Feeding Intolerance:
"What's Going on in There?"

Terry S. Johnson, APN, NNP-BC, ASPPS, MS
Neonatal Nurse Practitioner
Director, Education and Professional Development
Prolacta Bioscience

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Disclosures

- I prepared this slide deck; it is without commercial bias or influence
- I make no recommendations for the off-label use of a drug, nutritional products, or medical devices
- I received financial reimbursement for non-marketed, non-branded, non-promotional educational presentation through the Abbott Nutrition Health Institute (ANHI)

Terry S. Johnson
APN, NNP-BC, ASPPS

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Poll Time

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Objectives

- **At the conclusion of this presentation, the learner should be able to:**
  - Describe the concept of "dysbiosis" as the potential etiology of feeding intolerance.
  - Review the role and use of human milk in reducing the incidence and frequency of feeding intolerance.
  - Discuss the current research regarding checking gastric aspirates.
  - Identify the four components of the "NEC-Zero Toolkit".

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Feeding Intolerance (FI)

- ***"The Neonatologist (Neonatal Team) often prescribe enteral nutrition as if walking on a tightrope between the purposed attainment of full enteral feeding and the fear of NEC".***

SOURCE: anaro S (2012). Strategies to improve feeding tolerance in preterm infants. *J Madern Fetal Neonatal Med* Oct 25 Suppl4_54-56. doi: 10.3109/14767058.2012.715021

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Costs of Feeding Intolerance (FI)

"Feeding intolerance is one of the most common reasons to delay the advancement of enteral feeds or for suspension of feeds in the preterm infant."

SOURCE: Ramani M, Ambalavanan N. Feeding practices and necrotizing enterocolitis. *Clin Perinatol* 2013;40:1-10.

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Costs of Feeding Intolerance (FI)

- **Prolonged Parenteral Nutrition and Longer Hospitalization**
  - FI leads to slow gastric emptying and poor intestinal motility
  - ***Key hindrance in achievement of enteral feedings in VLBW infants***
  - Akintorin, et al.,
    - Prospective RCT of feeding methods in 80 VLBW infants,
    - FI positively associated with a delay in attainment of full enteral feedings
    - ***Directly related to length of hospitalization***

SOURCE: Parker LA,K rueger, C, Sullivan, S, Kelechi, T, & Mueller, M (20). Effect of Breast Milk on Hospital Costs and Length of Stay Among Very Low-Birth-Weight Infants in the NICU. *Advances in Neonatal Care: August 2012; vol.12-4; p254-259.* doi10.1097/ANC.0b013e318260921a
SOURCE: Akintorin SM, Kamat M, Pildes RS, Kling P, Andes SA (1997). Prospective randomized trial of feeding methods in very low birth weight infants. Pediatrics;100:24-e8.

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Costs of Feeding Intolerance (FI)

- **Methods**
  - Compare incidence of FI and association of co-morbid conditions with FI
  - Two groups of preterm (28-32 weeks and >32-36 weeks
  - Observational cohort study

measure what matters

	Group 1	Group 2	Results
Percent of FI	40%	34.3%	Not significant
Mean days to reach full feedings	19.8 days	11.5 days	p=0.0001
Association with Suspected sepsis	Significant	Significant	p=0.0003

- ***Concluded feeding intolerance is common in preterm infants -incidence is as high as 36%.***

SOURCE: Ahammad F, Begum T, Akter J, & Nasrin E (2018). Comparison of feeding intolerance between very preterm and moderate preterm neonates – a prospective cohort study. *J Pediatr Neonatal Care*. 2018;8(4):200-203. DOI:10.15406/jpnc.2018.08.00339

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"Dysbiosis"

What's Going on in There?

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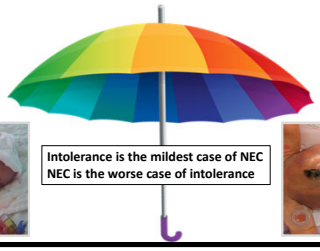
"What's Under the Big Umbrella?"



Incidence Estimate:
As high as 36%

Intolerance is the mildest case of NEC
NEC is the worse case of intolerance

Incidence Estimate:
~ 5% of VLBW Infants

Abammad F, et al. *J Pediatr Neonatal Care.* 2018;8(4):200-203. DOI: 10.15406/jpnc.2018.08.00339

INFLAMMATION

Horbar JD, et al., JAMA Pediatr 2017; 17(3): e164396

SOURCE: Adapted from B Modi, MD, in presentation; VON, Conference, Chicago, IL

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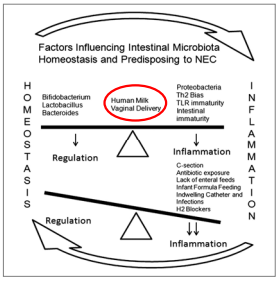
Dysbiosis: Inflammation and the Microbiome



"DISBIOSIS"

"Probably the key event associated with the pathogenesis of NEC"… and feeding intolerance.

