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MBSImP Protocol

Standardized Barium preparations and presentations are recommended (i.e., thin, nectar thick, honey thick, and pudding consistency). Compensatory postures and positioning should be applied as needed throughout the examination. It is suggested that the clinician record a brief image of the upper aerodigestive tract prior to introducing contrast in order to distinguish baseline observations of structures (i.e., calcification, surgical plates, sutures, etc.) from barium. The **validated** and recommended presentation order, manner, and volume are listed below:

Lateral View

Thin Liquid - 40% weight/ volume (w/v), 4 centipoise (cps)

1. **5mL via teaspoon***: Clinician should administer the bolus. Ask the patient to *“Hold this in your mouth until I ask you to swallow”*. Once bolus hold is achieved, patient instructed to *“Swallow when you’re ready”*.

**This first 5ml trial is NOT considered for scoring impairment when assigning Overall Impression (OI) scores. See explanation in the OI score description, page 3.*
2. **5mL via teaspoon**: Clinician should administer the bolus. Ask the patient to *“Hold this in your mouth until I ask you to swallow”*. Once bolus hold is achieved, patient instructed to *“Swallow when you’re ready”*.
3. **Single cup sip (~20mL)**: Clinician should provide the patient with the cup. Ask the patient to *“Take a sip as you normally would, but hold it in your mouth until I ask you to swallow”*. Self-administration is optimal from a 3-4 oz. disposable cup (patient controls the amount), but a straw (if currently being used at the bedside)** or clinician administration is acceptable. Once bolus hold is achieved, patient instructed to *“Swallow when you’re ready”*.
4. **Sequential swallow (~40mL)**: Clinician should provide the patient with the cup. Ask the patient to *“Drink this in your usual manner until I tell you to stop.”* Self-administration is optimal from a 3-4 oz. disposable cup, but straw (if currently being used at the bedside)** or clinician administration is acceptable. Patients will either perform a rapid sequence or produce a number of isolated swallows. The goal is to capture impairment during the task characteristic for that particular patient. They should not be forced to swallow a rapid sequence.

***If a patient is not currently using a straw, but the clinician wishes to assess the effects of straw on swallowing, this is treated as an intervention or compensation and the score for this swallow would not be included in the OI score.*

Nectar-Thick Liquid – 40% w/v, 300 cps

5. **5ml via teaspoon**: Clinician should administer the bolus. Ask the patient to *“Hold this in your mouth until I ask you to swallow”*. Once bolus hold is achieved, patient instructed to *“Swallow when you’re ready”*.
6. **Single cup sip (~20mL)**: Clinician should provide the patient with the cup. Ask the patient to *“Take a sip as you normally would, but hold it in your mouth until I ask you to swallow”*. Self-administration is optimal from a 3-4 oz. disposable cup (patient controls the amount), but a straw (if currently being used at the bedside)** or clinician administration is acceptable. Once bolus hold is achieved, patient instructed to *“Swallow when you’re ready”*.
7. **Sequential swallow (~40mL)**: Clinician should provide the patient with the cup. Ask the patient to *“Drink this in your usual manner until I tell you to stop.”* Self-administration is optimal from a 3-4 oz. disposable cup, but straw (if currently being used at the bedside)** or clinician administration is acceptable. Patients will either perform a rapid sequence or produce a number of isolated swallows. The goal is to capture impairment during the task characteristic for that particular patient. They should not be forced to swallow a rapid sequence.

***If a patient is not currently using a straw, but the clinician wishes to assess the effects of straw on swallowing, this is treated as an intervention or compensation and the score for this swallow would not be included in the OI score.*

Honey-Thick Liquid – 40% w/v, 1500 cps

8. **5ml via teaspoon:** Clinician should administer the bolus. Ask the patient to *“Hold this in your mouth until I ask you to swallow”*. Once bolus hold is achieved, patient instructed to *“Swallow when you’re ready”*.

Pudding Consistency – 40% w/v

9. **5ml via teaspoon:** Clinician should administer the bolus. **Do not** ask the patient to hold the bolus in the mouth. Once the bolus is presented, patient instructed to *“Swallow when you’re ready”*.

Solid Consistency

10. **½ shortbread cookie (1” x 1” x .25”) coated with 3mL pudding consistency:** Clinician should administer the bolus via teaspoon. Once the bolus is presented, patient instructed to *“Chew this as you normally would and swallow when you’re ready”*.

Anterior-Posterior View

11. **5mL Nectar-Thick Liquid via teaspoon:** should administer the bolus. Ask the patient to *“Hold this in your mouth until I ask you to swallow”*. The patient should be asked to slightly raise the chin to a neutral position, but head extension should be avoided. Once bolus hold is achieved, patient instructed to *“Swallow when you’re ready”*.
12. **5mL Pudding Consistency via Teaspoon:** Clinician should administer the bolus. **Do not** ask the patient to hold the bolus in the mouth. The patient should be asked to slightly raise the chin to a neutral position, but head extension should be avoided. Once the bolus is presented, patient instructed to *“Swallow when you’re ready”*.

