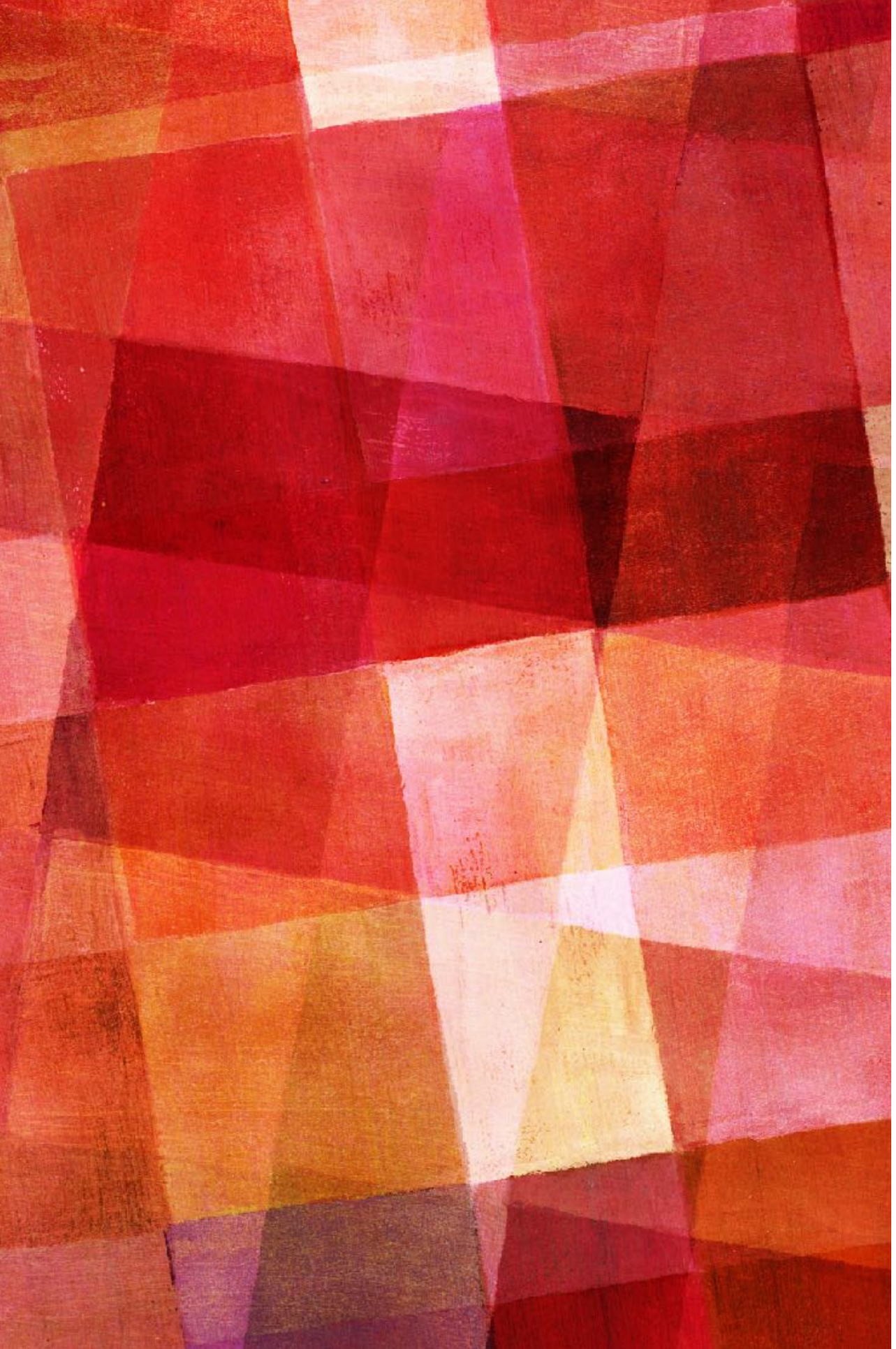
VIDEOFLUOROSCOPIC SWALLOW STUDIES: LOOKING BEYOND ASPIRATION

Brenda Sitzmann, MA, CCC-SLP
bksitzmann@cmh.edu
(816) 302-8037

DISCLOSURES

- Ms. Sitzmann is speech-language pathologist at Children's Mercy for which she receives a salary.
- Ms. Sitzmann is receiving an honorarium for presenting this workshop.
- Ms. Sitzmann has no non-financial relationships to disclose.



VIDEOFLUOROSCOPIC SWALLOW STUDIES

- VFS or VFSS for short
- Previously known as an OPM (Oral Pharyngeal Motility Study) at Children's Mercy (CMH)
- Modified Barium Swallow Study
- It is "video x-ray" of the patient's swallow

