The Future is Now: Earlier Discharge of the Dysfunctional Feeder

Anna Ermarth MD, MSc
Clinical Associate Professor
University of Utah, SFESOM

Kristin Brinker, CCC-SLP,
Neonatal Therapist
Primary Children's Hospital,
Intermountain Health

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DISCLOSURES

- Neither Dr. Ermarth nor Ms. Brinker have financial disclosures or conflicts of interest
- Our program works out of both Intermountain Health and University of Utah
- Author and Co-Author of topic – including published content

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OBJECTIVES

- 1. Identify risk factors for prolonged feeding dysfunction of NICU neonates.
- 2. Understand advantages & safety outcomes of earlier home discharge from the NICU.
- 3. Understand the post-discharge feeding needs for infants on feeding tubes.

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THANK YOUs

- “Ultimate Teams Experience:” ***No Competition, Just Winning***

- 2025 NICU Tube Program = Home Enteral Feeding Transitions, “HEFT”
  - 5 MDs: 3 Outpatient, 2 Neonatologists
  - 1 NP Outpatient: Countless NNPs
  - 2 SLPs on outpatient side: 10+ Neonatal Therapists on Inpatient
  - 2 Dietitians on outpt, 3+ RDs on inpatient
  - 2 MAs for Clinic
  - Schedulers, Case Managers, Home Health therapists, Pediatricians, etc etc

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THE FUTURE IS **NOW**

- We have evidence for SAFETY with NG/GT's and partial PO feeds at home
  - Evidence for safety of those <10% PO and NG
  - NG better than GT for complication rates
- We have evidence for EFFICACY of weaning NGT/GT at home
  - >67% babies will wean, <2 months post-DC; PO % matters, Neuro exam matters; maybe IVH doesn't matter
- We have better MODALITIES for care
  - Telehealth, remote monitoring, remote measurements
  - Thickener-based mechanisms

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HOW IT ALL BEGINS

INTRA-NICU outcomes

White et al (2018)

- Quarternary NICU: 1 in 3 discharged on
- GT, NG or NJ tube feeds
- CHD babies, 4-6 out of 10

Edwards et al. (2019)

- For infants born 29 - 34 week PMA
- **69%** of this population still required NICU hospitalization @ 36 weeks' PMA **due to feeding dysfunction ONLY**

Greene et al (2019)

- ~4% of infants had surgical GT placed before DC
- 10 out of 114 NICUS placed GTs >10% of infants
  - PCH SLC = 12% Median (2012—2022)

White et al, *J Ped Surg* 2018
Edwards et al, *J Perinatol* 2019

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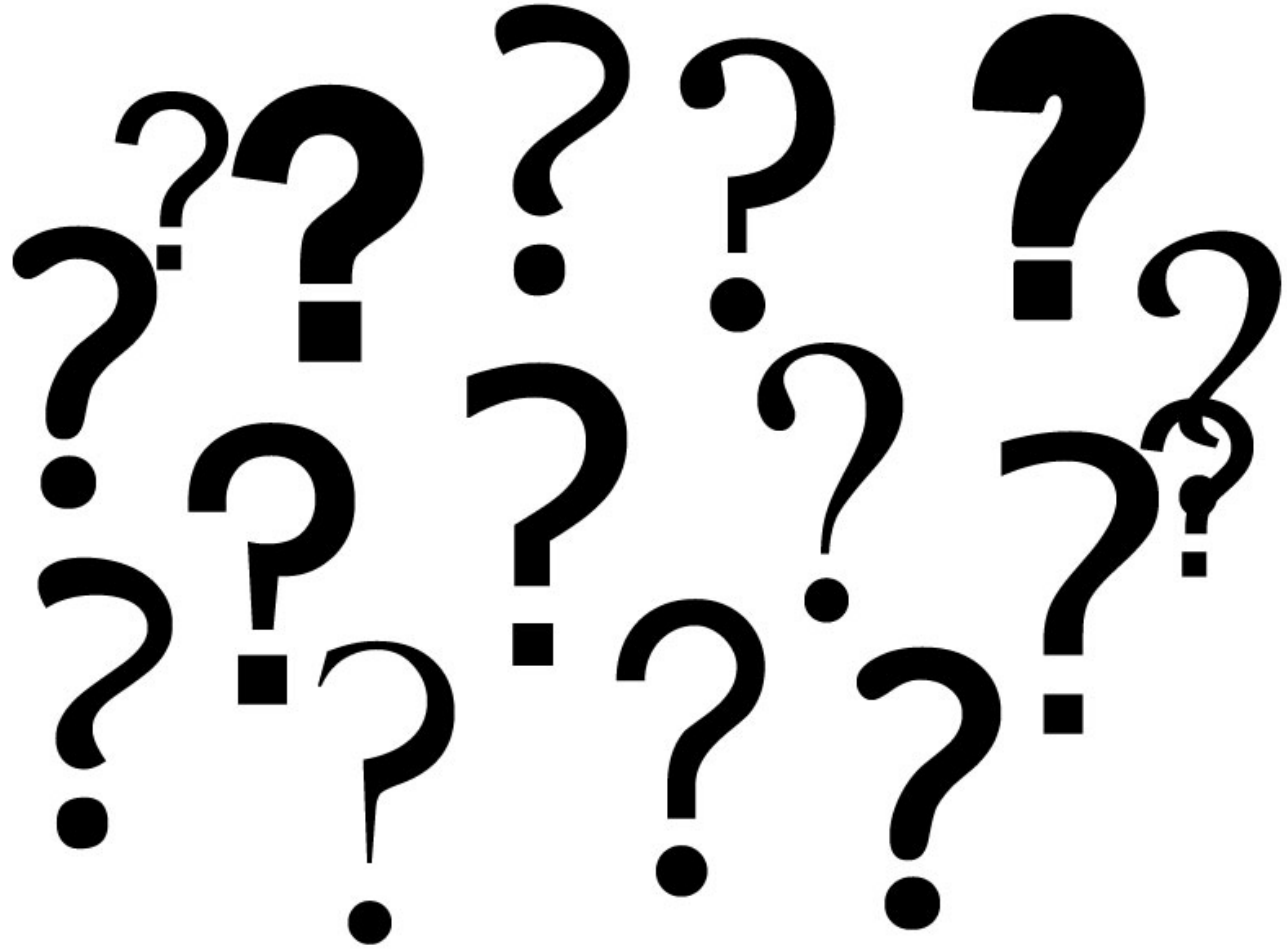
Why do we do this? – “The 3 whys”



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Why Do we Do this – Benefits to **PATIENT**

- Higher breastfeeding rates once home
- Reduced toxic stress to infant
- Shorter hospital stays = reduced risk of iatrogenic complications
- Favorable developmental outcomes

Why Do we Do this – Benefits to **Family**

- Reduced parental stress
- Parental Empowerment
- Provision of Family-centered care
- Emotional advantages out of the hospital

Why Do we Do this – Benefits **to System**

- **Denmark study:** Infants born <32 weeks saved
  - ~2100 Euros (~$1500/payer), this included costs for outpatient services post-DC

- **Utah study:** Using median time to NGT d/c as outpatient, NG/GT home-feeding program
  - ~13.5 days, would be over $27,000 per patient discharged (compared to last full day in NICU)
  - Using 2024 numbers, saved > $4,000,000 of hospital costs

- Improved turnover time of ICU bed availability

What were the risks/Concerns to early tube discharge programs?

- Aspiration and its sequelae
- Parental mismanagement of equipment
- Poor growth/malnutrition
- Readmissions/ER visits/hospitalizations

Why We Do This: It's Safe!

- 2018 White & 2017 Khalil et al
  - 2-15% readmitted for feeding tube related issue
  - 33-48% presented for ER visit
    - GT >>NGT
  - No support programs

- 2020: HEFT support
  - 13% ER or Hosp admission**
    - 4%, GT reason, 2% NGT reason

EXPOSURE INCIDENCE per **500 days**
(n = 182)

1.6 ER visits

0.8 hosp admissions

** No Dermatitis

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Earlier DC risks – 2024, van Hasselt et al.