Administering the Protocol

The full 12-swallow protocol should be administered for each patient whenever possible. It may appear that this practice would increase the amount of radiation exposure. We have found, however, that adherence to a standardized protocol improves the overall efficiency and timeliness of the examination, even in the context of using compensatory strategies and maneuvers. Further, we have demonstrated in our study that a clinician is able to capture impairment by observing components across bolus consistencies/swallow trials. There will be instances, however, when certain viscosities or volumes are not administered based on performance on the preceding administration or on the clinical status of the patient. The Overall Impression (OI) score (highest or worse) should be used to capture impairment even when all trials are not possible.

Overall Impression (OI) Scoring

The nature of the patient’s swallowing impairment will likely change between different bolus consistencies and volumes. The MBSImP captures and quantifies impairment by assigning Overall Impression (OI) scores for each of the 17 components. The OI score **represents the “worst” (i.e. most impaired) score observed across all consistencies and volumes**; however, there are exceptions to this general rule.

The first 5ml tsp. administration of thin liquid (trial #1 on the protocol) should not be considered when formulating the OI score. We routinely observe that the patient’s response to the first presentation of barium is not representative of their swallowing function. The patient is accommodating to the radiologic environment and the taste of barium and, thus, trial #1 should not be considered for OI scoring.

For each of the protocol’s remaining 11 swallow trials, the OI score is based on the initial swallow of each trial. If the patient swallows several times in an attempt to clear the bolus from the oral and/or pharyngeal cavity this would be considered *compensation* and does not change the impairment score observed on the initial swallow.

The **exception** are the sequential swallow tasks (trials #4 and #7), during which each swallow is to be considered in formulating the OI score. For example, let's examine Component 6 (Initiation of the Pharyngeal Swallow). If the first swallow in the series is initiated at the location of a score of (1) (valleculae) and the second swallow is initiated at the location for a score of (3) (pyriform sinus), your OI score would be a (3) because this is the impairment that you wish to capture. The **exception** would be the scores for oral (Component 5) and pharyngeal residue (Component 16). **Residue is scored after the sequential swallowing task is completed.** Typically, the OI score for residue (worst score) would not occur on the sequential liquid swallowing task, but it is possible.

There are some general guidelines when formulating OI scores across an entire examination. The following bolus consistencies are typically associated with the worst impairment on the components listed below. Therefore, you should shift your attention to these bolus types when judging the designated component. However, there will be exceptions but these guidelines should assist you with your efficiency of your OI scoring.

- Thin Liquid: Components 1, 2, 6, 7, 8, 9, 10, 11, 12, 14
- Nectar: Components 13, 17
- Pudding and/or Cookie: Components 3, 4, 5, 15, 16

Withheld Consistencies/Swallowing Tasks

If a consistency or swallowing task cannot be given due to safety concerns or logistical reasons, the related components are scored based on consistencies that can be given except in the case of the cookie (solid) task for which specific scoring rules are applied. In clinical practice, with rare exception, **the cookie swallow will be the only task scored the worst because of safety reasons.** If the cookie is withheld because of safety concerns related to mastication, oral preparation and/or oral clearance, the patient would be scored a (3) on Component 3 (Bolus Preparation/Mastication). If the cookie was not given for a reason other than these oral-related safety concerns, such as minimal to no pharyngeal clearance of preceding consistencies from the pharynx or the patient refuses the cookie, Component 3 would be noted as "cannot assess" during MBSImP scoring and is not included in the OI score. Unlike Component 3, you should rate all other components even if all tasks are not completed. For example, there are times when you do not give the sequential swallow task if the patient achieves very high scores (more severe) on single swallow liquid boluses. In cases such as this, the clinician should score the components related to liquid swallows based on the tasks that were presented.

Missing Anatomical Structures

In the case of missing structures, such as in patients following resections related to tumors of the head and neck, clinicians should score the component the worst score and note the structures that are missing. For example, if a patient does not have an epiglottis because of a surgical resection, the score on Component 10 (Epiglottic Inversion) would be scored a (3). Total laryngectomy cases are the exception. For these patients, Components 8, 9, 10 and 11 would be scored "cannot assess". If a structure is partially resected and/or reconstructed, the clinicians should score the component based on the movement of the residual structure that may include a flap reconstruction, etc. If a patient is edentulous and does not wear dentures when eating, the clinician should score the observed bolus preparation even when teeth are missing. Some patients are able to prepare even a solid bolus safely without teeth. Edentulous patients will unlikely score a (0) on Component 3 (Bolus Preparation/ Mastication), but may score (1), (2), or (3).

Presence of Hardware

In the case of oral or nasopharyngeal hardware (e.g. dentures, palatal appliance, nasogastric (NG) tube, etc.) score each component as you normally would. For example, in the case of an NG tube, if the soft palate is still able to make complete contact with the NG tube and there is no escape of air or contrast between the two structures, score (0) for Component 7 (Soft Palate Elevation).