SOURCE: Torrazza RM & Neu J *Clin Perinatol* 40 (2013) 93-108 http://dx.doi.org/10.1016/j.clp.2012.12.009

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Discovery of the Microbiome

(circa 2008)

Genes (20-25,000
Microbes 100 Trillion

Linda R. Hegstand &Roberta Jean Hine, 1986
Microbiologist Joshua Lederberg, 2001

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Feeding Intolerance (FI) and the Neonatal Microbiome

- **Study Groups**
  - < 37 weeks gestation
    - N=41 (FIG) preterm infants diagnosed with FI
    - 29 (CG) preterm infants without FI
    - No infants in either groups had to have never left their incubators before transferor discharge
  - FI defined
    - GR volume > 50% 0f previous feeding volume
    - Abdominal distention
    - Regurgitation/vomiting/emesis
  - FI resolved with resolution of symptoms

SOURCE: Yuan Z, Yan J, Wen H, Deng X, Li X, Su S (2019) Feeding intolerance alters the gut microbiota of preterm infants. PLoS ONE 14(1): e0210609.
https://doi.org/10.1371/journal.pone.0210609

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Feeding Intolerance (FI) and the Neonatal Microbiome

- **Findings**
  - Fecal samples collected at 3 three points
    - Within 48 hours of birth
    - Within 24 hours of FIG diagnosis
    - 7 days after FI resolved
  - Fecal samples analyzed
    - 16S rRNA genes and high-throughput sequencing
  - Treatment combination therapy
    - Probiotics
      - *Bifidobacterium longum*, *Lactobacillus acidophilus* *Enterococcus faecalis,* and *Bacillus subtilis*
    - PO erythromycin - doses based on body weight

SOURCE: Yuan Z, Yan J, Wen H, Deng X, Li X, Su S (2019) Feeding intolerance alters the gut microbiota of preterm infants. PLoS ONE 14(1): e0210609.
https://doi.org/10.1371/journal.pone.0210609

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Feeding Intolerance (FI) and the Neonatal Microbiome

- **Findings**
  - ***Community composition of the gut microbiota of the preterm infants in FI was greatly altered when feeding intolerance was diagnosed***
  - When feeding FI diagnosed, the comparison of gut microbiota between the FIG and CG infants ***revealed huge differences***
  - Certain microbes that were significantly different in samples were ***potential diagnostic markers of feeding intolerance***

YSOURCE:: Yuan Z, Yan J, Wen H, Deng X, Li X, Su S (2019) Feeding intolerance alters the gut microbiota of preterm infants. PLoS ONE 14(1): e0210609.
https://doi.org/10.1371/journal.pone.0210609

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Feeding Intolerance (FI) and the Neonatal Microbiome

- **Findings**
  - ***Klebsiella* significantly increased when feeding intolerance was diagnosed and significantly decreased after feeding intolerance resolved**
  - **In** this study the proliferation of *Klebsiella* was ***possibly related*** to the occurrence of FIG in the preterm infants

SOURCE: Yuan Z, Yan J, Wen H, Deng X, Li X, Su S (2019) Feeding intolerance alters the gut microbiota of preterm infants. PLoS ONE 14(1): e0210609. https://doi.org/10.1371/journal.pone.0210609

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Feeding Intolerance (FI) and the Neonatal Microbiome

Human Milk as Immuno-Nutrition

- Directly shapes the infant's intestinal colonization and establishes the microbiome
- Diminishes inflammation
- Provides anti-inflammatory and anti-oxidative factors that protect the bowel mucosa

SOURCE: Cacho NT & Lawrence RM (2017), Innate immunity and breast milk. *Front. Immunol.*, 29 May 2017 |https://doi.org/10.3389/fimmu.2017.00584

Human Milk as Immuno-Nutrition

"The modulation of the immune and inflammatory responses in critically ill patients with the use of enteral feedings enriched with immune-enhancing ingredients".

SOURCE: Neu J & Bernstein, H Update on host defense and immunonutrients *Clinics in Perinatology 29(1); 2002.*

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Poll Time

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Clinically Defining Feeding Intolerance

Specific, Measurable, Consistent

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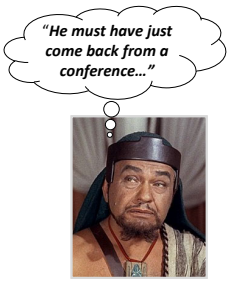
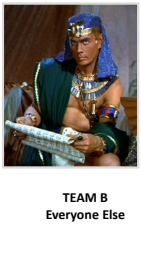
A Short History on the Development of Feeding Protocols

TEAM A
New Chief of the Department
New Fellow
New NNP
Consultant





TEAM B
Everyone Else

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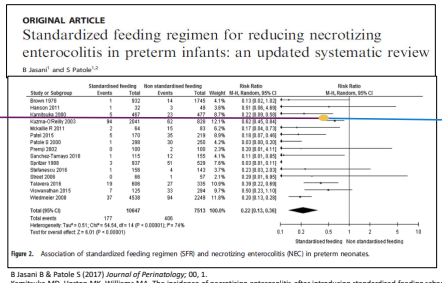
A Short History of Feeding Guidelines in the NICU

The risk of NEC was reduced 84% after the introduction of feeding protocols

FEEDING PROTOCOL



ORIGINAL ARTICLE

Standardized feeding regimen for reducing necrotizing enterocolitis in preterm infants: an updated systematic review

B Jasani[1] and S Patole[1,2]

