm infants for vitamins and trace elements are likely to be higher than for term infants however exacts requirements are unknown (27). Adequate vitamin and mineral supplementation and regular biochemical monitoring is therefore essential. It is recommended that trace elements, fat soluble vitamins and minerals are checked for babies that have been on PN > 28 days (13), and then checked monthly. However please follow local guidance. A baseline trace element at 21 days with 6 monthly repeats to monitor for deficiencies is recommended.

Specific micronutrients of note for surgical preterm are:

ZINC

Babies who have a stoma with high losses after NEC are more likely to be zinc deficient (1). It is suggested to check trace elements at day twenty-one and if low to supplement with 2mg/kg/day zinc for 4 weeks. Zinc deficiency can result in growth faltering and in more extreme cases acrodermatitis (34)

COPPER

Exclusive jejunal feeds have been associated with copper deficiency; it is recommended to check trace elements including copper on commencing jejunal feeds and 6 monthly thereafter (35–38). Copper deficiency is reported to cause anaemia, neutropenia and hypotonia; with early detection, and treatment, secondary complications can be prevented (39). To correct low levels Paediatric Seravit, given via the enteral route, is first choice, if this is not possible then intravenous Peditrace will be required to correct the deficiency. Copper should not be supplemented in the first 3 weeks of life.

IRON

Mid to late preterm infants are at risk of iron deficiency which can impact on their neurodevelopment. It is recommended they receive supplementation of 2-3 mg/kg/day of iron if less than 2000g at birth and supplemented with 1-2 mg/kg/day of iron if less than 2500g at birth (27).

FEED DELIVERY OPTIONS FOR THE SURGICAL NEONATE

Naso-gastric (NG) feeding

Enteral feeding is essential for early nutrition in preterm infants. NG feeding is extensively used on neonatal units to provide a safe method for feeding. Follow local trust guidance on NG feeding.

Naso-jejunal (NJ) feeding

Follow local guidance and recommendations for use of NJ feeding for neonatal infants. Contraindications include necrotising enterocolitis, intestinal perforation/obstruction, and mechanical/paralytic ileus. NJ use may be beneficial for infants with gastroesophageal reflux disease (40) and its use as trans-anastomotic tube (TAT) for babies post duodenal atresia repair can help reduce time on PN and quicker establishment of enteral feeding (41).

Gastrostomy feeding

Gastrostomy feeding is used for infants with long gap OA/TOF who cannot have a TAT tube placed.

Continuous vs. bolus feeding

Bolus feeds promote cyclical release of gastrointestinal tract hormones to stimulate gut maturation and motility. Systematic reviews show longer time to reach full enteral feeds with continuous versus bolus administration (1). Standardised feeding protocols for medically managed neonates in the UK usually recommend two to three hourly bolus feed administration (frequency dependent on weight/gestation).

Post gastrointestinal surgery, bolus feeds are usually the first line approach to commencing enteral feeds. Bolus feeds are preferred because they are more effective at stimulating gallbladder contraction thereby reducing the risk of biliary sludge accumulation which is a contributing factor to the development of intestinal failure associated liver disease (IFALD) (42).

Continuous feeds may be used in the following circumstances: severe reflux, respiratory compromise with bolus feeds and occasionally in patients with rapid bowel transit time to enhance absorptive capacity.

If continuous feeds are commenced these should ideally be given alongside small bolus feeds to allow for the development and/or preservation of oral feeding skills.

EBM and fat adherence to tubing

It should be noted that fat from expressed human milk can adhere to the plastic tubing of the bottles and giving sets required for continuous feed administration (43). Some centres choose to use enteral syringe drivers with the tip of the syringe angled upwards to ensure that the baby receives fat first.

Units using enteral feeding pumps and giving sets should be aware of potential fat loss (implications for energy intake 50% of energy in human milk is from fat), essential fatty acids and fat-soluble vitamins. Bolus administration of EBM is preferred.

NUTRITIONAL ASSESSMENT & MONITORING

Table 2: Monitoring parameters & frequency

FREQUENCY	PARAMETER
Daily	• Stoma output • Stooling • Gastric aspirates • Gastric losses
Daily (if on PN until stable) then once/twice weekly	• Body weight • Serum urea & electrolytes • Serum glucose • Serum phosphate • Serum magnesium
Weekly	• Body length • Head circumference • Serum conjugated bilirubin • Serum bone profile • Serum liver profile • Urine sodium
Monthly	• Serum zinc • Serum copper • Serum selenium • Serum ferritin

Gastric aspirates/residuals

Feed intolerance has been determined in many ways but there is no clear evidence that NG aspirates are a reliable measure. We do not routinely aspirate non-surgical babies' stomach to establish gastric residuals. For babies who are not nil by mouth, NG tubes should only be minimally aspirated to confirm position as per nursing protocol. For surgical neonates, gastric aspirates are measured pre and post operatively to collate volumes for fluid replacement, assessment of bile-colour and volume and for signs of reduction of daily gastric volumes e.g. in gastroschisis, duodenal atresia etc. A reduction in gastric daily volumes demonstrates improved tolerance and absorption.

- All babies should be monitored for feed intolerance and any baby showing signs of feed intolerance must be assessed.

- Gastric losses, for a baby nil enterally, may require ml-for-ml intravenous replacement to prevent dehydration and electrolyte disturbances.

Signs of feed intolerance include:

- Cardiovascular compromise – especially episodes of desaturation/bradycardia post feed.
- Vomiting after feeds – make note of colour, quantity, and frequency of vomiting.
- Abdominal distension and tenderness.
- Loose stools/diarrhoea, excessive stoma output- >20-30ml/kg/day (as per surgeon advice).