Compensatory Strategies

Two primary purposes of the MBS study include: identification of impairment and determination of effective interventions for improved bolus clearance and airway protection. You will continue to apply compensatory strategies according to the patient's performance and clinical status. ***A benefit of the MBSImP is to score changes in swallowing physiology and bolus clearance before and after introduction of a compensatory strategy. However, use the compensatory swallowing scores for your own data records and do not include them in the 17 baseline scores.***

Anterior Posterior (AP) View

The clinician should always attempt to view swallowing function in the anterior posterior (AP) viewing plane. This view is ideal for assessing pharyngeal contraction and esophageal clearance, and for observing the effect of certain compensatory strategies on swallowing physiology and bolus flow. Component 13 (Pharyngeal Contraction) and Component 17 (Esophageal Clearance) are scored on the AP view. If an AP view cannot be obtained, attempts should be made to score Component 17 (Esophageal Clearance) in the lateral or oblique view. Component 8 (Laryngeal Elevation) is an indirect measure of pharyngeal contraction in the lateral view; however, Component 13 (Pharyngeal Contraction) should not be scored if an AP view cannot be obtained. Mark the component as “cannot assess” on the score-sheet and address the protocol deviation in clinical documentation.

Poor or No Image Capture

We recognize that despite attempts at optimal patient positioning, every recorded study cannot be captured as planned. The primary areas that are often omitted or distorted are visualization of the lips in the lateral view and visualization of the pharynx and/or esophagus in the AP view. Extraneous patient movement, poor postural support, altered communication-cognitive status, and sub-optimal operation of the fluoroscope during the study are the primary culprits. The lateral view should include the lips anteriorly, the nasal cavity superiorly, the posterior pharyngeal wall posteriorly, and the cervical esophagus and upper tracheal air column inferiorly. Any patient movement (e.g., rocking, etc.) should be followed as completely as possible by the radiologist or radiologic technologist. If all efforts are unsuccessful and a component cannot be adequately observed because of poor image capture or none, mark the component as “cannot assess” on the score-sheet and address the protocol deviation in clinical documentation. There are instances in which a score can be given appropriately and with relative certainty for several components (e.g. Components 1 and 17) in a limited view. Follow the Component Specific Guidelines below to determine if a score can be given and what that score should be.

When scoring the training and reliability videos contained in the Training and Reliability Zones, there are some studies during which the full protocol was not completed. Patient safety was the primary reason. Each bolus volume, consistency and tasks are indicated in the video to guide the learner in what is being administered over the course of each practice and reliability study. If a task is not presented, the reason is also indicated in the video.

Scores of (1): Trace Appearance of Barium

It is important to recognize that components that include a score of (1) for trace appearance of barium between structures (Components 1, 5, 15, and 16) were included to enhance visual discrimination between normal coating (trace) and signs of impairment, such as, collection of residue or a narrow column of barium between structures. Scores of (1) (trace) are not included in the calculation of **Oral Total Sum** or **Pharyngeal Total Sum**.

Summary Scores

Finally, there is **not** a total summary score because the Oral domain components that relate to oral containment and motion of the tongue (Components 1-6) factored separately from the Pharyngeal (airway protection and pharyngeal clearance) (Components 7-16) and Esophageal (Component 17) domains. Oral Total Sum and Pharyngeal Total Sum are calculated separately.

Penetration-Aspiration Scale (PAS)

You will see that scores for airway invasion do not include the amount, level and patient response. These are not included in the MBSImP. The reason for their purposeful exclusion is that ***it is recommended the Penetration-Aspiration Scale* (PAS) be used in conjunction with the MBSImP.*** PAS scores were found to associate with MBSImP scores, but many patients were observed to have physiologic swallowing impairment of varying severity levels without penetration and/or aspiration. ***Physiologic impairment and PAS scores are both important but different types of clinical information and should be evaluated in tandem. The purpose of the MBS study is not to “pass or fail” a patient based on the presence of aspiration, but rather to identify the physiologic impairment (i.e. airway closure) and to target treatment accordingly.***

**Rosenbek JC, Robbins JA, Roecker EB, Coyle JL, Wood JL. A penetration-aspiration scale. Dysphagia. 1996; 11:93–8.*

Component Specific Guidelines

It is extremely important that the clinician ***pay attention to the time at which a component should be scored.*** These instructions appear in bold and are italicized below. The term ***“height of the swallow”*** is used often and represents the maximal anterior displacement of the hyoid bone. The term ***“maximal movement”*** refers to the maximum displacement of the targeted structure (i.e. tongue base, soft palate, pharyngoesophageal segment (PES), larynx).

