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THICKENING PRACTICES FOR INFANT POPULATIONS

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10/24/24
12:00 - 1:00 p.m.

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DISCLOSURES

- Financial
 - Associate Professor/Chair, The University of Alabama
 - PRN, Druid City Hospital & LeBonheur Children's Hospital
 - Royalties from Thieme
 - Honorarium from Dr. Brown's Medical, part of Dr. Brown's Company
- Non-financial
 - Elected member of CAA
 - Editorial board member of *AJSLP*
 - Co-Founder of ADC
 - Member ASHA, DRS, & Voice Foundation

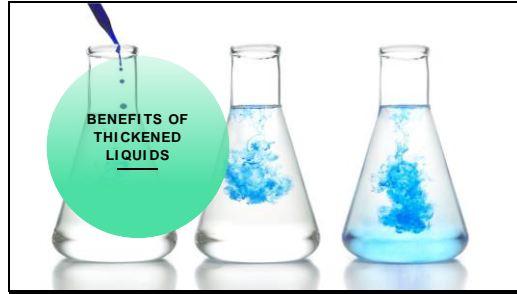
Speech And Hearing Center

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LEARNING OBJECTIVES




Describe	Describe at least one benefit of using thickened liquids for infant populations.
List	List at least 2 products that caregivers can use to safely thicken expressed human milk (EHM) and formula.
Determine	Determine at least 3 common challenges to achieving the desired thickness level.

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THICKENED LIQUIDS

-  Common intervention for treatment of GERD & Pediatric Dysphagia (infants & children)
-  Generally low-risk, non-pharmacologic intervention
-  Empirical evidence establishes efficacy of intervention

Barnes, D. R., Smith, J., & Wilson, B. (2016). Systematic Comparison of Thickening Foods, Drinks, and Medications. *Journal of Pediatric Gastroenterology and Nutrition*, 52(1), 1-10.

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THICKENED LIQUIDS

<p>GERD</p> <ul style="list-style-type: none"> • NASPGHAN & ESPGHAN recommend thickening as first-line approach for GERD in non-breastfeeding children • Works by 1) blocking reflux to the airway and away from the esophagus, 2) reducing volume, 3) the amount of reflux that might advance to the esophagus 	<p>PEDIATRIC DYSPHAGIA</p> <ul style="list-style-type: none"> • Last option to compensate for oropharyngeal dysphagia that results in severe compromise in non-breastfeeding children • Works by 1) Slowing the rate of liquid flow, 2) increasing the cohesiveness of the bolus, both of which contribute to reduced airway compromise events during the swallow
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THICKENED LIQUIDS: BENEFIT FOR GERD

- Hand Thickened Formula
 - ↻ Decreased emesis/regurgitation episodes, volume of emesis, & time crying; Increased sleep time after feeding; Reduced maximal height of refluxed material within the esophagus
 - ↻ No serious adverse events documented

Chen et al., 2012; Horvath, Schindler, & Rodriguez (2010); Rank, Ellis, & Darling (2017); Rank, Schindler, Schindler, Siny, Robinson, & Reynolds (2005)

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THICKENED LIQUIDS: BENEFIT FOR GERD

- Anti-Regurgitation Formula
 - ↻ Similar efficacy as hand thickened formula
 - ↻ More convenient; Standardized viscosity
 - ↻ Concern for expense

Wolansky, Ruckel, Bingham, Taylor, & Berman (2016); Pineda et al. (2005)

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THICKENED LIQUIDS: BENEFIT FOR GERD

- Blenderized Formula (thickening tube feedings)
 - ↻ Similar efficacy as hand thickened formula
 - ↻ NG tube requires use of specialty formulas that are thin enough to not clog NG tubes (i.e. Enfamil A.R.)
 - ↻ ↓ regurgitation & choke/gag/cough symptoms & sleep disturbance

Wolansky, Ruckel, Berman, & Berman (2016)

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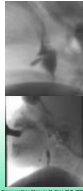
THICKENED LIQUIDS: BENEFITS FOR PEDIATRIC DYSPHAGIA

- Implemented following instrumental assessment
 - **Positional change, modifying flow rate, texture modification**
- Instrumental assessment allows for determination of which liquid consistency, position, and method of delivery improves swallowing function/reduces airway compromise events
- Focus of management is to ensure safe and efficient feeding for the promotion of adequate nutrition and hydration

Shaw, A. L., Miller, C. K., Fu, L., Sun, D., Wilging, J. P., de Abreu, A., & Perlick, S. P. (2014). Predictive Value of Laryngeal Penetration to Aspiration in a Cohort of Pediatric Patients Undergoing VFSS. *Journal of Pediatric Gastroenterology and Nutrition*, 58(2), 121-126.

