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COMIRB Protocol

COLORADO MULTIPLE INSTITUTIONAL REVIEW BOARD
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Project Title: Aspiration in Acute Respiratory Failure Survivors
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I. Hypothesis and Specific Aims

We hypothesize that the BSE assessment of swallowing certain consistencies will provide the most accurate diagnosis of aspiration.

A. Specific Aim #1: To develop a BSE-based non-invasive clinical prediction rule (CPR) that will accurately and efficiently diagnose aspiration in ARF survivors.
B. Specific Aim #2: To identify abnormalities in laryngeal structure and swallowing physiology that are associated with aspiration in ARF survivors.

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Study Design: Prospective cohort study of patients with acute respiratory failure who require mechanical ventilation for more than 48 hours.

Inclusion Criteria:
1. Admission to an ICU.
2. Mechanical ventilation with an endotracheal tube for greater than 48 hours.

Exclusion Criteria:
1. Age < 18 years
2. Contraindication to enteral nutrition administration.
3. Pre-existing or acute primary central or peripheral neuromuscular disorder
4. Pre-existing history of dysphagia or aspiration.
5. Pre-existing head and neck cancer or surgery.
6. Presence of a tracheostomy.
7. Coagulopathy resulting in uncontrolled nasal or pharyngeal bleeding.
8. Unable to participate due to altered mental status
9. Extubated for greater than 72 hours.
10. Inability to obtain informed consent from patient or an appropriate surrogate.
11. Pregnancy
12. Imprisoned at the time of admission, anytime during the hospitalization, or anytime during the follow up period

First, a SLP will perform a comprehensive BSE on each ARF survivor.
Subsequently a second blinded SLP/investigator will perform the FEES to determine whether aspiration is truly present. The FEES examination will also identify abnormalities associated with aspiration.

For Aim #1: Primary Outcome Variable: Aspiration (PAS score of ≥6) on the FEES with any of the five feedings. A PAS score of ≥ 6 includes patients with both silent and non-silent aspiration.
Statistical analysis: Recursive partitioning or Classification and Regress Tree (CART) analysis creates a tree that asks a series of yes/no questions, taking the user down different branches depending on the answers. At the end of each branch will be an estimated probability of outcome.

For Aim #2: Primary outcome variables: Presence of abnormalities in the four laryngeal functions and two swallowing physiology measures.
Statistical analysis: For each outcome and independent variable, a univariate logistic regression model will be developed.

Overall Sample Size Determination: In a simulated data analysis, a sample size of 200 yielded an area under the curve (AUC) of .75 for the resultant tree algorithm. To be conservative, we will enroll a total of 225 patients.

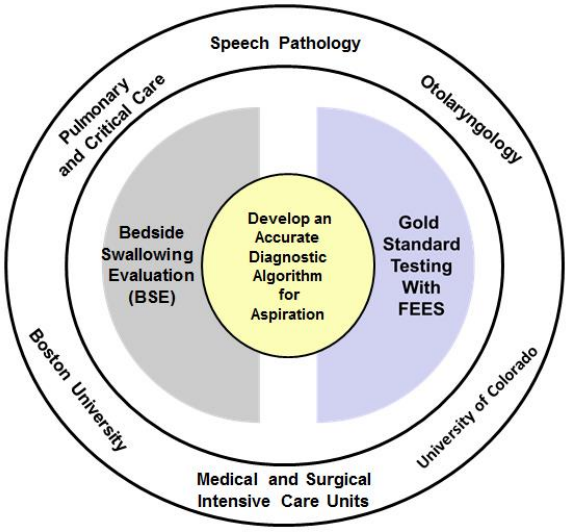
Significance: For the 455,000 acute respiratory failure (ARF) survivors each year, aspiration is a devastating complication that can develop after the initiation of oral nutrition.[1;2] Occurring in as many as 44% of ARF survivors, aspiration is associated with many deleterious consequences including pneumonia, percutaneous feeding tube placement, long term care facility admission, and increased hospital

mortality.[3-6] The complications of aspiration must be weighed against the consequences of inappropriately delaying the resumption of oral feeding. Delayed resumption of oral nutrition is associated with prolonged enteral tube feeding, increased caregiver burden, patient dissatisfaction, and increased health-related costs.[7-10] Improving the ability to easily and accurately diagnose aspiration in ARF survivors would both reduce the frequency and severity of aspiration and limit the problems associated with delaying oral nutrition. T*his proposal will develop an effective non-invasive bedside diagnostic clinical prediction rule (CPR) to detect aspiration in ARF survivors.*

Speech language pathologists (SLPs) determine when ARF survivors can resume oral feeding.[11] Based on our national survey, SLPs commonly rely upon the bedside swallow evaluation (BSE) to provide feeding recommendations for ARF survivors.[11] The BSE consists of a comprehensive history and physical examination followed by assessment of the patient's ability to swallow foods and liquids of different consistencies. SLPs do not routinely order or perform gold standard tests such as a videofluoroscopic swallow study (VFSS) or flexible endoscopic swallow study (FEES).[11] This is in part due to appropriate safety concerns about transporting critically ill patients to radiology for a VFSS and the lack of equipment or expertise to perform the FEES.[11] In patients with stroke or head and neck cancer, diagnostic CPRs have been developed that detect aspiration based on specific components of the BSE. [12-22] Due to differences in the reasons for aspiration, CPRs for these patients are unlikely to be effective for ARF survivors. [12-14;16;20] *As a result, there are no BSE-based diagnostic non-invasive CPRs that SLPs can use to provide feeding recommendations for ARF survivors.*

Figure 1: R21 Proposal Overview:

The outer circle represents our multidisciplinary infrastructure.



Using recursive partitioning analysis (RPA), we will develop an effective diagnostic CPR to accurately detect aspiration in ARF survivors. RPA has been previously used to create clinically useful CPRs including: identifying patients with chest pain that require hospitalization and selecting trauma patients that benefit from a cervical CT scan.[23;24] Based on our preliminary data, *we hypothesize that the BSE assessment of swallowing certain consistencies will provide the most accurate diagnosis of aspiration.* We propose to conduct a multi-center study that will enroll ARF survivors within 72 hours after extubation. First, a SLP will perform a comprehensive BSE on each ARF survivor. Subsequently a second blinded SLP/investigator will perform the FEES to determine whether aspiration is truly present (Figure 1).

In ARF survivors, the mechanisms responsible for aspiration are also relatively unexplored.[25;26] Though many mechanisms may contribute to aspiration in ARF survivors, abnormalities in laryngeal structure and swallowing physiology likely play a prominent role in the development of aspiration.[25] Specific abnormalities that may be responsible for aspiration include: laryngeal sensory defects and edema, vocal fold immobility and granuloma formation, delayed swallowing time, and reduced pharyngeal clearance.[25;27-31] Building on our compelling data, the FEES examination will identify abnormalities associated with aspiration, and pave the way for the development for targeted therapies to prevent and treat aspiration.

Aim #1: To develop a BSE-based non-invasive clinical prediction rule (CPR) that will accurately and efficiently diagnose aspiration in ARF survivors.
Aim #2: To identify abnormalities in laryngeal structure and swallowing physiology that are associated with aspiration in ARF survivors.

Dr. Moss' interest in dysphagia began with his 2000 *New England Journal of Medicine* article identifying the harmful effects of using blue dye to detect aspiration in ARF patients.[32] Our multidisciplinary team established a strong collaboration with Dr. Susan Langmore and her exemplary research group at Boston University.[26;33-49] Dr. Langmore developed the FEES procedure and she is one of the pioneers of dysphagia-related research.[50;51] These two productive research teams have contributed to the recent increased awareness of swallowing dysfunction and aspiration in ARF survivors.[25;26;33;52] Collectively, we have

generated substantial preliminary data demonstrating both the need for better diagnostic CPRs and for studies that identify the mechanisms responsible for aspiration. Utilizing our established research infrastructures, we are ideally positioned to conduct and complete the proposed multidisciplinary research studies.