Remember, the OI score is based on the initial swallow of each trial. If the patient swallows several times in an attempt to clear the bolus from the oral and/or pharyngeal cavity this would be considered *compensation* and does not change the impairment score observed on the initial swallow. The exception are the sequential swallow tasks (trials #4 and #7), during which each swallow is to be considered in formulating the OI score. Component 5 (Oral Residue) and Component 16 (Pharyngeal Residue) scores are derived following the **last** swallow of the sequential swallow task.

Component 1: Lip Closure

Lip Closure assesses the ability to seal the bolus within the anterior oral cavity. Like all other components, lip closure is based on what is observable on the MBS video. Score the presence and location of contrast material seen between or outside of the lips on the lateral view. If the lips are not completely in frame, the clinician should score what can be seen and note that the exam was limited based on these factors.

Score a (0) if there is no labial escape of the bolus between the lips; contrast is contained and there is no evidence of escape beyond the oral mucosa onto the vermillion. Score a (1) if there is a trace amount of contrast outlining the interlabial space but with no progression to the anterior lip. Score a (2) if there is escape from the interlabial space or lateral juncture onto but not beyond the vermillion boarder of the lower lip. If contrast material is ***only*** observed on the vermillion border of the upper lip, and in no other lip location (including interlabial escape, score of 1), this is consistent with common artifact related to mode of administration and is ***not*** considered impairment and should receive a score of (0). Score a (3) if there is escape of contrast material that progresses beyond the vermillion border of the lower lip to the mid chin and a (4) if there is profuse escape between open lips beyond the chin regardless of the bolus consistency or swallow task. Consult the Scoring Help link at mbsimp.com for further scoring clarifications.

Component 2: Tongue Control During Bolus Hold

Tongue Control During Bolus Hold represents a rating of the integrity of the patient’s ability to seal the tongue to the hard and soft palate during liquid presentations with the oral command, ***“hold this in your mouth until I ask you to swallow”*** (5mL thin, cup sip thin, 5mL nectar, cup sip nectar and 5mL honey). It is scored ***PRIOR TO initiation of productive tongue movement*** to propel the bolus through the oral cavity (this should not be confused with Component 6, Initiation of the Pharyngeal Swallow, which is judged after the initiation of productive tongue movement). Tongue control during bolus hold should be scored regardless of if the patient is unable to hold the bolus because of inability to follow instructions or due to neuromuscular impairment. It may be argued that this is not a natural drinking task and the argument would be correct. However, demonstration of the ability to control a bolus in the oral cavity is of diagnostic and prognostic value when

planning treatment strategies.

Tongue control during bolus hold is scored (0) if there is a cohesive bolus between the tongue and palatal seal anteriorly, posteriorly and laterally. Score a (1) if the bolus goes to either or both of the lateral sulci or the floor of mouth, or is spread diffusely throughout the oral cavity. Score a (2) if any portion less than half of the bolus (relative to the amount given) passes through the tongue-palate seal and a (3) if more than half of the bolus (relative to the amount given) enters the pharynx. Consult the Scoring Help link at mbsimp.com for further scoring clarifications on this component.

Note: Some patients may be quote “dippers” rather than the usual “tippers”, terms described by Jeri Dodds in the 1980’s. These are patients who hold the bolus on the floor of the mouth prior to swallowing and “dip” the material back. If this is their customary manner of holding, this is not impairment (unless uncollected bolus remains in the lateral sulci or floor of mouth) and you would score a (0).

Component 3: Bolus Preparation/Mastication

Bolus Preparation/Mastication is judged following presentation of ½ of a shortbread cookie coated with barium pudding. The patient is instructed to, “*Chew this as you normally would and swallow when you are ready.*”

Score a (0) if the patient demonstrates **timely and efficient** chewing and mashing. Score a (1) if the patient demonstrates **slow and prolonged** chewing and mashing, but complete recollection or formation of the bolus is achieved. Score a (2) if the bolus is not formed and pieces remain in the oral cavity after the initial swallow. If the patient continues to chew after the first swallow, it is likely that solid pieces remained unchewed and therefore receives a score of (2). A score of (3) reflects **minimal chewing and mashing with a majority of the bolus remaining unchewed**. Consult the Scoring Help link at mbsimp.com for further scoring clarifications on this component.

Note: If the shortbread cookie is withheld due to safety concerns related to oral preparation and/or oral clearance, the patient would be scored a (3), the highest or worst score. If the cookie was not given for a reason other than safety concerns related to the oral cavity (e.g. the patient refuses the cookie or there is minimal to no pharyngeal clearance of the pudding consistency), component 3 would be noted as “cannot assess”.

Component 4: Bolus Transport/Lingual Motion

Bolus Transport/Lingual Motion characterizes the pattern of bolus transport through the oral cavity and lingual movement. This scored observation begins **only after** the initial gesture toward productive tongue movement and oral bolus transport. Bolus accommodating movements prior to this attempt should not be considered when scoring.