Study or Subgroup	Standardised feeding Events	Standardised feeding Total	Non standardised feeding Events	Non standardised feeding Total	Weight	Risk Ratio M-H, Random, 95% CI
Brown 1978	1	832	14	1745	4.1%	0.13 [0.02, 1.02]
Hansen 2011	1	32	3	48	3.6%	0.51 [0.06, 4.69]
Kamitsuka 2000	5	487	22	477	8.1%	0.22 [0.09, 0.55]
Kosma-O'Reilly 2003	84	2041	62	628	12.1%	0.42 [0.31, 0.56]
Mokelke R 2011	2	64	15	83	6.2%	0.17 [0.04, 0.73]
Patel 2015	5	170	35	219	0.9%	0.19 [0.07, 0.49]
Patole S 2000	1	280	30	268	4.2%	0.03 [0.00, 0.20]
Premji 2002	0	160	2	160	2.3%	0.20 [0.01, 4.11]
Sanchez-Tamayo 2018	1	115	12	155	4.1%	0.11 [0.01, 0.85]
Sjoblan 1999	3	837	51	528	7.6%	0.03 [0.01, 0.11]
Stefanescu 2018	1	156	4	143	3.7%	0.23 [0.03, 2.03]
Sheet 2008	0	88	1	57	2.1%	0.20 [0.01, 8.09]
Teixeira 2018	19	806	27	335	10.9%	0.39 [0.22, 0.69]
Viswanathan 2015	7	125	33	264	9.7%	0.50 [0.23, 1.10]
Wiedmeier 2008	37	4538	94	2249	11.8%	0.20 [0.13, 0.28]
Total (95% CI)		10647		7513	100.0%	0.22 [0.13, 0.36]
Total events	177		406			

Heterogeneity: Tau² = 0.51; Chi² = 54.54, df = 14 (P < 0.00001); I² = 74%
Test for overall effect: Z = 6.01 (P < 0.00001)

Risk Ratio: M-H, Random, 95% CI
0.1 0.2 0.5 1 2 5 10
Standardised feeding Non standardised feeding

Figure 2. Association of standardized feeding regimen (SFR) and necrotizing enterocolitis (NEC) in preterm neonates.

B Jasani B & Patole S (2017) *Journal of Perinatology*; 00, 1.
Kamitsuka MD, Horton MK, Williams MA. The incidence of necrotizing enterocolitis after introducing standardized feeding schedules for infants between 1250 and 2500 grams and less than 35 weeks of gestation. *Pediatrics*. 2000;105(2):379-384. doi:10.1542/peds.105.2.379

The incidence of NEC was reduced by 77% with the use of an Exclusive Human Milk Diet

EXCLUSIVE HUMAN MILK DIET

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Definitions of Feeding Intolerance

- Specific/Measurable/Consistent
  - Patole, et al.

"The ability to achieve full enteral feeding volume of 140 mL/kg/day by 10 days after initiation of enteral feedings regardless of gestational age."

SOURCE: Moore, TA & Wilson, ME (2011). Feeding Intolerance: A Conceptual analysis. *Advances in Neonatal Care,* 11:3, pp.149-154.22

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Definitions of Feeding Intolerance

- Specific/Measurable/Consistent
  - Corpeleijn et al.

"Determined feeding intolerance by measuring the number of days required for the infant to reach full enteral feedings as well as the number of days required to regain their birthweight."

SOURCE: Moore, TA & Wilson, ME (2011). Feeding Intolerance: A Conceptual analysis. *Advances in Neonatal Care,* 11:3, pp.149-154.23

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Definitions of Feeding Intolerance

- Specific/Measurable/Consistent
  - Cochrane Collaborative

"Defined as the number of days required for the infant to reach full enteral feedings without any parenteral nutrition.

SOURCE: Moore, TA & Wilson, ME (2011). Feeding Intolerance: A Conceptual analysis. *Advances in Neonatal Care,* 11:3, pp.149-154.24

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Definitions of Feeding Intolerance

- Specific/Measurable/Consistent
  - Moore and Wilson

"Feeding intolerance in the premature infant is the inability to digest enteral feedings…and the disruption of the patient's feeding plan".

SOURCE: Moore, TA & Wilson, ME (2011). Feeding Intolerance: A Conceptual analysis. *Advances in Neonatal Care*, 11:3, pp.149-154.25

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Redefining Feeding Intolerance (FI)

"Individual interpretation of signs of feeding intolerance (FI) represents one of the most uncontrollable variables in the early nutritional management of these infants, and may lead to suboptimal nutrition, delayed attainment of full enteral feeding and prolonged intravenous nutrition supply."

SOURCE: Moore, TA & Wilson, ME (2011). Feeding Intolerance: A Conceptual analysis. *Advances in Neonatal Care*, 11:3, pp.149-154.26

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Improved Feeding Tolerance in VBLW Infants Fed an EHMD

METHOD

- Included 293 preterm infants ≤ 28 weeks gestational age and/or ≤ 1500 g (VLBW) from March 2009 until March 2014
- Four different feeding groups:

Human	Bovine	Mixed	Formula*
Average Gestational Age 27.7 wks	Average Gestational Age 28.3 wks	Average Gestational Age 27.6 wks	Average Gestational Age 30 wks
Entirely human milk-based (Prolact+ H²MF®) 30% n=87	Bovine fortifier and maternal milk (No DM or formula) 43% n=127	Mixed combination of maternal milk, bovine fortifier, and formula 17% n=49	Formula fed infants 10% n=30

293 Preterm and/or VLBW Infants

SOURCE: Assad M, Elliott MJ, Abraham JH. Decreased cost and improved feeding tolerance in VBLW infants fed an exclusive human milk diet. *J Perinatol*. 2016;36(3):216-220. doi.org/10.1038/jp.2015.168

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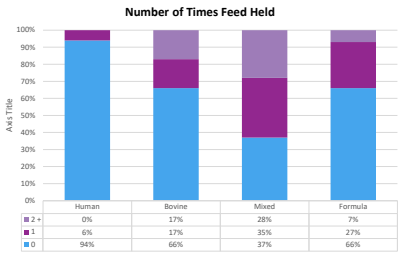
Improved Feeding Tolerance in VBLW Infants Fed an EHMD



Feeding intolerance was significantly worse in all groups compared with the human milk group

Fisher's exact test (P<0.001) for all groups, N = 293.