TRIAL DESCRIPTION

Background:

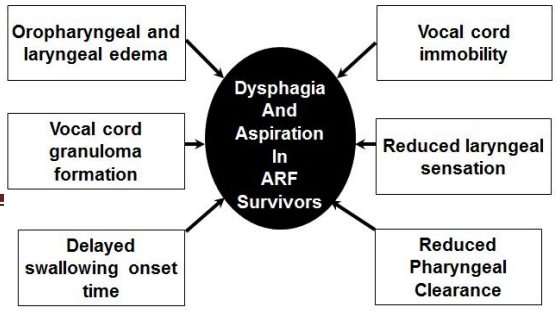
Dysphagia and subsequent aspiration are common in survivors of acute respiratory failure (ARF). Each year more than 700,000 patients develop ARF requiring mechanical ventilation. The care of these patients costs an estimated $27 billion, or 12% of all hospital expenses.[2] Based on a 65% rate of survival, 455,000 ARF patients are extubated and leave the hospital.[2] Unfortunately, many ARF survivors must cope with a variety of consequences of their critical illness.[53-58] One previously under-recognized consequence of ARF is dysphagia and subsequent aspiration.[6;25;26] As summarized in our two recently published clinical reviews on dysphagia and aspiration during recovery from critical illness, as many as 44% of ARF survivors (200,000 patients annually) have difficulty with aspiration.[25;26] Whether clinically significant or "silent" (without symptoms), aspiration is associated with pneumonia, percutaneous feeding tube placement, an increased need for institutionalized care, and increased hospital mortality. [9;59-61]

The bedside swallowing evaluation (BSE) is commonly used to diagnose aspiration in ARF survivors. Every 90 seconds, a critical care practitioner in the United States determines when it is safe to restart oral nutrition for an ARF survivor.[1;2] Most critical care practitioners delegate this decision to speech-language pathologists (SLPs).[11] In more than 60% of ARF survivors, SLPs perform a bedside evaluation (BSE) as their sole assessment to detect aspiration and determine feeding recommendations.[11] The BSE consists of two components: 1) a history and physical examination, and 2) an assessment of the patient's ability to swallow foods and liquids of different consistencies. SLPs do not routinely order or perform gold standard tests such as a videofluoroscopic swallow study (VFSS) or flexible endoscopic swallow study (FEES) to detect aspiration.[11]

The BSE may not accurately diagnose aspiration in ARF survivors. By combining specific components of the BSE, clinical prediction rules (CPRs) have been developed for patients with head and neck cancer or cerebrovascular accidents.[16-18;31;62-70] These disease-specific CPRs may not accurately detect aspiration in ARF survivors for the following reasons. 1) The proposed mechanisms responsible for aspiration in ARF survivors increase the likelihood of silent aspiration that would not be routinely detected on a BSE.[9;59-61] 2) Decreased saliva production after radiation alters swallowing function and has been included in head and cancer specific CPRs.[12-14;20;66;71] This criterion would most likely not contribute to aspiration in ARF survivors. 3) Some aspiration CPRs were developed using only patients referred for formal swallowing evaluations; creating both a selection bias and limiting generalizability of the results.[69;70;72] 4) Due to their diminished respiratory reserve, the consequences of aspiration are greater in ARF survivors.[73] Therefore CPRs might need to be more sensitive for the detection of aspiration. 5) Certain CPRs were developed without comparison to a gold standard test of aspiration such as a VFSS or FEES.[69;70;72] 6) The 3 ounce water swallow test (3-WST) is a sensitive initial screening test in hospitalized patients. However, it is unclear whether the 3-WST applies to ARF survivors, or what BSE components could be combined with the 3-WST to confirm aspiration.[74-76]

Because the mechanisms responsible for aspiration are essentially unknown, there are no medical therapies to treat or prevent aspiration in ARF survivors.[26] Currently SLPs treat patients with suspected aspiration by restricting oral nutrition, adjusting the consistency of their food or liquids, or teaching patients different swallowing maneuvers.[77-90] All of these interventions limit the chance of aspiration but do not treat the underlying cause of the swallowing dysfunction.[77-90] There are several abnormalities in ARF survivors that may be responsible for dysphagia and subsequent aspiration (Figure 2). These abnormalities may be caused by the prior endotracheal tube, deconditioning, critical illness polyneuromyopathy, reduced pharyngeal clearance, and/or limited respiratory reserve.[27-31;52;91-96] We identified specific abnormalities in laryngeal function and swallowing physiology that are associated with aspiration in ARF survivors (see preliminary data).[52] Additional studies are needed to delineate the

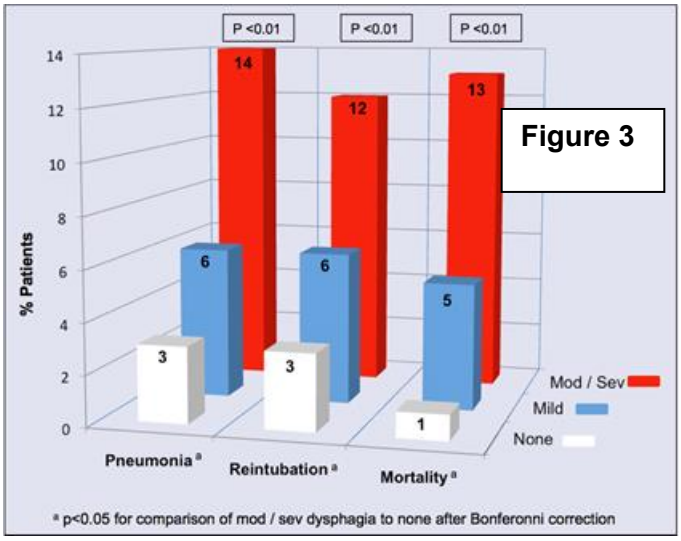
FIGURE 2



mechanisms responsible for aspiration in these patients.

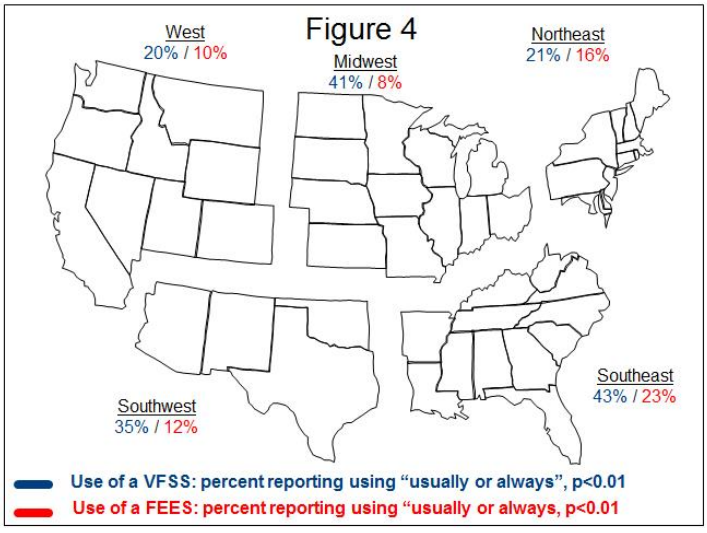
PRELIMINARY DATA: **1.Longer duration of mechanical ventilation is associated with dysphagia.**[5] We conducted a cohort study of 446 ARF patients admitted to the Medical ICU who required mechanical ventilation and received a BSE. Patients with prior neuromuscular disorders were excluded. Dysphagia was present in 84% of patients (mild in 52% and moderate/severe in 48%). After adjustment, longer duration of mechanical ventilation was independently associated with moderate/severe dysphagia (AOR 2.84 [1.78-4.56], p <0.01). *These results suggest that dysphagia is common in ARF survivors.*

2. In ARF survivors, dysphagia can persist until hospital discharge and is associated with prolonged hospitalization and delayed oral nutrition. [5] Moderate/severe dysphagia was independently associated with the composite outcome of pneumonia, re-intubation, or in-hospital death (AOR 3.31 [1.78-4.56], p<0.01) (Figure 3). In ARF survivors, dysphagia was still present in 55% of patients at hospital discharge. Hospital duration was longer in ARF survivors with dysphagia compared to those without dysphagia (8 [5-15] days vs 5 [3-8] days after the initial BSE was performed, p<0.01). Patients with moderate/severe dysphagia were more likely to be kept NPO after the initial BSE (74% vs 15%, p<0.01) and receive a surgical feeding tube during hospitalization (15% vs 5%, p<0.01).



3. Our nationwide survey of SLPs identified current practices to detect aspiration in ARF survivors. [11] We designed, validated, and distributed a survey to 1,966 SLPs working in an inpatient setting. Each survey included questions concerning SLP staffing and availability, and methods used in the diagnosis and treatment of dysphagia and aspiration. A total of 836 SLPs completed their survey (43%), 801 of whom were actively practicing. This survey represents the largest published study to date of SLP practices for ARF survivors.

4. There is currently no uniformly used diagnostic CPR to detect aspiration in ARF survivors.[11] Only 29% of hospitals have formal guidelines for when critical care providers should consult SLPs in the evaluation of ARF survivors. Most SLPs performed the BSE on average 24 hours after extubation. Importantly, the majority of SLPs (60%) only use the BSE to identify aspiration in ARF survivors. Gold standard tests (VFSS and FES) are not commonly used, and there is significant geographic variability in their use (Figure 4). VFSS and FEES are also more available and more utilized at university hospitals when compared to community hospitals (p < 0.01).