A score of (0) is represented by brisk motion of the tongue with no hesitation and rapid bolus transport from the anterior to posterior oral cavity. A score of (1) represents a delay in the initiation of any tongue motion or attempt to transport the bolus. This score is an example of a patient that typically experiences difficulty in initiating any goal directed motor task and often requires cueing to initiate the movement of the tongue. Once tongue movement is initiated, and if the bolus progresses normally from anterior to posterior, the observation will receive a score of (1). A score of (2) represents movement of the tongue and bolus that progresses from the anterior to posterior oral cavity; however, the motion is slowed contrasted with brisk movement. A score of (3) on the other hand, resembles repetitive and disorganized tongue motion and often rocks the bolus between alternating posteriorly and anteriorly back and forth movement prior to productively moving the bolus through the oral cavity. **Inherent in a score of (3) is greater than or equal to 3 rocking movements of the tongue and bolus.** Finally, a score of 4 represents minimal or no perceptible movement of the tongue. Consult the Scoring Help link at mbsimp.com for further scoring clarifications on this component.

Component 5: Oral Residue

Oral Residue is not a physiologic component; rather it is a clinical sign of physiologic impairment. Oral residue is included in the MBSImP because it was shown to be related to indicators of health and nutrition, such as the need for diet consistency modification and/or feeding tube, in our work and others. Oral residue is judged after the **completion of the first swallow** in all swallows with the exception of the sequential swallow. Oral residue is **scored following the last swallow of the sequential swallowing task**. If the patient spontaneously utilizes a secondary swallow on tasks other

than the sequential swallow, any residue seen after the primary swallow is the basis for the score, regardless of the end result after any secondary swallows. **You will record the number, type and effectiveness of compensatory strategies**, such as double or multiple swallows, on your report form. Remember, changes in component scores when trying a compensatory strategy are not included in your 17 OI scores.

Complete clearance is complete oral clearance with no observable contrast remaining in the oral cavity (0). (1) is characterized by trace residue that resembles an outline or coating of the oral structures, and is not included as impairment when using summative Oral Total Scoring. A score of (1) is a normal variant but is included in order for users to train their eyes to distinguish normal coating from the next score, (2). It may be difficult to identify trace residue on the video clip depending on the resolution of your computer screen. A collection (2) is an amount remaining from the original bolus presentation sufficient to extract or 'scoop'. ***It is important to note that there are variations of "collection"; however, we've found different variations cannot be reliably scored because they are not distinguishable when making visual judgments.*** A majority is more than half of the original bolus remaining and should be given a score of (3). A score of (4) is minimal or no clearance of the bolus from the oral cavity. Scores of (3) and (4) are relative to the bolus size. Consult the Scoring Help link at mbsimp.com for further scoring clarifications on this component.

Note: Clinicians should attempt to code the location of the pharyngeal residue and the method of pharyngeal clearance; however, these codes do not factor into the OI score.

Component 6: Initiation of the pharyngeal swallow

Initiation of the Pharyngeal Swallow represents the pharyngeal response to a number of sensory inputs including bolus characteristics and movement of the tongue. Initiation of the pharyngeal swallow is scored based on the position of the bolus head, or leading edge, at the time of first initiation of the pharyngeal swallow represented by the ***first movement of the brisk superior-anterior hyoid trajectory***. Small movements of the hyoid or larynx that occur during chewing, bolus manipulation or accommodation, or tongue stabilization should not be confused with the onset of brisk hyoid motion that is a component indicating the onset of the pharyngeal swallow. A scoring tip is to place your cursor on the superior-anterior corner of the hyoid bone. The onset of the pharyngeal swallow (point at which you score component 6) occurs when the hyoid moves from your cursor location.

A score of (0) is represented by the bolus head at the region of the posterior angle of the ramus and back of the tongue at the time of first movement of the hyoid trajectory. A score of (1) is indicated by the bolus head at the valleculae at the time of first movement of the hyoid trajectory. A score of (2) occurs when the bolus head is at the posterior laryngeal surface of the epiglottis at first onset of hyoid excursion (i.e., between the base of the valleculae and the superior border of the pyriform sinus). A score of (3) is represented when the bolus head is in the pyriform sinus at the time of first hyoid excursion. Studies have shown that the head of the bolus may be in the region of the pyriform sinuses even in healthy, nondysphagic adults. However, a score of 3 should still be assigned and is likely clinically significant in the presence of other impaired components. A score of (4) is indicated by no appreciable initiation at any bolus location. If laryngeal elevation, pharyngeal contraction and hyoid excursion are all absent but PES opening is somehow achieved, you would score Component 6 as (3). Consult the Scoring Help link at mbsimp.com for further clarifications on this component.

Note: Data show that many patients channel a masticated bolus to the valleculae during chewing. If a solid bolus is the **only** swallow where the bolus head reaches the valleculae prior to first hyoid trajectory, the patient would not be scored as impaired and receive an OI score of (0) on Component 6.