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THICKENED LIQUIDS: PEDIATRIC DYSPHAGIA

Aim	Characterize	Determine	
Aim: Determine the predictive factors for aspiration in a cohort of pediatric patients undergoing VFSS.	Characterize the relationship between aspiration and penetration according to the depth of penetration (using PAS), frequency of penetration, and liquid viscosity	Determine which penetration events were less likely to be associated with aspiration	

Shaw, A. L., Miller, C. K., Fu, L., Sun, D., Wilging, J. P., de Abreu, A., & Perlick, S. P. (2014). Predictive Value of Laryngeal Penetration to Aspiration in a Cohort of Pediatric Patients Undergoing VFSS. *Journal of Pediatric Gastroenterology and Nutrition*, 58(2), 121-126.

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THICKENED LIQUIDS: PEDIATRIC DYSPHAGIA

Retrospective cross-sectional analysis of random sample of 97 patients who underwent VFSS

Outcome measures:

- Presence or absence of aspiration
- Response to aspiration as defined by the penetration/aspiration scale

Participant characteristics:

- Median age 24 months
- 54% male
- Dx: Neurologic (29%), Cardiopulmonary (23%), & Anatomic/Structural (19%)
- Additional medical co-morbidities present in 43% of sample

Shaw, A. L., Miller, C. K., Fu, L., Sun, D., Wilging, J. P., de Abreu, A., & Perlick, S. P. (2014). Predictive Value of Laryngeal Penetration to Aspiration in a Cohort of Pediatric Patients Undergoing VFSS. *Journal of Pediatric Gastroenterology and Nutrition*, 58(2), 121-126.

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THICKENED LIQUIDS: PEDIATRIC DYSPHAGIA

Multivariate Regression Analysis

- Only **frequency of penetration of thin liquids** was a significant predictor of aspiration of thin or thickened liquids
- Age, gender, depth of penetration, primary visit diagnosis, and patient comorbidities did not independently predict increased frequency of aspiration

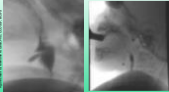
Miller, A. L., Miller, C. K., Fu, L., Sun, Q., Whiting, J. P., de Abreu, A., & Perrella, S. P. (2019). Predictive Value of Laryngeal Penetration to Aspiration in a Cohort of Pediatric Patients. *Disorders of Swallowing*, 36(1), 21-28.

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THICKENED LIQUIDS: PEDIATRIC DYSPHAGIA

Conclusions:

- Frequency of penetration and depth of penetration on VFSS are separate risk factors for aspiration
- Both increased frequency and depth of penetration are associated with increasing aspiration
- Shallow, intermittent laryngeal penetration is not consistent with clinical aspiration



Miller, A. L., Miller, C. K., Fu, L., Sun, Q., Whiting, J. P., de Abreu, A., & Perrella, S. P. (2019). Predictive Value of Laryngeal Penetration to Aspiration in a Cohort of Pediatric Patients. *Disorders of Swallowing*, 36(1), 21-28.

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THICKENED LIQUIDS: BENEFITS FOR PEDIATRIC DYSPHAGIA

- Infants with silent aspiration had reduction in hospitalization for acute respiratory infection (Cohen, Shrivastava, Shaddock, Reilly, Makinney, & Brannon, 2016)
- In infants/children with isolated laryngeal penetration, thickening was more effective than other feeding interventions in decreasing symptoms and respiratory hospitalization (Duncan, Larson, Davidson, May, Rabour, & Rosen, 2019)
- Infants/children with laryngomalacia effectively managed with thickened feeds (Laurance et al., 2021)
- Infants with acute bronchiolitis benefited from thickened feeds (Shrivastava, Rosen, Kelly, Stahl, & Brown, 2001; Khatibzadeh & Gabb, 1999)
- Infants w/ BRUE had reduction in persistent aspiration-related symptoms with thickened feeds (Duncan, Liu, Goodwin, Larson, & Rosen, 2022)
- Thickened liquids reduce the need for G-tube placement (McSwainey, Neri, Anirudh, Mitchell, Larson, & Rosen, 2016; McSwainey et al., 2020)

Also, in comparison to children with aspiration fed via G-tube, children given thickened oral feeds had decreased hospitalization risk

Shrivastava, S. K., Stahl, J., & Brown, S. G. (2001). Thickened Feeds Reduce Hospitalization Risk in Children with Acute Bronchiolitis. *Journal of Pediatric Gastroenterology and Nutrition*, 33(3), 391-394.