5. We already have enrolled 26 ARF survivors in Aim #1 without any adverse events. A total of 50% of ARF survivors had evidence of aspiration on FEES evaluation. The diagnostic accuracy of each individual assessment of

swallowing foods and liquids of different consistencies appears to be poor for detecting true aspiration (see Table 1). *These data demonstrate feasibility to complete the studies in Aim #1. By* combining specific components of the BSE, we anticipate that we will be able to develop a more accurate diagnostic CPR for aspiration.

6. In ARF survivors, abnormalities of laryngeal function and swallowing physiology are associated with aspiration (Aim #2 data). At Boston University Medical Center, 59 ARF survivors who required mechanical ventilation for at least 48 hours underwent FEES examination including laryngeal structure and swallowing physiology assessment. Upper airway abnormalities were common including: laryngeal edema, vocal cord immobility, and vocal cord granuloma formation. Vocal cord granulomas were associated with severe dysphagia or aspiration (p = 0.04). This work has been submitted for publication and demonstrates the feasibility to complete the studies in Aim #2.

Table 1: BSE accuracy for aspiration with different consistencies

National Dysphagia Diet	Sens. (%)	Spec. (%)	PPV (%)	NPV (%)
Honey-thick liquids	29	56	33	50
Nectar-thick liquids	25	62	40	45
Thin liquids	38	75	60	55
Pureed solids	13	75	33	46
Regular solids	38	63	50	50

OBJECTIVES

To develop a BSE-based non-invasive clinical prediction rule (CPR) that will accurately and efficiently diagnose aspiration in ARF survivors.

To identify abnormalities in laryngeal structure and swallowing physiology that are associated with aspiration in ARF survivors.

Primary Hypothesis: We hypothesize that the BSE assessment of swallowing certain consistencies will provide the most accurate diagnosis of aspiration.

1. Screening and recruitment:

Patients meeting enrollment criteria will be approached for informed consent no later than 72 hours after extubation. Surrogate consent may be used if patients are unable to provide their own informed consent due to lack of decisional capacity.

Inclusion Criteria: *Subjects will be eligible to participate in the study if they meet all of the following criteria:*
1. Admission to a University of Colorado Hospital ICU
2. Mechanical ventilation support through an endotracheal tube for greater than 48 hours

Exclusion Criteria:
1. Age < 18 years
2. Contraindication to enteral nutrition administration.
3. Pre-existing or acute primary central or peripheral neuromuscular disorder
4. Pre-existing history of dysphagia or aspiration.
5. Pre-existing head and neck cancer or surgery.
6. Presence of a tracheostomy.
7. Coagulopathy resulting in uncontrolled nasal or pharyngeal bleeding.
8. Unable to participate due to altered mental status
9. Extubated for greater than 72 hours.
10. Inability to obtain informed consent from patient or an appropriate surrogate.
11. Pregnancy
12. Imprisoned at the time of admission, anytime during the hospitalization, or anytime during the follow up period

If patients meet an exclusion criterion, they can be re-evaluated to determine if the exclusion criteria no longer exists; up to 72 hours after extubation. The presence of delirium is the one exclusion criterion that is

most likely to change over time and require repeated assessments.

There is no minimal amount of time that is required after extubation to be enrolled into the study (as long as the patient meets the inclusion criteria and does not currently meet any of the exclusion criteria. After enrollment, the research coordinator should complete the demographic information on the Case Report Forms. No fields on the Case Report Forms should be left blank. The research coordinator should also contact and the SLP who will perform the BSE, and the second SLP who will perform the FEES. The research coordinator should arrange a specific time that the BSE and FEES will be performed.

Screening and recruitment techniques:
Every new ICU admission receiving mechanical ventilation will be screened, wherein an established treatment relationship exists. This will include but not be limited to admissions from the ED, wards, and operating room. We will also assess patients transferred from outside hospitals. The enrollment window for these patients will include the time during admission at the outside hospital and during transfer.

The research coordinators or site PI will meet with the new incoming groups of ICU residents as part of their unit orientation. During this time, the residents will be alerted to each of the study inclusion and exclusion criteria. We would also recommend developing printed laminated cards with important study related and contact for the housestaff and other key members of the ICU teams. Each day, the research coordinator will identify each patient who is endotracheally intubated and receiving mechanical ventilation for at least 48 hours. Patients will then be followed until they are extubated.

At the time of extubation, the patient by definition meets inclusion criteria for the study. At this point the patient should be entered into the screening log in one of several ways
1. If they meet a permanent exclusion criteria, they should be entered as be excluded from the study
2. If they meet a potentially transient exclusion (like altered mental status), they should be followed for up to 72 hours after exclusion to determine if the exclusion criteria resolves. If it resolves they should approached for enrollment
3. If the patient meets no exclusion criteria, they should be approached about study participation.
4. If they agree to participate and sign the consent form then they are enrolled into the study.
5. If they decline to participate, then they should be entered as an excluded patient.

Informed consent:
Obtaining informed consent is a process that is reviewed by the appropriate members of our research team on a monthly basis. All of the personnel involved in screening and patient identification have successfully completed the on-line course on the Responsible Conduct of Research. Informed consent will be obtained from each patient or legally authorized representative (LAR) prior to enrollment in the trial. No study procedures will be done prior to obtaining informed consent. Permission to approach patients and/or LARs will be requested from the attending physicians.

In general our methods for obtaining informed consent include the following: 1. identification and contact of appropriate parties to perform informed consent, 2. arrangement of a mutually acceptable meeting time with this party in a private conference room or in the patient's room, and 3. a lengthy discussion between the study investigator and the interested party. The discussion includes an update of the patient's overall condition justifying the rationale for inclusion of the patient into the specific trial. The consent form is reviewed in detail including the background information and rationale regarding the specific intervention of the study, potential risks and options. Patients or their representatives are informed of their rights as a research subject and are informed of their ability to discontinue study participation at any time throughout the trial. Subjects or their representatives are given the opportunity to ask any questions regarding the verbally described consent form. Following this discussion, opportunity is given to privately read the consent form. If the patient or representative is illiterate, the consent form is read to them. After sufficient time, an additional question and answer session is performed if needed.

A few key points to the informed consent process.
1. Sit down when you are taking to the patient and/or surrogate.
2. Explain who you are and that you normally work with patients in the intensive care unit.
3. Explain that you are here to help determine if the patient is swallowing normally.
4. Explain that difficulty swallowing is common after being on a breathing machine
5. State that the standard tests to determine whether someone can swallow properly after being on a breathing machine are to have a nurse or speech therapist to observe a person swallow liquids and foods of different consistencies. However, these tests are not perfect. Sometimes it appears that the patient can eat normally, and they are actually swallowing things down the wrong tube (into their lungs), Other times, it appears that the patient is not swallowing properly when they actually are swallowing properly.
6. In addition to this normal swallowing exam, there is an additional simple test we can do that is above and beyond the normal swallowing exam. This additional technique will definitively identify if someone is swallowing normally, and allow us to identify the correct strategy for eating. Sometimes we do this test as part of the normal patient swallowing evaluation.
7. The test is simple and down right here in the patient's room. It takes 5-10 minutes and the patient can watch the test if they want. We will put a very small tube (like a very thin straw) down the back of the throat so we can see your vocal cords. We will then have you swallow liquids and foods of different consistencies and see if the material is actually going down the wrong tube.
8. Share these results with your doctors so they have the additional information and can use the information to potentially take better care of you in regard to your feeding and swallowing.

If the patient agrees to the study, then the coordinator should contact the SLP who will perform the BSE, and the second SLP who will perform the FEES.

STUDY PROCEDURES:

1. Baseline assessments:
This information will be collected by the study coordinator at the time of enrollment.

Patient Age
Patient Gender
Patient Race
Patient Height
Patient Weight
Primary Service
Hospital Admission Date
ICU Admission Date
Intubation Date and Time
Size of the Endotracheal Tube
Extubation Date and Time
Previous reintubation (y/n)
APACHE II score
Charlson Comorbidity Index

Next, a SLP will perform a comprehensive BSE on each ARF survivor, and a second blinded SLP will perform the FEES to determine whether aspiration is truly present. The order of the BSE and FEES exams will be randomized. The reason for the random order of the tests is that after several swallows, a patient who has not eaten orally in several days or weeks will start to do better as the system "wakes up". If the BSE always precedes the FEES, it might lead to a false result – it would show more aspiration on the BSE than the FEES. But it won't be because the BSE was showing a false positive; in fact it is just that the patient started to improve by the time he got the second exam.

2. Bedside Evaluation:

The BSE protocol should be performed within 24 hours from the time that the informed consent was signed. The BSE protocol will be performed in the same order and the amount of each bolus delivered in the exact manner for all patients. Unless there a medical restrictions (due to femoral lines, sacral wounds, etc), all BSEs should be performed in a sitting position. The SLP will document the patient position that the BSE was

performed.