Component 7: Soft Palate Elevation

The onset of first soft palate elevation/retraction is an early component of the pharyngeal swallow, and complete or maximum elevation/retraction represents the full contact of the soft palate and posterior pharyngeal wall as viewed in the lateral viewing plane. This component is scored at the ***height or maximum displacement*** of the soft palate. On this component, and several others, the height of the swallow represents the point of maximal contraction of the structure in question. Soft palate to pharyngeal wall contact is based on the presence of contrast or air between the two structures.

A score of (0) illustrates no bolus between the soft palate and pharyngeal wall. A score of (1) represents a trace column of contrast or air between the soft palate and pharyngeal wall. A score of (2) represents escape to the nasopharynx

represented by contrast material between the soft palate and pharyngeal wall in an amount greater than trace. A score of (3) represents escape of contrast material that progresses to the level of the nasal cavity and a score of (4) represents escape of contrast material progressing to the level of the nostril with or without nasal emission. Consult the Scoring Help link at mbsimp.com for further scoring clarifications on this component.

Component 8: Laryngeal Elevation

Laryngeal Elevation is judged during **initial elevation of the larynx at the time of early closure of the laryngeal vestibule (prior to the height of the swallow)**, in contrast with late laryngeal vestibular closure that occurs with maximum anterior hyolaryngeal displacement (Component 11, laryngeal vestibular closure). Laryngeal elevation refers to the early upward movement of the larynx toward the hyoid bone during which time the **arytenoid cartilages should progress anteriorly and fully contact the bulge at the base of the epiglottis** (or epiglottic petiole). The bulge is formed when the base of the epiglottis is compressed and traction is placed on the body of the epiglottis by elevation of the larynx bringing the epiglottis to a horizontal position (prior to full downward inversion). Score laryngeal elevation at the time **when the body of the epiglottis is in its MOST horizontal position**. Advance the video to the point when the epiglottis is horizontal and make your judgment of arytenoid to epiglottic base contact, the surrogate observation for laryngeal elevation. If the epiglottis does not invert, even to a horizontal position, laryngeal elevation should be scored when the epiglottis is maximally displaced, even if it is still relatively upright. Observations of laryngeal elevation in the lateral view have also been shown to give an indirect impression of pharyngeal contraction (shortening) (Component 13) because of the attachments of the pharyngeal muscles to the thyroid cartilage. Incomplete laryngeal elevation may represent a reduction in contractility of the pharynx, such as in the case of pharyngeal injury secondary to radiation-induced fibrosis.

A score of (0) is represented by full superior movement of the thyroid cartilage that results in complete approximation of the arytenoids to the epiglottic petiole. A score of (1) is represented by partial superior movement of the thyroid cartilage resulting in partial approximation of the arytenoids to the epiglottic petiole. Minimal superior movement of the thyroid cartilage resulting in minimal approximation of the arytenoids to the epiglottic petiole is scored as (2). A score of (3) is illustrated by no superior movement of the thyroid cartilage and no approximation of the arytenoids to the epiglottic petiole. Consult the scoring help link at mbsimp.com for further scoring clarifications on this component.

Note: Some patients are able to attain laryngeal closure during elevation but are unable to maintain the closure throughout the swallow. These patients are often good candidates for instruction in airway protection maneuvers. Scores on Component 8 (Laryngeal Elevation) **often, but not always**, correspond to scores on Component 11 (Laryngeal Vestibular Closure).

Component 9: Anterior Hyoid Excursion

Anterior Hyoid Excursion is judged at the **height of the swallow or maximal anterior displacement of the hyoid bone**. Although the hyoid and larynx move as a functional unit, when scoring this component keep your eyes on the angle of the thyroid and hyoid trajectory. The score is made when the hyoid reaches its maximal anterior displacement.

A score of (0) is complete anterior hyoid movement. Complete anterior displacement corresponds with a more acute angle between the thyroid cartilage and hyoid bone at the height of anterior hyoid movement. A score of (1) is partial anterior movement often characterized as the thyroid cartilage being in a more direct line with the hyoid at the height of anterior hyoid movement. A score of (2) is no anterior movement of the hyoid bone. Consult the Scoring Help link at mbsimp.com for further scoring clarifications on this component.

Component 10: Epiglottic Movement

Epiglottic Movement is judged at the **height of the swallow when the hyoid bone has reached its maximal anterior displacement**. It is at this point that the epiglottis should assume a fully downward/inverted position because of traction placed by the suprahyoid muscles on the hyolaryngeal complex and hence, the epiglottis. There is also current evidence to support the roles of the tongue base and pharyngeal muscles on epiglottic inversion.

A score of (0) is complete inversion of the epiglottis, while a score of (1) is characterized by movement of the epiglottis to a

horizontal position with no progression beyond the horizontal position. A score of (1) would also be given if the epiglottis moves inferiorly but does not reach a horizontal position. A score of (2) is minimal to no movement of the epiglottis. Consult the Scoring Help link at mbsimp.com for further scoring clarifications on this component.