REFERRALS

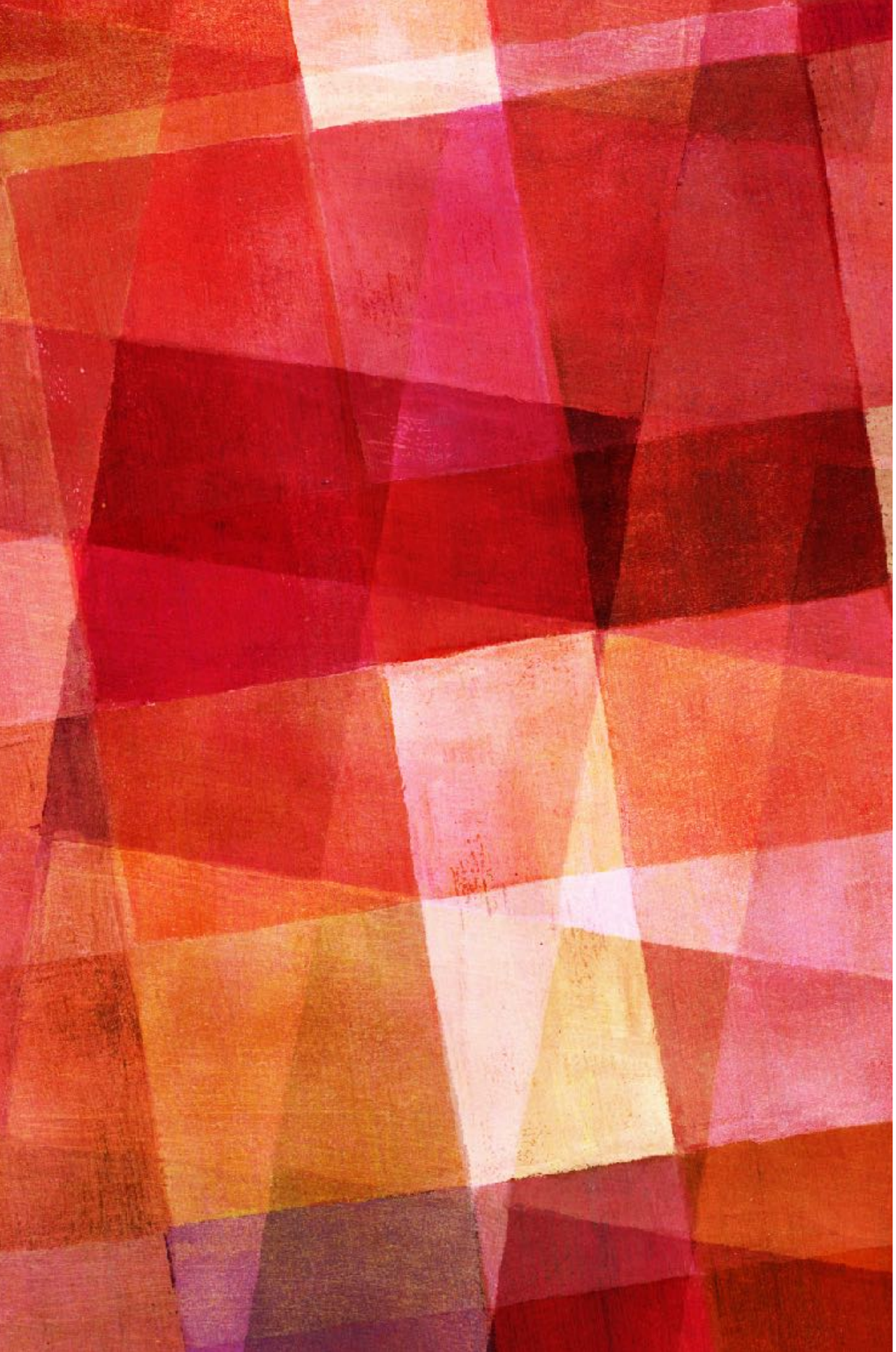
- Clinical signs of aspiration
  - coughing
  - choking
  - frequent respiratory infections
    - Pneumonia, Bronchiolitis vs. RSV
  - wet breath or vocal sounds with feedings
- Poor weight gain
- Limited interest in oral feedings

A WORD OF CAUTION RE: CLINICAL SIGNS OF ASPIRATION

- **Clinical signs and symptoms of oropharyngeal aspiration and dysphagia in children (Weir et al. 2009)**
- 150 children
  - median age = 16 months; range 2 weeks - 247 weeks (nearly 3 years)
  - 106 (71%) had a neurological impairment
- Findings
  - Cough, wet voice and wet breathing were most significantly associated with aspiration on thin liquids
    - These markers were **NOT** associated with aspiration on purees
  - No markers were associated with isolated laryngeal penetration or post-swallow residue on purees
  - Post swallow residue on thin liquids was associated with coughing

A WORD OF CAUTION RE: CLINICAL SIGNS OF ASPIRATION

- **Clinical signs and symptoms of oropharyngeal aspiration and dysphagia in children (Weir et al. 2009)**
- Findings (continued)
  - Infants were more likely to have wet voice on thin liquids
  - Older children who aspirated were more likely to demonstrate wet breathing with thin liquids and purees
- Isolated laryngeal penetration or post-swallow residue = no clinical markers regardless of consistency or age group
- Neurological impairment = strong correlation between wet voice and breathing and aspiration on thin liquids
- Non-neurological group = wet voice was associated with aspiration



REFERRALS

- A VFSS is not the best assessment for:
- Limited oral intake
  - Ideally patient is accepting at least 1 oz. orally
- Chewing concerns
  - Multidimensional process but VFSS typically only offers a lateral view
  - Best assessed clinically
- Barium allergy
  - Rare

PREPARATION FOR THE STUDY

- Requires a physician order
- Patient preparation:
  - Nothing to eat or drink for 2-3 hours prior to the study
    - goal = hungry and willing to accept barium
      - patient should be hungry but not “hangry”
  - No metal on clothing from the waist up
  - No siblings in the radiology suite
  - Bring familiar bottles, cups, utensils, preferred food
  - Items for a typical feeding after the study
  - Ideally caregiver will be present for the study