Anthropometry measurements

- Body weight monitoring is important for tracking growth and can also help with monitoring fluid balance and hydration.
- Daily weights may be warranted post-op for fluid management until stability is achieved, then reverting to local unit guidelines for weight monitoring (e.g. twice weekly).
- Length monitoring is reflective of skeletal and lean growth. Measurements once weekly are recommended (1).
- Head circumference is reflective of brain growth and has been shown to predict motor development and IQ outcomes (44,45). Measurements once weekly are recommended.

Biochemistry

- Serum biochemistry- see table 2.
- Urine sodium can be considered a more sensitive marker of total body sodium stores and has been shown to positively correlate with weight gain (46,47).
- Once or twice weekly spot sampling of urine sodium is recommended, and enteral or parenteral sodium supplementation is usually warranted if levels are below 20-30 mmol/L, particularly when growth is compromised (48,49).

- Gastric losses may require ml-for-ml intravenous replacement to prevent dehydration and electrolyte disturbances.

Stoma output / stooling

- In the absence of stoma recycling/refeeding, jejunal/high ileal stoma output exceeding 20 ml/kg/day (5ml/kg every 6 hours) may require intravenous replacement in the interim, and multidisciplinary review to help manage the excessive losses (see “Managing stoma output” section).
- Lower ileal/colonic stomas may be given a higher threshold (e.g. 30ml/kg/day) for intravenous replacement by the surgical team- this will vary on a case-by-case basis as it will also depend upon the underlying pathology affecting the infant.
- The use of loperamide may be considered to manage excess stoma losses. However, there are times when there is not enough bowel available for optimum absorption i.e. a very high jejunostomy or ileostomy. In this case enteral feeds may need to be paused at a set volume and the remaining nutritional requirements should be given via parenteral nutrition/lipids. This requires an MDT discussion and plan between clinicians, dietitian, and pharmacist.
- All stools must be recorded on daily nursing charts and details of consistency, colour and volume stated. These will be used as a basis for decision making for the following day’s feed progression. Monitor for more than 6 stools a day and for excoriated perineum with poor weight gain. These may be signs of excess stooling and will need alternate measures in discussion with the surgical and neonatal team.
- **For Stool output measurement - see Appendix 4**

STOMA REFEEDING

Stoma re-feeding/re-cycling is a practice used in some neonatal surgical centres. Stoma re-cycling in infants is simply the collection of stool from the proximal stoma (ileostomy / colostomy) and feeding the stool, via a tube, down the distal stoma as a continuous infusion or sometimes as a bolus infusion. The procedure will not be covered in this framework. It should only be performed in tertiary surgical centres where there is agreed clinical guidance, education and follow up plans.

There is evidence that demonstrates a number of benefits for stoma re-feeding and it has been shown to be a safe procedure. Please follow local guidelines and paediatric surgeons' advice for conducting this procedure. There are contraindications to be considered and there can also be adverse reactions (50).

Benefits of stoma re-feeding:

- Stoma re-feeding improves absorption of nutrients.
- Increases weight gain.
- Protects the liver by reducing need for or amount of PN.
- Help maintain healthy distal bowel (non-function end of bowel leading to babies' bottom).
- Help maintain good fluid balance.
- Improves maturity, adaptation, and size of distal bowel – this prepares bowel for successful joining together at a later date.
- Oral milk feeds can be introduced or increased.

MEDICINE MANAGEMENT

Formulation choice

When choosing an oral liquid formulation for a child the excipient content, the cumulative daily excipient intake from all medicines taken, and the potential for adverse effects due to excipients should be carefully considered (51).

NB: Sorbitol containing liquid medicines can cause increased stool or stoma losses due to osmotic diarrhoea, which can be particularly problematic in surgical infants.

Vitamin D

All term infants receiving less than 500ml infant formula, infants born weighing less than 2kg and infants born at less than 34 weeks gestation should receive supplementation to provide 400 IU vitamin D daily until 6-12 months of age. Vitamin D should be monitored monthly in those at risk of deficiency and maintained above 50 nmol/L and up to 120 nmol/L in preterm infants (1).

Sodium Chloride & Urine sodium

Deficits of sodium can result in growth impairment. Sodium depletion is common in infants undergoing intestinal surgery, even when the colon is in continuity. Infants with a stoma or where losses are >20ml/kg are at particular risk of depletion. Sodium depletion may become severe even when presenting with a normal serum sodium as well as an apparent normal fluid balance. Urine sodium is a better marker of total body sodium levels than serum sodium, due to homeostatic mechanisms, and should be monitored on a weekly basis and corrected to >30mmol/L.

BNFc gives recommendations for dosage started at 1-2mmol/kg/day in 3-4 divided doses.

Where an unlicensed sodium chloride liquid medicine is prescribed, the recommended standardised concentration is 5mmol/ml. Licenced concentration is 1mmol/ml (51).

Urine sodium levels should be monitored at least weekly while an inpatient. The urine sample is non-sterile and sent in a clear bottle to the biochemistry lab for urine analysis (46,49). Community testing of urine electrolytes is uncommon so clear information and instructions should be sent to the GP on discharge. Advice notes for GP on prescribing and monitoring is important to ensure compliance with treatment and reduce risk of unnecessary blood testing.

Loperamide

As feed volume increases in a baby with high volume stoma losses, loperamide can be considered to reduce intestinal transit time. BNFc gives recommendations for dosage.

- Doses should be given 30 minutes before feeds where possible.
- Changes in loperamide dose may take up to 3 days to result in altered stool volumes. Changes in loperamide dose take time to reduce stoma volumes, therefore dosage should be reviewed no more than twice weekly. Where stoma losses remain excessive on review, it is recommended that total daily dose of loperamide should be increased as per table 3 .