- ~5% of infants will be readmitted to the ICU
- Vast majority of these are respiratory and/or issues
- Earlier PMA at birth and LOS not necessarily a risk factor for readmission

UK Cohort: 46,600+ infants

Neonatal discharge timing			
Earlier (<25th centile PMA)	9950 (26.1)	485 (25.8)	
Expected (≥25th to <75th centile PMA)	18 520 (48.7)	835 (44.5)	<.001
Late (≥75th centile PMA)	9590 (25.2)	558 (29.7)	

Respiratory or Cardiovascular;
Apnea = #9 (2%),
Aspiration PNA = #15 (1%)

van Hasselt TJ, Wang Y, Gale C, et al., *JAMA Netw Open*. 2024

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Earlier D/C NICU programs

(adapted Ermarth & Ling, 2022)

PROGRAM	SIZE (est/yr)	TUBE	EXCLUDED INFANTS	PO min	PMA min	Follow-up Care	Time to tube wean, median days (n)	Tube AE's
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Mago-Shah, North Carolina, USA (2013-17)	163 (40)	NGT or GT	Not discharged from NICU; not GT candidates	50%	>36 wk	PCP w/in 2 days, Post-NICU clinic	12 (40)	0 for NGT
Williams, Ohio, USA (2016-17)	260 (173)	NGT or GT	Non-gastric feedings, TPN, GT within 7 days admission, hospice	50%	No limit	PCP +/- Post-NICU clinic	<60 (140)	NGT < GT
Ermarth, Utah, USA (2016-18)	183 (122)	NGT or GT	Craniofacial abnormalities, CICU patients, non-gastric feedings, TPN	None	>37 wk	GI/therapy/dietitian clinic	27 (106)	NGT < GT
Schuler, Germany, EU (2017-18)	119 (60)	NGT only	None mentioned	50%	No limit	Post-NICU clinic, 24/7 telephone access	8 (47)	0 for NGT
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Bardach, New Hampshire, USA (2020)	14 (30)	NGT	DCFS child, oxygen use, congenital anomalies	30%	35	Daily telehealth rounds, remote pulseOx, home scale	13 (14)	0
Fisher, Oregon, USA (2023)	104 (34)	NGT	No PO, parental refusal of NGT, non English/Spanish speaker	30%	35	TH only, remote scale, NICU MD daily	5 (85%)	1

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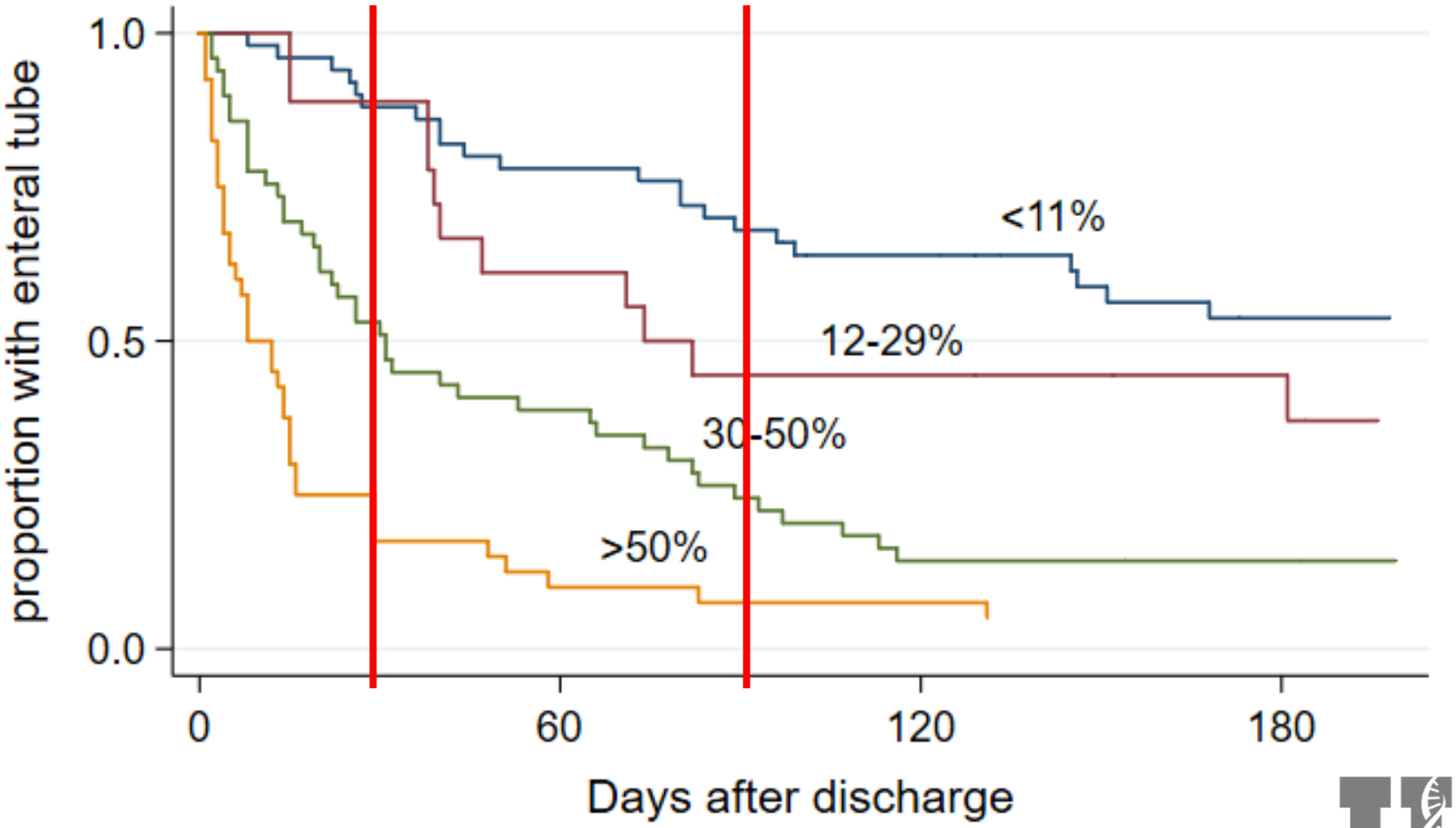
(adapted Ermarth 2020)

Tube Weaning: %PO @ discharge



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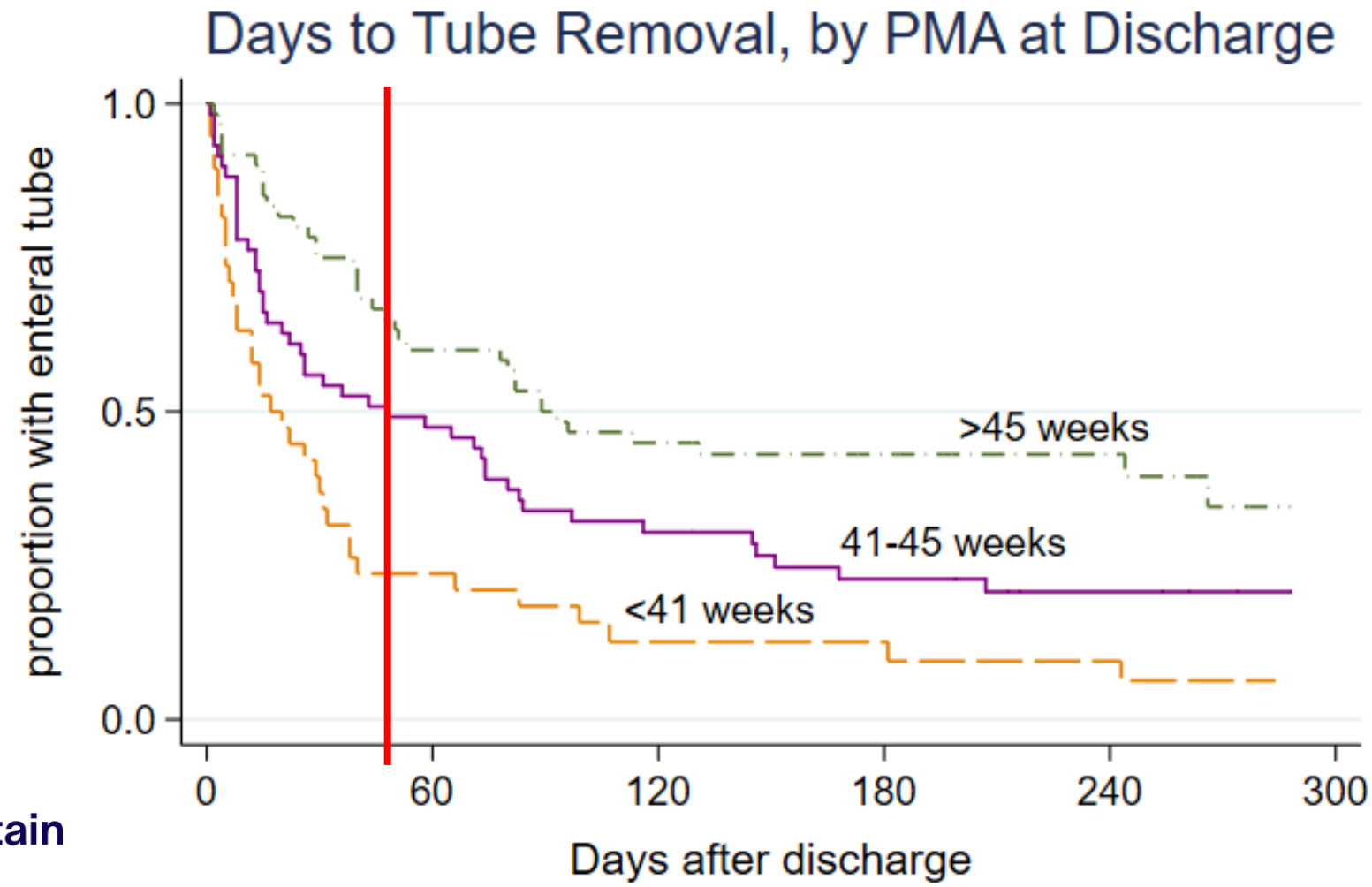
(adapted Ermarth 2020)