Part 1: Initial Assessment: The SLP will review the subject's medical record and become knowledgeable with the patient's medical history. The patient should be seated with the head of the bed as elevated as possible. A physical exam of the aerodigestive system will be performed including respiratory rate; saliva formation; lip seal; tongue movement, strength, and coordination; palate movement, gag reflex; cough reflex; and voice quality/dysphonia. In addition, the SLP will also determine cough strength in L/min using a peak flow meter (HealthScan, Cedar Grove, NJ).

Part 2: Standardized consistency testing: The SLP will then administer five standard consistencies.106 Some consistencies will be tested twice with different amounts. In general, the bolus should be administered with a medicine cup. A straw should only be used for the 3 ounce water test and the 2 ounce patient controlled trials.

Boluses will be administered from lowest to highest aspiration risk: 1) ½ tsp, then 1 tsp ice chips , 2) 1 tsp of nectar thick liquids, then 3 tsp of nectar thick liquids, 3) a 2 ounce patient controlled administration of nectar thick liquids, 4) 1 tsp of pureed solids (applesauce), then 10 mls of pureed solids (applesauce), 5) 5 mls of thin liquids (water or milk),15 mls of thin liquids (water or milk), and a 2 ounce patient controlled administration of thin liquids and 6) ¼ of a graham cracker.107 The patient will be instructed to chew the graham cracker before swallowing. In order to limit the complexity and duration of our consistency testing, honey-thick liquids will be excluded from the protocol.

The SLP will wait for 10 seconds following the completion of each individual trial before recording the results for that consistency. The following adverse outcomes (coughing/choking, change in breath sounds, and change in voice quality, throat clearing, or change in pulse oximetry recording by > 10%) will be recorded after each trial.

If the clinician feels it is unsafe to continue with the next bolus consistency, the protocol can be stopped at any time.

Coughing/coughing: Dichotomized as a single cough or choking sound within 10 seconds after diet administration (yes/no).

Change in breath sounds: Breath sounds will be assessed before and 10 seconds after the examination by either auscultating over the larynx at the thyro-cricoid space during quiet breathing or listening to the patient's breathing without a stethoscope. The SLP will record whether they used a stethoscope or not to listen for change in breath sounds. Patients will be classified as "gurgling" or "non-gurgling." Gurgling is a low/medium-pitched rattling sound on inhalation or exhalation.108

Change in vocal quality: Baseline vocal quality will be assessed initially and dichotomized as normal/abnormal. Any transition from normal to abnormal vocal quality during feeding will be recorded.

Part 3: Three Ounce Water Swallow Test (3-WST): During the standardized 3-WST, patients receive three ounces of water and are instructed to drink the entire amount, via cup or straw, completely and without interruption (the cup can be held to the patient's mouth by the SLP).74;76;109 The 3-WST will be scored as pass/fail. Criteria for failure of the 3-WST are: the inability to drink the entire amount, coughing or choking up to 1 minute after completion, or the presence of a wet-hoarse vocal quality.

At this point the SLP will document their diet recommendations, and whether further invasive testing (MBSS or FEES) is indicated.

Subsequently, the SLP can perform additional testing including specific maneuvers. The results of these additional tests will be recorded in the CRF. The SLP will then document their diet recommendations that include the knowledge gained from the additional testing. Again the SLP will document whether further invasive testing (MBSS or FEES) is indicated.

Based on these recommendations, the patient will be allowed to advance their diet prior to the performance of the FEES, if indicated.

The coordinator should make sure that the BSE CRF is completely filled out before the SLP who completed the test leaves the ICU.

The BSE form for consistency testing in attached as Appendix.

3. FEES examination: The SLP will review the subject's medical record and become knowledgeable with the patient's medical history. The FEES examination will be performed by a second SLP who is blinded to the results of the BSE. The FEES should be performed within approximately 4 hours of the BSE.

Similar to the BSE, the patient should be seated with the head of the bed as elevated as possible. At the discretion of the SLP/investigator, Afrin and Lidocaine spray can be administered into the nasal passage before the laryngoscope is inserted. The use of these medications will be noted in the case report form.

Part 1: First the SLP will perform and videotape the examination of the upper airway.
Velar closure, base of the tongue retraction, laryngeal elevation, right and left vocal cord/arytenoid mobility, right and left pharyngeal wall medialization, epiglottic retroflexion, granuloma formation, and upper airway edema will be assessed.

Laryngeal sensation will be assessed by observing the laryngeal adductor reflex (LAR) or a patient response to a light touch/poke to the aeryepiglottic folds bilaterally with the tip of the laryngoscope, and scored dichotomously.

Part 2: Standardized consistency testing: The SLP will then administer five standard consistencies in two trials of each consistency with different amounts.106

Boluses will be administered from lowest to highest aspiration risk: 1) ½ tsp, then 1 tsp ice chips , 2) 1 tsp of nectar thick liquids, then 3 tsp of nectar thick liquids, 3) a 2 ounce patient controlled administration of nectar thick liquids, 4) 1 tsp of pureed solids (applesauce), then 10 mls of pureed solids (applesauce), 5) 5 mls of thin liquids (water or milk),15 mls of thin liquids (water or milk), and a 2 ounce patient controlled administration of thin liquids and 6) ¼ of a graham cracker.107 The patient will be instructed to chew the graham cracker before swallowing. In order to limit the complexity and duration of our consistency testing, honey-thick liquids will be excluded from the protocol.

Table 3: PAS scoring system

Scale	Enters airway?	Relationship to vocal folds	Ejected from airway?	Effort made to eject?
1	No	--	--	--
2	Yes	Above	Yes	--
3	Yes	Above	No	--
4	Yes	Contacting	Yes	--
5	Yes	Contacting	No	--
6	Yes	Below	Yes	--
7	Yes	Below	No	Yes
8	Yes	Below	No	No

After the swallow, the laryngoscope will be advanced to closely view the patient's airway. The SLP will wait for 10 seconds following the completion of each individual trial before recording the results for that consistency. If necessary, patients will be allowed to drink water between consistency tests to clear any remaining residue from their upper airway

The entire FEES will be video recorded. The SLP will score each of the trials using the PAS score (Table 3).

In addition for each of the trials of the consistencies, the SLP will record the following two physiological measures:

1) Swallowing onset time: The time from first bolus visualization until swallow onset.
2) Incomplete bolus clearance: leaving residue in the pharynx or laryngeal vestibule after a swallow.

Using the video recordings, the quantification of the swallowing onset time and incomplete bolus clearance will be determined by a single observer.

Part 3: Three Ounce Water Swallow Test (3-WST): During the standardized 3-WST, patients receive three ounces of water and are instructed to drink the entire amount, via cup or straw, completely and without interruption (the cup can be held to the patient's mouth by the SLP).74;76;109 The 3-WST will be scored based on the PAS scoring system.
The results of the different components of the FEES assessment will be made available to the treating team if requested.
The coordinator should make sure that the FEES CRF is completely filled out before the SLP who completed the test leaves the ICU. See Appendix for FEES evaluation form.

4. Outcome Assessments
All patients will be followed for the subsequent outcome assessments.
Date of ICU discharge
ICU length of stay
Date of hospital discharge
Hospital length of stay
Discharge location
Reintubation since enrollment
    If yes, date of reintubation
Died during ICU stay
Died during hospital stay
Surgical feeding tube placed?

5. Statistical analysis for Aim #1: Recursive partitioning or Classification and Regress Tree (CART) analysis creates a tree that asks a series of yes/no questions, taking the user down different branches depending on the answers. At the end of each branch will be an estimated probability of outcome. Statistically, recursive portioning is a non-parametric approach to regression, in this case logistic regression. We will predict a class Y (aspiration vs. non-aspiration) based on the predictor variables, X1….Xn which can be either categorical or continuous. The main characteristic of this method is that predictor variables are "split" and partitions are created so that observations with the same response variable are grouped together. After the first split, further splits of variables will occur based on the groups which are made from the prior split separately. The goal is to group observations with the same response class minimizing misclassification. Some of the benefits of using recursive partitioning are that the splits are data driven, predictor variables can be used multiple times, and interactions will be included without having to decide which interactions are important. An algorithm (or tree) is obtained that splits the predictor variables until each person has been classified as with aspiration or non-aspiration in a terminal node. Pruning of the tree will take place by determining a value of the change in misclassification rate which is deemed too small to include the next branches on the trees. By splitting the data up into ten sets and choosing one set each time, ten-fold cross-validation will estimate the misclassification rate for the tree. The chosen set will be sent through a tree developed from randomly choosing nine of the sets. The misclassification for this set will be calculated, and performed 10 times until each set has been sent through a tree. An average rate of misclassification is developed to determine how well the tree based on all the data will perform on new data.