- Where stoma losses remain excessive the total daily dose can be increased according to BNFc recommendations. Review of enteral feed volumes should also be considered.
- Following stoma closure loperamide can be discontinued; however, if significant losses continue with enteral feeding after stoma closure, then re-introduction of loperamide can be considered.
- Loperamide Syrup, sugar-free, 1 mg/5 mL (Imodium®) should be avoided in the neonatal period as the synthetic sugar content may paradoxically increase output. To administer loperamide the content of 1 x 2mg capsule should be dispersed in 2mL of water to create a 1mg/mL suspension, the required dose should be drawn up and the remaining liquid discarded.
- Loperamide should be commenced at 100microgram/kg QDS where possible each dose should be given 30 minutes before feeds (52).
- Loperamide should be used with caution in severe hepatic impairment.

Loperamide dosing

DAILY LOPERAMIDE DOSE	QDS LOPERAMIDE DOSE
STEP 1: 400 micrograms/kg/day STEP 2: 1000 micrograms/kg/day STEP 3: 1600 micrograms/kg/day	• 100 micrograms/kg/dose • 250micrograms/kg/dose • 400 micrograms/kg/dose

The maximum dose of loperamide recommended in the BNFc for children aged 1 month to 1year is 2mg/kg/day (500microgram/kg/dose QDS). It is not recommended to exceed this dose (52).

GUIDANCE FOR DISCHARGE/TRANSFER/ REPATRIATION TO PAEDIATRIC WARD, LOCAL UNIT OR HOME

BLISS, the premature and sick baby charity offers a useful resource for preparing families for discharge from the neonatal unit on all aspects of care (54).

One in ten babies on neonatal units require at least one transfer. Please refer to the BAPM framework for safe and effective repatriation infants, for best practice guidance. https://www.bapm.org/resources/safe-and-effective-repatriation-of-infants

This nutrition and feeding framework transfer guidance should be used in parallel with these recommendations for babies that may need repatriation closer to home following surgery.

Follow the principles in the toolkit for high-quality neonatal services regarding discharge home following surgery:

- Parents should be involved in multidisciplinary discharge planning from the point of admission and plans should be continually reviewed.
- Families should have appropriate information and training before being discharged home. This should be started as soon as possible on the ward.
- Information and discussion should be given to parents/caregivers about potential problems: bowel obstruction caused by adhesions, poor weight gain, feeding issues, reflux, diarrhoea, or constipation.
- Information on who/how to contact in case of suspected problems. Being provided with a single point of contact from specialist centre MDT, e.g., clinical nurse specialist for consistent communication, access to information.
- The baby and family should have their ongoing needs at home coordinated and met by health professionals to provide care and support in the community, e.g., members of the centre's MDT/CNS, surgical outreach CNS.
- Centres should identify parental anxiety/mental health concerns related to child's health/development, and signpost for appropriate support.