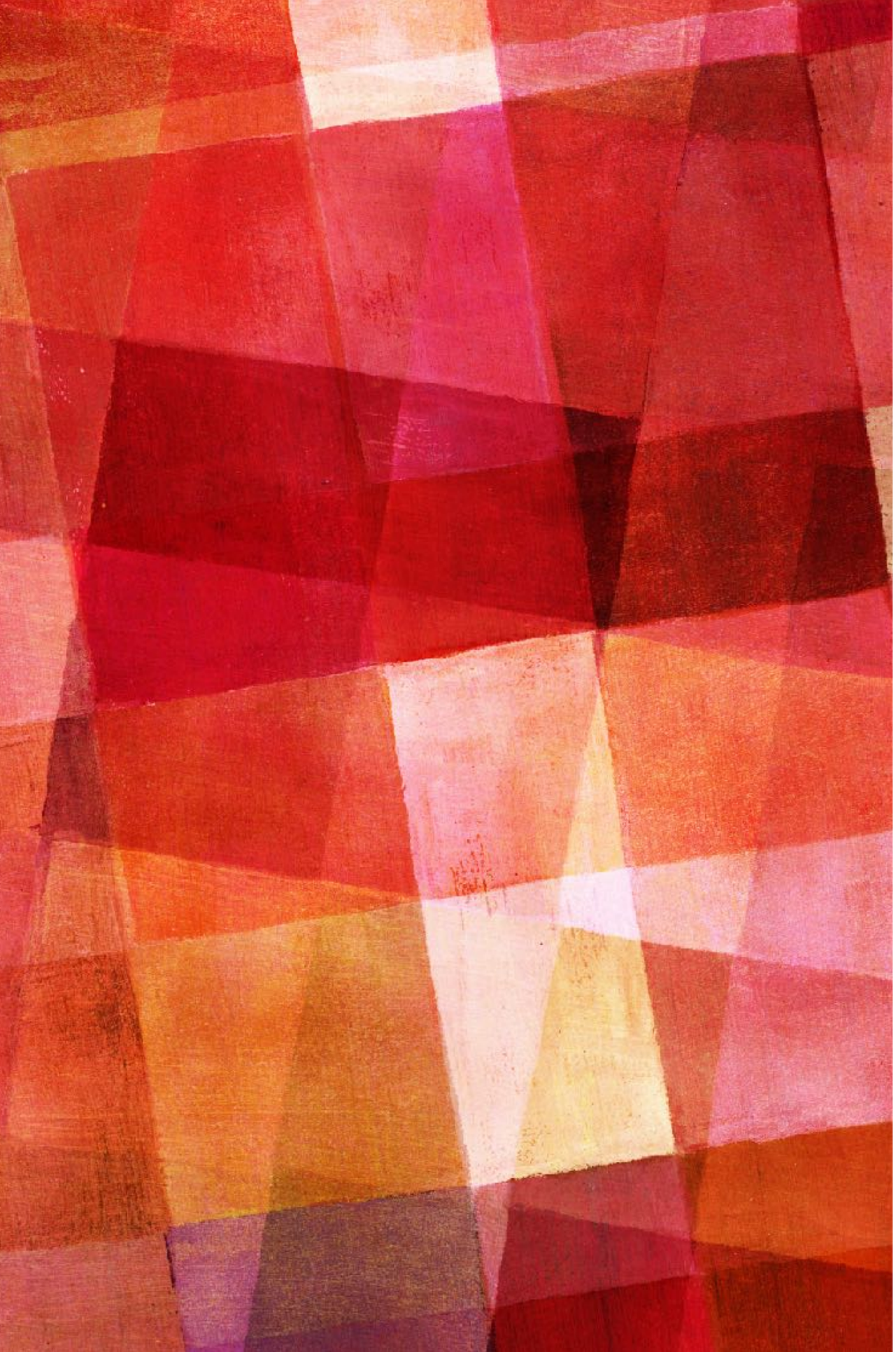
SET UP FOR THE PROCEDURE

- Goal is to replicate a typical feeding as much as possible
  - Positioning
    - Upright
    - Reclined
    - Side-lying
  - Bottle/cup
  - Utensils
  - Feeder techniques
- Most patients benefit from a clinical feeding evaluation prior to a VFS

SET UP FOR THE PROCEDURE

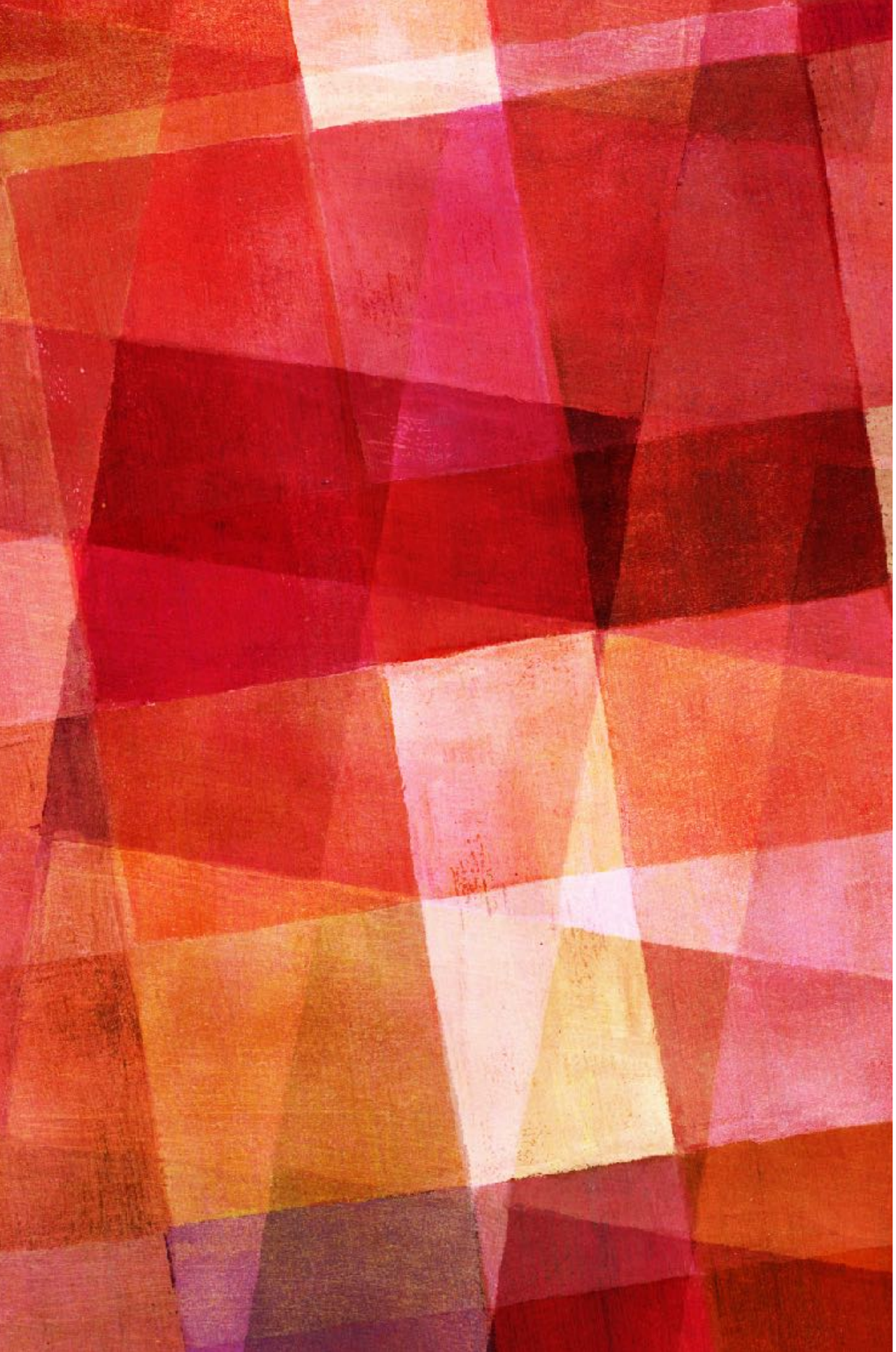
PROCEDURE

- Typically start with thin liquids
  - prefer to use patient's current bottle or cup
  - may evaluate swallow after a fatigue period (i.e. the patient continues to drink the barium but there is no fluoroscopy for a period of time (typically 30-60 seconds)
- Implement compensatory strategies before increasing viscosity of the liquid
- Typically progress from thin to nectar to honey to honey plus
  - this pattern varies depending on observations



