Individualized Dysphagia Plan: Using Evidence to Develop a Unique Plan for your Patient

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Disclosure

• Financial:
  – I receive a salary from Purdue University.
  – I occasionally provide prn services for Arnett Hospital for which I am compensated.
  – I will receive an honorarium for this presentation.

• Non-Financial:
  – None
Goals for this presentation

• Review current evidence as it applies to the continuum of care in the evaluation and treatment of dysphagia
• Include some anecdotal spice from an old/seasoned clinician
• Encourage conversation regarding incorporation of evidence into current practice patterns
Clinical Swallowing Evaluation

• What is our goal?
• What must be included and why?
What Is Our Goal?

• Screen
• Identify dysphagia
• Identify aspiration
• Determine etiology of dysphagia and direction of treatment
• Determine when to do instrumental assessment
Screening
James L. Coyle, Ph.D., CCC-SLP, BRS-S
ASHA, 2013

• Seeks to “rule out” signs of a disorder
  – Determines whether more testing is needed
  – Uses ONE sign (positive, negative)
  – Generates a PASS-FAIL result
  – Does NOT identify source/cause of the FAILED screen
  – Does NOT generate justifications for treatment
Screening

• Examples of Medical Screening
  – Glucose/blood sugar
  – Mammography
  – Blood pressure
  – Colonoscopy
Screening
James L. Coyle, Ph.D., CCC-SLP, BRS-S
ASHA, 2013

• Parallel screening
  – We have 2 (or more) tests
  – If patient fails either, we do not do the second test
  – Patient is referred for diagnostic test or is treated

• Series screening
  – We have 2 (or more) tests
  – Patient must fail both tests to be referred for diagnostic test or be treated.
Purpose of Dysphagia Screening

• To determine the likelihood that aspiration is present
• The need for formal swallow evaluation
• When it is safe to recommend resumption of oral alimentation.
MGH Nursing Screen
Patient Readiness

Part 1

Wakefulness
HOB elevated
Stable O2 stats
Oral care

Yes
Proceed to part 2

No
Remain NPO & Re-screen
MGH Nursing Screen
Clinical Screening

Part 2

- Tongue movement
- Vocal quality
- Pharyngeal sensation
- Volitional Cough
- Swallow water

Each worth 1 point except swallow = 2.
Pass = 5-6/Fail = ≤ 4
MGH-SST

• When compared to FEES, the MGH-SST performed similarly among the entire study population and stroke subset.
• Sensitivity was 0.89 and 0.93 respectively
• Specificity was 0.61 and 0.64 respectively

(Goldsmith et al., 2008; Goldsmith, Cohen, Vega-Barachowitz & Nalipinski, 2007)
The Three Ounce Water Test
DePippo, Holas, and Reding, 1992

• Identified 80% of patients aspirating (16/20)
  – Sensitivity 76%; Specificity 59%
• Identified patients with more severe dysphagia and aspirating larger amounts
  – Sensitivity 94%; Specificity 26%
• Identified patients aspirating thicker viscosities
  – Sensitivity 94%; Specificity 30%
Clinical Utility of the 3 oz. Water Test
(Suiter and Leder, 2008)

- Does the 3-ounce water swallow test identify individuals who aspirate thin liquids?
- Does a failed 3-ounce water swallow test identify individuals who are also unsafe for oral alimentation based on results of an instrumental swallow assessment?
- Does a successfully passed 3-ounce water swallow test permit specific diet recommendations to be made without further objective swallow assessment?
Clinical Utility of the 3 oz. Water Test
(Suiter and Leder, 2008)

• To determine presence of aspiration in 3000 patients
  – 38% passed
  – 62% failed
• Sensitivity 96.5%
• Specificity = 48.7%
• False positive rate = 51.3%
Clinical Utility of the 3 oz. Water Test
(Suiter and Leder, 2008)

• To determine safety of PO diet
• Sensitivity for safe for oral intake 96.4%
• Specificity 46.4%
• False positive rate 53.6%
Author’s Conclusions

• Failure does not indicate inability to tolerate thin liquids

• Unnecessarily restricts liquid intake for nearly half of the patients tested

• Over-referral for formal swallowing assessment

• If passed, diet recommendations can be made without additional testing—need to consider other variables though
Questions

• Was there bias in determination of diet due to fact FEES was completed first?
• Are milk and water comparable?
• What percentage coughed/couldn’t do/had vocal quality changes?
• What about treatment?
• What is the definition of “tolerates” diet?
• Were the patients followed for a period of time?

• Had to pass 3-ounce water swallow challenge for inclusion
• 9.3% disqualified
• 12–24 h after passing a 3-ounce challenge protocol
  – 90.7% study patients were drinking thin liquids and eating food successfully and safely
• Fluid intake: 240-460 ml
• Food intake: 10-100%

(Leder et al, 2012)
3-ounce water swallow challenge protocol

• Additional factors to consider and to assess prior to utilizing:
  – pre-morbid feeding status and ability
  – cognitive status
  – cooperativeness and level of consciousness
  – gross oral motor functioning
  – respiratory muscle function and endurance
  – posture limitations
Clinical Swallowing Evaluation

- Identify dysphagia
- Identify aspiration
- Determine etiology of dysphagia and direction of treatment
- Determine when to do instrumental assessment
Clinical Swallowing Evaluation

McCullough et al, 1999
- History
- Oral mech
- Voice
- Presentation of boluses

Wetzel et Wetzel
- Adjunct tools
  - Cervical auscultation
  - Palpation
  - Oximetry
History

• Reliability of reporting
  – Have an established history form
  – Include information supported by the literature
  – Utilize a consistent standardized inventory to rate the severity of dysphagia

Wetzel, ISHA 2014
History
Outcome Scales

• FOIS
  – Ordinal scale that rates the oral intake of the patient with dysphagia
  – 7 levels ranging from NPO to full oral diet with no restrictions

• NOMS
  – Ordinal scale
  – 7 levels ranging from NPO full oral diet
  – Includes use of strategies and degree of cueing needed
  – Corresponds with G-codes