SOURCE: Assad M, Elliott MJ, Abraham JH. Decreased cost and improved feeding tolerance in VBLW infants fed an exclusive human milk diet. *J Perinatol*. 2016;36(3):216-220. doi.org/10.1038/jp.2015.168

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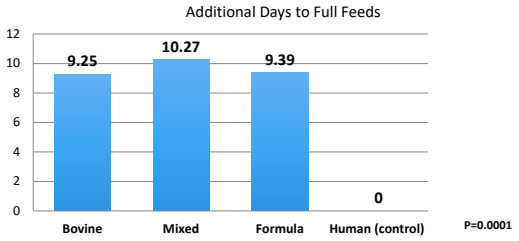
Improved Feeding Tolerance in VBLW Infants Fed an EHMD



SOURCE: Assad M, Elliott MJ, Abraham JH. Decreased cost and improved feeding tolerance in VBLW infants fed an exclusive human milk diet. *J Perinatol*. 2016;36(3):216-220. doi.org/10.1038/jp.2015.168

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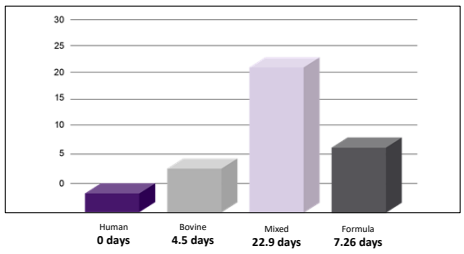
Improved Feeding Tolerance in VBLW Infants Fed an EHMD



SOURCE: Assad M, Elliott MJ, Abraham JH. Decreased cost and improved feeding tolerance in VBLW infants fed an exclusive human milk diet. *J Perinatol*. 2016;36(3):216-220. doi.org/10.1038/jp.2015.168

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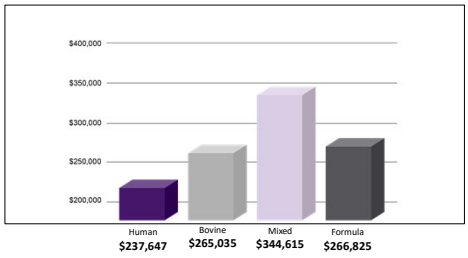
Improved Feeding Tolerance in VBLW Infants Fed an EHMD



SOURCE: Assad M, Elliott MJ, Abraham JH. Decreased cost and improved feeding tolerance in VBLW infants fed an exclusive human milk diet. *J Perinatol.* 2016;36(3):216-220. doi.org/10.1038/jp.2015.168

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Improved Feeding Tolerance in VBLW Infants Fed an EHMD

- **Neonatal Co-Morbidities N=293**

	Human	Bovine	Mixed	Formula	
Total	87(30%)	127 (43%)	49 (17%)	30 (10%)	
ROP	11 (14%)	40 (32%)	19 (40%)	4 (14%)	<0.001
BPD	13 (15%)	30 (24%)	21 (42%)	3 (10%)	<0.001
GA wks (+/-SD)	27.7(±2.7)	28.3(±2.8)	27.6(±2.8)	29.8(±2.5)	<0.002
Growth Velocity g/kg/d (+/-SD)	11.6(±2.7)	11.6 (±2.5)	11.2(±3.0)	12.1(±3.2)	0.377

SOURCE: Assad M, Elliott MJ, Abraham JH. Decreased cost and improved feeding tolerance in VBLW infants fed an exclusive human milk diet. *J Perinatol.* 2016;36(3):216-220. doi.org/10.1038/jp.2015.168

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"Measure What Matters"

Clinimetrics

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Poll Time

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Feeding Intolerance: *"Why Do We Tolerate It?"*

"Feeding intolerance is very common, especially in the VLBW infants weighing less than 1500 g at birth."

"Interpretation of signs of intolerance is one of the most uncertain and undefined problems in the nutritional care of these infants."

"Feeding intolerance is a major problem in preterm infants, but we lack adequate tools to quantify this."

SOURCE: 1- Neu J, Zhang L. Feeding intolerance in very-low-birthweight infants: what is it and what can we do about it? *Acta Paediatr Suppl.* 2005;99 (449):93. 2- Fanaro S (2013). Feeding intolerance in the preterm infant. Early Human Development. Volume 89, supplement 2; S13-S20. https://doi.org/10.1016/j.earlhumdev.2013.07.013 ; 3- Neu J. Gastroenterology and Nutrition: Neonatology Questions and Controversies, second edition (2012). Philadelphia, PA: Elsevier Saunders.

