

Proposed NNAP measure: Growth of preterm babies

Does a baby born before 32 weeks gestational age experience extrauterine growth restriction during their initial hospitalisation?

Rationale

Weight gain and head circumference growth in preterm babies have associations with neurodevelopmental outcomes measured at two years of life.^{1,2,3} Good growth is characterised by a sufficient magnitude of growth and by proportional growth, meaning that a failure of weight gain or head growth (or both) would be considered an adverse outcome.

There are well described quality improvement projects which have improved growth in preterm babies. Some of these have focused on single elements (for example, changes to parenteral nutrition composition)⁴ and others have applied complex multicomponent interventions.^{5,6}

Guidelines for nutritional intake are published by the European Society of Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN).^{7,8}

Inclusion criteria

Denominator: Babies born at less than 32 weeks gestational age who reach 44 weeks postmenstrual age (PMA) or discharge during the calendar year, excluding infants who die before discharge.

Numerator: Babies whose weight or head circumference z-score dropped by at least 2 standard deviation scores (SDS) from birth to 36 weeks PMA or discharge (whichever is the sooner).

Justification:

- *A fall of 2SDS was selected after consultation with the Neonatal Nutrition Network and discussion within the NNAP Methodology & Dataset Group. This definition will only identify infants with very significant growth failure, for whom adverse outcomes are particularly likely. It is consistent with some definitions of EUGR in published literature.⁹⁹*
- *Analysis of historic data suggests that around 6% of infants will meet the definition of weight gain failure, 12% will experience head growth failure and 15% will experience either weight failure or head growth failure or both.*
- *For weight, missingness is only around 2%.*
- *For head circumference, 31% of infants did not have a head circumference recorded during their first week of life and 69% did not have a head circumference measured at the composite endpoint. Actual data yield from BadgerNet may be slightly better than this as additional data fields could be included which were not available from the historic data.*
- *Addition of this measure to the NNAP audit is likely to improve measurement rates.*
- *Birth is recommended as the start point as it is easily understood and the BadgerNet data are relatively complete. An early fall in SDS is expected (especially for weight) due to early water loss, but an overall drop of 2SDS between birth and discharge is still considered abnormal. Head circumference measurements within the first week of life shall be accepted as reflective of head circumference at birth.*
- *36 weeks PMA was selected as the endpoint as most infants remain in the dataset at that age and it will capture the majority of an infant's neonatal care without being subject to the very wide variation in PMA at actual discharge, which could bias results.*

Cohort: Babies who reach 44 weeks PMA or are discharged in the calendar year of analysis.

Attribution

The outcome will be allocated to the **unit** which is providing care when the infant reaches 36 weeks PMA **or** the unit from which the infant was finally discharged if discharge was before 36 weeks PMA.

The outcome will be allocated to the **network** to which the allocated unit belongs.

Justification:

- *This attribution plan will mean that the outcome is usually allocated to the baby's local unit, or to a NICU which is likely to have provided most of the baby's care if he or she is too sick to transfer to the local centre by 36 weeks PMA.*
- *There may be some systematic differences between units of different kinds (e.g. SCBU vs LNU vs NICU vs NICU with surgical services). Therefore, units will be invited to compare their outcome with similar units. Case mix adjustment is not planned.*
- *Outlier analysis is not proposed at this time.*

Data source

Longitudinal weight gain data are captured by BadgerNet but may not currently be provided by System C to NNAP (see **Appendix 1** for additional BadgerNet fields required).

Statistical analysis would be required to identify the episode of weighing which meets the inclusion criteria and the postmenstrual age when the weight was measured. The weight z-score can be calculated using available packages in R or by writing functions in other statistical programming languages.

Stakeholder consultation

The Neonatal Nutrition Network (N3) has been consulted and their feedback has been summarised. A measure of growth was initially suggested by Dr A. Abelian (Betsi Cadwaladr University Health Board).

¹ Infant growth before and after term: Effects on neurodevelopment in preterm infants. *Pediatrics*. Belfort MB, Rifas-Shiman SL, Sullivan T, Collins CT, McPhee AJ, Ryan P, et al. 2011;**128**(4):e899-906.

² Association of poor postnatal growth with neurodevelopmental impairment in infancy and childhood: Comparing the fetus and the healthy preterm infant references. *J Pediatr*. Cordova EG, Cherkerzian S, Bell K, Joung KE, Collins CT, Makrides M, et al. 2020;**225**:37-43 e5.