Wetzel, ISHA 2014
History
Outcome Scales

• Symptom reporting
  – EAT-10
    • 10 item survey
    • Rate symptom from 0-4
    • Score > 3 abnormal
  – Sydney Swallow Questionnaire
    • Self-report symptom inventory
    • 17 item survey- Max score 1700
    • Visual analog scale
History
Outcome Scales

• Patient perceptions
  – SWAL-QOL
    • Assesses impact on QOL
    • Frequently cited in research
    • 4 choices
    • $10^{\text{th}}$ grade reading level
    • Limited accessibility
History
Outcome Scales

• MDADI
  – Self-administered questionnaire designed specifically for evaluating the impact of dysphagia on the QOL of patients with head and neck cancer
  – 20 items
  – 10 minute administration
Dysphagia Handicap Index

- Validated, reliable tool assessing psychosocial handicapping effects of dysphagia
  - Physical
  - Emotional
  - Functional
- Twenty five items. Limited to 3 choices
  - Never
  - Sometimes
  - Always
- 7 point scale rating perception of dysphagia severity

Wetzel, ISHA 2014
Items Rated As Important and Frequently Used by Clinicians
McCullough et al, 1999

<table>
<thead>
<tr>
<th>History</th>
<th>Research Support</th>
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<tbody>
<tr>
<td>Hx of pneumonia</td>
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<td>Patient report</td>
</tr>
<tr>
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<td>Family report</td>
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<td>Nutritional status</td>
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<td>GI anomaly</td>
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<td>Structure</td>
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<td>Previous surgery</td>
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<td></td>
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<tr>
<td>Other diseases</td>
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<tr>
<td>Medications</td>
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</table>
History
Predictive of Aspiration

- Pneumonia
  - Presence of 2/4 and 1/4
- Poor nutrition
  - 12.23x and 2.45 more
- Feeding tube
  - likely to aspirate
- Need suction

(Rosenbek et al, 2004)

- A history of pneumonia may also predict aspiration on VFSS
  (Cogen & Weinryb, 1989)
History
Predictive of Aspiration

- Presence of current pneumonia and bad oral hygiene most predictive of aspiration.

- Family or nursing report family of dysphagia, drooling, presence of non-oral feeding, need for suctioning, and dehydration had high positive likelihood ratios as well.

  (McCullough, 2005)
Predictors of Aspiration Pneumonia

• Best predictors for who will develop aspiration pneumonia are:
  – Dependence on others for feeding
  – Dependence for oral care
  – Number of decayed teeth
  – Tube feeding
  – Dysphagia and aspiration, although risk factors, were not the most predictive factors for development of aspiration pneumonia.

  (Langmore et al., 1998)
Cognitive Status

• Orientation
  – What is your name?
  – Where are you right now?
  – What year is it?

• Directions
  – Open your mouth.
  – Stick out your tongue.
  – Smile

(Leder, Suiter, & Lisitano Warner, 2009)
Cognitive Status

• Odds of liquid aspiration were 31% greater if not oriented to person, place, and time

• If unable to follow one step directives:
  – Odds of liquid aspiration 57% greater
  – Odds of puree aspiration 48 % greater
  – Odds of being deemed unsafe for any oral intake 69% greater

(Leder, Suiter, & Lisitano, Warner, 2009)
Cognitive Status

• Being able to answer orientation questions and follow single-step verbal commands provides information on odds of aspiration and overall eating status prior to dysphagia testing.

• Knowledge of potential increased odds of aspiration allows for individualization of dysphagia testing thereby optimizing swallowing success.

Leder, Suiter, & Lisitano Warner, 2009
Oral Mech Exam

• Cranial Nerves
• Oral Care
• Lesions
Items Rated As Important and Frequently Used by Clinicians
McCullough et al, 1999

<table>
<thead>
<tr>
<th>Oral Motor</th>
<th>Research Support</th>
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<tbody>
<tr>
<td>Dysarthria</td>
<td>Oral apraxia</td>
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<tr>
<td>Voluntary cough/clear</td>
<td>Lip seal/pucker</td>
<td></td>
</tr>
<tr>
<td>Poor secretion management</td>
<td>Jaw strength/lateralization</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Tongue strength/ ROM</strong></td>
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</tr>
<tr>
<td></td>
<td>Follow directions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intelligibility</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soft palate/symmetry</td>
<td></td>
</tr>
</tbody>
</table>
Oral Mechanism Exam

- Incomplete lingual range of motion had an odds of aspiration that was 2.72 times the odds of aspiration of those with complete lingual range of motion.
- Incomplete lingual range of motion was an independent risk factor for aspiration regardless of labial closure and facial symmetry.
- Incomplete facial symmetry had an odds of aspiration that was 0.76 times the odds of aspiration of those with complete facial symmetry.

Leder, Suiter, Murray and Rademaker, Dysphagia (2013)
Oral Mechanism Exam

- Tongue strength
- Cough strength
- Secretions

Presence of 1/3
1.96x more likely to aspirate

(Rosenbek et al, 2004)
<table>
<thead>
<tr>
<th>Voice</th>
<th>Research Support</th>
<th>No Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breathiness</td>
<td></td>
<td>Strained/strangled</td>
</tr>
<tr>
<td>Harshness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wet/gurgly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall dysphonia/aphonia</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Wetzel, ISHA 2014
Dysphonia and Dysarthria

• Dysphonia and dysarthria 1.32x more likely to aspirate (Rosenbek et al., 2004)

• Presence of dysphonia, has been identified in several studies (Daniels et al., 1998)

• Presence of dysarthria (Daniels et al., 1998; Hartelius & Svensson, 1994);
Pitch Elevation
(Malandraki et al, 2011)

• Is pitch elevation useful in predicting the likelihood of the following bolus flow outcomes:
  – (a) laryngeal invasion
  – (b) vallecular residue
  – (c) pyriform sinuses residue