Tube Weaning: PMA @ Discharge



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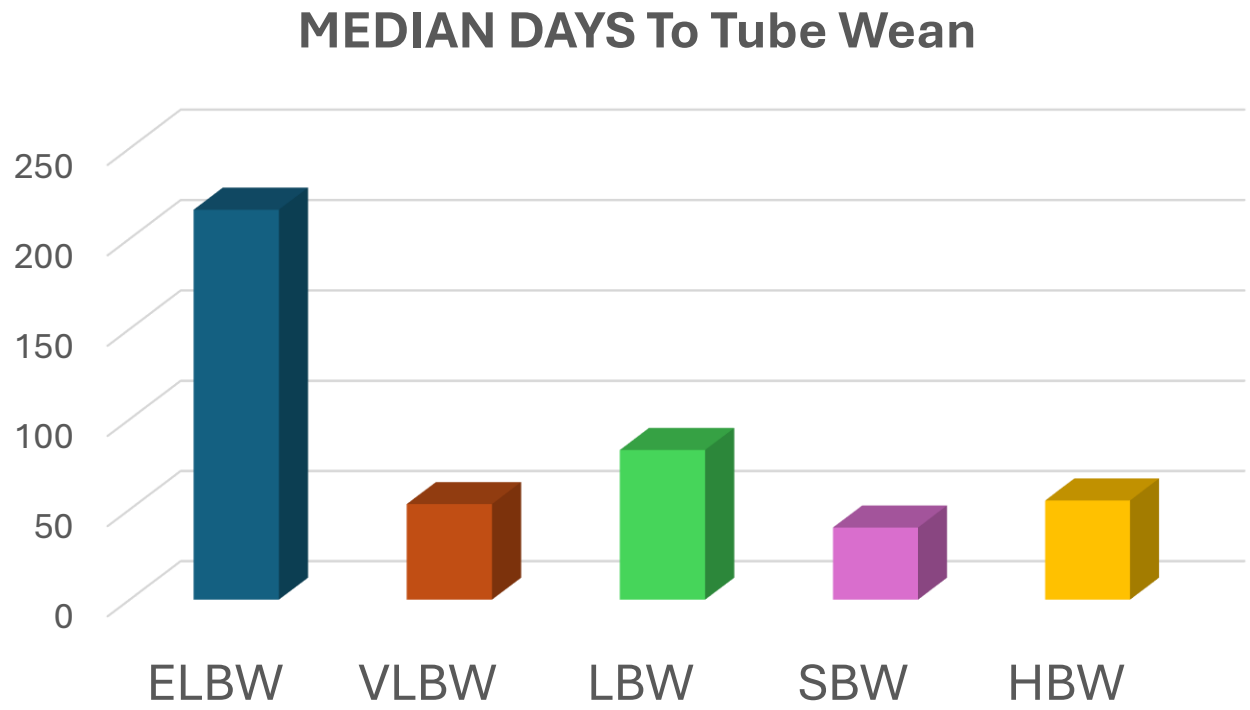
(adapted Ermarth 2020)

BW did NOT correlate w/ predictive tube wean

Table 2. Days to Tube Wean Based on Birth Weight Category.

Birth Weight Category, g	n (%)	Days After Discharge to Tube Wean, (IQR)
ELBW (<1000)	27 (15)	216 (65, 360)
VLBW (1000–1500)	23 (13)	53 (11, 123)
LBW (1501–2500)	44 (24)	83 (15, 266)
SBW (>2500–4000)	88 (48)	40 (15, 247)
HBW (>4000)	10 (6)	55 (19, 80)

ELBW, extremely low birth weight; HBW, high birth weight; IQR, interquartile range; LBW, low birth weight; SBW, standard birth weight; VLBW, very low birth weight.



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(adapted Ermarth 2020)

Smaller Weight at DC was protective of tube weaning

NICU WEIGHT TRENDS ASSOCIATED WITH SUCCESSFUL TUBE WEANING:

- BIRTHWEIGHT:
  - ***Larger BW*** trended toward tube weaning
    - 2510 g vs. 2270 g
- DISCHARGE WEIGHT
  - ***Smaller DC Weight*** trended toward tube weaning
    - 3700 g vs. 3975 g
    - Follows PMA data

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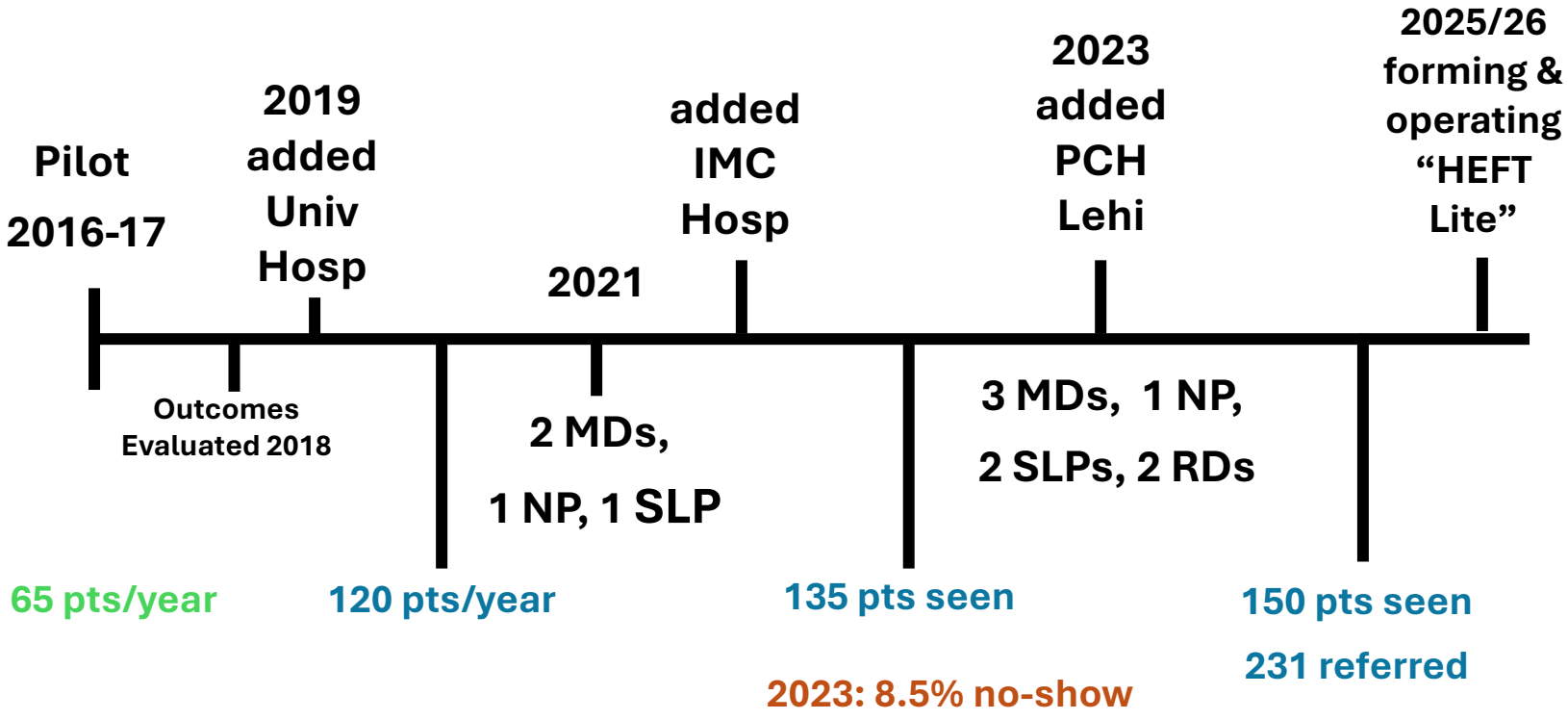
Pathway to Tube Weaning Program