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Clinimetrics

measure what matters

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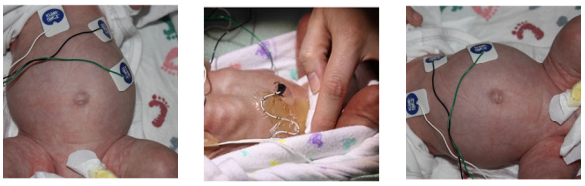
Clinimetrics: Accuracy and Precision (Reliability) Feeding Intolerance

ABDOMINAL DISTENTION

Descriptive Options: ***distended, full, round,*** **and** ***flat***



#1 **#2** **#3**

SOURCE: Moore TA & Pickler RH E(2013) Evaluating the precision of clinical assessments for feeding intolerance. *Newborn & Infant Nursing Reviews*. 13; 184-188. https://doi.org/10.1053/j.nainr.2013.09.005

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Clinimetrics: Accuracy and Precision (Reliability) Feeding Intolerance

STAGED EMESIS

Descriptive Options: ***small, moderate, large,;5 mL, 10 mL, 15 mL*** **and** ***20 mL***

#1 **#2** **#3**

SOURCE: Moore TA & Pickler RH E(2013) Evaluating the precision of clinical assessments for feeding intolerance. *Newborn & Infant Nursing Reviews*. 13; 184-188. https://doi.org/10.1053/j.nainr.2013.09.005

Add a footer

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Clinimetrics: Accuracy and Precision (Reliability) Feeding Intolerance

#1

#2

#3

ABDOMINAL DISTENTION

	Distended	Full	Round	Flat
Photograph #1	15%	52%	0%	33%
Photograph #2	0%	0%	46%	54%
Photograph #3	30%	59%	11%	0%

SOURCE: Moore TA & Pickler RH E(2013) Evaluating the precision of clinical assessments for feeding intolerance. *Newborn & Infant Nursing Reviews*. 13; 184-188. https://doi.org/10.1053/j.nainr.2013.09.005

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Clinimetrics: Accuracy and Precision (Reliability) Feeding Intolerance

#1

#2

#3

"STAGED" EMESIS

	Small	Moderate	Large	x1	5 mL	10 mL	15 mL	20 mL
#1 Actual amt = 5 mL	72%	2%	0%	54%	24%	0%	0%	0%
#2 Actual amt = 10 mL	17%	33%	13%	8%	59%	15%	2%	0%
#3 Actual amt = 20 mL	26%	28%	4%	6%	65%	15%	0%	0%
Years of clin. experience	<5 years	5-10 years	> 10 years					
	35%	15%	20%					

SOURCE: Moore TA & Pickler RH E(2013) Evaluating the precision of clinical assessments for feeding intolerance. *Newborn & Infant Nursing Reviews*. 13; 184-188. https://doi.org/10.1053/j.nainr.2013.09.005

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Clinimetrics: Accuracy and Precision (Reliability) Feeding Intolerance

- **Discussion**
  - First study to examine the precision of the physiologic clinical signs associated with FI
  - NICU nurses developed a wide variability of interpretation and how they charted
  - No relationship between interpretation of observations and years of experience
  - Lack of consistency across nurses may result in a missed "warning sign"
  - May result in failure of communication across the team to act
  - Can result in "failure to protect"

SOURCE: Moore TA & Pickler RH E(2013) Evaluating the precision of clinical assessments for feeding intolerance. *Newborn & Infant Nursing Reviews*. 13; 184-188. https://doi.org/10.1053/j.nainr.2013.09.005

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Clinimetrics for Feeding Intolerance (FI)

- **GRVs v. AGM in Assessment of Feeding Tolerance**
  - To compare prefeed aspiration for GRV and prefeed measurement of abdominal girth (AG) in time taken to reach full feeds in preterm infants
    - GA of 27-37 weeks; W of 750-2000 g
    - Required gavage feeds for at least 48 hours
    - Randomized to 24 infants in each group
    - AG group had only prefeed AG measured
    - GRV group had only prefeed gastric aspiration obtained
  - Primary outcome
    - Time to reach full enteral feeds at 150 mL/kg/d, tolerated for at least 24 hours

SOURCE: Shemi T et al., Gastric residual volumes verses abdominal girth measurement of feed tolerance in preterm neonates. *Advances in Neonatal Care* : August 2018 - Volume 18 - Issue 4 - p E13–E19 doi: 10.1097/ANC.0000000000000532

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Clinimetrics for Feeding Intolerance (FI)

- **GRVs v. AGM in Assessment of Feeding Tolerance**
  - Primary and secondary outcomes

Outcomes	GRV (n=24) Median (IQR)	AG (n=26) Median (IQR)
Time to reach full feeds, d	9.5 (6.75-13.0)	6(5-7.75)
Episodes of FI	0.5 (0.1)	0 (0-1)
No. of feeds withheld	0 (0-15)	0 (0-1.25)
Duration of hospital stay, d	30 (14.25-38.75)	21 (13-27)
Duration of PN, d	5.5 (3-11.75)	5 (3-7)
Sepsis, n	5	4
NEC, n	1	0

Recommendations for Practice and Research

- **There is not enough robust evidence to suggest that increased GRV is predictive for NEC**
- **Checking for GRV delays time to full feeds.**
- AG measurement is safe and helps preterm neonates reach full enteral feeds.
- Use AG measurements to assess feeding tolerance and not check for GRV.

SOURCE: Shemi T et al., Gastric residual volumes verses abdominal girth measurement of feed tolerance in preterm neonates. *Advances in Neonatal Care* : August 2018 - Volume 18 - Issue 4 - p E13–E19 doi: 10.1097/ANC.0000000000000532

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Clinimetrics for Evaluating Feeding Intolerance (FI)

History Behind Assessment of GRVs

- ***Aspiration and evaluation of GRs thought to accomplish three things***
  - Confirm correct placement of the orogastric/nasogastric OG/NG tube;
  - Monitor whether the previous feeding remains in the stomach;
  - Prevent aspiration of gastric contents which may contribute to ventilator associated pneumonia (VAP);

Emerging Evidence Regarding GRVs

- ***There is insufficient evidence that aspiration and evaluation of GRs***
  - Is a reliable indicator of OG/NG tube placement;
  - Assists in monitoring for feeding intolerance and NEC;
  - Prevents aspiration of gastric contents;

SOURCE: Parker L, Torrazza RM, Li Y, Talaga E, Shuster J, and Neu J. 2015. Aspiration and evaluation of gastric residuals in the NICU: State of the Science. *J Perinat Neonatal Nurs*. 29(1): 51-59. doi:10.1097/JPN.000000000000080.