Sample Size Calculation and Feasibility: Based on our 18 month data from the two medical centers, there were a total of 1087 patients who remained on mechanical ventilation for at least 48 hours and lived to be discharged to home or self-care. For recursive partitioning, there are no specific sample size calculations. However, in a simulated data analysis, a sample size of 200 yielded an area under the curve (AUC) of .75 for the resultant tree algorithm. To be conservative, we will enroll a total of 225 patients. Based on our estimated number of ARF survivors, we will need to obtain consent from only 20.6% of them to achieve our enrollment goal. This is a very conservative estimate for obtaining informed consent for research on swallowing function.

Additional Considerations: Our primary analysis will develop a CPR for the combined outcome of silent and non-silent aspiration. We will also develop a CPR for silent aspiration alone defined as a PAS score =8, and a CPR for non-silent aspiration alone defined as a PAS score of 6-7. For each of the five different consistencies, the accuracy of the BSE assessment for aspiration will also be compared to the presence of aspiration of the FEES examination (PAS ≥6). Sensitivity, specificity, positive and negative predicted values will be determined with 95% confidence intervals for each point estimate. Based on a sample size of 225 patients, the width of each 95% confidence interval point estimate will be 2-4%.

Statistical analysis for Aim #2: For each outcome and independent variable, a univariate logistic regression model will be developed. If the Wald test for an individual variable in the logistic regression model is significant at the $p < 0.10$ level, the variable will be included in a multivariable logistic regression model. ROC curves will be constructed to determine how well the regression models correctly predict

whether the subject had the outcome of interest. Using baseline demographical information, testing for confounding will also be assessed to better understand the relationships between independent variables and outcomes. Based on the enrollment described in Aim #1, we have powered the univariate comparison between our primary independent and dependent variables for these studies. A logistic regression with a sample size between 178 and 271 observations achieves 80% power at a 0.05 significance level to detect an odds ratio between 2.5 and 3.0.

Risks and Justifications of Procedures and Data Collection Tools: Risks of the FEES procedure include patient discomfort, gagging, vomiting, aspiration, mucosal injury, epistaxis, and an adverse reactions to topical anesthetics.[12, 15-17] One study of 500 consecutive FEES assessments reported the occurrence of minor epistaxis with spontaneous cessation of bleeding in 0.6% of cases.[15] Another survey of SLPs performing a total of 6000 FEES examinations reported 20 cases of epistaxis (0.3%).[18] Vasovagal syncope and laryngospasm, while theoretical concerns, have been shown to occur exceedingly infrequently (a total of two and four cases, respectively, ever reported out of all FEES procedures ever done).[18] None of these reported cases resulted in serious consequences.[18] The 3-WST has been shown to be a safe test in large groups of hospitalized patients.[11, 19] Our informed consent process will involve a complete discussion of each of these risks, citing reported frequencies of adverse events. Due to the risk of breach of confidentiality, we have assured that all data will be collected and stored in a safe manner. All data at each site, will be stored on a password protected research-specific server, and will not be transferred to any other computer or flash drive. Hard copies of consent forms and other forms will be kept in a locked drawer in a locked office at each enrolling site. Citrix ShareFile, a cloud-based, encrypted HIPAA compliant and University of Colorado IT approved application will be used to share de-identified FEES video recordings between the two enrolling sites. ShareFile will be accessible only to approved research staff and used for the fidelity and scoring of FEES procedures by investigators.

Potential Scientific Problems: This study will not determine the accuracy of these diagnostic tests for patients who require mechanical ventilation for fewer than 24 hours or with pre-existing or acute central neuromuscular disorders. This will affect the applicability of our results to these patient populations. We will also not determine the accuracy of the BSE and 3-WST against a VFSS, considered to also be a gold standard test to diagnose dysphagia.[10]

HUMAN SUBJECTS

Each study participant or a legally authorized representative (LAR) must sign and date an informed consent form. Institutional review board approval will be required before any subject is entered into the study. PETAL will use a central IRB.

SELECTION OF SUBJECTS

Federal regulations at 45 CFR 46(a)(3) require the equitable selection of subjects. The ICUs will be screened to determine if any patient meets inclusion and exclusion criteria. Data that have been collected as part of the routine management of the subject will be reviewed to determine eligibility. No protocol-specific tests or procedures will be performed as part of the screening process. If any subjects meet criteria for study enrollment, then the attending physician will be asked for permission to approach the patient or his/her LAR for informed consent. Study exclusion criteria neither unjustly exclude classes of individuals from participation in the research nor unjustly include classes of individuals from participation in the research. Hence, the recruitment of subjects conforms to the principle of distributive justice.

JUSTIFICATION OF INCLUDING VULNERABLE SUBJECTS

The present research aims to investigate the ability of a bedside evaluation to detect aspiration in acute respiratory failure survivors. Due to the nature of acute respiratory failure and its risk factors (eg, sepsis, trauma), some patients will have impaired decision-making capabilities. This study cannot be conducted if limited to enrolling only those subjects with retained decision-making capacity. Hence, subjects recruited for this trial are not being unfairly burdened with involvement in this research simply because they are easily available.

INFORMED CONSENT

Federal regulations 45 CFR 46.111(a)(5) require that informed consent will be sought from each prospective subject or the subject's legally authorized representative (LAR). As we will enroll patients recovering from acute respiratory failure we anticipate some consents will be from the subject's LAR, and thus the remainder of this section will focus on LARs. The investigator is responsible for ensuring that the LAR understands the risks and benefits of participating in the study, and answering any questions the LAR may have throughout the study and sharing any new information in a timely manner that may be relevant to the LAR's willingness to continue the subject's participation in the trial. The consenter will make every effort to minimize coercion. All study participants or their LARs will be informed of the objectives of the study and the potential risks. The informed consent document will be used to explain the risks and benefits of study participation to the LAR in simple terms before the patient is entered into the study, and to document that the LAR is satisfied with his or her understanding of the risks and benefits of participating in the study and desires to participate in the study. The investigator is responsible for ensuring that informed consent is given by each LAR. This includes obtaining the appropriate signatures and dates on the informed consent document prior to the performance of any protocol procedures and prior to the administration of study agent.

CONTINUING CONSENT

For subjects for whom consent was initially obtained from a LAR, but who subsequently regains decision-making capacity while in hospital, all sites will obtain formal consent for continuing participation, inclusive of continuance of data acquisition. The initial consent form signed by the LAR should reflect that such consent will be obtained.

WITHDRAWAL OF CONSENT

Patients may withdraw or be withdrawn (by the LAR) from the trial at any time without prejudice. Data recorded up to the point of withdrawal will be included in the trial analysis, unless consent to use their data has also been withdrawn. If a patient or LAR requests termination of the trial during the study period, the study will be stopped but the patient will continue to be followed up as part of the trial. If a patient or LAR withdraws consent during trial treatment, the trial will be stopped but permission will be sought to access medical records for data related to the study. If a patient or LAR wishes to withdraw from the trial after completion of trial treatment, permission to access medical records for study data will be sought.

Identification of Legally Authorized Representatives

Many of the patients approached for participation in this research protocol will invariably have limitations of decision-making abilities due to their critical illness. Hence, most patients will not be able to provide informed consent. Accordingly, informed consent will be sought from the potential subject's legally authorized representative (LAR).

Regarding proxy consent, the existing federal research regulations ('the Common Rule') states at 45 CFR 46.116 that "no investigator may involve a human being as a subject in research…unless the investigator has obtained the legally effective informed consent of the subject or the subject's legally authorized representative"; and defines at 45 CFR 46 102 (c) a legally authorized representative (LAR) as "an individual or judicial or other body authorized under applicable law to consent on behalf of a prospective subject to the subject's participation in the procedures(s) involved in the research." OHRP defined examples of "applicable law" as being state statutes, regulations, case law, or formal opinion of a State Attorney General that addresses the issue of surrogate consent to medical procedures. Such "applicable law" could then be considered as empowering the LAR to provide consent for subject participation in the research. Interpretation of "applicable law" may be state specific and will be addressed by the IRB.

According to a previous President's Bioethics Committee (National Bioethics Advisory Committee), an investigator should accept as an LAR…a relative or friend of the potential subject who is recognized as an LAR for purposes of clinical decision making under the law of the state where the research takes place (National Bioethics Advisory Committee (NBAC), 1998). Finally, OHRP has stated in their determination letters that a surrogate could serve as a LAR for research decision making if such an individual is authorized under applicable state law to provide consent for the "procedures" involved in the research study (Office of

Human Research Protections (OHRP), 2002).