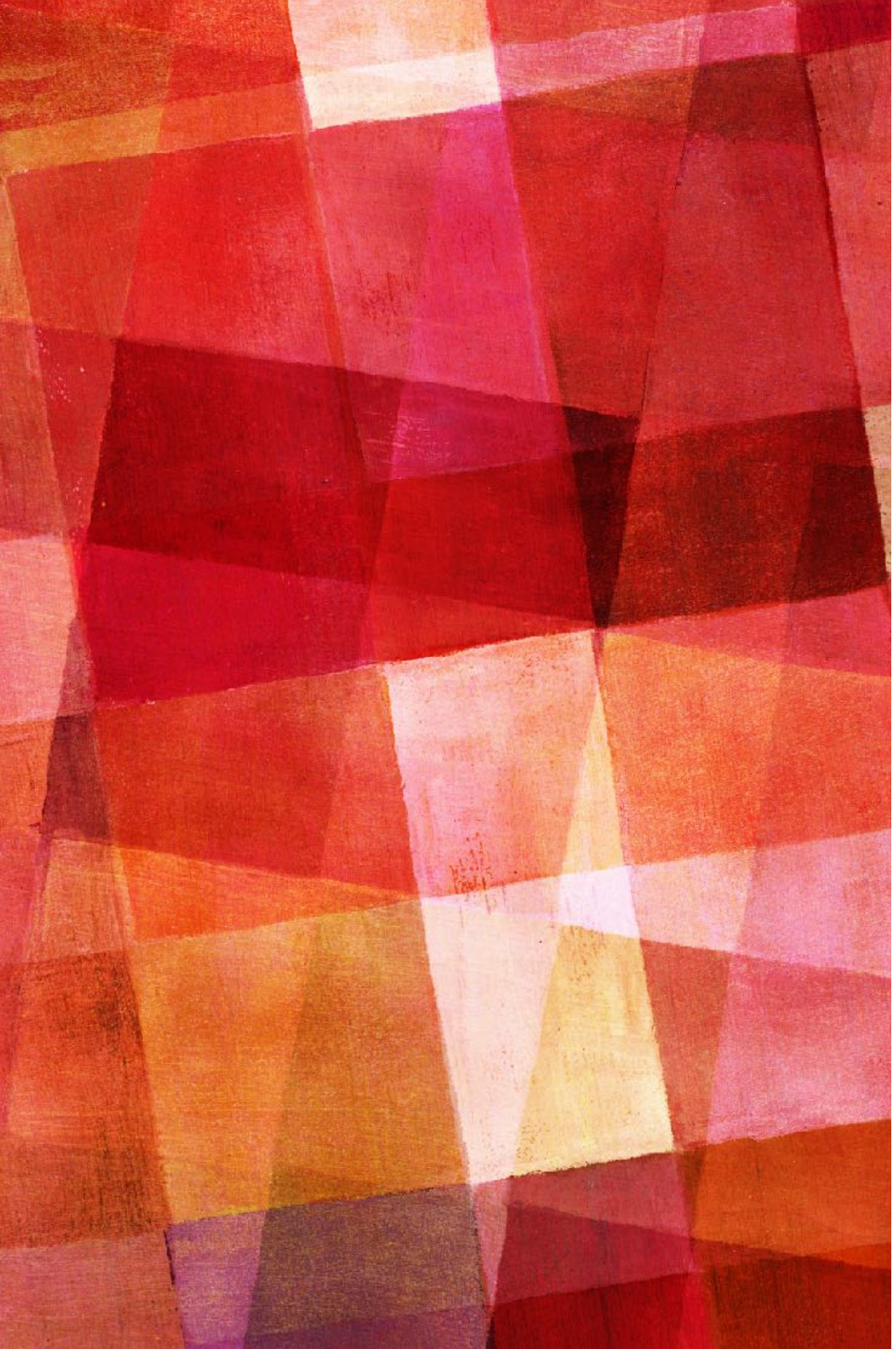
COMPENSATORY STRATEGIES

- Ideally, we want to try all other options before thickening liquids.
- Positioning
  - Elevated side-lying
  - More upright
  - Slightly reclined
- Flow rate
  - Slower flowing nipple
  - Sippy cup vs. open cup
  - Straw
    - Use with caution



COMPENSATORY STRATEGIES

- Techniques
  - Pacing
  - Chin tuck
  - Multiple swallows
  - Chin/jaw support
- Consistency of liquids
  - Thin
  - Nectar
  - Honey
  - Spoon Thick
    - typically requires supplemental non-oral feedings due to dehydration concerns



COMPENSATORY STRATEGIES

- Information from the feeding therapist is very helpful
  - Helpful strategies
    - Positioning
    - Pacing
    - Bolus presentation
  - Challenging liquids/foods
  - Current treatment plan
- Clinical feeding plan prior to the VFSS

BARIUM

- Basic Element
  - On the periodic table
- "White when it goes in and white when it comes out"
- Can be mildly constipating but typically intake during a VFSS is limited
- Slightly chalking
- Can flavor it
  - Kool-Aid packets
  - Avoid products that would alter the consistency

BARIUM

- We use Varibar Barium at CMH
  - Thin
  - Nectar
  - Thin Honey
    - this corresponds to the standard “honey” recipe for most thickening agents
  - Honey
  - Pudding