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THICKENED LIQUIDS: BENEFITS FOR PEDIATRIC DYSPHAGIA

- In infants/children w/ dysphagia, receiving enteral feeds- thickening enteral feeds reduces risk of reflux related aspiration events
 - ◊ Hirsch et al. (2022) reported that addition of free water to blenderized feeds decreased thickness & increased pulmonary risk
 - ◊ Infants w/ NG tube feeding can receive benefit of thickened feeds via specialty formulas (Enfamil A.R.) (Vanderhoof, Moran, Harris, Merkel, & Orenstein, 2003)

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THICKENING OPTIONS FOR INFANTS


Cereals, Commercial Thickeners, & Food Purees

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THICKENING IS COMPLICATED...

Thickness of formula/EHM is influenced by:

- Type of thickening agent
- Base fluid
- Amount of base fluid
- Temperature
- Standing time
- Mixing method



Ortiz & Dunne, 2017; Nash et al., 2021; Orsini et al., 2020; Orsini & Chappell, 2021

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OPTIONS FOR THICKENING


- Thickening agents used for children with dysphagia should be labelled as suitable for use with **infants/children with dysphagia**
- The packaging should contain clear **instructions** on how much thickening agent is required to prepare fluids that are consistent with the levels set out in IDDSI
- Speech pathology staff, dietetic, pharmacy, and medical staff should be involved in deciding which types of thickening agents are suitable for use with children
- Be aware that some thickening agents may contain allergens- take particular care if suspected allergy/ intolerance to corn, wheat, or gluten

(Owen et al., 2020)

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OPTIONS FOR THICKENING

 Most suppliers of thickening agents do not recommend the use of their products with infants prior to term age (i.e. premature babies), or if the child has certain types of gut pathology, as some kinds of thickening agent may not be digested by the premature/ pathological gut and may possibly cause gut complications.

 Many suppliers of xanthan gum do not recommend the use of their product with children under 3 years (Thicken Up Clear, Simply Thick)


(Owen et al., 2020)

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OPTIONS FOR THICKENING WITH INFANTS

Liquids can be thickened with

1. A.R. Formula
2. Increasing caloric density of A.R. formula
3. Infant cereals
4. Commercial thickeners
5. Food-based products



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**OPTIONS FOR THICKENING WITH INFANTS:
INCREASING CALORIC DENSITY OF A.R. FORMULA**

2 anti-reflux formulas were tested at 20 kcal/oz **ready to feed** formulations & at **graduated caloric densities of their powder formulations**


Aim: determine the effect of clinical variables on thickness of Enfamil AR & Similac Spit-Up in their ready to feed & powder formulations

McGrath, K. E., Spiller, A., Stanek, A., Cole, M. M., Beckstrand, M., & Hernandez, K. (2022). Validity of anti-reflux formulas as a slightly thick liquid: effect of time, caloric density, and integrated thickeners on formula thickness. Pediatric Medicine, 3.

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**OPTIONS FOR THICKENING WITH INFANTS:
INCREASING CALORIC DENSITY OF A.R. FORMULA**

Time



- Ready to feed formulations
 - Enfamil AR: slightly thick (IDDSI Level 1)
 - Similac Spit-Up: thin (IDDSI Level 0)
- Remained constant throughout the 30m testing period
- Powder formulations
 - Enfamil AR, started out as thin, steady increase over 30 m that resulted in slightly thick consistency @20 minutes
 - Similac Spit-Up, remained a thin liquid consistency throughout the 30 m testing period

McGrath, K. E., Spiller, A., Stanek, A., Cole, M. M., Beckstrand, M., & Hernandez, K. (2022). Validity of anti-reflux formulas as a slightly thick liquid: effect of time, caloric density, and integrated thickeners on formula thickness. Pediatric Medicine, 3.


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**OPTIONS FOR THICKENING WITH INFANTS:
INCREASING CALORIC DENSITY OF A.R. FORMULA**

Caloric Density


Powder formulations

- ❖ **Enfamil A.R.:** stepwise increase in thickness with every 2 kcal/oz increase of caloric density beyond 22 kcal/oz
 - All formulations of **Enfamil A.R.** increased in thickness throughout the 30-minute testing period
- ❖ **Similac Spit-Up,** did not exhibit any change in thickness based on caloric density (remained at IDDSI Level 0/Thin throughout testing)



McGrath, K. E., Spiller, A., Stanek, A., Cole, M. M., Beckstrand, M., & Hernandez, K. (2022). Validity of anti-reflux formulas as a slightly thick liquid: effect of time, caloric density, and integrated thickeners on formula thickness. Pediatric Medicine, 3.