JUSTIFICATION OF SURROGATE CONSENT

According to the Belmont Report, respect for persons incorporates at least two ethical convictions; first, that individuals should be treated as autonomous agents, and second, that person with diminished autonomy are entitled to protection. One method that serves to protect subjects is restrictions on the participation of subjects in research that presents greater than minimal risks. Commentators and Research Ethics Commissions have held the view that it is permissible to include incapable subjects in greater than minimal risk research as long as there is the potential for beneficial effects and that the research presents a balance of risks and expected direct benefits ***similar*** to that available in the clinical setting (Dresser, 1999). Several U.S. task forces have deemed it is permissible to include incapable subjects in research. For example, the American College of Physicians' document allows surrogates to consent to research involving incapable subjects only "if the net additional risks of participation are not substantially greater than the risks of standard treatment." (American College of Physicians, 1989). Finally, the National Bioethics Advisory Committee (NBAC) stated that an IRB may approve a protocol that presents greater than minimal risk but offers the prospect of direct medical benefits to the subject, provided that…the potential subject's LAR gives permission…" (National Bioethics Advisory Committee (NBAC), 1998)

Consistent with the above ethical sensibilities regarding the participation of decisionally incapable subjects in research and the previous assessment of risks and benefits in the previous section, the present study presents a balance of risks and potential direct benefits that is ***similar*** to that available in the clinical setting.

ADDITIONAL SAFEGUARDS FOR VULNERABLE SUBJECTS

The present research will involve subjects who might be vulnerable to coercion or undue influence. As required in 45CFR46.111(b), we recommend that additional safeguards be included to protect the rights and welfare of these subjects. Such safeguards might include, but are not limited to: a) assessment of the potential subject's capacity to provide informed consent, b) the availability of the LAR to monitor the subject's subsequent participation and withdrawal from the study; c) augmented consent processes. The specific nature of the additional safeguards will be left to the discretion of the central IRB, in conjunction with the sites.

CONFIDENTIALITY

Federal regulations at 45 CFR 46 111 (a) (7) requires that when appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of data. To maintain confidentiality, all laboratory specimens, evaluation forms, and reports will be identified only by a coded number. The coded number will be generated by a computer, and only the study team will have access to the codes. All records will be kept in a locked, password protected computer. All computer entry and networking programs will be done with coded numbers only. All paper case report forms will be maintained inside a locked office. Study information will not be released without the written permission of the patient, except as necessary for monitoring by the National Heart, Lung, and Blood Institute, and the PETAL Clinical Coordinating Center.

ADVERSE EVENTS

SAFETY MONITORING

Assuring patient safety is an essential component of this protocol. Each participating investigator has primary responsibility for the safety of the individual participants under his or her care. The Investigators will determine daily if any adverse events occur during the period from enrollment through **study day 2** or ICU discharge, whichever occurs first.

The following adverse events will be collected in the adverse event case report forms:

- Serious adverse events

- Nonserious adverse events that are considered by the investigator to be related to study procedures or of uncertain relationship

A clinical study adverse event is any untoward medical event associated with the study procedure in humans, whether or not it is considered related to a study procedure.

Adverse events related to protocol procedures must be evaluated by the investigator. If the adverse event is judged to be reportable, as outlined above, then the investigator will report to the medical monitor their assessment of the potential relatedness of each adverse event to protocol procedure. Investigators will assess if there is a reasonable possibility that the study procedure caused the event, based on standard criteria. Investigators will also consider if the event is unanticipated or unexplained given the patient's clinical course, previous medical conditions, and concomitant medications.

If a patient's participation in the study is discontinued as a result of an adverse event, study site personnel must report the circumstances and data leading to discontinuation of treatment in the adverse event case report forms.

SERIOUS ADVERSE EVENTS

Serious adverse event collection begins after the patient or surrogate has signed informed consent and has undergone study procedures. If a patient experiences a serious adverse event after consent, but prior to the start of the study, the event will NOT be collected unless the investigator feels the event may have been caused by a protocol procedure.

Study site personnel must alert the medical monitor of any **serious and study procedure related** adverse event within 24 hours of investigator awareness of the event. Alerts issued via telephone are to be immediately followed with official notification on the adverse event case report form.

As per the FDA and NIH definitions, a serious adverse event is any adverse event that results in one of the following outcomes and is not classified as a clinical outcome of acute respiratory failure using the definitions noted above:

- Death
- A life-threatening experience (that is, immediate risk of dying)
- Prolonged inpatient hospitalization or rehospitalization

  As per http://www.fda.gov/Safety/MedWatch/HowToReport/ucm053087.htm: Report if admission to the hospital or prolongation of hospitalization was a result of the adverse event. Emergency room visits that do not result in admission to the hospital should be evaluated for one of the other serious outcomes (e.g., life-threatening; required intervention to prevent permanent impairment or damage; other serious medically important event).

- Persistent or significant disability/incapacity

  As per http://www.fda.gov/Safety/MedWatch/HowToReport/ucm053087.htm: Report if the adverse event resulted in a substantial disruption of a person's ability to conduct normal life functions, i.e., the adverse event resulted in a significant, persistent or permanent change, impairment, damage or disruption in the patient's body function/structure, physical activities and/or quality of life.

Important medical events that may not result in death, be life-threatening, or require hospitalization may be considered serious adverse events when, based upon appropriate medical judgment, they may jeopardize the patient and may require medical or surgical intervention to prevent one of the outcomes listed in this definition.

Serious adverse events will be collected during the first **2 study days** or until ICU discharge, whichever

occurs first, regardless of the investigator's opinion of causation. Thereafter, serious adverse events are not required to be reported unless the investigator feels the events were related to either study drug or a protocol procedure.

APPENDIX: Case Report Forms

Part 1: BSE Direct Physical Examination

Facial symmetry	**Normal** | **Asymmetric** | **Not Done**
Lip seal/strength	**Complete seal** | **Reduced Seal/ Weak** | **Not Done**
Lip movements	**Normal** | **Slow, uncoordinated** | **Not Done**
Tongue strength/ ROM	**Normal/complete** | **Weak/Reduced** | **No movement** | **Not Done**
Tongue movements	**Normal** | **Slow, uncoordinated** | **Not Done**
Dentition	**Adequate** | **Missing teeth** | **Dentures** | **Edentulous** | **Not Done**
Saliva	**Normal** | **Drools at times** | **Drools constantly** | **Not Done**
Palate/velar elevation	**Adequate** | **Incomplete** | **Not Done**
Baseline voice	**Normal** | **Aphonic** | **Hoarse** | **Wet, gurgly** | **Not Done**
Baseline Breathing sounds	**Normal** | **Wet** | **Hoarse/noisy** | **Stridorous** | **Not Done**
Respiratory rate (count breaths for 20 seconds and then multiple by 3)	_____(breaths/min) or Not performed
Volitional cough	**Strong** | **Weak** | **Absent** | **Not done**
Volitional cough with peak flow meter	_____(liters/min) or Not performed

Part 2: Bolus administration

Study ID:	Date:	Time:

Note: Determine signs and symptoms of aspiration within 10 seconds after swallowing

Ice Chips **(1/2 tsp)** **Bolus given:** **YES NO** **Stethoscope used for auscultation** **YES NO**	**Signs of Aspiration** Can check 1,2, 3, 4, or 5 signs ___ No aspiration or ___ Cough/Choking ___ Throat Clearing ___Change in voice ___Change in Breath sounds ____ Change in Pulse Ox (Greater than 10%)	**Oral Phase** Can check 1,2, 3, or 4 signs __ Normal or __ Prolonged/Slow/Delayed/Cued __ Disorganized __ Weak (oral residual) ___Other impairment Explain: _____	**Hyolaryngeal excursion** Can check 1, 2, or 3 signs __ Normal or __Delayed/Slow ___ Reduced _____ Multiple swallows
Ice Chips **(full tsp)** **Bolus given:** **YES NO** **Stethoscope used for auscultation** **YES NO**	**Signs of Aspiration** Can check 1,2, 3, 4, or 5 signs ___ No aspiration or ___ Cough/Choking ___ Throat Clearing ___Change in voice ___Change in Breath sounds ____ Change in Pulse Ox (Greater than 10%)	**Oral Phase** Can check 1,2, 3, or 4 signs __ Normal or __ Prolonged/Slow/Delayed/Cued __ Disorganized __ Weak (oral residual) ___Other impairment Explain: _____	
Nectar Thick **(5 ml)** **Bolus given:**	**Signs of Aspiration** Can check 1,2, 3, 4, or 5 signs ___ No aspiration or	**Oral Phase** Can check 1,2, 3, or 4 signs __ Normal or	