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Clinimetrics for Evaluating Feeding Intolerance (FI)

GRV

- ***The absence of GR does not indicate malposition of the feeding tube***
  - Gastric residual volume is influenced by body position
  - The size of the tube also influences GR volume (LG bore 2-3Xmore)
  - 38% of attempts fail to obtain any aspirate

GRV

- Aspiration of GRs may damage the gastric mucosa from negative suction
  - Aspirated GRs underestimate the actual content volume by 19%
  - Only 4% of nurses consistently refed GRs → in loss of HCL, pepsin
- ***96% of clinicians cite GRs as the main determinate in feeding decisions***

SOURCE: Parker L, Torrazza RM, Li Y, Talaga E, Shuster J, and Neu J. 2015. Aspiration and evaluation of gastric residuals in the NICU: State of the Science. *J Perinat Neonatal Nurs*. 29(1): 51-59. doi:10.1097/JPN.000000000000080.

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Redefining Feeding Intolerance (FI)

- Therapeutic window is the time range between injury and treatment during which the treatment is still effective
- As the disease progresses, the therapeutic window narrows and closes
- ***And the patient's risk of death and/or significant morbidity increases***

Aspirates

Girths

Question of Sensitivity

Question of Specificity

SOURCE: https://www.sciencedirect.com/topics/medicine-and-dentistry/therapeutic-window

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"NEC-Zero Toolkit"

A Potential Model for Feeding Intolerance?

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NEC-Zero Toolkit (2020)

- **Model to Increase Access/Integration of EB Tools Into Bedside Care**
  - Historically evidence took time and was "unit-based"
  - High reliability organizations f(HROs) focus on the concept of "zero"
  - Certain things "never" happen
  - Effort to accomplish this is "worth the cost"
  - HROs s signs, scripts, huddles – "bundles" and other safety interventions
- **Used TRIP (Translating Research Into Practice) Model**
  - Operate with organizational systems
  - Tailoring communication strategies
  - Align with clinical workflow
  - Promote family engagement
  - Strategies were ow cost and minimally controversial

What can we learn from the NEC-Zero Toolkit that can help us in preventing FI?

SOURCE: Gephart SM et al., (2020). Development of the NEC-Zero Toolkit: Supporting reliable implementation of necrotizing enterocolitis prevention and recognition. *Neonatal Network,39:01; 6-15.* http://dx.doi.org/10.189/0730-0832.39.1.6

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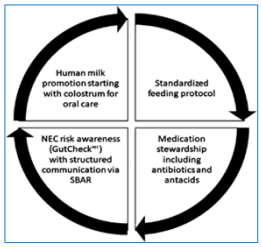
NEC-Zero Toolkit (2020)

- **The NEC–Zero Bundle**



SOURCE: Gephart SM et al., (2020). Development of the NEC-Zero Toolkit: Supporting reliable implementation of necrotizing enterocolitis prevention and recognition. *Neonatal Network,39:01; 6-15*. http://dx.doi.org/10.189/0730-0832.39.1.6

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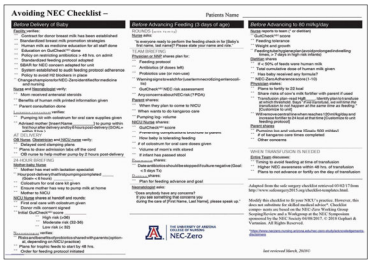