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OPTIONS FOR THICKENING WITH INFANTS: INFANT CEREALS

- In response to concerns over arsenic in rice cereal, the AAP recommends parents of children with GERD and/or dysphagia use OATMEAL cereal instead of rice
- Rationale: Children with GERD/Dysphagia are exposed to more rice cereal (and, therefore, more arsenic) for longer
- Infants- increased exposure comes at a time of rapid development & may be at the greatest risk for side effects of arsenic
- Therefore, oatmeal is proposed as a safer alternative

(Duncan et al., 2019)

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OPTIONS FOR THICKENING WITH INFANTS: INFANT CEREALS

- AAP also recommends following consumer reports suggested intake of ¼ C of infant rice cereal per day
- ¼ C = 36 t of rice cereal/day (additional 180 kcal per day)
- Discussions with patient families should focus on balancing potential risks w/ the clear risks of untreated oropharyngeal dysphagia/GERD



(Duncan et al., 2019)

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OPTIONS FOR THICKENING WITH INFANTS: RICE CEREAL

Goss & Dodrill 2017

- 1 t Gerber Rice Cereal to 1 oz Good Start (20kcal) Formula
5m after mixing- IDDS Level 2, Nectar
30m after mixing- IDDS Level 1, ½ Nectar
- 1 T Gerber Rice Cereal to 1 oz Good Start (20kcal) Formula
5m after mixing- IDDS Level 3, Honey
30m after mixing- IDDS Level 2, Nectar

Rush, Bolland, & Goss, 2021

- 2 T Beechnut Rice Cereal per 4 oz of various formulas
5m after mixing- IDDS Level 1, ½ Nectar; except Similac Advance (19kcal/oz)- IDDS Level 0, Thin
- 4 T Beechnut Rice Cereal per 4 oz of various formulas
5m after mixing- IDDS Level 3, Honey

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OPTIONS FOR THICKENING WITH INFANTS: OATMEAL CEREAL

Brooks, DiStefano, Clayton, & Gethers, 2024

- 1.5 t Oatmeal to 1 oz EHM
 - 0m @40 F: IDDSI Level 2, Nectar 5-20m @40 F: IDDSI Level 1, 1/2 Nectar
 - 0m & 10m @70 F: IDDSI Level 0, Thin; 5m & 20m @70 F: IDDSI Level 1, 1/2 Nectar
 - 0m @98.6 F: IDDSI Level 0, Thin; 5-20m @98.6 F: IDDSI Level 1, 1/2 Nectar


Gosa & Choquette, 2021

- 1.75 t Oatmeal per 1 oz of various formulas
 - 0m: IDDSI Level 2, Nectar (6/9, 67%); IDDSI Level 1, 1/2 Nectar (3/9, 33%)
- 2.5 t Oatmeal per 1 oz of various formulas
 - 0m: IDDSI Level 3, Honey


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OPTIONS FOR THICKENING WITH INFANTS: INFANT CEREALS

- Can separate to thin fluid and solid mass
- Can block nipple
- Contains potential allergens
- Increase risk of constipation
- Increases energy content of feed



1 t Rice/Oatmeal Cereal = 5 kcal
Increases 1 oz of formula from 20 kcal
→ 25 kcal
25% increase in calories



1 T Rice/Oatmeal Cereal = 15 kcal
Increases 1 oz of formula from 20 kcal
→ 35 kcal
75% increase in calories

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OPTIONS FOR THICKENING WITH INFANTS: COMMERCIALY AVAILABLE THICKENING AGENT

Thickening Agent	Active Ingredient	Manufacturer's Guidelines	Nutrition Information	Additional Information
GelMix	Carob Bean Gum	>42 wks PMA, >6 pounds	5 kcal/scoop	Requires heating of liquid
Simply Thick	Xanthan Gum	Do not use under 12 years of age without consulting a healthcare professional	5 kcal/mildly thick packet	N/A

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**OPTIONS FOR THICKENING WITH INFANTS:
COMMERCIALY AVAILABLE THICKENING AGENT**

Rush, Gosa, & Bolland, 2021

Formula	GelMix-Target IDDSI Level 2 (Nectar), Measured w/ Syringe Test
Pregestimil	IDDSI Level 1, $\frac{1}{2}$ Nectar
Enfamil 20	IDDSI Level 1, $\frac{1}{2}$ Nectar
Enfamil 24	IDDSI Level 1, $\frac{1}{2}$ Nectar
Enfamil 30	IDDSI Level 1, $\frac{1}{2}$ Nectar
Similac Advance	IDDSI Level 1, $\frac{1}{2}$ Nectar
Similac Soy	IDDSI Level 1, $\frac{1}{2}$ Nectar
Similac Special Care	IDDSI Level 1, $\frac{1}{2}$ Nectar
Similac Neosure	IDDSI Level 3, Honey

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**OPTIONS FOR THICKENING WITH INFANTS:
COMMERCIALY AVAILABLE THICKENING AGENT**