LIQUID CONSISTENCIES

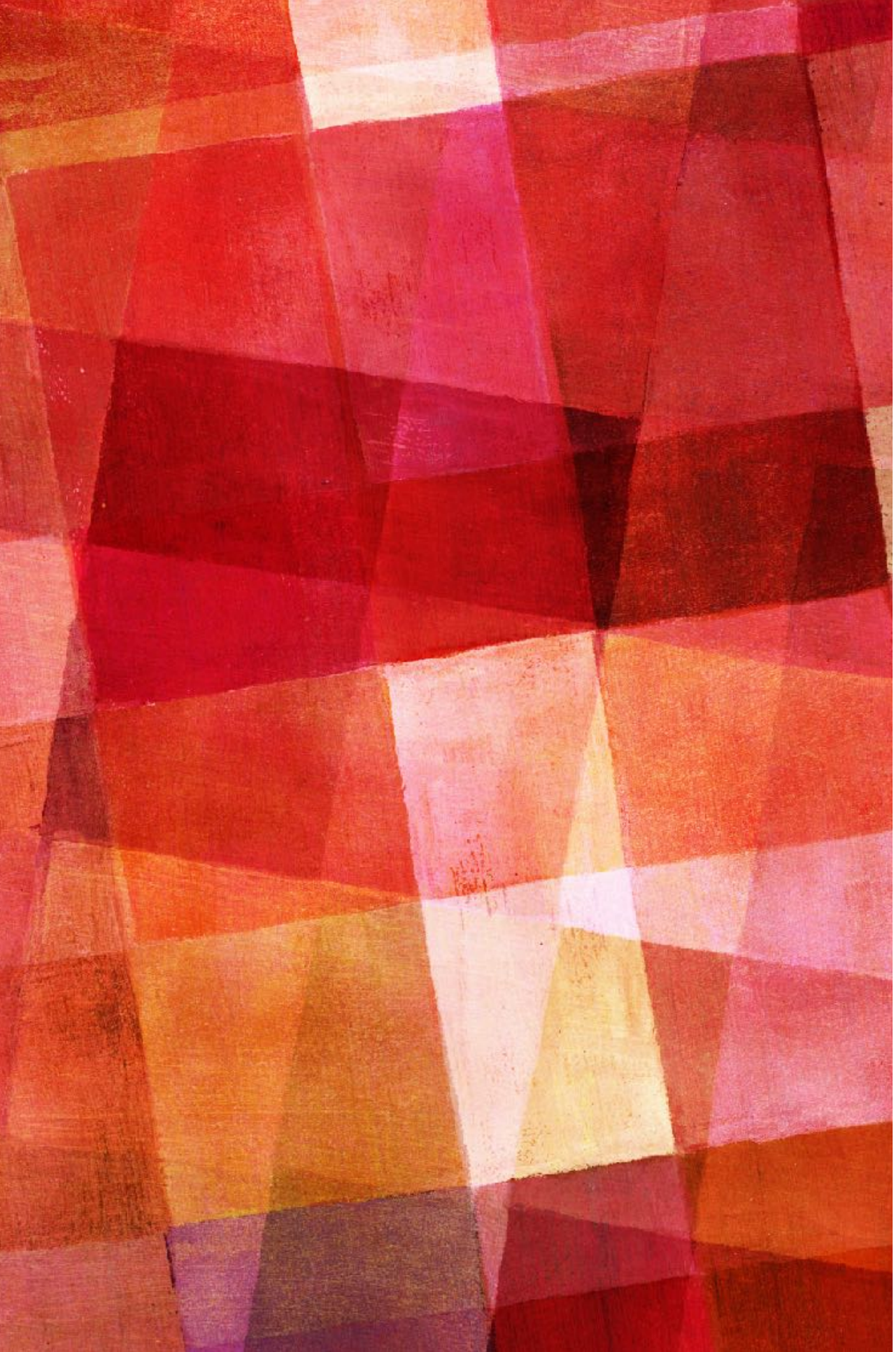
- At Children's Mercy, we use the following consistencies clinically:
  - Thin
    - Water, milk, breastmilk
  - Nectar
    - 3 teaspoons of Thick & Easy per 4 oz. of liquid
  - Syrup (this is typically called honey consistency)
    - 4 1/2 teaspoons of Thick & Easy per 4 oz. of liquid
  - Honey (this is typically called spoon thick)
    - 5 1/2 teaspoons of Thick & Easy per 4 oz. of liquid

LIQUID CONSISTENCIES

- Currently working on standardizing recipes and identifying the best thickening agents
  - Would like our recipes to match the viscosity of the Varibar Barium products we use during swallow studies
    - Visualization is a very inaccurate way to assess viscosity
  - Improve education and compliance with thickening recommendations

OPTIMAL SAMPLING RATE

- ASHA recommends a national standard of 30 frames per second
  - We currently use 15 fps at Children's Mercy
  - SLPs are working with radiology to change this practice
- Bonilha, et. al. 2013
  - scores from MBSImp and Penetration-Aspiration Scale varied between pulse rates
- Cohen 2009
  - The full depth of laryngeal penetration was visible on only 1 frame for 70% of the studies



THREE PHASES OF SWALLOWING

- Oral phase
- Pharyngeal phase
- Esophageal phase

- At CMH, a swallow study is used to evaluate the first 2 phases

ORAL PHASE

- During a swallow study, we are evaluating the following areas:
- Lip seal
  - Bottling
  - Cup drinking
  - Spoon feeding
  - Oral containment of the bolus
- Tongue movement
  - Tongue base retraction
  - Tongue pumping, fasciculations

ORAL PHASE

- Bolus control
  - Is the bolus split, pocketed
- Chewing
  - A swallow study is not typically the best evaluation of chewing concerns (recommend a clinical feeding evaluation)
- Lingual-palatal seal
  - Prevents the bolus from entering the pharynx too soon
- Piecemeal deglutition
  - Bolus is divided into smaller parts before swallowing

ORAL PHASE

- Residue after the swallow
- Bolus size
  - Too big
  - Too small
    - Inefficient extraction
- Pacing
  - Difficulty coordinating suck-swallow-breathe pattern
  - Consecutive swallows
  - Controlled pattern

PHARYNGEAL PHASE

- Trigger of the swallow response
  - Lots of opinions on this topic
- Pooling/filling in the valleculae and pyriforms
  - Associated with poor oral containment and a delayed swallow
  - Acceptable pooling varies by age
- Epiglottic inversion
  - Simplified version of airway protection:
    - Epiglottis inverts (“caps the larynx”)
    - Aryepiglottic folds tighten (purse-like strings)
    - Vocal folds adduct (close)

PHARYNGEAL PHASE

- Hyo-laryngeal elevation
  - The larynx moves up and forward during the swallow to initiate airway protection
  - Decreased elevation may contribute to reduced epiglottic inversion, laryngeal penetration, aspiration, cricopharyngeal dysfunction, and residue after the swallow
    - Cricopharyngeal dysfunction may cause reduced hyo-laryngeal elevation
- Nasopharyngeal reflux
  - Part of the bolus enters the nasal cavity
  - Somewhat acceptable in neonates
  - Common in infants with unrepaired cleft palate

PHARYNGEAL PHASE

- Pharyngeal peristalsis
  - Pharyngeal weakness will result in residue
    - Increases risk for aspiration
  - Uncoordinated
    - May divide the bolus
    - May contribute to nasopharyngeal reflux
- Laryngeal penetration
- Aspiration
- Residue after the swallow
  - Location of residue can provide cues about swallowing difficulties

PHARYNGEAL PHASE

- Cricopharyngeal/upper esophageal sphincter function
  - Does the bolus easily pass into the esophagus?
  - May be caused by reduced hyo-laryngeal elevation but may also be limiting hyo-laryngeal elevation (tethering effect)
- Signs of a tracheoesophageal fistula
  - Barium in the airway without aspiration

LARYNGEAL PENETRATION

- Food or liquid enters the laryngeal vestibule but does not go below the vocal folds
- Severity:
  - Amount of barium
    - Trace, slight, moderate, entire bolus
  - Level of penetration
    - Upper 1/3 of the laryngeal vestibule
    - Upper 2/3
    - Deep = touches or nearly touches the vocal folds
      - Not a safe feeding plan
      - Will often stop testing that consistency during a VFS to minimize radiation exposure
- Residue in laryngeal vestibule