³ Antenatal and postnatal growth and 5-year cognitive outcome in very preterm infants. *Pediatrics*. Leppanen M, Lapinleimu H, Lind A, Matomaki J, Lehtonen L, Haataja L, et al. 2014;**133**(1):63-70.

⁴ High early parenteral lipid in very preterm infants: A randomized-controlled trial. *J Pediatr*. Alburaki W, Yusuf K, Dobry J, Sheinfeld R, Alshaikh B. 2021;**228**:16-23 e1.

⁵ Successfully implementing and embedding guidelines to improve the nutrition and growth of preterm infants in neonatal intensive care: A prospective interventional study. *BMJ Open*. Johnson MJ, Leaf AA, Pearson F, Clark HW, Dimitrov BD, Pope C, et al. 2017;**7**(12):e017727.

⁶ Early postnatal growth failure in preterm infants is not inevitable. *Arch Dis Child Fetal Neonatal Ed*. Andrews ET, Ashton JJ, Pearson F, Beattie RM, Johnson MJ. 2019;**104**(3):F235-F41.

⁷ Enteral nutrition in preterm infants (2022): A position paper from the espghan committee on nutrition and invited experts. *Journal of Pediatric Gastroenterology and Nutrition*. Embleton ND, Jennifer Moltu S, Lapillonne A, van den Akker CHP, Carnielli V, Fusch C, et al. 2023;**76**(2).

⁸ Espghan/espen/espr/cspen guidelines on pediatric parenteral nutrition. *Clin Nutr*. Mihatsch WA, Braegger C, Bronsky J, Cai W, Campoy C, Carnielli V, et al. 2018;**37**(6 Pt B):2303-5.

⁹ Variability in definitions and criteria of extrauterine growth restriction and its association with neurodevelopmental outcomes in preterm infants: A narrative review. *Nutrients*. González-López C, Solís-Sánchez G, Lareu-Vidal S, Mantecón-Fernández L, Ibáñez-Fernández A, Rubio-Granda A, et al. 2024;**16**(7).

Appendix 1

The following data fields will be required from BadgerNet. Some of these fields may already be obtained by NNAP. In addition to the listed fields, additional data will be required to assign infants to units and to track their transfers. The daily data points (Database Table Name: NNUDaySum) will need to be assigned to a day of life.

Database Table Name	Database Field Name	Form Name in BadgerNet	Field label in form	Field Type	Method of Input/Generation	Coded Values for field	Additional Notes/Comments
BabyEpisodeIndex	Birthweight	Admission Details - Baby Details	Birth weight	int	User entered	99999 Unknown	-
BabyEpisodeIndex	GestDays	Admission Details - Baby Details	Agreed gestation at birth (Days)	int	User entered	-	-
BabyEpisodeIndex	GestWeeks	Admission Details - Baby Details	Agreed gestation at birth (Weeks)	int	User entered	-	-
BabyEpisodeIndex	Sex	Admission Details - Baby Details	Sex	string	Picklist - Single Choice	Female F Male M Indeterminate I	-
NNUEpisodes	AdmitHeadCircumference	Neonatal episode summary	-	float		999.9 Unknown	
NNUEpisodes	AdmitWeight	Neonatal episode summary	-	int		-	
NNUEpisodes	BirthHeadCircumference	Admission Details - Baby Details	Head Circumference at Birth	float	User entered	-	-
NNUEpisodes	Birthweight	Admission Details - Baby Details	Birth weight	int	User entered	99999 Unknown	-
NNUEpisodes	DischargeHeadCircumference	Discharge Details - Discharge Details	Head Circumference	float	User entered	-	Provided as cm
NNUEpisodes	DischargeWeight	Discharge Details - Discharge Details	Weight	int	User entered	-	Provided as grams (g)
NNUEpisodes	Sex	Admission Details - Baby Details	Sex	string	Picklist - Single Choice	Female F Male M Indeterminate I	-
NNUDaySum	HeadCircumference	Neonatal daily Details Summary for DBSync	-	float		-	
NNUDaySum	Weight	Neonatal daily Details Summary for DBSync	-	int		-	
NNUDaySum	WeightToday	Neonatal daily Details Summary for DBSync	-	int		-	