Rush, Gosa, & Bolland, 2021

Formula	Target IDDSI Level 3 (Honey), Measured w/ Syringe Test
Pregestimil	IDDSI Level 1, $\frac{1}{2}$ Nectar
Enfamil 20	IDDSI Level 3, Honey
Enfamil 24	IDDSI Level 1, $\frac{1}{2}$ Nectar
Enfamil 30	IDDSI Level 1, $\frac{1}{2}$ Nectar
Similac Advance	IDDSI Level 3, Honey
Similac Soy	IDDSI Level 3, Honey
Similac Special Care	IDDSI Level 3, Honey
Similac Neosure	IDDSI Level 3, Honey

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**OPTIONS FOR THICKENING WITH INFANTS:
COMMERCIALY AVAILABLE THICKENING AGENT**

Brooks et al., 2024

Thickener & Volume of EHM	Temperature	IDDSI Level			
		0m	5m	10m	20m
Gel Mix & 3oz EHM	98.6 F	Thin	Slightly Thick	Slightly Thick	Slightly Thick
Gel Mix & 3oz EHM	98.6 F	Thin	Slightly Thick	Slightly Thick	Slightly Thick

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**OPTIONS FOR THICKENING WITH INFANTS:
FOOD BASED PRODUCTS**



- Aim: Investigate the effect of time, temperature, and thickener on expressed human milk thickened for infants with dysphagia
- Thickening agents: Raw oatmeal cereal, commercial thickeners (Gelmix, Purathick), **pureed fruits, pureed vegetables, yogurt, & pudding**
- IDDSI flow test measured thickness at various temperatures (refrigerated, room temperature, & warmed-body temperature) & time (0-20 minutes)

Brooks, L., O'Brien, C. C., Clayton, H., & Gehres, C. T. (2024). Thickening human milk: the effect of time, temperature, and thickener for infants with dysphagia. *European Journal of Pediatrics*, 193(1), 1323-1331.

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**OPTIONS FOR THICKENING WITH INFANTS:
FOOD BASED PRODUCTS**



- Milk donated from one mother; collected over 4 consecutive days
- Samples immediately frozen & then thawed/warmed to desired temperatures
- Thickeners included: Gerber baby foods @ room temperature (bananas, apples, peach, pear, sweet potato, green beans, squash), Oatmeal cereal, yogurt, vanilla pudding, Gelmix, and Purathick
- Samples mixed by shaking for approximately 10 seconds
- Flow test @0m, 5m, 10m, and 20m after mixing

Brooks, L., O'Brien, C. C., Clayton, H., & Gehres, C. T. (2024). Thickening human milk: the effect of time, temperature, and thickener for infants with dysphagia. *European Journal of Pediatrics*, 193(1), 1323-1331.

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**OPTIONS FOR THICKENING WITH INFANTS:
FOOD BASED PRODUCTS**

Brooks et al., 2024

Thickener & Volume of EHM	Temperature	IDDSI Level			
		0m	5m	10m	20m
1 oz Yogurt & 1 oz EHM	40.0 F	Slightly Thick (2.2ml)	Slightly Thick (1.2ml)	Slightly Thick (1.2ml)	Slightly Thick (1.0 ml)
1 oz vanilla pudding & 1 oz EHM	40.0 F	Mildly Thick (4.8ml)	Thin (0ml)	Thin (0ml)	Thin (0ml)
0.5 oz Banana & 1 oz EHM	40.0 F	Mildly Thick (3.4ml)	Mildly Thick (4.0ml)	Mildly Thick (3.8ml)	Mildly Thick (3.0ml)
	70.0 F	Mildly Thick (1.8ml)	Mildly Thick (1.8ml)	Mildly Thick (2.0ml)	Mildly Thick (2.0ml)
	98.6 F	Thin (0.8ml)	Thin (0.8ml)	Thin (0.8ml)	Thin (0.8ml)

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OPTIONS FOR THICKENING WITH INFANTS: FOOD BASED PRODUCTS					
Thickener & Volume of EHM	Temperature	IDDSI Level			
		0m	5m	10m	20m
1 oz Banana & 1 oz EHM	40.0 F	Mildly Thick (7.6m)	Mildly Thick (7.4m)	Mildly Thick (7.4m)	Mildly Thick (7.0m)
	70.0 F	Mildly Thick (6.0m)	Mildly Thick (6.0m)	Mildly Thick (6.0m)	Mildly Thick (5.0m)
	98.6 F	Mildly Thick (4.2m)	Mildly Thick (5.0m)	Mildly Thick (5.0m)	Mildly Thick (5.2m)
1 oz Peach & 1 oz EHM	40.0 F	Slightly Thick (3.5m)	Mildly Thick (4.2m)	Mildly Thick (4.2m)	Slightly Thick (3.5m)
	70.0 F	Slightly Thick (2.5m)	Slightly Thick (4.0m)	Slightly Thick (4.0m)	Slightly Thick (3.2m)
	98.6 F	Slightly Thick (2.0m)	Slightly Thick (2.0m)	Slightly Thick (2.0m)	Slightly Thick (2.2m)
1 oz Pear & 1 oz EHM	40.0 F	Slightly Thick (3.0m)	Mildly Thick (3.5m)	Slightly Thick (3.5m)	Slightly Thick (3.0m)
	70.0 F	Slightly Thick (3.0m)	Slightly Thick (4.0m)	Slightly Thick (4.0m)	Slightly Thick (4.0m)
	98.6 F	Slightly Thick (3.5m)	Slightly Thick (3.5m)	Slightly Thick (4.0m)	Mildly Thick (4.2m)