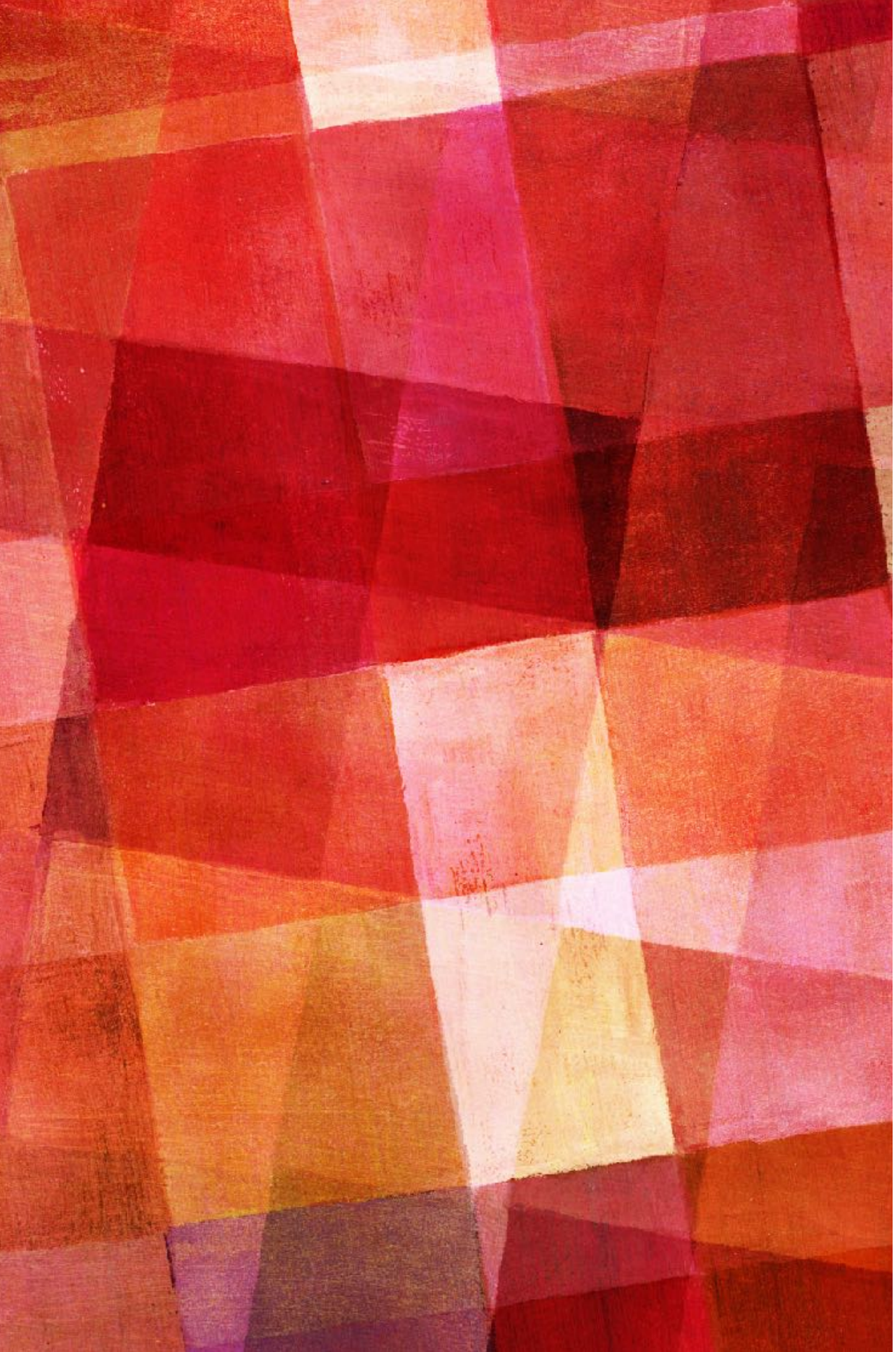
LARYNGEAL PENETRATION

- Gurberg, J., et al. 2015.
  - 165 pediatric patients with a wide range of diagnoses
    - 58 had neither laryngeal penetration or aspiration
    - 59 had laryngeal penetration
    - 48 had tracheobronchial aspiration
  - "Children with laryngeal penetration on videofluoroscopic swallowing study had significantly more pneumonia than patients with neither penetration nor aspiration."
    - 2 pneumonias compared to 0
  - Increased risk for pneumonia and aspiration for patients with glottic abnormalities (ex. laryngeal cleft)
  - Associated syndromes did not appear to impact risk for pneumonia or aspiration

LARYNGEAL PENETRATION

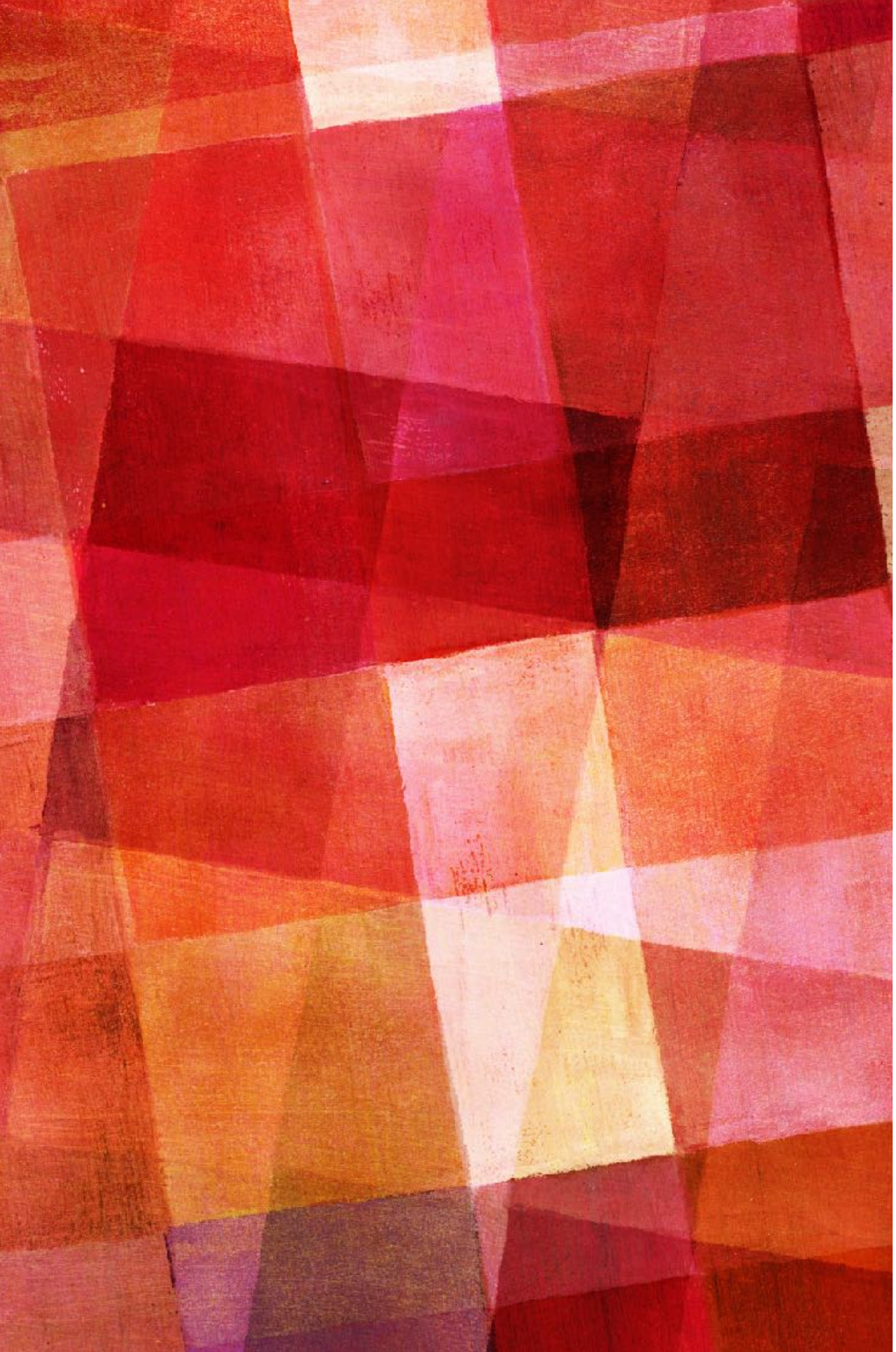
- **Friedman, B., et al. 2000**
- 60% of the 125 children in the study demonstrated laryngeal penetration
  - 31% = deep laryngeal penetration
- 85% of these children eventually aspirated during the study