REFERENCES

1. Embleton ND, Moltu SJ, Lapillonne A, van den Akker CHP, Carnielli V, Fusch C, et al. Enteral Nutrition in Preterm Infants (2022): A Position Paper from the ESPGHAN Committee on Nutrition and invited experts. J Pediatr Gastroenterol Nutr [Internet]. 2023;76(2):248–68. Available from: https://journals.lww.com/jpgn/Fulltext/9900/Enteral_Nutrition_in_Preterm_Infants__2022___A.204.aspx
2. Savino F, Garro M, Farinasso D, Liguori S, Cavecchia I, Mignone F, et al. Feeding difficulties in infants hospitalized in a NICU: An observational study. J Pediatr Gastroenterol Nutr. 2018;66.
3. Wong T, Whyte L. How to manage paediatric intestinal failure. Vol. 32, Paediatrics and Child Health (United Kingdom). 2022.
4. Edwards L, Cotten CM, Smith PB, Goldberg R, Saha S, Das A, et al. Inadequate oral feeding as a barrier to discharge in moderately preterm infants. Journal of Perinatology. 2019;39(9).
5. JOSEPH S, SHORES D. Neonatal feeding in practice: Nutrition principles for babies with a history of intestinal injury or resection. Contemp Pediatr. 2021;38(10).
6. Hopkins J, Cermak SA, Merritt RJ. Oral Feeding Difficulties in Children With Short Bowel Syndrome: A Narrative Review. Vol. 33, Nutrition in Clinical Practice. 2018.
7. Christian VJ, Van Hoorn M, Walia CLS, Silverman A, Goday PS. Pediatric Feeding Disorder in Children with Short Bowel Syndrome. J Pediatr Gastroenterol Nutr. 2021;72(3).
8. NASPGHAN Annual Meeting Abstracts. J Pediatr Gastroenterol Nutr. 2019;69(S2).
9. National Institute for Health and Care Excellence. NICE guideline [NG204] Babies, children and young people's experience of healthcare [Internet]. 2021 Aug [cited 2023 Nov 12]. Available from: https://www.nice.org.uk/guidance/ng204/chapter/Recommendations#improving-healthcare-experience
10. British Association of Perinatal Medicine. Family Integrated Care: A Framework for Practice [Internet]. 2021 Nov [cited 2023 Nov 7]. Available from: https://hubble-live-assets.s3.eu-west-1.amazonaws.com/bapm/file_asset/file/793/BAPM_FICare_Framework_November_2021.pdf
11. Borra C, Iacovou M, Sevilla A. New evidence on breastfeeding and postpartum depression: the importance of understanding women's intentions. Matern Child Health J. 2015 Apr;19(4):897–907.
12. Yuen M, Hall OJ, Masters GA, Nephew BC, Carr C, Leung K, et al. The Effects of Breastfeeding on Maternal Mental Health: A Systematic Review. J Womens Health (Larchmt). 2022 Jun;31(6):787–807.
13. National Institute for Health and Care Excellence. NICE guideline [NG154] Neonatal parenteral nutrition [Internet]. 2020 [cited 2022 Mar 8]. Available from: www.nice.org.uk/guidance/ng154
14. Moltu SJ, Bronsky J, Embleton N, Gerasimidis K, Indrio F, Köglmeier J, et al. Nutritional Management of the Critically Ill Neonate: A Position Paper of the ESPGHAN Committee on Nutrition. J Pediatr Gastroenterol Nutr. 2021 Aug 1;73(2):274–89.
15. Lapillonne A, Fidler Mis N, Goulet O, van den Akker CHP, Wu J, Koletzko B, et al. ESPGHAN/ESPEN/ESPR/CSPEN guidelines on pediatric parenteral nutrition: Lipids. Clinical Nutrition. 2018;1–13.
16. ESPGHAN/ESPEN/ESPR/CSPEN Guidelines on pediatric parenteral nutrition. Clinical Nutrition [Internet]. 2018;2018. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0261561418302152
17. Spatz D, Edwards T. The use of colostrum and human milk for oral care in the neonatal intensive care unit. National Association of Neonatal Nurse E-News [Internet]. 2009 [cited 2024 Apr 2];1(4):1–4. Available from: http://www.nann.org/pubs/enews/sept_09.html
18. Brindle ME, McDiarmid C, Short K, Miller K, MacRobie A, Lam JYK, et al. Consensus Guidelines for Perioperative Care in Neonatal Intestinal Surgery: Enhanced Recovery After Surgery (ERAS®) Society Recommendations. World J Surg. 2020;44(8).
19. British Association of Perinatal Medicine, National Neonatal Audit Programme. Optimising Early Maternal Breast Milk for Preterm Infants: A Quality Improvement Toolkit (Part 1) [Internet]. 2020 Nov [cited 2023 Oct 7]. Available from: https://hubble-live-assets.s3.amazonaws.com/bapm/redactor2_assets/files/755/BAPM_Preterm_MBM_Toolkit_Final_for_publication.pdf
20. Ziegler EE. Human milk and human milk fortifiers. Koletzko B, Poindexter B, Uauy R, editors. Vol. 110, World Review of Nutrition and Dietetics. Karger; 2014. p. 215–27.
21. Ballard O, Morrow AL. Human milk composition: nutrients and bioactive factors. Pediatr Clin North Am [Internet]. 2013;60(1):49–74. Available from: http://linkinghub.elsevier.com/retrieve/pii/S0031395512001678
22. Dvorak B, Fituch CC, Williams CS, Hurst NM, Schanler RJ. Increased epidermal growth factor levels in human milk of mothers with extremely premature infants. Pediatr Res. 2003;54(1).
23. Bode L, Jantscher-Krenn E. Structure-function relationships of human milk oligosaccharides. Advances in Nutrition. 2012;3(3).
24. Neelis EG, Olieman JF, Hulst JM, De Koning BAE, Wijnen RMH, Rings EHHM. Promoting intestinal adaptation by nutrition and medication. Vol. 30, Best Practice and Research: Clinical Gastroenterology. 2016.

25. Goulet O, Olieman J, Ksiazyk J, Spolidoro J, Tibboe D, Köhler H, et al. Neonatal short bowel syndrome as a model of intestinal failure: Physiological background for enteral feeding. Vol. 32, Clinical Nutrition. 2013.

