Royal Hospital for Women (RHW)
NEONATAL BUSINESS RULE
COVER SHEET

Ref: T24/458

NAME OF DOCUMENT	Enteral Nutrition - Preterm infants 1001-1500g
TYPE OF DOCUMENT	Clinical Business Rule
DOCUMENT NUMBER	RHW CLIN016
DATE OF PUBLICATION	8 January 2024
RISK RATING	Low
REVIEW DATE	2029
FORMER REFERENCE(S)	Medical LOP – Enteral Nutrition in Neonates
EXECUTIVE SPONSOR	S Bolisetty (Medical Co-Director Newborn Care Centre); S Wise (Nursing Co-Director Newborn Care Centre)
AUTHORS	S Bolisetty (Medical Co-Director), S Allworth (Dietitian), SJ Tapawan (NICU CMO), E Jozsa (CNS), M O'Connor (Acting CMC), A Scott-Murphy (NUM), R Jackson (NE), P Everitt (CMC), K Lindrea (CNC), T Parmar (NICU fellow), E Deibe (CNE)
SUMMARY	To provide feeding guidelines for preterm neonates with birth weight 1001g-1500g

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Enteral Nutrition - Preterm infants 1001-1500g RHW CLIN016

1. BACKGROUND

This CBR provides feeding guidelines for preterm neonates with birth weight 1001-1500g.

2. RESPONSIBILITIES

Medical, Nursing and Allied Health Staff

3. PROCEDURE

3.1 Nutrition Goals

- Regain birthweight by 10-14 days of age[1]
- Achieve physical growth targets in the NICU [2]
  - Weight – 21 g/kg/day (±2 g/kg/day)
    - Weight gain may slow to 25-30g/day as approaches 40 weeks CGA
  - Length – 1.1 cm/week (±0.2 cm)
  - HC target – 1.1 cm/week (±0.2 cm)
- Minimise the risk of necrotising enterocolitis
- Prevent osteopenia of prematurity
- Improve neurodevelopmental outcomes

3.2 Clinical Practice

Prior to birth

- Antenatal counselling: NICU medical team or CMC for lactation to provide counselling for the woman and her partner about the importance of expression of mother's own milk, breastfeeding, feeding goals, availability of pasteurised donor human milk (PDHM) and probiotic. But DO NOT encourage expression prior to delivery, which may facilitate preterm labour
- Consent: Obtain written informed consent for PDHM and probiotic

At birth

- Commence trophic gavage feeding 1 mL mother's own milk (MOM) or PDHM 2 hourly and increase by 1 mL 12 hourly. First feed to be administered within 6 hours of life
- Commence probiotic within 6 hours of life

After 24 hours of life – Grading up feeds

- Continue 2 hourly bolus feeds
- Increase feeds by 20-30 mL/kg/day until 170-180 mL/kg/day is reached

Current weight	Rate of increase	
	If 2 hourly bolus feeds	If 1 hourly bolus/continuous feeds
1001-1200g	1 mL per feed 8 hourly	0.5 mL per feed 8 hourly
1201-1500g	1 mL per feed 6 hourly	0.5 mL per feed 6 hourly

  - Grading up feeds may need to be slow or altered (eg. hourly bolus feeds, slow bolus feeds over 20-30 minutes, continuous feeds, transpyloric feeds) in special circumstances, such as:
    - Growth restriction
    - Abnormal umbilical Doppler's
    - Feed intolerance
    - Necrotising enterocolitis and other medical or surgical gastrointestinal conditions
    - Haemodynamically significant PDA (particularly infants on indomethacin or ibuprofen)
    - Infants on inotropic support and/or muscle relaxants
  - If continuous enteral feed is chosen – draw up only 2-hour feed volume into syringe and administer it using an infusion pump. Feed should be agitated gently every 1 hour to avoid sedimentation.
- Consider changing frequency of feeds to 3rd hourly once the infant is ≥1500g