- **Why are these studies important?**
  - Laryngeal penetration is not benign
  - Minimize radiation exposure
    - deep laryngeal penetration is not a safe plan so we can move to the next strategy or consistency faster vs. waiting to witness aspiration



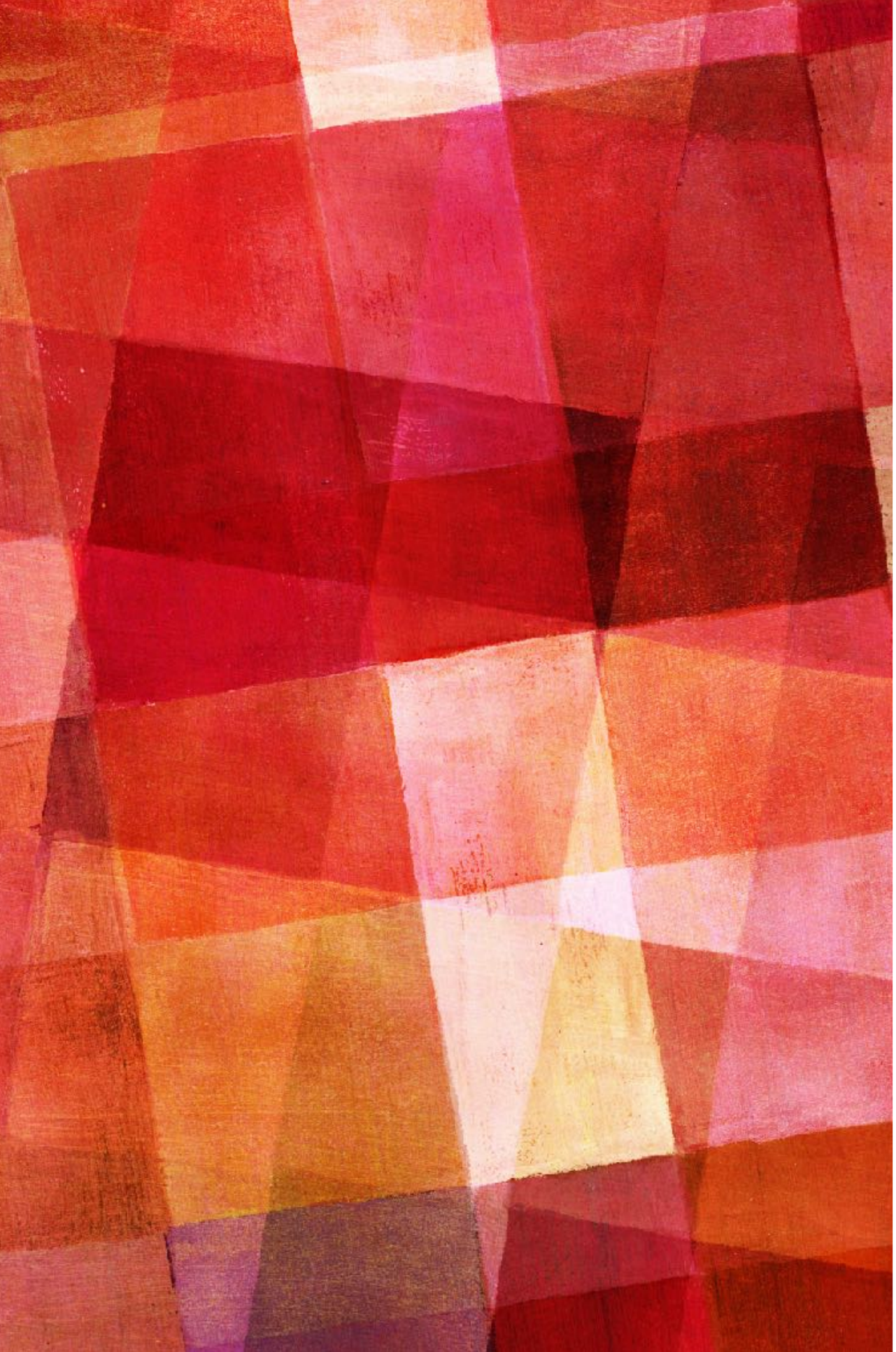
ASPIRATION

- Food or liquid passes through the vocal folds and into the sub-glottic space
- Types
  - Silent (no cough)
    - very common in the pediatric population
    - Can be very hard to detect silent aspiration clinically – VFSS is the gold standard
  - Aspiration with a cough
  - Aspiration with a delayed cough



ASPIRATION

- Timing of the aspiration event
  - Before the swallow
    - suggests a delayed or absent swallow
  - During
    - suggests incomplete vocal fold closure, reduced hyo-laryngeal elevation, laryngeal cleft
  - After
    - often due to residue