26. British Association of Perinatal Medicine. The Use of Donor Human Milk in Neonates: A BAPM Framework for Practice [Internet]. 2023 Apr [cited 2023 Sep 7]. Available from: https://hubble-live-assets.s3.eu-west-1.amazonaws.com/bapm/file_asset/file/1779/The_use_of_Donor_Human_Milk_FFP_April_2023.pdf
27. Lapillonne A, Bronsky J, Campoy C, Embleton N, Fewtrell M, Fidler Mis N, et al. Feeding the Late and Moderately Preterm Infant: A Position Paper of the European Society for Paediatric Gastroenterology, Hepatology and Nutrition Committee on Nutrition. J Pediatr Gastroenterol Nutr. 2019;69(2):259–70.
28. Warner BW, Vanderhoof JA, Reyes JD. What's new in the management of short gut syndrome in children. J Am Coll Surg. 2000;190(6).
29. Goulet O, Nader EA, Pigneur B, Lambe C. Short bowel syndrome as the leading cause of intestinal failure in early life: Some insights into the management. Vol. 22, Pediatric Gastroenterology, Hepatology and Nutrition. 2019.
30. Sharif S, Meader N, Oddie SJ, Rojas-Reyes MX, McGuire W. Probiotics to prevent necrotising enterocolitis in very preterm or very low birth weight infants. Cochrane Database Syst Rev. 2020 Oct 15;10(10):CD005496.
31. Trivedi A, Teo E, Walker KS. Probiotics for the postoperative management of term neonates after gastrointestinal surgery. Vol. 2024, Cochrane Database of Systematic Reviews. 2024.
32. Ubesie AC, Kocoshis SA, Mezoff AG, Henderson CJ, Helmrath MA, Cole CR. Multiple micronutrient deficiencies among patients with intestinal failure during and after transition to enteral nutrition. Journal of Pediatrics. 2013;163(6).
33. Jeffrey Yang CF, Duro D, Zurakowski D, Lee M, Jaksic T, Duggan C. High prevalence of multiple micronutrient deficiencies in children with intestinal failure: A longitudinal study. Journal of Pediatrics. 2011;159(1).
34. Islam M, Chowdhury M, Siddika M, Qurishi S, Bhuiyan M, Hoque M, et al. Effect of oral zinc supplementation on the growth of preterm infants. Indian Pediatr. 2010;47(10).
35. Camblor M, De La Cuerda C, Bretón I, Pérez-Rus G, Alvarez S, García P. Copper deficiency with pancytopenia due to enteral nutrition through jejunostomy. Clinical Nutrition. 1997;16(3).
36. Jacobson AE, Kahwash SB, Chawla A. Refractory cytopenias secondary to copper deficiency in children receiving exclusive jejunal nutrition. Pediatr Blood Cancer. 2017;64(11).
37. Jayakumar S, Micallef-Eynaud PD, Lyon TDB, Cramb R, Jilaihawi AN, Prakash D. Acquired copper deficiency following prolonged jejunostomy feeds. Ann Clin Biochem. 2005;42(3).
38. 38. Nishiwaki S, Iwashita M, Goto N, Hayashi M, Takada J, Asano T, et al. Predominant copper deficiency during prolonged enteral nutrition through a jejunostomy tube compared to that through a gastrostomy tube. Clinical Nutrition. 2011;30(5).
39. Aoki T. Copper Deficiency and the Clinical Practice. Journal of the Japan Medical Association. 2004;47(8).
40. Gonzalez Ayerbe JI, Hauser B, Salvatore S, Vandenplas Y. Diagnosis and management of gastroesophageal reflux disease in infants and children: From guidelines to clinical practice. Vol. 22, Pediatric Gastroenterology, Hepatology and Nutrition. 2019.
41. Harwood R, Horwood F, Tafilaj V, Craigie RJ. Transanastomotic tubes reduce the cost of nutritional support in neonates with congenital duodenal obstruction. Pediatr Surg Int. 2019;35(4).
42. Jawaheer G, Pierro A, Lloyd DA, Shaw NJ. Gall bladder contractility in neonates: Effects of parenteral and enteral feeding. Arch Dis Child. 1995;72(3 SUPPL.).
43. Castro M, Asbury M, Shama S, Stone D, Yoon EW, O'Connor DL, et al. Energy and Fat Intake for Preterm Infants Fed Donor Milk Is Significantly Impacted by Enteral Feeding Method. Journal of Parenteral and Enteral Nutrition. 2019;43(1).
44. Broekman BFP, Chan YH, Chong YS, Quek SC, Fung D, Low YL, et al. The influence of birth size on intelligence in healthy children. Pediatrics [Internet]. 2009;123(6):e1011-6. Available from: http://dx.doi.org/10.1542/peds.2008-3344
45. Belfort MB, Anderson PJ, Nowak VA, Lee KJ, Molesworth C, Thompson DK, et al. Breast Milk Feeding, Brain Development, and Neurocognitive Outcomes: A 7-Year Longitudinal Study in Infants Born at Less Than 30 Weeks' Gestation. J Pediatr. 2016 Oct;177:133-139.e1.
46. Mansour F, Petersen D, De Coppi P, Eaton S. Effect of sodium deficiency on growth of surgical infants: a retrospective observational study. Pediatr Surg Int. 2014 Dec 1;30(12):1279–84.
47. O'Neil M, Teitelbaum DH, Harris MB. Total body sodium depletion and poor weight gain in children and young adults with an ileostomy: A case series. Nutrition in Clinical Practice. 2014;29(3):397–401.
48. Saeman MR, Piper HG. Recent advances in the management of pediatric short bowel syndrome: An integrative review of the literature. Vol. 4, Current Surgery Reports. Springer; 2016.
49. Butterworth SA, Lalari V, Dheensaw K. Evaluation of sodium deficit in infants undergoing intestinal surgery. In: Journal of Pediatric Surgery. W.B. Saunders; 2014. p. 736–40.
50. Leeds Teaching Hospitals NHS Trust. Guideline for the management of bolus, intermittent abdominal stoma refeeding for infants. Leeds; 2022.
51. Royal College of Paediatrics and Child Health, Neonatal

REFERENCES CONTINUED...

and Paediatric Pharmacist Group. Position statement 2020-01 Choosing an Oral Liquid Medicine for Children [Internet]. 2020 [cited 2024 Apr 2]. Available from: https://nppg.org.uk/wp-content/uploads/2020/12/Position-Statement-Liquid-Choice-V1-November-2020.pdf

52. National Institute for Health and Care Excellence. BNFc- Loperamide hydrochloride [Internet]. [cited 2024 Apr 2]. Available from: https://bnfc.nice.org.uk/drugs/loperamide-hydrochloride/
53. Ainsworth S. Loperamide Monograph. In: Neonatal Formulary. 8th ed. Oxford University Press; 2020.
54. Bliss. Going home from the neonatal unit [Internet]. 2020 [cited 2024 Apr 2]. Available from: https://www.bliss.org.uk/parents/going-home-from-the-neonatal-unit

USEFUL DOCUMENTS

1. **NHS England** – A good practice guide to support implementation of trauma-informed care in the perinatal period: https://www.england.nhs.uk/wp-content/uploads/2021/02/BBS-TIC-V8.pdf
2. **British Association of Perinatal Medicine** – Maternal Breastmilk Toolkit: https://www.bapm.org/pages/196-maternal-breast-milk-toolkit
3. **British Association of Perinatal Medicine** – The Use of Donor Human Milk in Neonates (framework): https://www.bapm.org/resources/the-use-of-donor-human-milk-in-neonates
4. **British Association of Perinatal Medicine** – Safe and Effective Repatriation of Infants (framework): https://www.bapm.org/resources/safe-and-effective-repatriation-of-infants