2024: 28% no-show

Median PO of NS: 34%

Median PO Seen: 18%

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From NICU to Outpatient

How We Do It All:

A recipe for success

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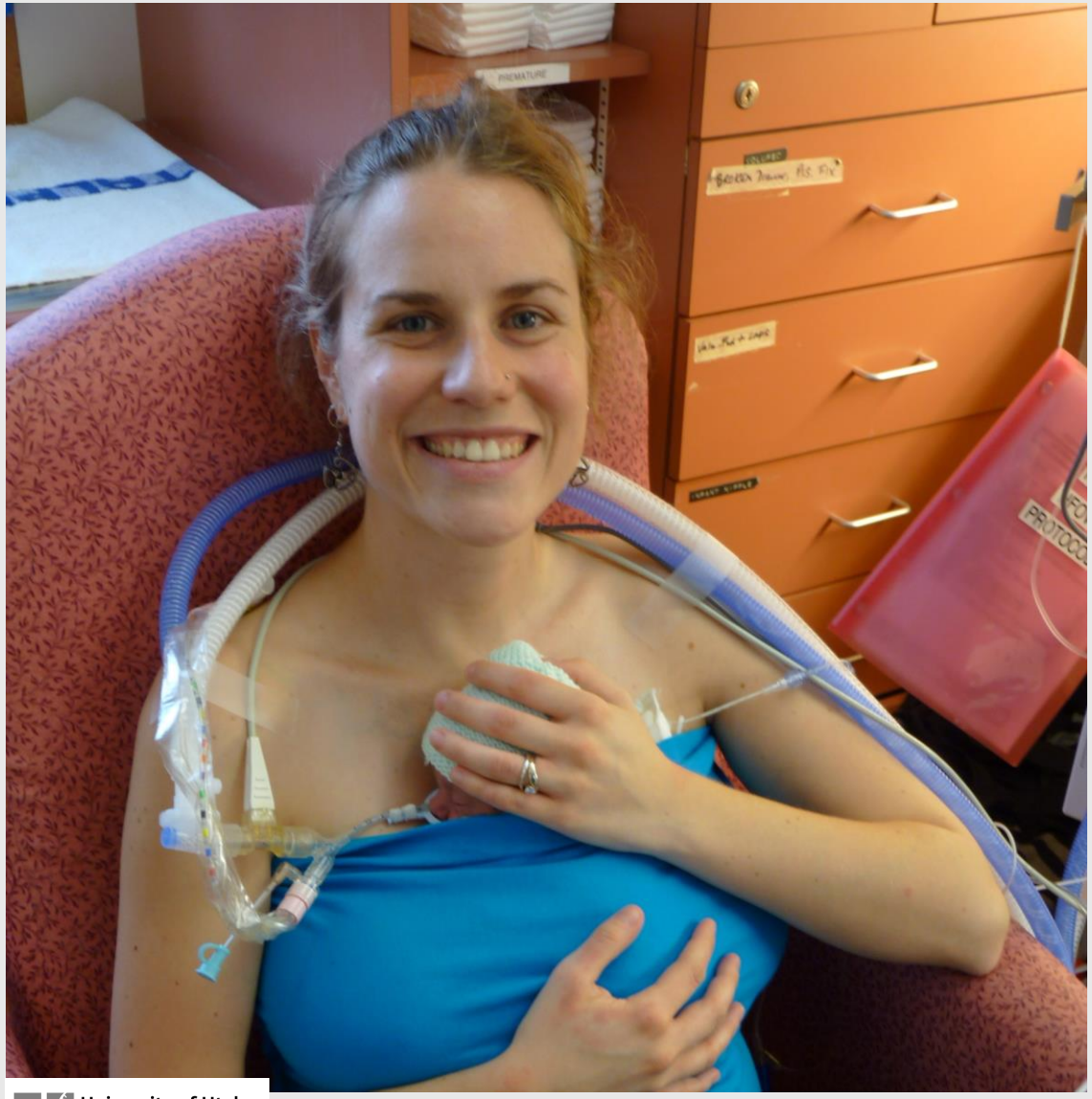

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Tube Weaning Starts in the NICU:

Neonatal Therapy

- Standard requirement for Level III/IV NICU
- Integrated, neuroprotective, family-centered model
- Provide individualized therapeutic interventions
- Support optimal long-term development, prevent adverse sequelae, and nurture the infant-family dyad

Neonatal Therapy Core Scope of Practice. [Core Scope of Practice]. Available from https://neonataltherapists.com/resources;
Pediatrics. 2023;151(6):e2023061957.

Tube Weaning Starts in the NICU:

Role of the therapy team

- Provide multidisciplinary expertise
  - Orders received for all infants on admission
  - Partner with family and medical team through the duration of the hospitalization
  - Provide objective assessment regarding infant feeding and development
  - Support cue-based oral feeding

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Neonatal Therapy Core Scope of Practice. [Core Scope of Practice]. Available from https://neonataltherapists.com/resources;

Tube Weaning Starts in the NICU

Speech Language Pathology

- Provides specialty-based dysphagia assessment
- Early recognition of dysphagia for infants is essential to the success of the home feeding plan
- Early diagnosis and treatment of feeding and swallowing difficulties is crucial for improving long-term pulmonary and feeding outcomes

Cue-Based Feeding: A Foundation for Positive Feeding

Traditional Feeding

- Volume-driven
- Timing and amount of oral feeding is prescribed by the medical team
- Infant's "stop signs" are typically disregarded
- Reduced quality of feeding when trying to "drink it all"

Cue-Based Feeding

- Quality-driven
- Timing and amount of oral feeding is a by-product of quality feeding
- Careful observation of the infant and responsive interventions
- Caregiver learns from the newborn what will be needed for neuroprotection and safety

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Semin Speech Lang. 2017;38(2):96-105.

Cue-Based Feeding is Neuroprotective Care

Negative feeding experiences while feeding is established

Sucking reflex integrates and feeding becomes voluntary

Increase in feeding disruptive behaviors and feeding refusal

Semin Speech Lang. 2017;38(2):96-105.

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Neurodevelopmental Assessment

What

- Prec
  - A
- NICU
  - Higher attention scores were associated with a shorter time to achieve full oral feeds
  - W
- Ha
  - S
- Bay
  - I

clinic

ARTICLE

Method of home tube feeding and 2–3-year neurodevelopmental outcome

Allison Fisher[1], Anna Ermarth[2], Con Yee Ling[1], Kristin Brinker[3] and Tara L. DuPont[1]

Feeding dysfunction in NICU patients with cramped synchronized movements

Anna Ermarth [a b], Kristin Brinker [d], Betsy Ostrander [a c]

J Perinatology, 2024, 1630–1634;
Early Human Development. 2023;187:105879.;
The Journal of Pediatrics. 2019;214:71-78.e2.;
Journal of Occupational Therapy. 2023;77(3):7703205170.