Avoiding NEC Checklist – Patients Name

Before Delivery of Baby	Before Advancing Feeding (3 days of age)	Before Advancing to 80 mlkg/day
Family ensures: Intent for donor breast milk has been established Standardized breast milk promotion strategies Human milk as medicine education for all staff done Standardized feeding protocol Policy on restricting antibiotics < 48 hrs. on admit Standardized feeding protocol adopted Policy to avoid H2 blockers in place System established to audit feeding protocol adherence Policy to avoid H2 blockers in place Nurse and Neonatologist verify: Mom's intent to breastfeed/pump/feeds Benefits of human milk protocol information given Parent consultation done Environmental/equipment verifier: Pumping kit with colostrum for oral care supplies given Breastfeeding/pump/feeding/oral care kit given Kitchen/coffee/drinks/snacks/[illegible] for pump mothers Pump/breastfeeding/oral care kit given (NICU, L&D, or antenatal Rm#) 24 HOUR BREFING OB Nurse - Neonatologist and NICU nurse verify: Delayed cord clamping plans Cord blood gas collected prior to cord off the cord OB nurse to help mother pump by 2 hours post-delivery 24 HOUR BREFING Neonatologist verifies: Mother has met with lactation specialist Hour post-delivery that first/subsequent pump completed Pump kit given Colostrum for oral care kit given Ensure mother has way to pump milk at home Mom's intent to pump NICU Nurse checks at handoff and daily: First oral care with colostrum given Donor milk consent signed Initial Gut Check score: High risk (>08) Moderate risk (30-36) Low risk (< 30) Documentation verifier: Protocol/medication/nutrition/antibiotics/phenol/H-parenteral/option-al, depending on NICU practice) Ensure Gut Check score is < 30 at 48 hrs. Order for feeding protocol initiated	Nurse verifies: Gut Check score (score must be 30) Nurse verifies: "Is everyone ready to perform the feeding check-in for [Baby's first name, last name]? Please state your name and role." Nurse verifies: Physician or NNP checks plan for: Feeding protocol Antibiotics (if doses left) Probiotics use (or non-use) Nursing/pharmacists/RN/Lactation/neonatologist/nutrition-ist Nurse: GutCheck™ NEC risk assessment Nutrition/Lactation/NICU/L&D/PRN/[illegible] Parent shares: When they plan to come to NICU When wants to do kangaroo care Pumping log: volume Nutrition/Lactation: GutCheck™ score Promoting complications (emotional or parent) How baby is tolerating feeding # of colostrum for oral care doses given Mom's intent to pump/feed/[illegible] If intent has passed about Documentation verifier: Feeding should be stopped if culture negative (Dead-line 48 hrs.) Documentation verifier: Plan for feeding advance and goal Neonatologist notes: Is there anything else any concerns? If any risk identified that contains only during the care of [First Name, Last Name], please speak up."	Nurse checks in: Gut Check score (< or = mentor) Nurse verifies: Feeding tolerance Weight and growth Nutrition/Lactation/Neonatologist/pediatrician/feeding team, (< 7 days in high risk volume) Nutrition/Lactation: If > 50% of feeds were human milk Total cumulative dose of human milk given Has baby received any formula? Gut Check (Enterocolitis score) (< 10) Physician states: Plans to family to 20 kcal Plans to family to 20 kcal/oz, whether with parent if used Transfusion plan-start high ____ (specify plan-to transfuse at which threshold. Base PCV/Hct/Hemoglobin, not volume (by weight) or Hct/Hemoglobin, not volume (by weight) (Transfusion to-ol) Transfusion plan-start high ____ (specify plan-to transfuse at which threshold. Base PCV/Hct/Hemoglobin, not volume (by weight) or Hct/Hemoglobin, not volume (by weight) (Transfusion to-ol) Nutrition/Lactation/Neonatologist/pediatrician (ID/Hemo/Ophthalmo and Surgeons further to 24 hours at that time (ID/Lactation to-ol) (Transfusion to-ol) Parent shares: Plumpsize loss and volume (Glasks 600 mlkkd) Mom's intent to pump/feed/[illegible] Other concerns WHEN TRANSFUSION IS NEEDED Entire Team discusses: Higher NEC awareness feeding at time of transfusion Higher NEC awareness within 48 hrs. of transfusion Plans to not advance or fortify on the day of transfusion

SOURCE: Gephart SM et al., (2020). Development of the NEC-Zero Toolkit: Supporting reliable implementation of necrotizing enterocolitis prevention and recognition. *Neonatal Network,39:01; 6-15*. http://dx.doi.org/10.189/0730-0832.39.1.6

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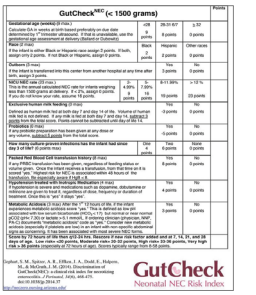
NEC-Zero Toolkit (2020)

- **The NEC–Zero Bundle**



GutCheck^{NEC} (< 1500 grams)

				Points
Gestational age (weeks) (9 max) Gestational age is most accurate if based preferably on due date (ultrasound), or menstrual dates. If that is unreliable, use the gestational age assessment at delivery (Ballard or Dubowitz)	<28	28-31 6/7	≥ 32	
	9 points	6 points	0 points	
Race (2 max) If the infant is either Black or Hispanic race assign 2 points. If both, assign only 2 points. If not Black or Hispanic, assign 0 points.	Black	Hispanic	Other races	
	2 points	2 points	0 points	
Outborn (2 max) If the infant was transferred into this center from another hospital at any time after birth, assign 2 points.	Yes	No		
	2 points	0 points		
NICU NEC rate (20 max) This is the annual calculated NEC rate for infants weighing < 1500 grams in the NICU. Example: If at 5%, assign 6 points. If you do not know your rate, assume 16 points.	< 5%	7-20%	8-11.99%	> 12 %
	6 points	16 points	10 points	20 points
Exclusive human milk feeding (2 max) Defined as human milk fed at both day 7 and day 14 of life. Volume of human milk fed is not defined. If any milk is fed at both day 7 and day 14, subtract 2 points from the total score. Points cannot be subtracted until day of life 14.	Yes	No		
	-2 points	0 points		
If any probiotic preparation has been given at any dose or any volume, subtract 2 points from the total score.	Yes	No		
	-2 points	0 points		
Have many outlying glucose infusions has the infant had since day 3 of life? (6 points max)	One or more	Two or more	None	
	6 points	6 points	0 points	
Packed Red Blood Cell transfusion history (8 max) If any PRBC transfusion has been given, regardless of feeding status or feeding volume, assign 8 points. If the infant has been given a PRBC and is scored "yes" "Highest risk for NEC is associated within 48 hours of the transfusion. Its especially severe if FAR > 0.	Yes	No		
	8 points	0 points		
Pharmacologic Gastrointestinal Medication (4 max) If hypokalemia is severe and medications such as dopamine, dobutamine or milrinone are given to treat it, regardless of dose, frequency or duration of treatment. Circle this in "yes" if drugs "yes"	Yes	No		
	4 points	0 points		
Metabolic Acidosis (3 max) After the 1st 12 hours of life, if the infant has metabolic acidosis (defined as pH < 7.20 or base deficit > 8 mEq/L) associated with non-sun-fecalemmatic (NSFL) (< 1% fecal neutral or lower normal alkaline phosphatase (AP) or gamma glutamyl transferase (GGT) or direct bilirubin (DB)) circle this in "yes" Circle "no" if metabolic acidosis "cause" is not associated with non-specific enteroscopic ischemic (especially if probiotics are fed to an infant with non-specific enteroscopic ischemic (NSFL) or if the infant is receiving a PRBC transfusion.	Yes	No		
	0 points	0 points		
Score by 72 hours of life (Max 32) 24 hrs. Receive if new risk factor added and at 7, 14, 21, and 28 days of age. Low risk< ≤20 points, Moderate risk> 20-22 points, High risk> 23-26 points, Very high risk > 26 points (especially of 72 hours of age). Scores typically range from 6-28 points.				