Reada, L., O'Brien, C. C., Clayton, H., & Gebrek, C. T. (2016). Thickening human milk: the effect of time, temperature, and thickener for infants with dysphagia. *European Journal of Pediatrics*, 193(4), 1659-1664.

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OPTIONS FOR THICKENING WITH INFANTS: FOOD BASED PRODUCTS					
Thickener & Volume of EHM	Temperature	IDDSI Level			
		0m	5m	10m	20m
1 oz Sweet Potato / 1 oz Carrot & 1 oz EHM	40.0 F	Thin (0.9 - 0.4 ml)	Thin (0.5 - 0.2 ml)	Thin (0.5 - 0.2 ml)	Thin (0.5 - 0.2 ml)
	70.0 F	Thin (0.9 - 0.2 ml)	Thin (0.9 - 0.2 ml)	Thin (0.0 - 0.0 ml)	Thin (0.0 - 0.0 ml)
	98.6 F	Thin (0.5 - 0.0 ml)	Thin (0.0 - 0.0 ml)	Thin (0.0 - 0.0 ml)	Thin (0.0 - 0.0 ml)
1 oz Green Beans & 1 oz EHM	40.0 F	Thin (0.0m)	Thin (0.0m)	Slightly Thick (1.0m)	Slightly Thick (1.0m)
	70.0 F	Thin (0.0m)	Thin (0.0m)	Thin (0.0m)	Thin (0.0m)
	98.6 F	Thin (0.0m)	Thin (0.0m)	Thin (0.0m)	Thin (0.0m)
1 oz Squash & 1 oz EHM	40.0 F	Slightly Thick (3.4m)	Slightly Thick (3.2m)	Slightly Thick (2.6m)	Slightly Thick (2.6m)
	70.0 F	Thin (0.0m)	Thin (0.0m)	Thin (0.0m)	Thin (0.0m)
	98.6 F	Thin (0.0m)	Thin (0.0m)	Thin (0.0m)	Thin (0.0m)

Reada, L., O'Brien, C. C., Clayton, H., & Gebrek, C. T. (2016). Thickening human milk: the effect of time, temperature, and thickener for infants with dysphagia. *European Journal of Pediatrics*, 193(4), 1659-1664.

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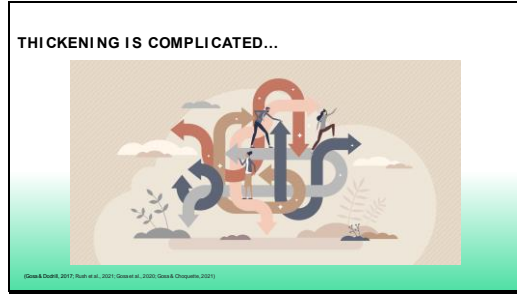


OPTIONS FOR THICKENING WITH INFANTS: FOOD BASED PRODUCTS

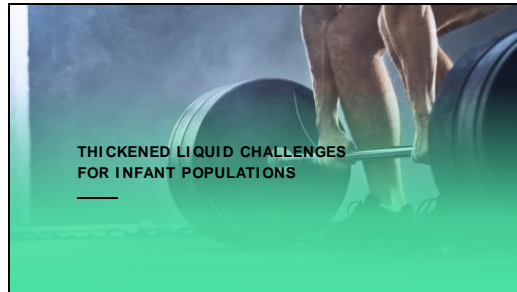
- Using **type of thickener, time, and temperature** as predictors of thickness explains 83% of the thickness variations in the included sample
- Fruit purees, squash, & yogurt, may effectively thicken human milk
- Can be considered for older infants with dysphagia

Reada, L., O'Brien, C. C., Clayton, H., & Gebrek, C. T. (2016). Thickening human milk: the effect of time, temperature, and thickener for infants with dysphagia. *European Journal of Pediatrics*, 193(4), 1659-1664.