• It was hypothesized that reduced vocal range (defined as average pitch to falsetto) and/or reduced maximum fundamental frequency ($F_0$) would significantly predict higher (worse) Penetration-Aspiration Scale scores

• What is the relationship between acoustic and perceptual voice evaluation?
Pitch Elevation Measures

• Pitch elevation judged perceptually and acoustically
• Pitch elevation task completed at time of VFSS
• Penetration Aspiration Scale
  – a score of 3 or more
• Residue scale
  – (Hind et al. 2001) uses 3 points to rate the degree of residue (0 = normal, 1 = coating, and 2 = pooling)-a score of 1 or more
Pitch Elevation Results

• Lower maximum $F_0$ and perceptual identification of abnormal pitch elevation were associated with higher (more severe) PASS

• Lower maximum $F_0$ was associated with significantly higher mean residue scores over all five locations, including the valleculae and pyriform sinuses
Pitch Elevation
Results

• Perceptual evaluation of vocal pitch elevation was sensitive in identifying patients with reduced maximum $F_0$ and worse Penetration-Aspiration Scale scores (binary score)

• Reduced vocal range (defined here as normal voice to falsetto) did not significantly predict likelihood of airway invasion or pharyngeal residue
Wet Vocal Quality
(Wright et al, 2010)

• 62% of the participants exhibited penetration or aspiration
• 36% exhibited deep penetration to the level of the vocal folds.
• Thin liquids were aspirated the most with 67%.
• During the perceptual assessment of vocal quality, the agreement between pairs of raters was usually slight or poor.
Conclusions

• Wet vocal quality is not reliably perceived by clinicians when material is present in the larynx during phonation.

• No actual definition used to distinguish “wet” vocal quality from any other vocal quality

• Material in the larynx can elicit other vocal qualities
Wet Vocal Quality
(Rosenbek et al, 2004)

• Wet voice after swallow on the CSE, despite its clinical appeal, is less than impressive as a sign for predicting aspiration on VFSE.

• Post-test probability for this patient aspirating is about 45%
Cough and Absence of Gag

• Predictive of aspiration?
  – Abnormal, volitional cough (Daniels et al., 1998; Gordon, Hewer, & Wade, 1987; Horner, Brazer, & Massey, 1993; Horner, Massey, & Brazer, 1990)
  – Absence of a pharyngeal gag reflex (Daniels et al., 1998; Gordon et al., 1987; Horner et al., 1988; Linden & Siebens, 1983; Logemann, Veis, & Colangelo, 1999)

• Or not so much?
  – (DeJong, 1967; Leder, 1997; Linden, Kuhlemeier, & Patterson, 1993).
Cough

• Inspiratory Phase – diaphragm-lung volume
  – Flow rate and duration

• Compression Phase – full laryngeal adduction and quick abduction
  – Measure duration

• Expiratory Phase
  – Peak expiratory flow rate
  – Peak expiratory flow rise time
  – Cough volume acceleration
Cough
(Hegland, Crossroads Conference 2013)

- Disordered = too much or too little
- Voluntary cough
  - Single
  - Sequential
- Reflexive/induced cough
  - Capsaicin, L-Tartaric acid, Distilled water (FOG)
- Reflexive cough
Reflexive Induced Cough
(Addington et al. 1999)

- Used tartaric acid to induce cough
- Classified as “normal” or “weak/absent”
- Weak or absent cough was deemed a significant predictor for aspiration pneumonia and dysphagia
Cough

Summary of Findings
(Hegland, Crossroads Conference 2013)

• Cough of patients with dysphagia significantly different than cough of patients without dysphagia

• Cough peak flow decreased in stroke, and further in stroke with dysphagia

• Vital capacity was less in stroke with dysphagia versus without dysphagia and healthy controls
Urge to Cough
(Hegland, 2012)

• A respiratory sensation that precedes cough after penetration/aspiration
• Healthy awake individuals can modify their cough reflex
• Testing reflex cough thresholds and the UTC in PD patients with and without dysphagia
• PD patients with dysphagia demonstrate significantly blunted UTC
Impact and Significance

(Hegland 2012)

• UTC ratings may be important in understanding the mechanism underlying morbidity related to aspiration pneumonia in people with PD, or possibly other neurogenic disorders, and dysphagia

• Future Directions
  – Understand blunted UTC in people with PD and dysphagia
  – Development of strategies and treatments to address deficits of airway protection in this population by targeting UTC.
Predicting Aspiration in Patients With Ischemic Stroke

(Smith Hammond et al, 2009)

• All objective cough measures were associated with aspiration risk except inspiration phase duration and glottic closure duration

• Voluntary cough measures independently associated with aspiration
  – Volume acceleration
  – Higher expulsive phase rise times

• Reflexive cough after ice or water had low sensitivity

• Efficacy of cough may be as important if not more in determining aspiration risk
Predicting Aspiration in Patients With Ischemic Stroke

(Smith Hammond et al, 2009)

- Only 1.6% of non-aspirating patients had a history of pneumonia compared to 24.2% of those at high aspiration risk

- Mortality of non-aspirators and aspirators
  - @ 3 months: 4.8% and 33.3%
  - @ 18 months: 17.5% and 45.5%
Comparison of Clinical Signs and Aerodynamic Measures of Voluntary Cough

• Clinical signs of aspiration, speech problems, disorientation, cognitive deficits, and mortality were substantially more likely to be present among those patients at high risk of aspiration compared to the non-aspirating subjects

Wetzel, ISHA 2014
# Items Rated As Important and Frequently Used by Clinicians

McCullough et al, 1999

<table>
<thead>
<tr>
<th>Trial Swallows</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Support</td>
<td>No Research</td>
</tr>
<tr>
<td>Thin liquid</td>
<td>Puree</td>
</tr>
<tr>
<td>Thick liquid</td>
<td>Solid</td>
</tr>
<tr>
<td>Laryngeal elevation</td>
<td>Oral transit estimate</td>
</tr>
<tr>
<td>Voice after swallow</td>
<td>Estimate swallow delay</td>
</tr>
<tr>
<td>Self feeding</td>
<td>Estimate total duration</td>
</tr>
<tr>
<td>Spontaneous cough</td>
<td>Swallows per bolus</td>
</tr>
<tr>
<td>Penetration/aspiration estimate</td>
<td>Estimate of oral stasis</td>
</tr>
<tr>
<td>Observation of meal</td>
<td></td>
</tr>
</tbody>
</table>
Presentation of Boluses