Component 11: Laryngeal Vestibular Closure

Laryngeal Vestibular Closure is judged at the **height of the swallow** (point of maximal anterior hyoid movement and maximal laryngeal vestibular closure). Laryngeal vestibular closure is judged on the presence or absence of contrast material or air in the laryngeal inlet.

Complete laryngeal vestibular closure with no air or contrast in the laryngeal vestibule is scored as (0). A score of (1) is characterized by a narrow column of air or contrast in the laryngeal vestibule, and a score of (2) is characterized by a wide column of air or contrast in the laryngeal vestibule.

Note: Patients **may but not always** demonstrate entry of contrast into the laryngeal vestibule during early laryngeal elevation receiving a score of (1) on Component 8, but completely or partially expel the penetrated material at the height of the swallow and receive a score of (0). Consult the Scoring Help link at mbsimp.com for further scoring clarifications on this component.

Component 12: Pharyngeal Stripping Wave

Pharyngeal Stripping Wave represents a progressive wave of contraction from the full length of the pharyngeal wall beginning at the nasopharynx and ending at the pharyngoesophageal segment (PES). The word “stripping” has historically been used to characterize this wave of contraction in studies that have combined manometry and videofluoroscopy. Therefore, we chose to maintain that nomenclature in the MBSImP operational definition.

A score of (0) represents a full wave of contraction from the level of the nasopharynx continuing to the level of the pharyngoesophageal segment at the time of collapse. A score of (1) is represented by a diminished or absence of wave along any portion of the posterior pharyngeal wall. For example, the wave of contraction may be present in the region of superior or middle constrictor then stop prior to reaching the PES. Or, there may not be a wave superiorly, but the wave is present only in the mid or inferior pharynx. A score of (2) is complete absence of the pharyngeal stripping wave often represented by a straight line of the posterior pharyngeal wall throughout the swallow. Consult the Scoring Help link at mbsimp.com for further scoring clarifications on this component.

Component 13: Pharyngeal Contraction

Pharyngeal Contraction represents a combination of pharyngeal shortening and stripping as viewed in the AP plane and is scored in the **AP view only**. Even if the esophagus cannot be observed because of the patient’s size or posture, assessment of pharyngeal function in the AP view can often be conducted and has implications for identifying rehabilitation and treatment strategies.

A score of (0) is symmetrical shortening and complete inward contraction of the pharynx depicted by lateral walls that are relatively straight, and compress against the bolus tail through the pharynx, bilaterally. A score of (1) is represented by a dynamic pouch termed pseudodiverticulum because it is not observed at rest and only during pharyngeal contraction. It may be unilateral or bilateral (pseudodiverticula) and located high in the pharynx usually lateral to the valleculae. When observed, the pouch fills with contrast during the height of the swallow, empties as the pharynx returns to rest and typically result in a small amount of pharyngeal residue. When observed, the clinician should take note of any downstream resistance to bolus flow related to outflow obstruction in the region of the PES. These may, but not always, represent pulsion diverticula indicative of herniation of the pharyngeal wall secondary to increased pharyngeal swallowing effort. A score of (2) is represented by a unilateral bulging of one pharyngeal wall. This observation is an *indirect* measure or surrogate for pharyngeal muscle tone and often reflects weakness of the pharyngeal musculature on one side of the pharynx. A score of (3) is bilateral bulging characterized by an outward bulging of both pharyngeal walls that represents an indirect measure of muscle weakness or tone.

Note: Fluoroscopy does not directly assess the integrity of muscle strength. Some patients, such as in the case of chronic

pulmonary disease, may present with unusually enlarged pharyngeal spaces observed at rest. However, Component 13 (Pharyngeal Contraction) targets the **function during the swallow**. Consult the Scoring Help link at mbsimp.com for further scoring clarifications on this component.

Component 14: Pharyngoesophageal Segment (PES) Opening

PES Opening is judged **during maximum distention of the PES and throughout opening and closure**. Three dimensions are considered when scoring PES: distension (how wide the segment opens), duration (how long the segment stays open), and obstruction to flow (whether or not bolus flow is obstructed); one or any combination may be impaired. For example, the PES may fully distend but close early (incomplete duration) because of suprahyoid muscle weakness to sustain hyolaryngeal displacement, a primary traction force that contributes to PES opening. Even if the patient has only one or two impaired dimensions, they would receive a score that characterizes the most severely impaired dimension.

A score of (0) is the appearance of relatively straight edges through the segment with no appreciable narrowing from pharynx to proximal esophagus. A score of (1) is partial distention, partial duration with partial obstruction to flow that can be represented by a narrowing of the PES at the esophageal inlet while maintaining opening long enough for most of the bolus to pass; good distention but early collapse of the PES, which is often associated with incomplete anterior movement of the hyoid (Anterior Hyoid Excursion, Component 9); or both narrowing and early collapse of the PES. A score of (2) is minimal distention, minimal duration with marked obstruction as result of significant narrowing of the PES, rapid collapse of the PES, or both that results in resistance to bolus passage. A score of (3) is the absence PES opening and no bolus clearance. Consult the Scoring Help link at mbsimp.com for further scoring clarifications on this component.