NOTE:
- Some infants may tolerate 3rd hourly feeds earlier than these guidelines and NICU team may decide to change the feed intervals as appropriate for these infants

Fortification

- Commence half fortification (22-23 kcal/30mL) when enteral feeds reach 100-120 mL/kg/day and full fortification (24-25 kcal/30mL) at 120-150 mL/kg/day of enteral feeds
- If standard fortifier is not tolerated or extra protein or calorie is required, NICU dietitian and team may opt to use beneprotein and/or MCT oil

Parenteral nutrition (PN)

- If peripheral IVC is used for PN administration
  - 2 options are available: (1) Peripheral preterm solution +/- SMOFlipid, or (2) standard preterm solution +/- SMOFlipid
- If PICC line is used for PN administration
  - Administer standard preterm solution + SMOFlipid
  - Change to **concentrated** preterm PN once the standard preterm PN volume is <100 mL/kg/day
  - Maximum **concentrated** preterm PN solution should not exceed 100 mL/kg/day. Volume >100 mL/kg/day requires approval from neonatologist/NICU dietitian.
  - Maximum **standard** preterm PN solution that can be given is 135 mL/kg/day
- Cease intravenous lipid emulsion once the infant tolerates 120 mL/kg/day of enteral feed.
- Cease PN solution and remove central line once the infant tolerates 150 mL/kg/day feeds.

Multivitamins and Iron supplementation

- Add Multivitamin once the feeds reach 120 mL/kg/day or the day after SMOF lipid ceased

  - Pentavite 0.45 mL daily OR
  - Brauer 0.5 mL twice per day + vitamin D 400 IU daily
- Iron is not required if PreNaN FM85 Fortifier is used at >160mL/kg/day

Monitoring

- Clinical monitoring for feed intolerance
  - Medical team to assess the abdomen once a shift or more frequently if concerns of abnormal findings such as abdominal distension, discolouration or blood in stool
  - Prefeed gastric aspirate to confirm the Intragastric tube (IGT) position: Aspirate only up to 0.5 mL to check the colour of aspirate and the pH for tube position
    DO NOT ROUTINELY ASPIRATE THE ENTIRE GASTRIC RESIDUALS (GR)
  - If aspirate/vomit is heavily bile stained (colour number 7 or 8 (Figure 1) – return the aspirate, stop feeds and notify medical team for assessment
  - Occasionally, the volume of aspirate would be measured.
    - If aspirate volume is <50% of previous 4-6 hour volume, not heavily bile stained and clinically stable abdomen, return aspirate and continue to feed.
    - If aspirate volume ≥50% of previous 4-6 hour volume or heavily bile stained, return aspirate, stop feed and assess the infant for any abdominal pathologies.

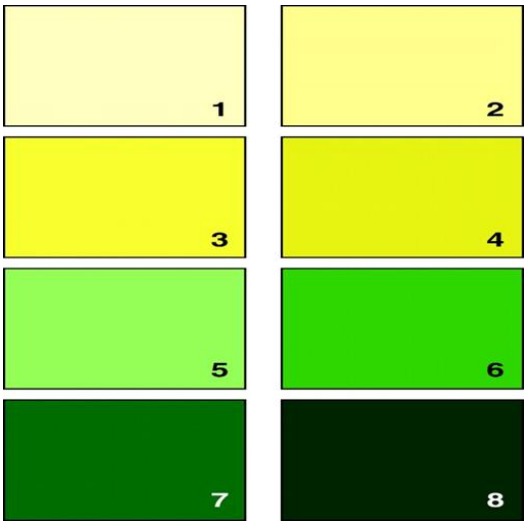

Figure 1

- Growth
  - Weigh every Monday, Wednesday and Friday.
    - Weight target 21 g/kg/day (±2 g/kg/day)
      - Weight gain may slow to 25-30g/day as approaches 40 weeks CGA.
  - Measure length and head circumference every Wednesday.
    - Length and head circumference target 1.1 cm/week (±0.2 cm)
- Biochemical markers
  - Weekly urine Calcium (Ca) and Phosphorus (P) (Sunday night)
    - Aim for urine Ca and P of 1-2 mmoL/L.[3, 4] This is a surrogate marker of an adequate intake of Ca and P with a slight surplus.
    - If too much of Ca (>2 mmol/L) and P (>2 mmol/L) in the urine it may need further intake/output assessment to rule out excess intakes or excess excretion.
  - Fortnightly serum Ca/Mg/P/urea/Cr and liver function test