• Timing
• Laryngeal elevation
• Number of swallows

• Spontaneous cough
• Wet voice

• Esophageal symptoms
Palpation/4 Finger Method

(dysphagiaramblings.net)
Cervical Auscultation
(Leah Fullman & Valerie Boyer /www.asha.org)

- Low rate of inter-rater reliability
- High rate of false positives
- Studies concluded reliability of cervical auscultation is too low for it to be a stand-alone, objective tool
- Any information from cervical auscultation needs to be verified using objective tools such as VFSS or FEES
- Speculated that successful raters have better critical listening skills/musical training??

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Cervical Auscultation
(Balasubramaniam & Bhat)

• No consistent pattern available for acoustic event of swallowing in normals due to the variations in the instrumentation used
• Bolus type and volume and age and gender have not been controlled
• Studies on individuals with dysphagia revealed significant differences between dysphagic and non dysphagic individuals.
• It can be regarded as a tool for the assessment of dysphagia
Personal Thoughts

• Would never use it as a stand alone tool
• Do not believe that I can reliably hear aspiration
• Do believe that it provides me additional information related to control and the timing of the swallow
• Do believe that it provides additional information regarding upper airway sounds before, during, and after the swallow
Pulse Oximetry

- Has its appeal as an indicator of aspiration that is accurate, noninvasive, easy to administer, and widely available.
- Reviewed 19 studies that evaluated oxygen saturation during oral feeding, the effect of aspiration on oxygen saturation, and/or the ability to predict penetration/aspiration based upon fluctuation in oxygen saturation.

Colodny, 2004
Pulse Oximetry

• Each study has been flawed by either
  – Failure to use instrumentation simultaneously with pulse oximetry
  – Use of the 2% desaturation criterion
  – The inclusion of penetrators with aspirators

(Colodny, 2004)
Pulse Oximetry

– Lack of a control group
– Measurement errors
– Inadequate sample size
– “There is not sufficient support to conclude that there are distinctive alterations in $S_pO_2$ during swallowing
What About a Runny Nose????
So....We Don’t Have One Sign That Predicts Aspiration or the Severity of Dysphagia

• We need to learn how to identify combinations of patient signs during the CSE to predict VFSS performance.
Predicting Aspiration  
(McCullough et al, 2001)

- 2 signs during the trial swallows were found to be statistically significant for sensitivity and specificity
  - the presence of a spontaneous cough during the swallow
  - an overall estimate of the presence or absence or aspiration.
Predicting Aspiration  
(Rosenbek et al, 2004)

<table>
<thead>
<tr>
<th>Combined Clinical/Bedside Signs</th>
<th>Likelihood</th>
<th>Ratio of Aspiration</th>
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<tbody>
<tr>
<td>History 2/4</td>
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<tr>
<td>Signs present from all categories</td>
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<td>History 1/4</td>
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<td>Oral motor 1/3</td>
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<tr>
<td>Dysarthria or dysphonia</td>
<td>1.32</td>
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Predicting The Severity of Dysphagia
(Daniels, McAdam, Brailey, Foundas, 1997)

<table>
<thead>
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<th>Variable</th>
<th>Sens.</th>
<th>Spec.</th>
<th>$x^2$</th>
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<td>Dysphonia</td>
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<td>Cough p swallow</td>
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<td>Two features</td>
<td>92.3</td>
<td>66.7</td>
<td>20.96</td>
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</table>
When to do instrumental assessment

- When the patient coughs on the 3 ounce water challenge?
- When the combination of signs observed indicate increased likelihood of aspiration or severe dysphagia?
- When you need to determine the etiology?
- When you need to design a treatment plan?
- When the patient/family/MD insist?
Instrumental Assessment

• What is our goal
• What must be included and why
(Mis-)Perceptions

- Pass/Fail
- One: one correlation
- Thicker is better
Normal Variability
Swallow Onset

• 80% of participants initiated hyoid motion after arrival of the bolus at the ramus of the mandible
  – 25% at the vallecular pits
  – 13 at the hypopharynx
  – 5 at the pyriform sinuses (all over 50)

• Healthy individuals over 50 have longer delays than younger individuals

• Onset of apnea was variable but occurred prior to onset of hyoid motion
  (Martin-Harris et al, 2007)
Normal Variability Penetration

• 97%-100% healthy individuals scored 1-3 PA Scale (Martin-Harris et al 2007)
• Healthy adults will score 1-2 on the PA Scale (Robbins, 1999)
• Scores as high as 3 were found to be normal in older individuals (Rosenbek, 1996)
Reliability of VFSS
(McCullough G.H., Review Perspectives SIG 13)

• The rating of the presence or absence of aspiration has been the best.
• Even good clinicians did not rate most VFSS measures consistently with one another.
• Intra-rater reliability has reportedly been higher than inter-rater reliability.
• Inter-rater reliability seems to improve when ratings are made after group discussion
Improving Reliability

• Continuing education can improve skills and reliability
  – Results showed significant improvement in identification of radiographic anatomy and swallowing disorders after a four hour training period
    – (Logemann et al. Dysphagia 2000)
Standardization

- MBS Imp
- Penetration/Aspiration
- Residue
  - Residue ordinal scales
  - Oropharyngeal Swallow Efficiency Ratio (OPSE)
  - Normalized Residue Ratio Scale (NRRS)
MBS Impairment Profile

• Two primary purposes: identification of impairment and determination of effective interventions
• Rates 17 components of the swallow
• Operational definitions of components
• PA Scale can be used in tandem
• Calculates an Overall Impression score which represents the “worst” score across the consistencies
• Must be trained to use

Wetzel, ISHA 2014
8-point Penetration/Aspiration Scale
(Rosenbek et al, 1996 Robbins et al, 1999)

1. Material does not enter the airway.
2. Material enters the airway, remains above the vocal folds, and is 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 the airway, contacts 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.
Penetration

- None
- Occasional < 30%
- Intermittent 30%-40%
- Frequent >50%
Residue

Ordinal Rating Scales

• Measure the height or width and the degree of residue
  – 0 = none
  – 1 = coating/trace
  – 2 = < 25% mild
  – 3 = > 25% <50% moderate
  – 4 = > 50% severe
Normalized Residue Ratio

• Do perceptual and quantitative methods demonstrate good agreement?