APPENDIX 1: SUPPORTING DEVELOPMENT OF ORAL FEEDING IN INFANTS WITH GI ISSUES - SLT RECOMMENDATIONS

- Due to the negative short- and long-term outcomes for infants with gastrointestinal complications, it is essential that positive feeding experiences, both non-oral and oral, are proactively supported in the early stages of the babies feeding journey, e.g. when the baby is on PN or having tube feeds. This is necessary to maximise feeding potential and to minimise adverse and negative feeding and neurodevelopmental outcomes.
- Examples of these pre-oral feeding strategies include; skin to skin, mouth care, ideally with EBM. opportunities for non-nutritive sucking (dummy/finger/expressed breast – as is appropriate for the infant), dips/tastes of milk etc. It is also vital to maintain hygiene and minimise damage to the lips and skin of babies who are not receiving oral/suck feeds. This can be achieved through frequent/regular mouth care using expressed breast milk or sterile water. Early positive oral experiences reduce negative and aversive feeding behaviours developing later on in the oral feeding journey.
- Oral/suck feeding is the preferred method of feeding where possible as this is more physiologically supported; however, this may not always be appropriate depending in the individual situation. Cue-based and infant-led feeding experiences promote the development of effective and typical neural pathways (Shonoff et al, 2000).
- An early introduction to oral feeds aims to reduce the risks of oral aversion and feeding difficulties developing. If it is not appropriate to introduce oral feeding, pre-oral feeding strategies above can be implemented that promote positive oral experience.
- Please see Infographic Table in Appendix 2 for good practice pre-oral and oral feeding strategies for the surgical neonate. Referral to the speech and language therapy service should take place, should the infant and family require individualised support around pre-oral feeding skills, support with introduction of oral feeds or support with establishing oral feeds.
- In cases where surgical or feeding teams have a clear rationale to limit oral intake to a few mils only, opportunities for positioning practice at the breast and positive oral-sensory learning for the infant may be started by offering an expressed breast. When the infant is medically stable and there is no evidence-based rationale to limit breastmilk from a surgical or swallow perspective, a baby may be offered the breast without needing to express first
- Breast milk is the best form of enteral nutrition for babies (Puoti et al, 23) and in addition it "... most naturally supports co-regulation between infant and mother" (Warren, 2021). Maternal Breast Milk Toolkit (BAPM, 2020) and the UNICEF Baby Friendly Standards. If bottle feeding is chosen, then parents should be supported to responsively bottle feed (UNICEF responsive bottle-feeding standards

SPEECH AND LANGUAGE THERAPY GUIDANCE

Feeding Outcomes for Babies with GI issues, including: NEC, gastroschisis, intestinal failure, short bowel syndrome, bowel injury, intestinal failure and gut problems

Oral feeding disorders/ feeding difficulties/swallow concerns	Children with Short Bowel Syndrome (SBS) are likely to have feeding disorders. This improves towards 3-4 years	Hopkins et al (2018)
	Percentage of children with SBS who have feeding difficulties: at 1 year old = 80%, 2 years = 70.6%, 3 years = 62.5% and 4 years = 50%	Christian et al (2021) NASPGHAN (2019)
	51% of children with intestinal failure had a feeding disorder	ESPGHAN (2022)
	Infants with a history of neurodevelopmental delay, or who required prolonged periods of bowel rest and PN early in life, may experience poor development of oral-motor coordination or oral aversion. Clinical signs of this include dysphagia, gagging with feeds, or oral feed refusal. Such children might require swallow evaluation and multidisciplinary support.	Jospeh and Shaw (2011)
Later acquisition of oral feeding	Premature babies who had inadequate oral feeding at 36 weeks PMA were more likely to have had surgical or medical NEC. It is hypothesised in this study that poor oral feeding could be because feeds have been withheld and the baby has missed the PMA window for acquiring oral skills or they may have just been too poorly so had more negative procedures and feeding experiences which impact on oral skills	Edwards et al (2019)
Poor/delayed oral motor co-ordination	Critical oral motor skills for feeding develop during the first year of life, especially in the first 6 months. Absence of oral feeding during this time may result in delayed oral motor skills	Fullerton et al (2017)
Oral aversion	57% of patients with short bowel syndrome had oral aversion	Hopkins et al (2018) ESPGHAN (2022) Winder et al (2022)

Food refusal/ Poor Oral Intake	Critical oral motor skills for feeding develop during the first year of life, especially in the first 6 months. Without feeding experience in this time frame food refusal can develop	Fullerton et al (2017)
	Children with Intestinal failure experience poor oral intake, failure to thrive, and nutritional deficits	Joseph and Shaw (2011)
Negative psychological impact	33% of parents felt that oral feeding issues impacted negatively on their child's life	Neumann et al ( )
Gastrointestinal difficulties	Children with intestinal failure experience intestinal dysmotility, GORD	Joseph and Shaw (2011)
	Intestinal dysmotility secondary to resection or injury can cause chronic vomiting, diarrhoea, abdominal distension, and small intestinal bacterial overgrowth (SIBO).	
	Clinical reflux is also a common cause of vomiting and fussiness with feeds. However, the possibilities of delayed gastric emptying or partial obstruction also need consideration, particularly as infants with a history of NEC are prone to dysmotility and strictures.	
Prolonged tube feeding	In children with SBS, those who had complete ileal resection and gastroschisis are more likely to need GT and PN	ESPGHAN (2022) NASPGHAN (2018)
	The majority of infants with intestinal injury are discharged with some proportion of supplemental tube feeding via nasogastric or gastrostomy tube, but most will be weaned to primarily oral feeds by the time they are aged 1 year. Those with a history of NEC and spontaneous intestinal perforation were found to have poor weight gain 3 months after discharge. In some studies, poor weight gain in children with surgical NEC persisted through the first 2 years of life. J	Joseph and Shaw (2011)

APPENDIX 2: GOOD PRACTICE PRE-ORAL AND ORAL FEEDING STRATEGIES FOR THE SURGICAL NEONATE.