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Abnormal GMA + Feeding

Clinical characteristics	(+) CSM	Tube weaned group	Non-weaned group	*p* value*
n (%)	56	32 (57)	24 (43)	
Tube use at discharge, n (%)	42 (75)	18 (56)	24 (100)	<0.001
GT placed, n (%)	23 (41)	3 (9)	20 (83)	<0.001
Sex, male (%)	35 (63)	20 (63)	15 (63)	1.00
Birthweight, g (IQR)	1052 (735, 1746)	1065 (752, 1746)	1017 (691, 1762)	0.92
Gestational age at birth, weeks (IQR)	28 (25, 32)	28 (25, 31)	27 (25, 34)	0.69
LOS, days (IQR)	110 (65, 167)	98 (53, 141)	150 (83, 186)	0.02
PMA at discharge, weeks (IQR)	44 (41, 49)	43 (39, 45)	48 (43, 57)	<0.001
IVH, n (%)	30 (54)	16 (50)	14 (58)	0.59
ELBW, n (%)	26 (46)	14 (44)	12 (50)	0.64
PO at discharge, % (IQR)	30 (0, 98)	86 (32,100)	0 (0,10)	<0.001
Tube discharge, days (IQR)	74 (5, 365)	18 (0, 38)	n/a	
F/u Wt-for-length *Z* -score (IQR)	0 (−0.80, 0.74)	−0.01 (−0.76, 0.37)	0.40 (−0.94, 0.84)	0.37

Early Human Development. 2023;187:105879.;

General Movements Assessment and Feeding

MBS Results	CSM	F-
# of infants with MBS, n (%)	16/36 (44)	8/11 (73)
Silent Aspiration	9/16 (56)	4/11 (36)
0 (thin)	8/16 (50)	3/11 (27)
1 (slightly)	2/16 (13)	0/11 (0)
2 (mildly)	5/16 (31)	2/11 (18)
Sensate Aspiration	1/16 (6)	1/11 (9)
0 (thin)	1/16 (6)	1/11 (9)
1 (slightly)	0/16 (0)	0/11 (0)
2 (mildly)	0/16 (0)	0/11 (0)
Deep Penetration (aspiration risk)	2/16 (13)	1/11 (9)
0 (thin)	2/16 (13)	1/11 (18)
1 (slightly)	2/16 (13)	2/11 (18)
2 (mildly)	3/16 (19)	1/11 (18)
Pharyngeal Dysphagia	12/37 (32)	5/11 (45)

Brinker, Ermarth, & Ostrander (2023)

The Clinical Feeding Evaluation

Why standardized feeding assessment?

- The new diagnostic code for “Pediatric Feeding Disorder” requires that feeding-related specialists use valid and reliable assessment tools that capture the complexity of PFD.
- Subjective decision-making, trial and error
- Lack of consensus among the multidisciplinary members of the NICU team regarding best treatment

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The American Journal of Occupational Therapy. 2023;77(4):7704205110;
Front Pediatr. 2020;8:296.

Neonatal Eating Outcome (NEO)

- Flexible
  - Pre-term to 4-6 weeks post-term
  - Breastfeeding or bottle feeding
- Provides a risk assessment for feeding readiness
- Guides decision-making
- Allows comparison of intervention strategies

- SCALE = 18-90
  - Normal feeding = >77
  - Questionable = 58-76
  - Problem feeder = <57

The American Journal of Occupational Therapy. 2020;74(2):7402205050p1-7402205050p1

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Instrumental Assessment: Videofluoroscopic Swallowing Study (VFSS)

- If Clinical Concern w/ Bedside assessment → Perform/Order VFSS
  - A good screening tool
  - Not always *specific for aspiration*
- CAVEATS to using VFSS:
  - Only ordered after 38 weeks (approx.)
  - < 2L HFNC
  - Ability to accept ~10 mL OR non-nutritive sucking for at least 5 minutes with transitional suck bursts
  - Appropriate oral readiness cues at >50% of infant care times

International Journal of Pediatric Otorhinolaryngology. 2021;149:110856.

VFSS Techniques

- Intermittent imaging
  - Max exposure = 2:00
- pVFSS Value scale
- Familiar feeding method, Caregiver supported provided, comfortable positioning
- Graduated trials of liquid thickness
  - Thins → Mildly → Moderately

VFSS Value Scale

Participation

Crying

Volume taken

Bolus size Description

Method (age typical vs. altered)

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Am J Speech Lang Pathol. 2022;31(2):689-704.;
International Journal of Pediatric Otorhinolaryngology. 2020;138:110396.;

Penetration Vs. Aspiration
OR "…but the radiology report said **no aspiration**"

- Aspiration Risks
  - How often does it occur
  - Depth
  - Volume
  - Bedside symptoms
  - Tube dependence
  - Pulmonary health and risk

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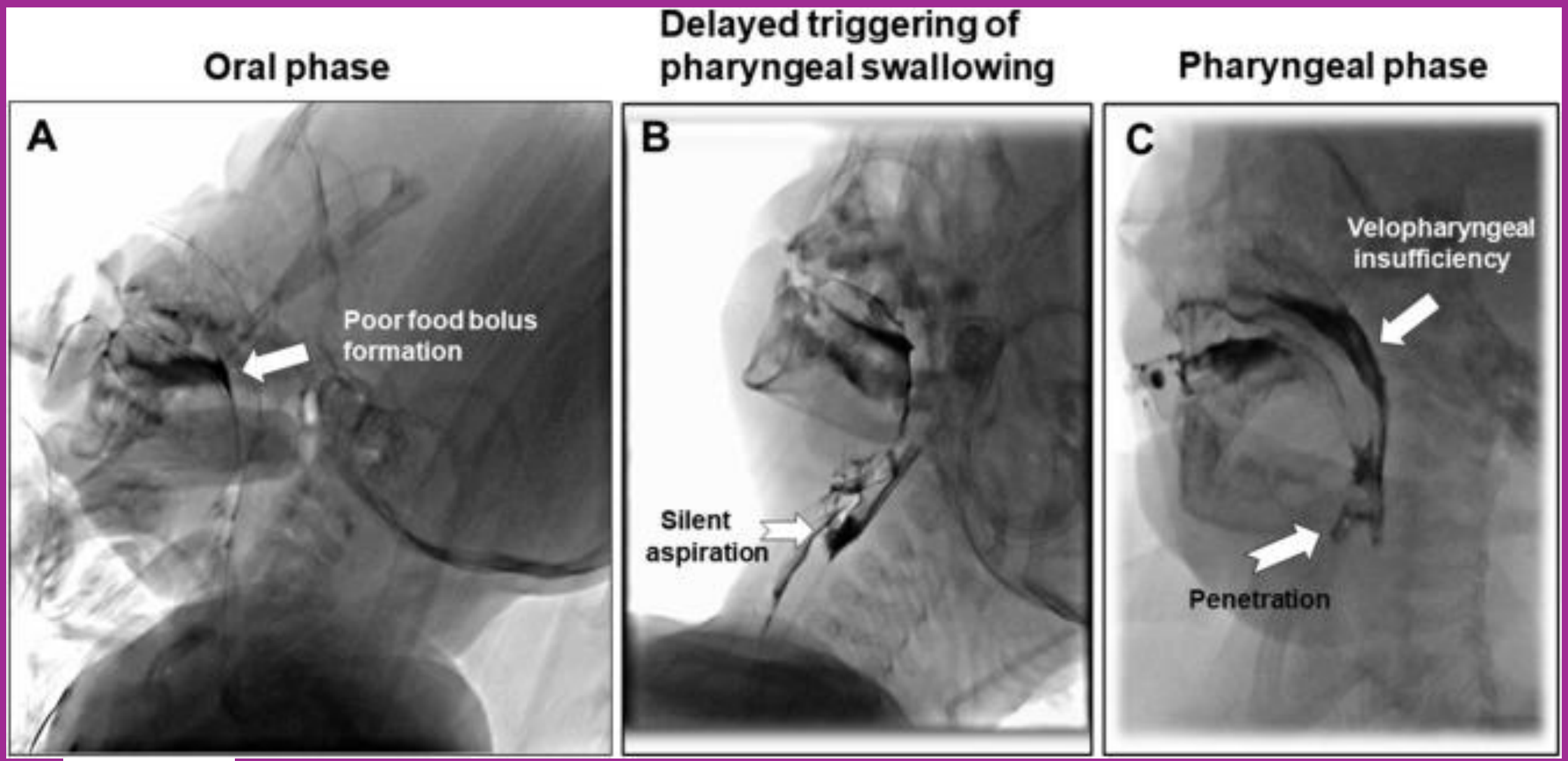
Dysphagia. 2024;39(1):33-42.
J pediatr gastroenterol nutr. 2019;68(2):218-224.
Dysphagia 2000; 15: 153–158.
Pediatr Radiol 1999; 29: 762–765.

Interpreting Results

- Interpreting variables outside of aspiration/penetration
  - Nasopharyngeal reflux
  - Pharyngeal residue
  - Swallow timing
  - Incoordination/sucks per swallow

Acta Otorhinolaryngol Ital. 2020;40(1):38-43.
Am J Speech Lang Pathol. 2022;31(3):1244-1263.
Dysphagia. 2022;37(6):1740-1747.
Am J Speech Lang Pathol. 2021;30(2):687-696.