• What differences in precision are apparent by measurement method (one-dimensional, two-dimensional, and circumscribed area ratios)?

• Do residue ratios agree strongly with residue area measures that are anatomically normalized?
Normalized Residue Ratio

- Perceptual and quantitative ratings for valleculae did not achieve agreement.
- Perceptual vs. quantitative ratings for pyriforms were similar.
- Linearly derived ratios lack precision in comparison to circumscribed ratio measures.
- However, circumscribed area ratios didn’t show strong agreement with measures normalized for body size.
Implications

• Semi-automated version suitable for clinical settings

• Validation study of the NRRS against perceptual measures of residue severity from experienced clinicians to determine cut points

• Future studies to explore the association between quantified measures of residue severity and aspiration risk.
Snapshot in Time
So How Do We Incorporate This Information???
## Predictors of Aspiration

(Perlman et al, 1994)

<table>
<thead>
<tr>
<th>Disordered Physiology</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delayed initiation of the pharyngeal stage of the swallow</td>
<td>1.4</td>
</tr>
<tr>
<td>Moderate-to-severe hypopharyngeal stasis</td>
<td>1.4</td>
</tr>
<tr>
<td>Moderate-to-severe vallecular stasis</td>
<td>1.9</td>
</tr>
<tr>
<td>Reduced hyoid elevation</td>
<td>3.7</td>
</tr>
<tr>
<td>Deviant epiglottic deflection</td>
<td>4.4</td>
</tr>
</tbody>
</table>
Retention is Predictive of Aspiration
(Eisenhuber et al, 2002)

<table>
<thead>
<tr>
<th>Pharyngeal Retention</th>
<th>Aspiration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild &lt; 25% = 1</td>
<td>25%</td>
</tr>
<tr>
<td>Moderate 26-50% = 2</td>
<td>29%</td>
</tr>
<tr>
<td>Severe &gt;50% = 3</td>
<td>89%</td>
</tr>
</tbody>
</table>

• Retention increased with increasing bolus size or repeated swallowing in 82% of patients

• Penetration or aspiration occurred in 93% of the patients with retention and only 31% of those without
Esophageal Screen
(Easterling, 2012)

• ASHA Guidelines indicate we should do it
• ACR Guidelines do NOT mention it
• ACR Guidelines do mention completion of esophagram if warranted
• No criterion or procedures provided in either document
• Allen study cited
  – 20ml bolus A-P for 15 seconds
  – 63% sensitivity/100% specificity
So How Do We Incorporate This Information???
## Cognitive Status

<table>
<thead>
<tr>
<th>Question</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is your name?</td>
<td>Open your mouth</td>
</tr>
<tr>
<td>Where are you right now?</td>
<td>Stick out your tongue</td>
</tr>
<tr>
<td>What year is it?</td>
<td>Smile</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>/</strong></td>
</tr>
<tr>
<td><strong>/</strong></td>
<td><strong>Total</strong></td>
</tr>
<tr>
<td><strong>/</strong></td>
<td><strong>/</strong></td>
</tr>
</tbody>
</table>
Swallowing History

General Swallowing Hx:

<table>
<thead>
<tr>
<th>Y/N</th>
<th>Y/N</th>
<th>Y/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambulatory</td>
<td>0 1</td>
<td>Hx. of pneumonia</td>
</tr>
<tr>
<td>Independent ADLS</td>
<td>0 1</td>
<td>Hx. of feeding tube</td>
</tr>
<tr>
<td>Self-feeds</td>
<td>0 1</td>
<td>Adequate nutrition</td>
</tr>
<tr>
<td>Oral hygiene</td>
<td>0 1</td>
<td>Unintentional wgt. loss</td>
</tr>
</tbody>
</table>

GI History/GERD:

<table>
<thead>
<tr>
<th>Y/N</th>
<th>Y/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manages secretions</td>
<td>0 1</td>
</tr>
<tr>
<td>Suction</td>
<td>1 0</td>
</tr>
<tr>
<td>Decayed teeth</td>
<td>1 0</td>
</tr>
</tbody>
</table>

Outcome Measure:

History Total:
### Oral Mech Findings

<table>
<thead>
<tr>
<th></th>
<th>+</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN VII Facial Symmetry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CN VII Labial ROM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CN VII Labial seal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CN XII Lingual protrusion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CN XII Lingual ROM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CN XII Lingual strength</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CN IX X Palatal symmetry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CN IX X Gag</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CN X Vocal quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CN X Pitch elevation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CN X Cough</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor speech disorder</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In Summary

• Incorporate the evidence we *do* have into your clinical swallowing evaluation

• Use the evidence when providing rationale for the instrumental assessment to MD

• Implement outcome measures

• Continue to strive for standardization and reliability in instrumental assessments

• Don’t underestimate the difference you make!
Individualized Dysphagia Plan: Using Evidence to Develop a Unique Plan for your Patient

INTERVENTION
Treatment

• Rehabilitative
  • Direct
  • Indirect
  • Motor with Swallow
  • Motor without Swallow

• Compensatory
  – Postural
    • Chin tuck
  – Dietary
    • Thickened liquids
## Compensation