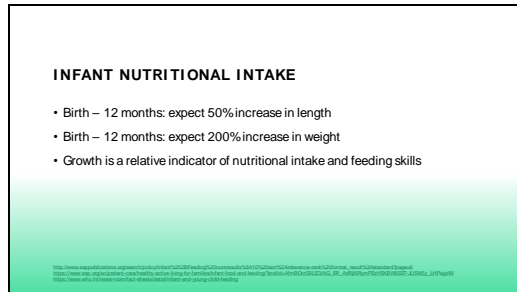
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NIPPLE FEEDING IS ACCOMPLISHED WITH SUCTION

- Flow of fluid from a region of high pressure into a region of low pressure
- Fluid is propelled to the area of lower pressure

- Milk/Formula is housed in breast or bottle
- Mouth grasped around breast or bottle nipple provides a closed system with equal pressure in each chamber
- With changes to oral cavity volume (increased), pressure within the oral cavity is lowered
- Milk/Formula is sucked into the oral cavity

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THICKENED LIQUID CHALLENGES

- Nipple size and other characteristics impact flow rate of EHM/formula from bottle
- Bottle nipples largely unregulated products; no regulations about flow rates &/or how they are marketed/named
- Thickening slows the flow rate & increases flow variability of nipples from the same brand

Melamed, D. P. (1982). Determinants of milk flow through nipples: Effect of hole size and nipple thickness. *Developmental Journal of Pediatrics*, 14(5), 222-224.
Chang, Y. J., Liu, C. P., Liu, Y. J., & Liu, C. H. (2007). Effect of single-hole and cross-cut nipple walls on feeding efficiency and physiological parameters in premature infants. *Journal of Pediatric Research*, 1(2), 159-163.
Parker, B. P. (2017). Milk flow rates from bottle nipples: What we know and why it matters. *Nursing for Women's Health*, 23(5), 229-235.

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THICKENED LIQUID CHALLENGES: EMPIRICAL DATA

- Flow rates of Dr. Brown's Medical Ultra-Premie™ Nipple, Preemie Flow™ Nipple, Newborn, and Levels 1-4 (Dr. Brown's Company, St. Louis, MO) were tested with three different thicknesses of formula (DDSI Level 0 (thin) – 2 (mildly thick))
- Measured: Mean flow-rate and coefficient of variation of the flow rate for each nipple type (Ultra-Premie™ Nipple, Preemie Flow™ Nipple, Newborn, and Levels 1-4) and thickness (DDSI Level 0 (thin) – 2 (mildly thick)) combination
- Thickened Simlac Advance 20 cal/oz RTF with Gelmix (Parapharma Tech, LLC, Sunrise, FL)

Palusz, S. P., & Malloy, M. (2021). Effect of Thickening on Flow Rates Through Infant Nipples. *Journal of Obstetric, Gynecologic & Neonatal Nursing*, 50(1), 79-87.

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THICKENED LIQUID CHALLENGES: EMPIRICAL DATA

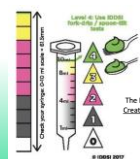
- Tested flow w/ standard breastpump– only expression/not compression
- Known that infants feed with variable sucking rates and pressures within a single feeding
- Flow testing as described in this methodology “is not intended to replicate an infant feeding” (pg. 80)
- Reported flow rates not intended to be reflective of flow rates that an infant would achieve during feeding

Palusz, S. P., & Malloy, M. (2021). Effect of Thickening on Flow Rates Through Infant Nipples. *Journal of Obstetric, Gynecologic & Neonatal Nursing*, 50(1), 79-87.

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THICKENED LIQUID CHALLENGES: EMPIRICAL DATA

- **DDSI Level 0/Thin:** Dr Brown's Company Level 4 nipple fastest mean flow rate (82.29 mL/min, SD = 6.72) → Ultra-Premie™ nipple slowest mean flow rate (5.77 mL/min, SD = 0.58); statistically significant differences in flow rate between the 7 different nipples tested



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Palusz, S. P., & Malloy, M. (2021). Effect of Thickening on Flow Rates Through Infant Nipples. *Journal of Obstetric, Gynecologic & Neonatal Nursing*, 50(1), 79-87.

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THICKENED LIQUID CHALLENGES: EMPIRICAL DATA

IDDSI Level 1/Slightly Thick

- No statistically significant difference in flowrate between Dr. Brown's Medical Ultra-Premie™ nipple (2.25 mL/min) & Dr. Brown's Medical Premie Flow™ nipple (2.3 mL/min)
- No statistically significant difference in flowrate between Dr. Brown's Medical Newborn nipple (6.45 mL/min) & Dr. Brown's Medical Level 1 nipple (8.21 mL/min)
- All other nipple comparisons revealed significantly different flow rates (slowest to fastest in order of presentation)

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IDDSI 2.0 | July 2019

Pedlow, B. P., & Melroe, M. (2021). Effect of Thickening on Flow Rates through Bottle Nipples. *Journal of Clinical, Child, Adolescent & Behavioral Nursing*, 25(1), 79-87