- Blood urea nitrogen of 3.2-5 mmoL/L is a surrogate marker of adequate protein intake.[17-18] However, aiming that range of BUN may mean excess protein intakes in daily practice. Consult with NICU dietitian to individualise the protein intakes.
- Serum P <1.6 mmoL/L is considered as hypophosphataemia.[5]

3.3 Educational Notes

- The recommended nutritional practice for very low birthweight infants is to provide their own mother's human milk along with a human milk fortifier (HMF) to avoid protein and nutrient deficiencies[1]
- A 2021 Systematic review and meta-analysis included 2 RCTs, 4 with a total of 334 infants<1250g. This review found that human milk-based fortifier compared with cow's milk-based fortifier reduced the risk of necrotising enterocolitis (risk ratio 0.47, 95% CI 0.22 to 0.98) but the overall quality of evidence was low[2]
- A 2017 systematic review summarised the evidence regarding the association of donor human milk, exclusive human milk diet and different human milk doses with incidence of NEC in preterm infants. This review found consistent evidence that a higher dose of mother's own milk (at least 50%) reduces the risk of NEC. There is preliminary evidence that an exclusive human milk diet may provide protection against NEC[3]
- These local guidelines are a compilation of an integrated system for providing optimal newborn care, family integrated care, kangaroo care (skin-to-skin contact), rooming-in, respecting the WHO/UNICEF Ten Steps to Successful Breast-feeding expanded in 2011 for use in NICUs, and other best practices for neonatal care.[4,5]
- Early intervention with milk expression soon after delivery (ideally within 1 hour of birth) is critical for milk production of NICU mothers; therefore, mothers should be taught a method of milk expression within this time frame.
- This feeding strategy should be done in conjunction with Immuno-Supportive Oral Care (ISOC).[5]
- Regaining birthweight: Initial weight loss of 7%–10% is expected, reaching a nadir at days 3–4, nutritional strategies should aim to regain birth weight by 7–10 days of age. Nutritional management and growth assessment for SGA infants should be the same as those born AGA, but initial weight loss is often less and acceptable up to 4%–7% of birth weight.[1] It is to be noted that, in Ehrenkranz RA et al study, the "highest growth velocity during the NICU stay" group took significantly longer to regain birthweight (average 19 days) compared to lowest growth velocity group in their cohort (average 16 days).[6]
- Advancement of feeds: A 2021 Cochrane review concluded that advancing enteral feed volumes at increments of 30 to 40 mL/kg/day (compared to 15 to 24 mL/kg/day) does not increase the risk of NEC or death in VLBW infants (<1500g). This review found that advancing the volume of enteral feeds at slow rates results in delay in establishing full enteral feeds (on average 3 days extra in the largest trial in the meta-analysis) and may slightly increase the risk of invasive infection (RR 1.14, 95% CI 0.99 to 1.31; RD 0.02,95% CI −0.00 to 0.05; certainty of evidence is low). Applicability of these findings to extremely preterm, extremely low birth weight, or growth-restricted infants is uncertain, although authors suggested the findings can be extrapolated to ELBW infants.[7] A 2022 systematic review on fast feed advancement (≥30 ml/kg per day) compared with slow feed advancement (<30 ml/kg per day) in preterm (<37 weeks) and low birth weight infants (<2.5 kg) found that fast feed advancement reduces time to regain birth weight and likely reduces the length of hospital stay; it also likely reduces the risk of neonatal morbidity and mortality slightly. However, it may increase the risk of neurodevelopmental disability slightly. This meta-analysis included 12 RCTs with 4291 participants.[8] The Ireland Speed of Increasing Milk