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Behavioral Plasticity</th>
<th>Neural Plasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chin tuck</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Head Rotation</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Head Tilt</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Head Back</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Side Lying</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Breath Hold</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Bolus Consistency</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>
Chin Down/Chin Tuck

• Widens the vallecular space
• Approximates tongue base to posterior pharyngeal wall
• Approximates epiglottis to laryngeal vestibule
• Varying reports on how to complete
• May make swallow worse
• Reported to eliminate aspiration anywhere from 8%-57% of the time (Ashford et al)
Diet Modification

Thin vs thickened liquids

Wetzel, ISHA 2014
Thickened Liquids
Variability Among SLPs

• Purpose: To determine if SLPs were able to reliably repeat their relative perceptions of nectar, honey, and pudding thick over multiple mixings.
• Subjects: 23 certified and licensed SLPs with 6 months to 10 years experience
• Results
  – No inter-subject repeatability for nectar or honey
  – Weak intra-subject repeatability for nectar
  – Moderate intra-subject repeatability for honey
    (Glassburn DL, and Deem JF, 1998)
Thickened Liquids
Variability Among SLPs

• Conclusions
  – Subjective judgment of consistency is not a valid method for dysphagia management
  – There is a need for a standardized procedure for mixing consistencies for dysphagia evaluation and treatment
    • Must be consistent from evaluation to treatment
    • Must be consistent from day to day

Wetzel, ISHA 2014
Thickened Liquids

Variability Among Products and Time

• The gum-based samples did not significantly change in their mean viscosity over time for nectar or honey

• For nectar- and honey-like consistencies the majority of starch-based product/liquid combinations were significantly thicker at 10 minutes and some continued to thicken at 30 minutes.

• Thicken Up was more similar to gum-based thickeners (except milk)

(Garcia JM, Chambers E. IV, Matta Z, Clark M)
Thickened Liquids
Variability Among Products and Time

• Any comparison of thickening product depends on the beverage with which it is mixed and the time it thickens

• The effect of time depends on the thickener/beverage combination

• The comparison of beverage depends on the type of thickening product and the thickening time

Garcia JM, Chambers E. IV, Matta Z, Clark M, 2008
Thickened Liquids
Variability Among Products and Time

• Simply Thick generally maintained a consistent level of thickness across 30 minutes and produced the most repeatable level of thickness across beverages

• The two starch-based thickeners showed a tendency to thicken over time- particularly honey thick.

• Thick & Easy > Thicken Up
Thickened Liquids
Variability Among Products and Temperatures

• Would also expect viscosity of xanthan gum to decrease with increased temperature, but it remained relatively stable

• But this study demonstrated that heating of starch dispersions usually caused the starch granules to swell and further gelatinize with increased viscosity

• Most cold beverages (gum- and starch-based) were more viscous when compared to room temperature
Current Findings about the Line Spread Test
(As presented by Garcia, ASHA 2013)

• Not a substitute for viscosity measurement
• We know that flow distance will be impacted by time/temperature/thickener
• Not useful for comparing mealtime fluids to MBS modifications (barium changes density)
• BUT line spread measurements distinguish nectar-thick and honey-like consistency across variety of modified liquids (Nicosia & Robbins, 2007)
There are currently no objective criteria for thickened liquid preparation for assessment and treatment
Training Line Spread Test
A Low Tech training tool
(Garcia, ASHA 2013)

• A Plexiglas board marked with concentric circles spaced .5 cm apart at a distance of 2.5 to 7.5 cm, divided into four quadrants (90° intervals)
• A hollow tube (cylinder of 3.5 cm height × 5 cm diameter) positioned at the center of the concentric circles.
• Each thickened sample was poured into the cylinder after 5 min of setting time.
• The tubes were slightly overfilled and were leveled with a metal spatula to ensure that the same amount of sample was placed in each tube and the tube was lifted.
• Measurements from each quadrant were taken after 60 secs and averaged to represent the amount of spread in cm.

Wetzel, ISHA 2014
Clinical Application with the LST
(Garcia, ASHA 2013)

• Survey findings consistently report “nectar” as the most common level of modification
  SLPs 72.4% (Garcia et al., 2005)
  RDs 81.3% (Garcia & Chambers, 2012)
• Targets one level—caregivers who overly thicken nectar-consistencies tend to follow a similar pattern of thickening with honey-like samples (Garcia et al., 2010)
• Nectar = 4.5; Honey = < 4.5
In Summary

• The difference between nectar thick and honey thick is important

• Unreliable preparation may have potential consequences for patients

• Thicker is not necessarily better and may negatively impact airway clearance and increase risk for aspiration pneumonia for some (Robbins et al., 2008)
Efficacy of Thickened Liquids

- Although thickening liquids is a very common treatment, neither it’s mechanism of action nor level of efficacy has yet been adequately demonstrated.

- Available literature contains no evidence to suggest that texture modification reliably reduces aspiration or facilitates improved bolus clearance.
Three Interventions for Aspiration of Thin Liquids
(Logemann et al, 2008)

- Compared chin-down posture, nectar thick, honey thick
- 711 subjects: PD patients with and without dementia; dementia patients
- ↑ severity of dementia = ↑ severity dysphagia
- ↑ severity of Parkinson’s = ↑ severity of dysphagia
- 49% aspirated on all three interventions
- For ~ half of the patients there was one intervention that was consistently best
Three Interventions for Aspiration of Thin Liquids
(Logemann et al, 2008)

• Immediate elimination of aspiration occurred most often with honey thick, then nectar thick, and lastly chin-down posture

• Patients (without dementia) preferred chin-down posture

• Success with honey thick was dependent upon when it was presented. More likely to aspirate on honey if it was administered last in the sequence
Three Interventions for Aspiration of Thin Liquids

- To determine short term elimination of aspiration must use instrumental assessment
- Must consider patient’s preference when constructing treatment plan
- Many patients will not comply with thickened liquids
- Long term effectiveness not yet known
Three Interventions for Aspiration of Thin Liquids-Part II