Gephart, S. M., Spitzer, A. R., Effkan, J. A., Dodd, E., Halpern, M. D., Anton, B., Lake, E. T., Martin, C. R. (2014). GutCheck(NEC): a clinical risk index for neonatal enterocolitis. *J Perinatol, 34*(6), 468-475. doi:10.1038/jp.2014.37

http://nelson.nursing.wisc.edu/

GutCheck Neonatal NEC Risk Index

SOURCE: Gephart SM et al., (2020). Development of the NEC-Zero Toolkit: Supporting reliable implementation of necrotizing enterocolitis prevention and recognition. *Neonatal Network,39:01; 6-15*. http://dx.doi.org/10.189/0730-0832.39.1.6

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NEC-Zero Toolkit (2020)

- **The NEC–Zero Bundle**

Structured communication form for clinical concern when NEC is suspected

S — **Situation:** Purpose of call

Hello, this is _____ I am calling about _____ in room _____

Reason I have some concerns about his/her/ent/ent/ent

B — **Background:** All pertinent info factors and recent history

Gestational Age _____ Postnatal/GA _____ Day of Life _____

Birth Weight _____ Sex _____

Feeding type (EBM, fortified F and formula) _____

Transfusion within the last 48 hours? _____

Current Medications _____

A — **Assessment:** Give your conclusion about the present situation based on assessment

Is the patient concerned? Y N

Increase in apnea/bradycardia spells? Y N

Blood present in stool or emesis? Y N

Abdominal distension, tenderness or of abdomen? Only

(Circle appropriate statement) Y N

Change in abdominal girth > 1cm? Y N

Bowel sounds present? Y N

Feeding intolerance Residual > 4hrs, emesis, little tolerance? Y N

Emesis in last 24 hours? Y N

Feeding? Y N Change in gastric data (abs or perforated) Y N

Abdominal wall erythema? Y N

Thrombocytopenia? Y N Hypotensive? Y N

Temp<36.5 Or Temp>37.5 Hypo-metabolic/unstable? Y N

Significant increase in ventilator requirement? Y N

R — **Recommendation:** Clearly communicate – may differ with severity of situation or institutional policy

Ask to consulting about:

- Abdominal X-ray?
- Abdominal ultrasound?
- Come in to see baby?
- Change in feeding?

Content based on evidence about NEC and clinical presentation (Christensen et al., 2010; Gephart, Weitzel, & Kirstein, 2014; Gregory, Dabrowa, Nanda, Phillips, & Van Marter, 2011)

Christensen, R. D., Wiedmeier, S. E., Baer, V. L., Henry, E., Gordon, P., Lambert, D. K., … Besner, G. E. (2010). Associations of Bell stage III necrotizing enterocolitis. *J Perinatol, 30*(1), 54-57. doi:10.1038/jp.2009.102

Gephart, S. M., Weitzel, C., & Kirstein, B. (2014). Prevention and early recognition of necrotizing enterocolitis: a tale of 2 tools—NEC and GutCheckNEC. *Adv Neonatal Care, 14*(3), 201-210; quiz 211-202. doi:10.1097/anc.0000000000000062

Gregory, K. E., Dabrowa, N., Nanda, S., Phillips, R., & Van Marter, L. J. (2011). Necrotizing enterocolitis in the premature infant: neonatal nursing assessment, disease pathogenesis, and clinical presentation. *Adv Neonatal Care, 11*(3), 155-164; quiz 165-156. doi:10.1097/ANC.0b013e31213ea4f4

SOURCE: Gephart SM et al., (2020). Development of the NEC-Zero Toolkit: Supporting reliable implementation of necrotizing enterocolitis prevention and recognition. *Neonatal Network,39:01; 6-15*. http://dx.doi.org/10.189/0730-0832.39.1.6

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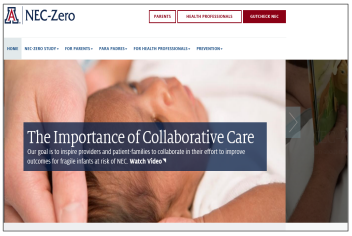

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Collaborate with Clinical Experts

Nursing Practice npac Advisory Council

NICU Nurse Support for the

- **NNP, CNS, RN, NICU Manager**
  NPAC@prolacta.com

NAC Nutrition Advisory Committee

NICU Dietitian Support
NAC@prolacta.com
Linkedin.com/groups/7037835/

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