Feeds trial (SIFT) was the largest trial (n = 2804). Among 2804 infants, SIFT trial included 1020 extremely low-birth-weight infants (<1000 g), 994 extremely preterm infants (<28 weeks of gestation), and 435 infants with absent or reversed end-diastolic umbilical flow on antenatal Doppler studies. In this large, pragmatic, randomized, controlled trial, advancing milk feeding volumes at daily increments of 30 ml per kilogram as compared with 18 ml per kilogram did not affect survival without moderate or severe neurodevelopmental disability at 24 months, corrected for gestational age. The speed of increment in feeding volumes also did not affect the risks of late-onset sepsis, necrotizing enterocolitis, or death during hospitalization. However secondary-outcome analysis showed the risk of moderate or severe motor impairment was higher in the faster-increment group.[9]

- The most recent evidence from the SIFT study showed that slow advancement of feeding in very low birthweight infants did not reduce the risk of NEC showing no advantage in increasing at 18ml/kg/day versus 30ml/kg/day.[9]
- Routine prefeed gastric residual (GR) aspiration of entire contents in the clinically stable infant is not recommended. Assessment of GR volumes should be performed only when other clinical signs associated with feed intolerance or NEC are present.[1]
- Bolus feeds promote cyclical release of gastrointestinal tract hormones to stimulate gut maturation and motility but marked variations in practice exist and many use continuous feeds. Low-quality evidence suggests feeding 3-hourly is comparable to 2-hourly feeding although extremely low-birth-weight infants may reach full enteral feeds earlier when fed 2-hourly compared with 3-hourly. Bolus feeding increases splanchnic perfusion more than continuous feeding. Energy expenditure may increase upon bolus feeding as compared to continuous feeding. Systematic reviews show longer time to reach full enteral feeding using continuous rather than intermittent feeding infants[10] and fat loss may also be greater although there were no significant effects on growth. Data on apnoea are inconsistent.[1] In our guideline, fat loss and sediment formation will be mitigated by limiting the continuous feed volume to not more than 2-hour volume, meaning milk is prepared every 2 hours and infusion syringe and pump are placed vertically.
- Growth targets of weight - 21 g/kg/day (±2 g/kg/day), length and HC target: 1.1 cm/week (±0.2 cm) during NICU stay were associated with less likelihood of cerebral palsy, Bayley's mental developmental index (MDI) and psychomotor developmental index (PDI) <70 and neurodevelopmental impairment. Also, these growth targets showed better weight, length and HC at 18-22 months CGA.[6] These growth targets also matched with intrauterine growth[11] and maintain the birth percentile in extra uterine life. (Hypothetical growth charts on eRIC created by C Brites, RHW eRIC senior analyst)
- Growth curves: For preterm AGA infants, maintain the rate/velocity of growth that will achieve and maintain the birth percentile for the infant's birth weight. If the birth percentiles for weight or length are exceeded, consider decreasing nutrient intake. For SGA infants, similarly, maintain daily growth charts and at a minimum maintain the birth percentile for a given birth weight. In SGA infants, achieving the tenth percentile for weight for a given postconceptional age by increasing nutrient intake is a reasonable end point at this time, assuming head growth will follow.[1,12]
- Urine Calcium and Phosphate**:** Preterm infants have been shown to achieve fetal bone mineral accretion rate by maintaining a simultaneous slight excretion of Ca and P in urine (urine concentrations of 1-2 mmoL/L). A large international cohort study demonstrated that regular measurement of urinary Ca and P a valuable and easy means of adjusting Ca and P intake.[13,14]