- Only included patients who didn’t aspirate at all or those who aspirated on all consistencies
- 52/515 developed pneumonia
- Difference in frequency of pneumonia was not significant between chin-down and thickened liquids
- Comparison of the two thickened liquids revealed that honey thick has a two-fold pneumonia risk
Plasticity

- Ability of the brain to change
  - Changes can be due to normal aging, disease, training etc.
  - Changes in neural substrate lead to behavioral change

- Neural plasticity
- Behavioral plasticity
Ten Principles of Neuroplasticity

(Kleim and Jones as cited by Robbins et al, 2008)

1. Use it or lose it
2. Use it and improve it
3. Plasticity is experience specific
4. Repetition matter
5. Intensity matters
6. Time matters
7. Salience matters
8. Age matters
9. Transference
10. Interference
Treatment

- Rehabilitative
- Direct
- Indirect
- Motor with Swallow
- Motor without Swallow
- Compensatory
Treatment
(Adapted from Burkhead, ASHA, 2013)

**Direct exercise**
- Mendelsohn
- Effortful swallow
- Tongue hold swallow (Masako)

**Indirect exercise**
- Shaker head lift
- EMST
- Lingual strengthening

- Skill specific
- Strength training

Wetzel, ISHA 2014
Treatment
(Robbins et al, 2008)

• Motor with swallow
  – Mendelsohn*
  – Super supraglottic
  – Effortful*
  – Tongue Hold*
  – Swallow frequency

– All have demonstrated evidence of behavioral plasticity but no evidence of neural plasticity-yet!
Mendelsohn Maneuver

- Can be used as strengthening/ROM or as a maneuver
- Load= holding larynx in elevated position against resistance
- Using with bolus may increase salience, load
- Increased activation of submental muscles
- Increased vertical-anterior duration & extent of hyoid & laryngeal movement
- Increased A-P diameter and duration of UES opening
- Improved coordination
- Improved timing
- Increased pressure/BOT-PPW
Effortful Swallow

• Began as compensatory strategy
• Then considered strengthening
• Evolved to skill training
• Task-oriented form of skill training with a strength component from greater muscular activation
Effortful Swallow

- Impacts submental muscle activation
- *May* consequently affect airway protection and UES activation earlier onset/longer duration /extent motion
- Increased generation of oral pressure-dependent upon instruction
- Increased pharyngeal pressure BOT/PPW with longer duration and UES relaxation
- Potential for increase load/resistance by increasing bolus viscosity
sEMG as biofeedback
(Steele, 2004)

• Effective in a variety of populations
• Reported cases, clients with long-standing dysphagia underwent a short course of 10-15 sessions of swallowing treatment, delivered on an intensive schedule (5-15 days).
• Used with swallowing maneuvers, such as Mendelsohn or effortful swallow.
• Outcomes superior with biofeedback when compared with “traditional” therapy alone.
• Crary- sEMG plus Mendelsohn (12-32 sessions)- 55% of nonoral feeders progressed to total oral feeding
Masako/Tongue Hold

• Designed to improve swallow physiology in individuals demonstrating decreased bolus clearance in upper pharynx due to decreased tongue base retraction or upper pharyngeal constrictor anterior ward motion

• Created in response to observation of increased anterior bulging of posterior pharyngeal wall after oral resection-passive load

• Conflicting findings: ↑ pharyngeal pressure – H/N ↓ pharyngeal pressures - nls
McNeill Dysphagia Therapy Program

• Targets swallowing
• Uses volume and viscosity as the load/resistance
• Known to change effort, duration, degree of movement
• 11 step hierarchy of food and liquid sequenced to exercise the mechanism based on speed/coordination and progressive resistance
McNeill Dysphagia Therapy Program

• Start at most advanced level that is “safe”
• 15 sessions
• Swallow hard and swallow fast
• 80-100 swallows/session
• Mass practice and increased load
• Authors report that individuals using MDT had 69% reduction in their dysphagia when compared to the more traditional therapy with biofeedback group
• FOIS increased. PASS decreased
• Does not report specific physiologic improvements

Wetzel, ISHA 2014
Treatment
(Robbins et al, 2008)

• Motor without Swallow
  – ROM
  – Strengthening-tongue*
  – Strengthening-respiratory*
  – Tongue control
  – Shaker*
  – LSVT*

  – All have evidence of behavioral plasticity, but not neural plasticity
Treatment

(Robbins et al, 2008)

• Motor without Swallow
  – Pharyngeal exercises*
  – Gargling
  – Vocal exercises
  – Velar elevation
  – Airway closure/breath hold

  lack evidence of
  lack evidence of
  behavioral plasticity

  No evidence of neural plasticity
Strength Training
(Burkhead, Sapienza, Rosenbek, 2007)

• Intensity:
  – Mechanical or resistive load
  – Amount/repetition of practice regimen
  – Duration of training over time

• Transference
  – Cross training and non-specific strength training

• Specificity
  – How closely the exercise task corresponds with the targeted outcome
Lingual Strengthening

• MOST (Madison Oral Strengthening Therapeutic device)
  – Swallowsolutions.com/most-info
• Kay/Pentax – part of the swallowing signals lab
  – Kayelemetrics.com
• IOPI (Iowa Oral Performance Instrument)
  – www.iopi.info
• Tongue depressor
Lingual Strengthening
Robbins

- 10 reps, 3x/day, 3 nonconsecutive days/week
- 60% on week 1
- 80% of 1RM on weeks 2-8
- Can re-assess 1RM every 2 weeks
- 8 weeks
Lingual Strengthening  
(Robbins, 2005)

• 8-week progressive resistance exercise with IOPI in older, healthy volunteers
• 100% increased their isometric pressures and also oral pressure during swallowing tasks
• 5.1% volume increase in tongue bulk on MR
Lingual Strengthening
(Robbins et al, 2007)