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Intermountain Health

Pediatrics & Neonatology. 2023;64(5):547-553.

Instrumental Swallowing Assessment:
Flexible Endoscopic Evaluation of the Swallow (FEES)

- Advantages over VFSS:
  - When oral intake is negligible
  - Can use for exclusively breastfed infants
  - No radiation
- Complimentary with VFSS:
- Can further define pharyngeal/laryngeal anatomy, function, sensory threshold and monitor progress/change over time
- Limitations: Cannot visualize bolus patterns like VFSS

Ann Otol Rhinol Laryngol. 2020;129(5):469-481.

Inclusion criteria:

- ≥36 week PMA
- No further medical contraindications to discharge
- Stable feeding method (either NGT or GT)
- Infant safely working on oral feeding for at least 5 days
- Caregiver competence with discharge plan and tube replacement if NGT

Exclusion criteria:

- Clinical issues that prevent ability to safely secure feeding tube
- Trans-pyloric feeding tube or critical feeding tube
- No social/environmental barriers to home enteral feeding

Abbreviations:

HEFT = Home enteral feeding transition;
PMA = post-menstrual age;

NGT = nasogastric tube;

GT = gastrostomy tube;
HEN = home enteral nutrition;

J Parenter Enteral Nutr. 2020;44(5):920-927.

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Post-NICU Feeding

Intermountain Health

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First visit

- 4-6 weeks post-discharge

Return visits

- 4-12 weeks, based on patient needs and acuity
- At least 1 follow-up visit after achieving full oral feeds or transition to gastrostomy tube

Discharge from Clinic

- 100% PO, infant is thriving, OR
- Limited PO and GT + growing
- Thickener needs are minimal

Urgent HEFT visits (<2 weeks post-DC)

- <10% PO, banana thickening or IDDSI level 3, complex social, multiple thin liquid strategies

Ermarth, *JPEN* 2020.

Role of Virtual Visits

INCREASED TELEHEALTH

- Patients across the Intermountain region
  - Increases access
  - Provides interval visits
  - Supports Families

Tube Weaning Strategies

- Feeding readiness cues
- Maturation and developmental expectations based on CGA
- Hunger provocation and growth (RD support)
  - Enteral tube use strategies
- Non-nutritive sucking and oral stimulation
- Using additional therapy resources
  - More PT, More OT

Progress in Pediatric Cardiology. 2021;62:101406.

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Dysphagia Management Strategies

Clinical strategies

Positioning, Bottle/Nipple choice, External pacing, Cold stimulation

Nutritional strategies

Fortification, Supplemental enteral feeding, Enteral feeding schedule manipulation

Liquid thickening

Clinical trial	Instrumental testing

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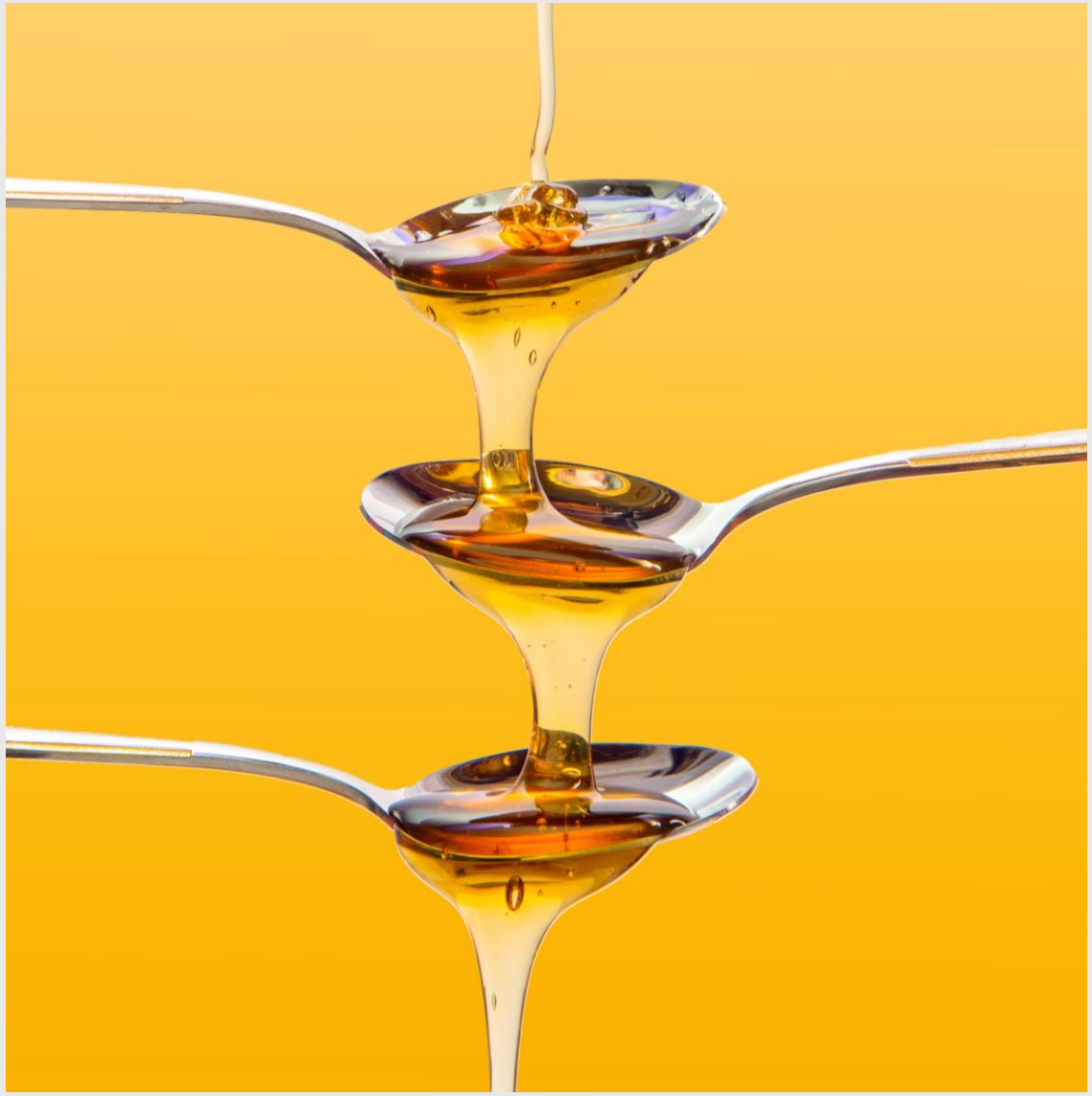
Dysphagia. 2018;33(5):593-601.

How does liquid thickening work?

- Move slower
- Stick together better
- Enhanced oropharyngeal sensation



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Goldfield EC, *Dysphagia*. 2013;28(2):234-244.

The IDDSI Framework

Providing a common terminology for describing food textures and drink thicknesses to improve safety for individuals with swallowing difficulties.