- Beneprotein is 100% whey protein isolate. It's PDCAAS (Protein Digestibility Corrected Amino Acid Score): 100. Osmolality is 44 mOsm/kg water.
- Lipid emulsions have a low osmotic load and are isotonic. Amino acid and glucose solutions are hypertonic. Therefore the co-infusion of lipid with amino acid and glucose into peripheral veins is encouraged and may also exert a protective effect on vascular endothelium to prolong venous patency and reduce risk of thrombophlebitis.10 However, there is also concern that intravenous lipid emulsion is also known to be a medication that can lead to extravasation injury.[15,16]

3.4 Abbreviations

MOM	Mother's Own Milk	HMF	Human Milk Fortifier
NICU	Neonatal Intensive Care Unit	PDA	Patent Ductus Arteriosus
PN	Parenteral Nutrition	CMBF	Cow's Milk Based Fortifier
SMOF lipid	Soybean oil, medium-chain triglyceride, olive oil, fish oil	IGT	Intra Gastric Tube
GR	Gastric residue	Ca	Calcium
P	Phosphorus	Mg	Magnesium
Cr	Creatinine	BUN	Blood Urea Nitrogen

3.5 References

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4. RELATED BUSINESS RULES AND POLICY DOCUMENTS

- RHW NCC Medical CBR – Pasteurised Donor Human Milk (PDHM) for vulnerable infants - Refer to DOH PD2018_043
- RHW NCC Medical CBR – Enteral Nutrition - formula preparations in Newborn Care Centre
- RHW NCC Medical CBR – Enteral Nutrition - human milk fortification - preparation
- RHW NCC Nursing CBR – Breastfeeding - First Expression - Refer to CBRs Lactation/Infant Feeding topic
- RHW NCC Nursing CBR – Enteral Feed Warming – Calesca
- RHW NCC Nursing CBR – Immuno-Supportive Oral Care (ISOC)

5. CULTURAL SUPPORT

- When clinical risks are identified for an Aboriginal family, they may require additional supports. This may include Aboriginal health professionals such as Aboriginal liaison officers, health workers or other culturally specific services.
- For a Culturally and Linguistically Diverse CALD family, notify the nominated cross-cultural health worker during Monday to Friday business hours.
- If the family is from a non-English speaking background, call the interpreter service: NSW Ministry of Health Policy Directive PD2017_044-Interpreters Standard Procedures for Working with Health Care Interpreters.

6. IMPLEMENTATION PLAN

This revised CBR will be distributed to all medical, nursing and midwifery staff via @health email. The CBR will be discussed at ward meetings, education and patient quality and safety meetings. Education will occur through in-services, open forum and local ward implementation strategies to address changes to practice. The staff are asked to respond to an email or sign an audit sheet in their clinical area to acknowledge they have read and understood the revised CBR. The CBR will be uploaded to the CBR tab on the intranet and staff are informed how to access.

7. RISK RATING

- Low

8. NATIONAL STANDARDS

- Standard 1 Clinical Governance
- Standard 2 Partnering with Consumers
- Standard 3 Preventing and Controlling Infections
- Standard 4 Medication Safety
- Standard 5 Comprehensive Care
- Standard 6 Communicating for Safety

9. REVISION AND APPROVAL HISTORY

Date	Revision No.	Author and Approval
2010	1	S Bolisetty (lead clinician); Newborn Care Management Committee and RHW Quality & Patient safety
2018	2	S Bolisetty (lead clinician); NCC LOPs Committee
2019	3	S Bolisetty (lead clinician); NCC LOPs Committee
2023 5.1.24	4	S Bolisetty (Medical Co-Director), S Allworth (Dietitian), SJ Tapawan (NICU CMO), E Jozsa (CNS), M O'Connor (Acting CMC), A Scott-Murphy (NUM), R Jackson (NE), P Everitt (CMC), K Lindrea (CNC), T Parmar (NICU fellow), E Deibe (CNE); NCC CBR Committee Endorsed RHW Safety and Quality Committee