- 10 dysphagic stroke pts 51-90 y.o. (6 acute, 4 chronic) 8-week progressive resistance with IOPI
- All increased isometric pressures and oral swallowing pressures
- Airway protection improved with liquids
- Tongue volume increased on 2 subjects
Tongue Pressure Resistance Training
(Steele, 2009, 2010)

• Uses the IOPI

• Protocol:
  – 45-60 minute session
  – 60 tongue presses
  – 8 weeks long
  – Establishes MAXTP for anterior and posterior tongue
  – Interested in tongue pressure accuracy and targets range from 25%-110%
  – Dense foods require pressure/Liquids more precise control
Tongue Pressure Resistance Training
(Steele, 2010)

- Hyoid excursion is closely times with tongue pressure events
- Anterior MAXTPs may engage hyoid elevation
- Posterior MAXTPs may elicit anterior hyoid movement
- Found one occurrence of maladaptation and decoupling between the hyoid and larynx.
Lingual Strengthening
(Lazarus et al, 2003)

- Examined 31 normal subjects
- Randomized into 3 groups
  - No exercise
  - IOPI
  - Tongue depressor
- Measured lingual strength at baseline and after one month exercise
- Protocol:
  - 10 reps/5xday/5xweek
Lingual Strengthening  
(Lazarus et al, 2003)

• No difference between the 2 exercise groups—both demonstrated significant increase in mean maximal tongue strength

• No increase in mean max tongue strength in the no-exercise group

• Those who had lower baseline scores demonstrated the most increase

• Endurance was not trained and an increase was not noted
Expiratory Muscle Strength Training

• Exhaling into a device with a one-way, spring-loaded pressure release valve
• Threshold to set release of the valve set at 60%-80% of max expiratory pressure
• Allows progressive quantifiable increase in resistance
• Transference – training neural substrates and muscles common to respiration and swallowing
• Potential effect on suprahyoid muscle recruitment, expiratory driving pressures for cough, vocal loudness
Expiratory Muscle Strength Training
(Sapienza et al, 2004)

• Parkinson’s patients
• Reduced pharyngeal delay
• Improved speed and extent of hyolaryngeal movement
Expiratory Muscle Strength Training
(Wheeler-Hegland et al)

• Achieved higher sEMG activation of submental muscles when compared to normal swallow
• Appears to result in increased vertical hyoid movement
• Mendelsohn, effortful swallow and EMST result in 1.5x the effort/load required in typical swallow
Shaker

• Incorporates passive resistance
• Isometric and isokinetic contractions
• Strap muscles of the neck and suprahyoid musculature
• Increased laryngeal anterior excursion and cross sectional opening of the UES
• Improved swallowing function noted with decreased post-swallow aspiration
• Return to PO intake
• Needs to be replicated
Lee Silverman Voice Therapy

• Improved oral transit times
• Improved triggering of the pharyngeal swallow
• Decreased oral residue
• Improved lingual strength and endurance
• Improved quality of life
Determining Our Treatment Plan
The Treatment Plan

• Strengthening
  – Isolated strength training is particularly effective for frail decompensated individuals
  – Strength training prior to or in conjunction with dynamic exercise resulted in improved functional outcomes
  – Training *especially* the frail patient in strength and/or skill training is always preferred to “merely observing and documenting”
  – Pair strength training AND a compensation to keep the patient taking at least something
The Treatment Plan

• Intensity
  – 60% of 1RM (Repetition Maximum)
  – Increase by 10%/week

• Repetitions
  – Fatigue: Strength and endurance: 8-12 reps
  – Weakness: Strength and power: 6-8 reps
  – Existing programs:
    • 10 reps 3x/day
    • 60 reps/1 hr
    • 80-100 swallows/hr
The Treatment Plan

• Frequency
  – Extended, continuous practice
  – Existing programs
    • 3x/day-3x/week /8 weeks
    • 5x/week/15 sessions
    • 3x/day /6 weeks
The Treatment Plan

- Tailoring the plan
- Power/tongue base – rapid force generation
- Endurance – consecutive sips
- Speed- liquid swallows
The Treatment Plan

• Specificity
  – Strength training may work best when paired with task-specific practice—Use it or lose it
  – Swallow with a controlled portion of physiologic load
  – McNeill Dysphagia Therapy Program
  – Effortful swallow and Mendelsohn with boluses

• Use any kind of feedback you can!
When You Try and Nothing Works

DONT EVER GIVE UP!
Alternative Nutrition
(Rochester Community-wide Practice Guidelines)

• Rochester handout:
  http://www.mcms.org/QualityCollaborative

• Purpose: To provide data, information, and tools, to physicians, other clinicians and patients, to help fully inform the decision making process around the use of tube feeding/PEG placement

Wetzel, ISHA 2014
Alternative Nutrition
(Rochester Community-wide Practice Guidelines)

• Checklist for Global Assessment
• Tube Feeding Worksheet
• Benefits and Burdens Chart

• Potential benefits of tube feeding questions:
  – To prolong life?
  – To improve quality of life?
  – To enable potentially curative therapy or reverse the disease process?
Outcomes

• Variety of rating scales exist to measure changes:
  – Ability to eat
  – Health status
  – Patient/Caregiver satisfaction
  – Quality of life
In Summary

• Much of the existing dysphagia treatment and research has evolved from the clinic
• Much is unknown but research is coming
• Data indicates that what we do can effect positive change
• But we have to DO something
• Treatment is not the same as monitoring
In Summary

- Too weak to exercise – Too weak NOT to exercise!!
- PO if at all possible
- Thicker is NOT necessarily better
- WFL- may not be good enough
We Must Think Critically

• One size does not fit all
• Consider the unique needs of your patient
  – What is the etiology
  – Can he tolerate any PO
  – Define the weakness vs. the tone vs. structural changes
  – What is it that the patient needs- speed, strength, endurance
We Must Think Critically

• Consider known principles of exercise
  – Specificity
  – Isolate
  – Overload
  – Intensity
  – Dosage
  – Frequency
Quit Being So Nice!!!!!!

Photo Credit: ranplett/e+/getty images