IDDSI LEVEL 0: THIN
IDDSI LEVEL 1: SLIGHTLY
IDDSI LEVEL 2: MILDLY
IDDSI LEVEL 3: MODERATELY

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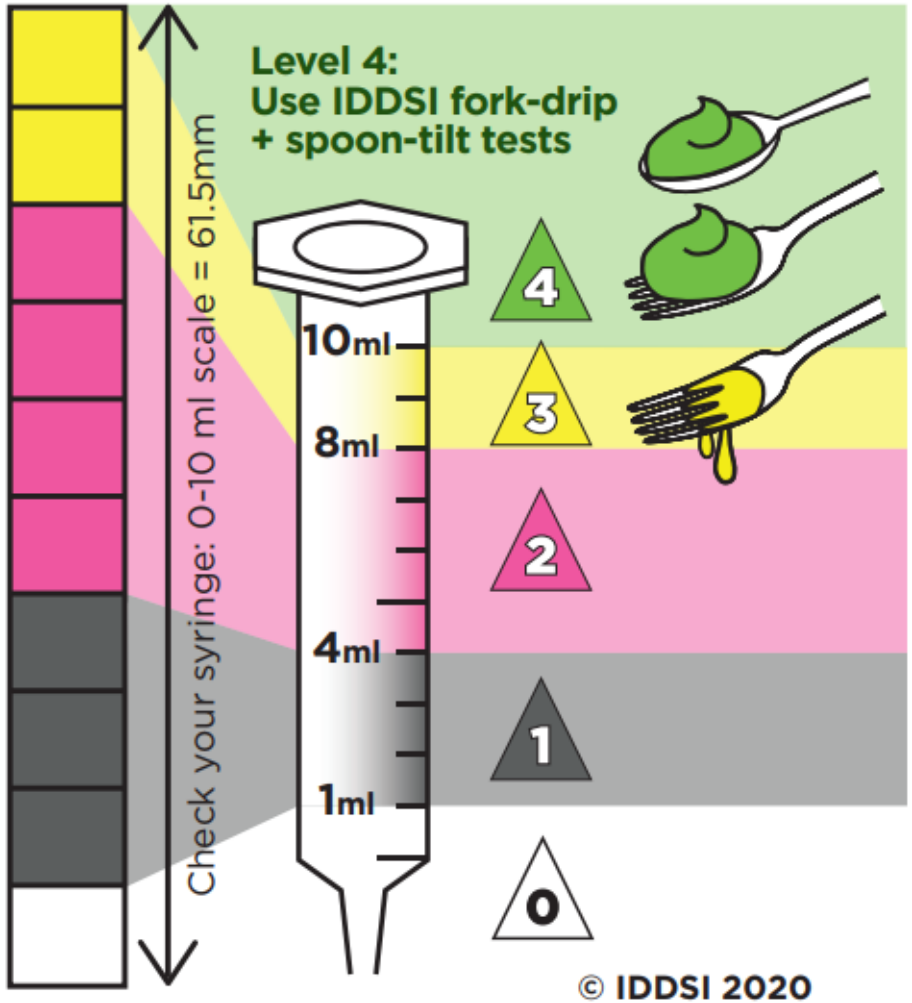
IDDSI International Dysphagia Diet Standardisation Initiative

www.iddsi.org

Flow Test

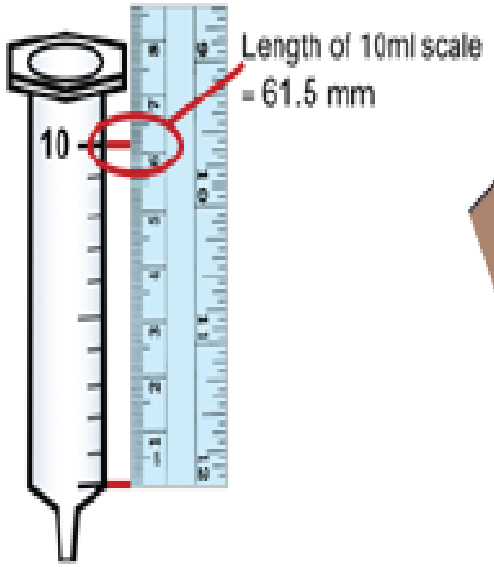
IDDSI level depends on liquid remaining after 10 seconds flow.

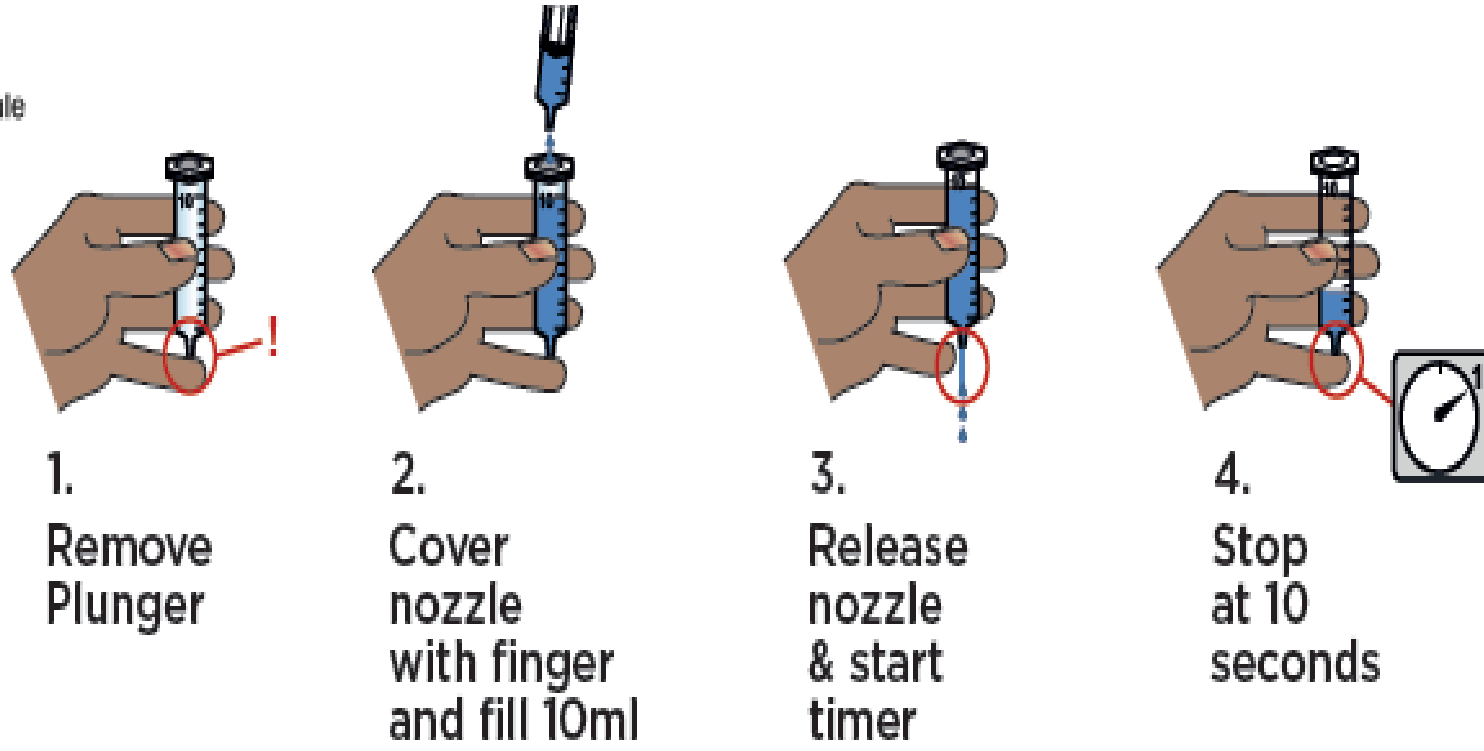


FLOW TEST INSTRUCTIONS

Tools:

- 10mL Slip Tip Syringe
- Stopwatch
- IDDSI Chart





https://iddsi.org/framework/drink-testing-methods/

The International Dysphagia Diet Standardisation Initiative 2016
@https://iddsi.org/framework/

CLINICAL RESEARCH

The nutrition profile and utility of banana puree as a liquid thickener for medically complex infants with dysphagia

Kristin Brinker MS, CCC-SLP[1] | Lauren Winn[2] | Anne E. Woodbury RDN, CNSC[2] | Amara Finch MD[2] | Michelle Taggart MS, CCC-SLP[2] | Debbie Thomas DPT, CNT[1] | Anna Ermarth MSc, MD[2] | Belinda Chan MD[2]

ree

- Advantages:
  - 39-42 weeks CGA
  - Can achieve target IDDSI levels
  - Palatable w/milk
  - Can be used with both breastmilk and formula
  - Cheap and widely available
- Disadvantages
  - Have to limit in milk based on electrolyte and nutrition displacement

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Dysphagia. 2022;37(3):578-590.
Nut in Clin Prac. 2025;40(1):227-238.

Thickener types: Gelmix©

- Organic carob bean gum and tapioca maltodextrin
- Advantages:
  - Palatable
  - Can be mixed with **breastmilk** or formula
  - Can batch thicken
- Disadvantages:
  - 42 weeks CGA or TERM at birth
  - Variability
  - $$$

Parapharma Tech, accessed May 22, 2025, https://www.healthierthickening.com/wp-content/uploads/2018/11/GelmixThickener_Spec_OCT2020.pdf.

Thickener types: Reflux Formulas (AR)

- Advantages:
  - Cheap and widely available
- Disadvantages:
  - Standard mixing is a thin liquid (IDDSI Level 0)
  - Must be fortified to achieve target IDDSI levels
  - Confusion with fortification

Pediatr Med. 2022;5:14-14.