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THICKENED LIQUID CHALLENGES: EMPIRICAL DATA

IDDSI Level 2/Milkly Thick

- Did not flow through Dr. Brown's Medical Ultra-Premie™ nipple
- No statistically significant difference in flowrate between Dr. Brown's Medical Premie Flow™ nipple (0.19 mL/min), Dr. Brown's Medical Newborn nipple (0.85 mL/min) & Dr. Brown's Medical Level 1 nipple (1.69 mL/min)
- No statistically significant difference in flowrate between Dr. Brown's Medical Level 2 nipple (8.15 mL/min) & Dr. Brown's Medical Level 3 nipple (8.74 mL/min)
- All other nipple comparisons revealed significantly different flow rates (slowest to fastest in order of presentation)

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IDDSI 2.0 | July 2019

Pedlow, B. P., & Melroe, M. (2021). Effect of Thickening on Flow Rates through Bottle Nipples. *Journal of Clinical, Child, Adolescent & Behavioral Nursing*, 25(1), 79-87

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THICKENED LIQUID CHALLENGES

- Work to establish flowrates of bottle nipples was completed under laboratory conditions
- This kind of work cannot replicate in vivo flowrate conditions that an infant may achieve when feeding
- Information/data about flowrates, particularly with thickened feeds, must therefore be used to GUIDE decisions about nipple selection
- Empirical data about nipple flow rates is not a substitute for thorough and accurate clinical and instrumental assessment

Pedlow, B. P. (2021). 505. How do you know if your nipple is the right one? *Nursing for Women's Health*, 25(3), 229-230

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**THICKENED LIQUID CHALLENGES:
CLUMPING/INCONSISTENT THICKENING**

- Can use finer grain cereal
- Pulverize grain (increases caloric density)
- Mix with immersion blender/whisk

Reznek, D. R., Jankis, J., & Wilson, W. (2016). Supplemental Guidelines When Thickening Foods: Safety and Feeding. Pediatric Management Protocol for Gastrointestinal Disorders, 1-10.

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**THICKENED LIQUID CHALLENGES: INCREASING
THICKNESS OVER TIME**

- Consider changing thickening agent
- Consider time elapsing between mixing and feeding
- Consider temperature of feeding

Reznek, D. R., Jankis, J., & Wilson, W. (2016). Supplemental Guidelines When Thickening Foods: Safety and Feeding. Pediatric Management Protocol for Gastrointestinal Disorders, 1-10.

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**THICKENED LIQUID CHALLENGES: NIPPLE
CLOGGING**

- Confirm thickness with LST or IDDSI Syringe Test
- Consider different nipple- if confirmed safe with VFSS
- DO NOT ADVISE families to cut/manually enlarge nipple hole

Reznek, D. R., Jankis, J., & Wilson, W. (2016). Supplemental Guidelines When Thickening Foods: Safety and Feeding. Pediatric Management Protocol for Gastrointestinal Disorders, 1-10.

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THICKENED LIQUID CHALLENGES: DECREASED INTAKE

- Consider extraction time/total feeding time- changes after starting thickener?
- Confirm thickness with LST or IDDSI Syringe Test
- Consider different nipple- if confirmed safe with VFSS
- Consider other thickening agents

Source: S. R. Jaki, L. A. Wilson. © 2010. Supplemental Considerations When Thickening Foods: Safety and Feeding. Pediatric Management: Practice in Gastroenterology, Springer, 1-10.

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THICKENED LIQUID CHALLENGES: CHANGES IN STOOLING

- Consider changing thickening agents
- Rotate between different thickening agents as appropriate

Source: S. R. Jaki, L. A. Wilson. © 2010. Supplemental Considerations When Thickening Foods: Safety and Feeding. Pediatric Management: Practice in Gastroenterology, Springer, 1-10.

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CONCLUSIONS

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THICKENING AGENT CONSIDERATIONS

- How old? (< 1 year of age, 1 year of age or older)
- What are they drinking? (EHM, Formula- what kind & at what kcal/oz)
- Can they tolerate extra calories?
- Any contraindications to thickening agents?

Shaw, D.R., Jank, L., & Wilson, R. (2016). Supplemental Considerations When Thickening Feeds: Safety and Efficacy. Pediatric Management: Pediatric & Gastroenterology, 1(2).

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THICKENING AGENT CONSIDERATIONS: INFANTS

- Less than 1 year of age, >42wks corrected age, & drinking EHM = **Gel Mix**
- Less than 1 year of age, drinking formula, does not need additional calories = **Gel Mix** (> 42wks corrected age)
- Less than 1 year of age, drinking formula, needs additional calories = **Cereal / Purees / Yogurt**

Shaw, D.R., Jank, L., & Wilson, R. (2016). Supplemental Considerations When Thickening Feeds: Safety and Efficacy. Pediatric Management: Pediatric & Gastroenterology, 1(2).

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THANK YOU