YES NO **Stethoscope used for auscultation** **YES NO**	___ Cough/Choking ___ Throat Clearing ___Change in voice ___Change in Breath sounds ____ Change in Pulse Ox (Greater than 10%)	__ Prolonged/Slow/Delayed/Cued __ Disorganized __ Weak (oral residual) ___Other impairment Explain: _____	
Nectar Thick **(15 ml)** **Bolus given:** **YES NO** **Stethoscope used for auscultation** **YES NO**	**Signs of Aspiration** Can check 1,2, 3, 4, or 5 signs ___ No aspiration or ___ Cough/Choking ___ Throat Clearing ___Change in voice ___Change in Breath sounds ____ Change in Pulse Ox (Greater than 10%)	**Oral Phase** Can check 1,2, 3, or 4 signs __ Normal or __ Prolonged/Slow/Delayed/Cued __ Disorganized __ Weak (oral residual) ___Other impairment Explain: _____	
Nectar Thick **2 ounce Patient Controlled With a Straw** **Bolus given:** **YES NO** **Stethoscope used for auscultation** **YES NO**	**Signs of Aspiration** Can check 1,2, 3, 4, or 5 signs ___ No aspiration or ___ Cough/Choking ___ Throat Clearing ___Change in voice ___Change in Breath sounds ____ Change in Pulse Ox (Greater than 10%)	**Oral Phase** Can check 1,2, 3, or 4 signs __ Normal or __ Prolonged/Slow/Delayed/Cued __ Disorganized __ Weak (oral residual) ___Other impairment Explain: _____	
Puree	**Signs of Aspiration** Can check 1,2, 3, 4, or 5 signs	**Oral Phase** Can check 1,2, 3, or 4 signs	**Hyolaryngeal excursion** Can check 1, 2, or 3 signs

(applesauce) (5 ml) **Bolus given:** **YES NO** **Stethoscope used for auscultation** **YES NO**	___ No aspiration or ___ Cough/Choking ___ Throat Clearing ___Change in voice ___Change in Breath sounds ____ Change in Pulse Ox (Greater than 10%)	__ Normal or __ Prolonged/Slow/Delayed/Cued __ Disorganized __ Weak (oral residual) ___Other impairment Explain: _____	__ Normal or __Delayed/Slow ___ Reduced _____ Multiple swallows
Puree (applesauce) (15 ml) **Bolus given:** **YES NO** **Stethoscope used for auscultation** **YES NO**	**<u>Signs of Aspiration</u>** Can check 1,2, 3, 4, or 5 signs ___ No aspiration or ___ Cough/Choking ___ Throat Clearing ___Change in voice ___Change in Breath sounds ____ Change in Pulse Ox (Greater than 10%)	**<u>Oral Phase</u>** Can check 1,2, 3, or 4 signs __ Normal or __ Prolonged/Slow/Delayed/Cued __ Disorganized __ Weak (oral residual) ___Other impairment Explain: _____	
Thin Liquid (water) (5 ml) or a tsp **Bolus given:** **YES NO** **Stethoscope used for auscultation** **YES NO**	**<u>Signs of Aspiration</u>** Can check 1,2, 3, 4, or 5 signs ___ No aspiration or ___ Cough/Choking ___ Throat Clearing ___Change in voice ___Change in Breath sounds ____ Change in Pulse Ox	**<u>Oral Phase</u>** Can check 1,2, 3, or 4 signs __ Normal or __ Prolonged/Slow/Delayed/Cued __ Disorganized __ Weak (oral residual) ___Other impairment Explain:	

	(Greater than 10%)	_____	
Thin Liquid (water) (15 ml) **Bolus given:** **YES NO** **Stethoscope used for auscultation** **YES NO**	**Signs of Aspiration** Can check 1,2, 3, 4, or 5 signs ___ No aspiration or ___ Cough/Choking ___ Throat Clearing ___Change in voice ___Change in Breath sounds ____ Change in Pulse Ox (Greater than 10%)	**Oral Phase** Can check 1,2, 3, or 4 signs __ Normal or __ Prolonged/Slow/Delayed/Cued __ Disorganized __ Weak (oral residual) ___Other impairment Explain: _____	
Thin Liquid (Water) **2 Oz Patient controlled With a straw** **Bolus Given:** **YES NO** **Stethoscope used for auscultation** **YES NO**	**Signs of Aspiration** Can check 1,2, 3, 4, or 5 signs ___ No aspiration or ___ Cough/Choking ___ Throat Clearing ___Change in voice ___Change in Breath sounds ____ Change in Pulse Ox (Greater than 10%)	**Oral Phase** Can check 1,2, 3, or 4 signs __ Normal or __ Prolonged/Slow/Delayed/Cued __ Disorganized __ Weak (oral residual) ___Other impairment Explain: _____	
Solid **(1/4 graham cracker)** **Bolus given:** **YES NO** **Stethoscope used**	**Signs of Aspiration** Can check 1,2, 3, 4, or 5 signs ___ No aspiration or ___ Cough/Choking ___ Throat Clearing ___Change in voice	**Oral Phase** Can check 1,2, 3, or 4 signs __ Normal or __ Prolonged/Slow/Delayed/Cued __ Disorganized __ Weak (oral residual)	

for auscultation **YES NO**	___Change in Breath sounds ____ Change in Pulse Ox (Greater than 10%)	___Other impairment Explain: _____	

Part 3. 3 oz Water Swallow Test (Yale Protocol)

Patient is given a cup with 3 oz water. He is asked to drink the entire amount, slowly and steadily, *but without stopping*.(use your judgment). He can drink from the cup with a straw and the SLP can hold the cup or straw

Was the 3 oz water test performed? YES NO

If yes complete the following table.

Patient stopped 1+ times?		**Patient failed to drink the entire amount?**		**Cough/Choking?**		**Change in Voice??**		**Change in Breath Sounds?**		**No signs of aspiration**	
Yes	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**

RESULTS of 3 oz water test? PASS FAIL

Pass= drinks the entire amount without stopping (use your judgment), and without coughing, choking during or immediately after completion.

Fail = does not finish the total amount, stops 1+ times (for more than a few seconds), or has overt signs of aspiration immediately after swallowing

SUMMARY OF CLINICAL EXAM

Results:

Dysphagia detected? *Yes/no (oral or pharyngeal)*

Aspiration detected? *Yes/no*

Diet texture recommendations (circle one)

Solids: regular (NDD3) mechanical (NDD2) puree (NDD1) npo

Liquids thin nectar honey npo

Part 4: Scoring Sheet for the FEES Testing

R 21 FEES Evaluation Form		
Study ID:	**Date:**	**Time:**

MAKE SURE THE ENTIRE EXAMINATION IS VIDEOTAPED

Afrin spray used: YES NO

Topical lidocaine used: YES NO

Velar Closure (hiss like a snake)	**Complete** | **Incomplete** | **N/A**
Base of Tongue Retraction (Paul is tall)	**Present** | **Absent** | **N/A**
Right Vocal Cord/Arytenoid Mobility	**None** | **Mild** | **Moderate** | **Severe** | **N/A**
Left Vocal Cord/Arytenoid Mobility	**None** | **Mild** | **Moderate** | **Severe** | **N/A**
Glottic Closure (breath hold, cough, phonation)	**Complete** | **Incomplete** | **N/A**
Laryngeal Elevation/ Arytenoid lift (glide with an "eee"	**Present** | **Absent** | **N/A**
Right Pharyngeal Wall Medialization	**Complete** | **Reduced** | **Absent** | **N/A**
Left Pharyngeal Wall Medialization	**Complete** | **Reduced** | **Absent** | **N/A**
Epiglottic Retroflexion (during swallow)	**Complete** | **Reduced** | **Inconsistent** | **Absent** | **N/A**
Granuloma Formation	**None** | **Mild** | **Moderate** | **Severe** | **N/A**
Upper Airway Edema	**None** | **Mild** | **Moderate** | **Severe** | **N/A**

Right Laryngeal Sensation touch on the aryepiglottc fold, if no sensation then repeat x1;	**None** | **Mild** | **Moderate** | **Severe** | **N/A**
Left Laryngeal Sensation touch on the aryepiglottc fold, if no sensation then repeat x1;	**None** | **Mild** | **Moderate** | **Severe** | **N/A**

<table>
<tr>
<td>Ice Chips

(1/2 tsp)

Bolus given:

YES NO</td>
<td>PAS score

_____

Not Determined

If penetration (2-5):

<table><tr><td>Before Swallow</td><td>During Swallow</td></tr><tr><td colspan="2">After Swallow</td></tr></table>
If aspiration (6-8)

<table><tr><td>Before Swallow</td><td>During Swallow</td></tr><tr><td colspan="2">After Swallow</td></tr></table></td>
<td>Swallowing Onset Time

_____

Not Done</td>
<td>Incomplete bolus clearance

<table><tr><td>Yes</td><td>No</td></tr></table>
Not Determined

Residue location:
Circular all that apply

<table><tr><td>BOT</td><td>valleculae</td><td>Lateral channels</td></tr><tr><td>piriforms</td><td>Laryngeal vestibule</td><td></td></tr></table>
Response to residue:

<table><tr><td>Spontaneous clearing</td><td>None</td></tr></table></td>
</tr>
<tr>
<td>Ice Chips

(full tsp)

Bolus given:

YES NO</td>
<td>PAS score

_____

Not Determined

If penetration (2-5):

<table><tr><td>Before Swallow</td><td>During Swallow</td></tr><tr><td colspan="2">After Swallow</td></tr></table>
If aspiration (6-8)

<table><tr><td>Before Swallow</td><td>During Swallow</td></tr><tr><td colspan="2">After Swallow</td></tr></table></td>
<td>Swallowing Onset Time

_____

Not Done</td>
<td>Incomplete bolus clearance

<table><tr><td>Yes</td><td>No</td></tr></table>
Not Done

Residue location:
Circular all that apply

<table><tr><td>BOT</td><td>valleculae</td><td>Lateral channels</td></tr><tr><td>piriforms</td><td>Laryngeal vestibule</td><td></td></tr></table>
Response to residue:

<table><tr><td>Spontaneous clearing</td><td>None</td></tr></table></td>
</tr>
<tr>
<td>Nectar Thick

(5 ml) or 1 tsp

Bolus given:

YES NO</td>
<td>PAS score

_____

Not Determined

If penetration (2-5):

<table><tr><td>Before</td><td>During</td></tr></table></td>
<td>Swallowing Onset Time

_____

Not Done</td>
<td>Incomplete bolus clearance

<table><tr><td>Yes</td><td>No</td></tr></table>
Not Done

Residue location:
Circular all that apply</td>
</tr>
</table>

	Swallow | **Swallow** **After Swallow** **If aspiration (6-8)** **Before Swallow** | **During Swallow** **After Swallow**		**BOT** | **valleculae** | **Lateral channels** **piriforms** | **Laryngeal vestibule** **Response to residue:** **Spontaneous clearing** | **None**
Nectar Thick **(15 ml)** **Bolus given:** **YES NO**	**PAS score** **_____** **Not Determined** **If penetration (2-5):** **Before Swallow** | **During Swallow** **After Swallow** **If aspiration (6-8)** **Before Swallow** | **During Swallow** **After Swallow**	**Swallowing Onset Time** **_____** **Not Done**	**Incomplete bolus clearance** **Yes** | **No** **Not Done** **Residue location:** **Circular all that apply** **BOT** | **valleculae** | **Lateral channels** **piriforms** | **Laryngeal vestibule** **Response to residue:** **Spontaneous clearing** | **None**
Nectar Thick **2 ounce Patient Controlled With a Straw** **Bolus given:** **YES NO**	**PAS score** **_____** **Not Determined** **If penetration (2-5):** **Before Swallow** | **During Swallow** **After Swallow** **If aspiration (6-8)** **Before Swallow** | **During Swallow** **After Swallow**	**Swallowing Onset Time** **_____** **Not Done**	**Incomplete bolus clearance** **Yes** | **No** **Not Done** **Residue location:** **Circular all that apply** **BOT** | **valleculae** | **Lateral channels** **piriforms** | **Laryngeal vestibule** **Response to residue:** **Spontaneous clearing** | **None**

<table>
<tr>
<td>Puree (applesauce) (5 ml)

Bolus given:

YES NO</td>
<td>PAS score

_____

Not Determined

If penetration (2-5):

<table><tr><td>Before Swallow</td><td>During Swallow</td></tr><tr><td colspan="2">After Swallow</td></tr></table>
If aspiration (6-8)

<table><tr><td>Before Swallow</td><td>During Swallow</td></tr><tr><td colspan="2">After Swallow</td></tr></table></td>
<td>Swallowing Onset Time

_____

Not Done</td>
<td>Incomplete bolus clearance

<table><tr><td>Yes</td><td>No</td></tr></table>
Not Done

Residue location:
Circular all that apply

<table><tr><td>BOT</td><td>valleculae</td><td>Lateral channels</td></tr><tr><td>piriforms</td><td>Laryngeal vestibule</td><td></td></tr></table>
Response to residue:

<table><tr><td>Spontaneous clearing</td><td>None</td></tr></table></td>
</tr>
<tr>
<td>Puree (applesauce) (10 ml)

Bolus given:

YES NO</td>
<td>PAS score

_____

Not Determined

If penetration (2-5):

<table><tr><td>Before Swallow</td><td>During Swallow</td></tr><tr><td colspan="2">After Swallow</td></tr></table>
If aspiration (6-8)

<table><tr><td>Before Swallow</td><td>During Swallow</td></tr><tr><td colspan="2">After Swallow</td></tr></table></td>
<td>Swallowing Onset Time

_____

Not Done</td>
<td>Incomplete bolus clearance

<table><tr><td>Yes</td><td>No</td></tr></table>
Not Done

Residue location:
Circular all that apply

<table><tr><td>BOT</td><td>valleculae</td><td>Lateral channels</td></tr><tr><td>piriforms</td><td>Laryngeal vestibule</td><td></td></tr></table>
Response to residue:

<table><tr><td>Spontaneous clearing</td><td>None</td></tr></table></td>
</tr>
<tr>
<td>Thin Liquid (Water) (5 ml)

Bolus given:

YES NO</td>
<td>PAS score

_____

Not Determined

If penetration (2-5):

<table><tr><td>Before Swallow</td><td>During Swallow</td></tr><tr><td colspan="2">After Swallow</td></tr></table></td>
<td>Swallowing Onset Time

_____

Not Done</td>
<td>Incomplete bolus clearance

<table><tr><td>Yes</td><td>No</td></tr></table>
Not Done

Residue location:
Circular all that apply

<table><tr><td>BOT</td><td>valleculae</td><td>Lateral channels</td></tr></table></td>
</tr>
</table>

	If aspiration (6-8) **Before Swallow** | **During Swallow** **After Swallow**		**piriforms** | **Laryngeal vestibule** | **Response to residue:** **Spontaneous clearing** | **None**
Thin Liquid (Water) (15 ml) **Bolus given:** **YES NO**	**PAS score** _____ **Not Determined** **If penetration (2-5):** **Before Swallow** | **During Swallow** **After Swallow** **If aspiration (6-8)** **Before Swallow** | **During Swallow** **After Swallow**	**Swallowing Onset Time** _____ **Not Done**	**Incomplete bolus clearance** **Yes** | **No** **Not Done** **Residue location:** **Circular all that apply** **BOT** | **valleculae** | **Lateral channels** **piriforms** | **Laryngeal vestibule** | **Response to residue:** **Spontaneous clearing** | **None**
Thin Liquid (Water) **2 Oz Patient controlled With a straw** **Bolus given:** **YES NO**	**PAS score** _____ **Not Determined** **If penetration (2-5):** **Before Swallow** | **During Swallow** **After Swallow** **If aspiration (6-8)** **Before Swallow** | **During Swallow** **After Swallow**	**Swallowing Onset Time** _____ **Not Done**	**Incomplete bolus clearance** **Yes** | **No** **Not Done** **Residue location:** **Circular all that apply** **BOT** | **valleculae** | **Lateral channels** **piriforms** | **Laryngeal vestibule** | **Response to residue:** **Spontaneous clearing** | **None**
Solid **(1/4 graham**	**PAS score** _____	**Swallowing Onset Time**	**Incomplete bolus clearance** **Yes** | **No**

<table>
<tr>
<td>cracker)

Bolus given:

YES NO</td>
<td>Not Determined

If penetration (2-5):

<table><tr><td>Before Swallow</td><td>During Swallow</td></tr><tr><td colspan="2">After Swallow</td></tr></table>
If aspiration (6-8)

<table><tr><td>Before Swallow</td><td>During Swallow</td></tr><tr><td colspan="2">After Swallow</td></tr></table></td>
<td>_____

Not Done</td>
<td>Not Done

Residue location:
Circular all that apply

<table><tr><td>BOT</td><td>valleculae</td><td>Lateral channels</td></tr><tr><td>piriforms</td><td>Laryngeal vestibule</td><td></td></tr></table>
Response to residue:

<table><tr><td>Spontaneous clearing</td><td>None</td></tr></table></td>
</tr>
</table>

3 oz Water Swallow Test:

Patient is given a cup with 3 oz water. He is asked to drink the entire amount, slowly and steadily, but without stopping. He can drink from the cup or a straw and the SLP can hold the cup or straw

Was the 3 oz water test performed? YES NO

If yes complete the following table.

Did the patient stop 1 + times	Did the patient finish the entire amount	Cough/Choking	Change in Voice	Wet Breath Sounds	No signs of aspiration
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No

RESULTS of 3 oz water test? PASS FAIL

Pass= drinks the entire amount without stopping (use your judgment), and without coughing, choking during or immediately after completion.

Fail = does not finish the total amount, stops 1+ times (for more than a few seconds), or has overt signs of aspiration immediately after swallowing

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