Thickener types: Cereals

Disadvantages:

- Not compatible with breastmilk
- Displaces nutrition
- Variability in thickening
- Frustrating to use: e.g. Parents alter the nipples

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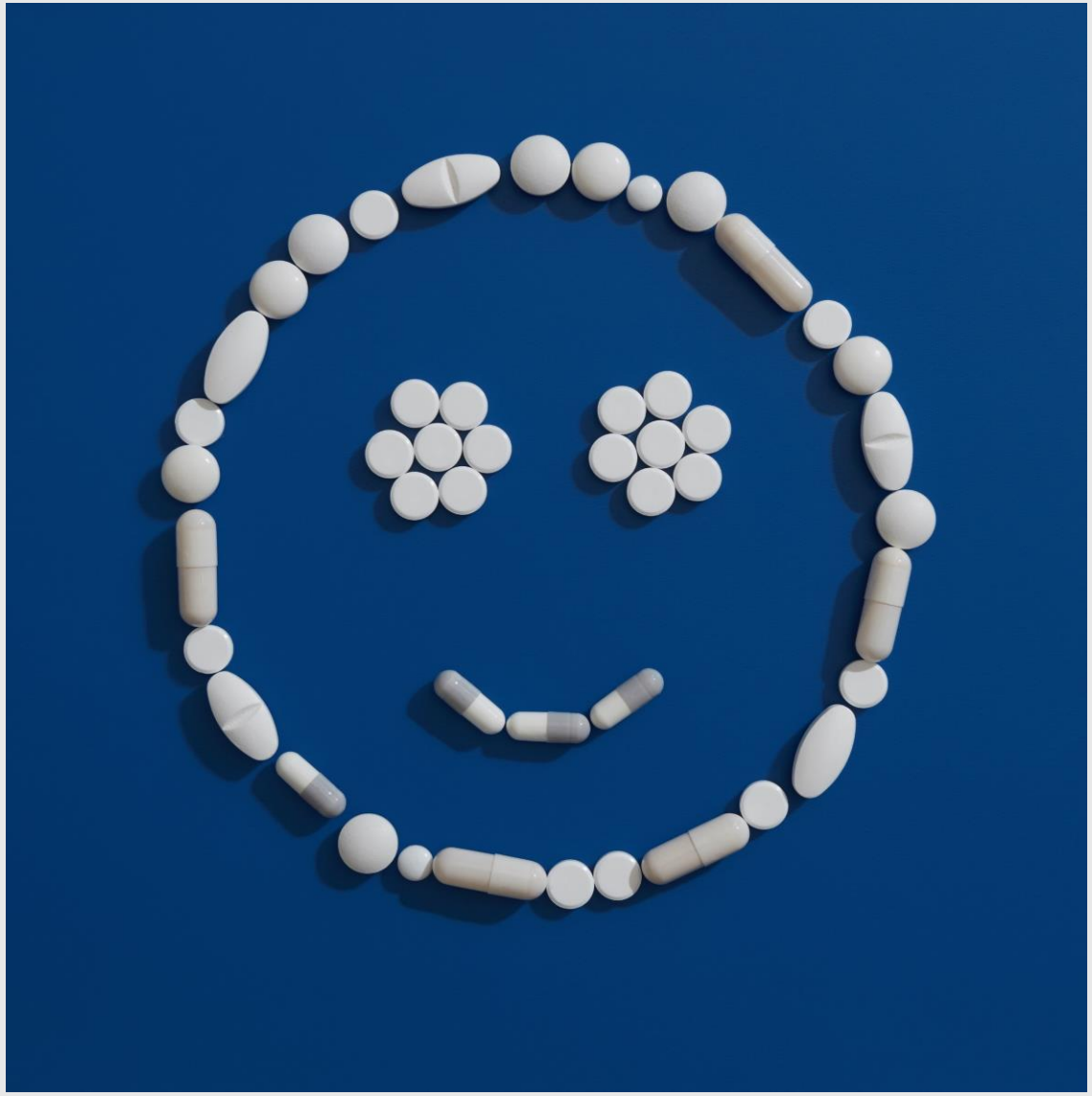
https://healthybabycereals.org/sites/healthybabycereals.org/files/2017-12/HBBF_ArsenicInInfantCerealReport.pdf.

Am J Speech Lang Pathol. 2022;31(4):1601-1610.

Thickening Medications

- Use of commercial thickening agents to thicken liquid medicines is not recommended
  - Bioavailability of medications reduced leading to sub-therapeutic medication levels
- Most medications can be mixed into a small amount of pureed bananas
- Consult to pharmacy!



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Cichero JA. *Nutrition Journal*. 2013;12(1):54.

IDDSI Level 3: Moderately thick consistency

- Age of patient
- Medical history (e.g. NEC)
- Quantity of thickening agent
- Manufacturer's recommendations
- Ability to extract liquid from nipple
- Need for supplemental enteral nutrition
  - More free H20/hydration

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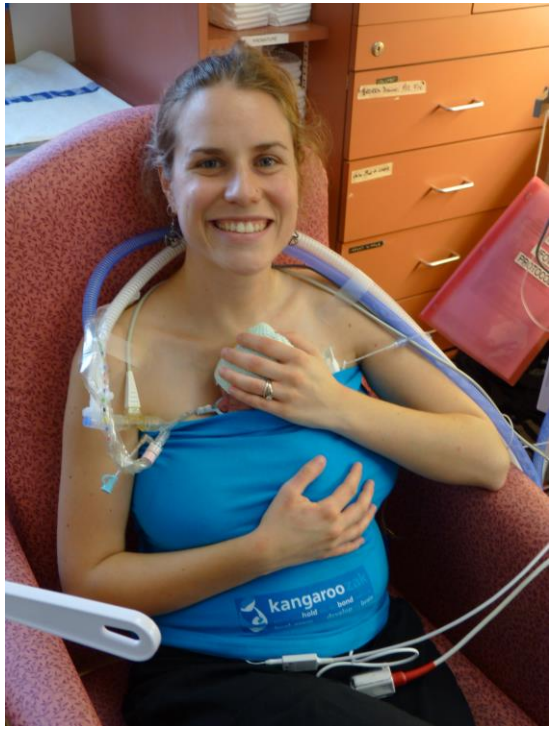
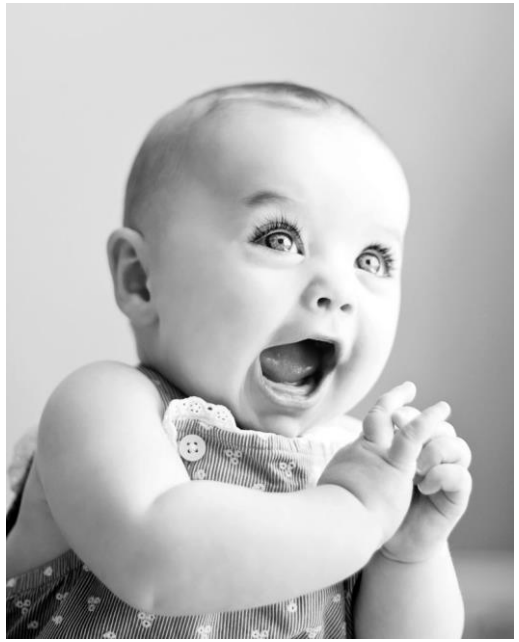
Establish early positive oral experiences…



…Foster long term feeding success



WHAT LESSONS HAVE WE LEARNED?

- The goal of early discharge program is **NOT GT avoidance**.
  - "Give feeds a chance"
  - Not anti-G-tube, we are anti placing a GT too-early
  - 2-4 months of NGT trial is reasonable
- **Be careful of setting a PO minimum**: this may have unintended consequences
  - Risk of Volume-driven rather than cue-based feeding experience
- Neuro Exams are Prognostic (GMAs)
- Thickener is a low-risk tool to continue positive oral experience.
  - Provide education and therapists who are willing to use it and study it on VFSS
- Telehealth could be a better modality to meet families early-on
  - Consider Neonatalogist Follow-up with HH or Outpatient therapy resources
  - Can utilize NICU-based resources to offer 1st visit by RD + SLP while awaiting a more comprehensive clinic evaluation
- There is no absolute crystal ball in a baby's journey, but we have data to support 'the norm' of EARLIER DISCHARGE
- **The discharge process on the NICU side means a LOT and is not without significant personnel support (care mgmt, HH resources, NICU Med Director, etc).**

THANK YOU!

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