BUILDING POSITIVE FEEDING FUTURES FOR FAMILIES:

By optimising our simple neuro-protective and ficare interventions. We can reduce the risk of oral motor difficulties, oral aversion and longer term, post-discharge feeding difficulties.

NHS
Oxford University Hospitals
NHS Foundation Trust

ALL FAMILIES DAY 0/1

Determining maternal feeding intention and provide information on benefits of human milk for birth parent and infant

Delivery room cuddles wherever possible

Skin to skin (STS) on the unit as soon as possible or positive touch if STS is not possible- parental education on the importance of their presence, STS and positive touch

Encouraging early expressing, ideally within first 2 hours post delivery and at least x 8 times a day including at least once overnight- access to feeding team asap

Slowly delivering cue-based mouthcares ideally with EBM/DBM

Providing families with information on the benefits of non-nutritive sucking (NNS) and introducing this with consent

Buccal colostrum/ early breast milk as per local guidelines

Encouraging use of parent & infant scent cloths to provide comfort through smell and bonding

EARLY DAYS: TPN

Supporting maternal expressing and monitoring milk volumes especially for mothers post c-section

Supporting infant smell development- encouraging maternal scent/milk drops on bonding cloth

Facilitating frequent and prolonged STS

Encouraging non-nutritive sucking with an appropriate sized dummy

Exploring milk tastes from breast/dummy dips as appropriate- discuss with surgical team +/- SALT

Avoiding over-suctioning

Considering oral-facial taping/tubing- avoiding naso-labial folds wherever possible and ensuring oral motor movements are not restricted

Considering referral to SALT for longer term support if surgical condition with known long term feeding challenges e.g. TOF/OA, CDH, syndromic presentations

TRANSITION TO ENTERAL FEEDS

Encouraging frequent tastes of milk on dummy at expressed breast as soon as possible

Proritising use of breastmilk over artifical milk unless contraindicated as per dietitian/surgeon advice

Observing, and supporting parents to observe behavioural cues as to feed tolerance/discomfort alongside autonomic and gastro related measures

Supporting parents to build close and loving relationships with their baby and support feeding tolerance by encouraging them to hold and talk to their baby during tube feeds

Offering NNS during tube feeds and +/-dummy dips as per surgical/SALT guidance

Observing for behavioural cues as to feed tolerance/ enjoyment/discomfort alongside autonomic and gastro related measures early referral to dietitian +/- SALT if concerns

Offering parental education and support in learning to give tube feeds

ESTABLISHING SUCKING FEEDS

Sharing observations of readiness for sucking feeds- enteral feed tolerance, sustained periods of alertness during tube feeds, state regulation, NNS with parents

Focus on the quality of feeds over the volumes the baby has sucked- observing the infants physiological, motor and state cues when orally feeding and stopping sucking feeds if frequent loss of stability/engagement

Considering referral to SALT as part of MDT assessment if repeated stress cues or feeding challenges

Setting realistic expectations around feeding for families- considering their gestation, respiratory needs, brain maturity and family needs not just their chronological age and surgical recovery/needs

Offering smaller more frequent feeds may be more comfortable and enable baby's to maintain their regulation

Observing the baby's feeding cues and ability to co-ordinate sucking, swallowing and breathing- most babies coordinate better at the breast than on a bottle

Using a consistent approach to breastfeeding top ups

Teaching parents about responsive tube/breast/bottle feeding

Always ensure the infant's environment is neuro-protective. Consider their individual responses to light, noise, touch and smell and need for paced interventions. Support parent-infant bonding and parental choice recognising parents as the primary carer for their baby.

APPENDIX 3: COMMUNICATION, LANGUAGE, INTERACTION AND BONDING AS PART OF THE SURGICAL INFANT FEEDING JOURNEY

It is important to remember that feeding is more than just nutrition. Attachment and bonding development are supported by, among other things, responsive feeding. Through breast feeding mothers can build a close and loving relationship with their baby, "...feeds are not just for nutrition, but also for love, comfort and reassurance between baby and mother" (UNICEF, 2016, *https://www.unicef.org.uk/babyfriendly/wp-content/uploads/sites/2/2017/12/Responsive-Feeding-Infosheet-Unicef-UK-Baby-Friendly-Initiative.pdf).*

As well as an attachment and bonding experience, every feed is also a communication experience. To responsively feed and provide care and social interaction for their baby, parents and carers need to read and respond to their baby's feeding cues and communication behaviours. Bahorski et al (2023) *https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10015354/.*

Children born preterm are at high risk of developing speech, language and communication difficulties (Rautava et al., 2010; Stene-Larsen et al., 2014; Johnson et al., 2015). In addition to this, evidence shows that Neurodevelopmental delay is an outcome of both surgical and medical NEC, with studies (Bazacliu and Neu, 2019, Hickey et al, 2018) showing an increased rate of Cerebral Palsy (CP), Visual Impairment (VI) and Hearing Impairment (HI), which are also associated with risk of speech, language and communication difficulties.

Coaching parents and caregivers to read and respond to their babies' cues is proposed to support the foundations to an infant's early language development, (Bahorski et al (2023)). In addition to coaching, the SLT can also provide Linguistic parent-infant interaction approaches to further support language and communication development for infants on the neonatal unit, with a view to support longer term speech, language, and communication outcomes.

SLT working takes place within an MDT context and close working would be expected with the ward, Infant feeding teams, dietitian, specialist nurses and other AHPs and specialities as appropriate.