ASPIRATION

- Amount of barium aspirated
  - Trace, minimal…
- Was the patient able to clear the barium from the airway?
  - Effective cough
  - Cue to cough or spontaneous
- Other signs of aspiration
  - Watery eyes
  - Stopped the feeding
  - Wet breath or vocal sounds

PENETRATION-ASPIRATION SCALE

➤**Rosenbeck, J.C., et al. 1996.**

- ➤ 1 = Material does not enter the airway
- ➤ 2 = Material enters the airway, remains above the vocal folds, and is not ejected from the airway
- 3 = Material enters the airway, remains above the vocal folds, and is not ejected from the airway
- 4 = Material enters the airway, contacts the vocal folds, and is ejected from the airway
- 5 = Material enters with airway, passes below the vocal folds, and is not ejected from the airway
- 6 = Material enters the airway, passes below the vocal folds, and is ejected into the larynx or out of the airway
- 7 = Material enters the airway, passes below the vocal folds, and is not ejected from the trachea despite effort
- 8 = Material enters the airway, passes below the vocal folds, and no effort is made to eject

MBSIMP™

➤Martin-Harris, B. et al. 2008

- ➤ Modified Barium Swallow Impairment Profile (MBSImP)
- ➤ A standardized approach to instruction, assessment, and reporting of physiologic swallowing impairment
- ➤ Evidence based
- ➤ Assesses 17 components of swallowing
- ➤ SLPs become a “Registered MBSImP Clinician” upon successful completion of the MBSImP Online Training and Reliability Testing
- ➤ Pediatric protocol is being developed

DOCUMENTATION

- Findings
  - Safe swallow for …
  - Aspiration/penetration
    - note consistencies
    - Possible reason for dysphagia concerns
- Diagnosis
  - Oral dysphagia
  - Pharyngeal dysphagia
  - Oral-pharyngeal dysphagia
- Support for diagnosis

DOCUMENTATION

- Recommendations
  - Feeding plan
    - liquid consistency recommended
      - recipe
      - recommended thickening agent
    - solids
    - will require physician approval for thickening
- Therapy
  - ideally will include recommendations for therapy goals/ activities

DOCUMENTATION

- Recommendations (continued)
  - Referrals
    - ENT
    - GI
  - Repeat swallow study
    - recommend limiting studies as much as possible
      - Approximately every 6-12 months
      - Change in swallow
      - Change in medical status
    - Clinical feeding evaluation prior to a repeat study

FEES VS. VFSS

FEES

- Flexible Endoscopic Evaluation of Swallowing (FEES)
- A flexible endoscope is used to evaluate the pharyngeal phase of the swallow
- At Children's Mercy, ENT typically places the scope
- Use green dye for contrast
- Multiple positioning options including:
  - Caregiver's lap
  - Exam chair
  - Wheelchair

FEES

- **Candidates for FEES include:**
  - Suspect structural issues are impacting swallow safety
  - Assessing secretion management
    - typically done with children who are not oral eaters
  - Only instrumental assessment to further evaluate breastfeeding
  - Special positioning needs
  - Unable to tolerate a VFSS

FEES

➤ **Pros:**

- ➤ No radiation exposure
  - ➤ Study time is limited only by patient's tolerance/ willingness to participate
- ➤ Able to use the patient's preferred foods
  - ➤ Breastfeeding
  - ➤ No need to alter taste or texture with barium
  - ➤ Green dye is optional
- ➤ Able to view saliva swallows
- ➤ More flexible seating/positioning

FEES

- **Pros (continued):**
  - Excellent view of pharyngeal anatomy
    - Base of tongue
    - Epiglottis
    - Vocal folds
    - Arytenoid cartilage
  - Able to view asymmetry
    - Unilateral pooling

FEES

➤**Cons:**

- ➤ “White out” during the swallow
- ➤ Challenging to identify aspiration
  - ➤ looking for signs of the aspirated bolus between or below the vocal folds
- ➤ Blocks the nasal airway
  - ➤ May impact bottle and breastfeeding
  - ➤ Nasogastric tubes
- ➤ May be uncomfortable
- ➤ Pharyngeal phase only
  - ➤ unable to assess tongue movement or other elements of the oral phase

VFSS

➤ Pros:

- ➤ Gold standard for identification of laryngeal penetration and aspiration
- ➤ Able to track the bolus through the oral and pharyngeal phases as well as esophageal phase
- ➤ May be able to see possible signs of a TE fistula and/or laryngeal cleft
  - ➤ further work-up may be necessary to fully evaluate these concerns

VFSS

➤ Cons:

- ➤ Radiation exposure
- ➤ Must use barium
- ➤ Unable to clearly evaluate structures
  - ➤ vocal folds
- ➤ More challenging to identify asymmetries
  - ➤ At CMH, we typically only complete a lateral view to minimize radiation exposure
  - ➤ Anterior posture view

CASE STUDIES & VIDEOS

REFERENCES

- Bonilha, H.S., Blair, J., Carnes, B., Huda, W., Humphries, K., McGrattan, K., Michel, Y., Martin-Harris, B., 2013. Preliminary investigation of the effect of pulse rate on judgments of swallowing impairment and treatment recommendations. Dysphagia. 28(4): 528-538.
- Cohen, M.D. 2009. Can we use pulsed fluoroscopy to decrease the radiation does during video fluoroscopic feeding studies in children? Clinical Radiology. 64(1): 70-73.
- Delaney, A.L., Barkmeier-Kraemer, J. 2017. Instrumental Swallowing Assessment: Considerations for standardized protocols and on-line decision making. Feeding Matters. Phoenix, AZ.
- Friedman, B., Frazier, J.B. 2000. Dysphagia. 15:153-158.

REFERENCES

- Gurberg, J., Birnbaum, R., Daniel, S.J. 2015. Laryngeal penetration on videofluoroscopic swallowing study is associated with increased pneumonia in children. International Journal of Pediatric Otorhinolaryngology. 79: 1827-1830.Ro
- Rosenbek, J.C., Robbins, J., Roecker, E.B., Coyle, J.I., Wood, J.L. 1996. A Penetration-Aspiration Scale. Dysphagia. 11: 93-98.
- Martin-Harris, B., Brodsky, M., Michel. Y., Castell, D., Schleicher, M., Sandige, J., Maxwell, R., Blair, J. 2008. MBS measurement tool of swallow impairment - MBSImp: Establishing a standard. Dysphagia. (4): 392-405.
- Weir, K., McMahon, S., Barry, L., Masters, I.B., & Chang, A.B. 2009. Clinical signs and symptoms of oropharyngeal aspiration and dysphagia in children. European Respiratory Journal. 33:604-611.

QUESTIONS?

THANK YOU!

Brenda Sitzmann, MA, CCC-SLP
bksitzmann@cmh.edu
(816) 960-4005