APPENDIX 4: RECORDING STOOL OUTPUT IN CHILDREN WITH DIARRHOEA

(From the Gastroenterology Team at Birmingham Children's Hospital)

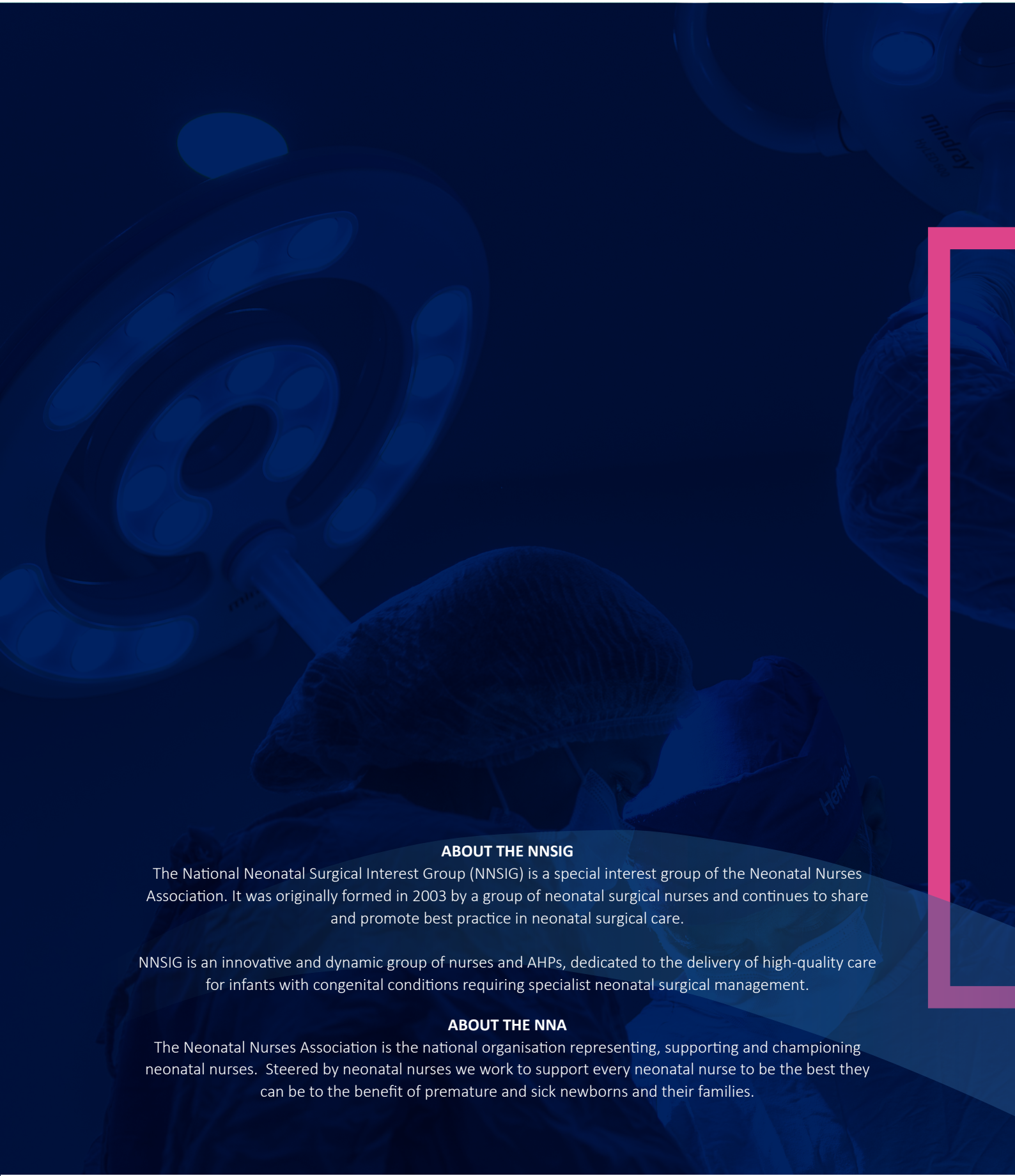
- An accurate record of stool output is essential for the management of infants and children with malabsorption and diarrhoea. In these patients the principal issue is the total daily quantity of stool output. It is therefore particularly important to document the stool frequency and to indicate the volume/size of each stool. Finally, it is essential to record the stool consistency using accepted descriptive terms, as discussed below.
- Descriptions of stool colour are of less importance. Very pale stools may of course suggest the presence of cholestasis. If blood is present this should be recorded, stating the exact colour (bright red, dark red, maroon, black), the estimated quantity (specks, teaspoon, cupful etc), and whether it is mixed with the stool or otherwise.

Standardised description of stool:

- Frequency: Record every stool using criteria outlined below. State total number per day.

Volume / Size:
1 = small stool stain in nappy
2 = moderate or 'normal' sized stool
3 = Large stool 'filling' most of nappy
4 = Huge, leaking from the nappy

Consistency:
a = firm, hard stool. May form pellets
b = formed stool, but not hard
c = soft unformed stool
d = Semi-liquid, 'runny' stool
e = watery stool, i.e., some or all soaks away into the nappy (may look like urine)



ABOUT THE NNSIG

The National Neonatal Surgical Interest Group (NNSIG) is a special interest group of the Neonatal Nurses Association. It was originally formed in 2003 by a group of neonatal surgical nurses and continues to share and promote best practice in neonatal surgical care.

NNSIG is an innovative and dynamic group of nurses and AHPs, dedicated to the delivery of high-quality care for infants with congenital conditions requiring specialist neonatal surgical management.

ABOUT THE NNA

The Neonatal Nurses Association is the national organisation representing, supporting and championing neonatal nurses. Steered by neonatal nurses we work to support every neonatal nurse to be the best they can be to the benefit of premature and sick newborns and their families.

NATIONAL NEONATAL SURGICAL *Interest Group*

NEONATAL NURSES ASSOCIATION