Component 15: Tongue Base Retraction

Tongue Base Retraction is judged at **maximum retraction of the tongue base**. Observations of tongue base retraction are made based on the presence and degree of **contrast or air** between the base of tongue (BOT) and posterior pharyngeal wall (PPW).

A score of (0) is complete retraction that results in a ‘merging’ of the BOT with the superior and middle PPW and is indicated by no contrast or air between the tongue base and posterior pharyngeal wall in the lateral viewing plane. A score of (1) represents a trace column of contrast or air that resembles an outline made with a fine tip pen between the BOT and PPW *or a small triangle created by the epiglottis, BOT, and PPW*. Like Components 1 (Lip Closure) and 5 (Oral Residue), a score of (1) is a normal variant observation, should not be considered impairment when using composite pharyngeal total scoring, and is maintained to train the user to distinguish normal variation from collection observed for a score of (2). A score of (2) is a narrow column of contrast or air between the BOT and PPW, which resembles an amount of contrast or air similar to “collection” (Components 5 and 16, Oral Residue and Pharyngeal Residue, respectively) A score of (3) is represented by a wide column of contrast (majority of the bolus) or air between the BOT or PPW. A score of (4) is no appreciable posterior movement of the base of the tongue. Consult the Scoring Help link at mbsimp.com for further scoring clarifications on this component.

Component 16: Pharyngeal Residue

Pharyngeal Residue is not a physiologic measure, but a clinical sign of physiologic impairment that relates to external indicators of oral intake and nutritional status on the MBSImP. Pharyngeal residue is the amount of bolus material remaining in the pharynx **after the first swallow** in all swallows with the exception of the sequential swallow. Pharyngeal residue is scored following **the last swallow in the sequential liquid swallow task**. The terms “trace, collection, majority, and minimal/no” are referenced the same as in Component 5 (Oral Residue).

There are five potential scores for pharyngeal residue **made relative to the standard volume of barium administered to or taken by the patient** (e.g. 5mL versus cup sip). It represents the amount of bolus remaining in the pharynx after the **initial** swallow and only after the last of multiple swallows on the sequential swallow task. Complete pharyngeal clearance of the pharynx with no contrast remaining is scored as (0). A score of (1) is illustrated by a trace, or lining, of residue within or on

any of the pharyngeal structures, and like oral residue (Component 5) is not considered impairment when using summative Pharyngeal Total Scoring. A score of (2) is represented by a collection of residue within or on pharyngeal structures in the amount that an observer could “scoop out” the remaining material. A score of (3) is represented by the majority of contrast remaining either within or on the pharyngeal structures. A score of (4) is represented by minimal to no clearance of the pharynx. Consult the Scoring Help link at mbsimp.com for further scoring clarifications on this component.

Note: Clinicians should attempt to code the location of the pharyngeal residue and the method of pharyngeal clearance; however, these codes do not factor into the OI score.

Component 17: Esophageal Clearance

Esophageal Clearance is optimally scored from the AP view but can also be assessed in the lateral and slightly oblique planes, if necessary. The bolus is followed from the oral cavity through the lower esophageal segment (LES). The component is scored only using nectar and pudding consistencies (similar to Component 13, Pharyngeal Contraction). The goal is to observe esophageal clearance in the position in which the patient eats and drinks (bolus flow assisted by gravity). It must be clear to the attending radiologist that the clinician is not attempting to “diagnosis motility or structural anomalies”. Rather, clearance affects the process of eating and drinking, treatment strategies and has been shown to influence oropharyngeal-swallowing function. Our studies and others have shown that problems with esophageal clearance may negatively influence oropharyngeal swallowing dynamics.

Complete esophageal clearance, even with esophageal coating, after a primary or secondary wave of contraction is scored a (0). A score of (1) is represented by esophageal retention. Esophageal retention with retrograde flow below the PES is scored as (2). A score of (3) is illustrated by esophageal retention with retrograde flow through the PES from esophageal retention or retrograde flow through an adynamic diverticulum, such as a Zenker’s diverticulum. A score of (4) is illustrated by minimal to no esophageal clearance. A classic example is seen in patients with LES achalasia.

Note: It is always best to obtain complete esophageal visualization whenever possible, but when not possible, the guidelines below allow for the existing impairment to be documented. Consult the Scoring Help link at mbsimp.com for further scoring clarifications on this component.

Scoring When a Limited Esophageal View

Certain clinical circumstances can prevent capture of complete bolus transit through the lower esophageal sphincter. However, there are instances in which a score can be given appropriately and with relative certainty. Follow these general guidelines to determine if a score can be given and what that score should be:

- If you cannot see the entire esophagus (e.g. limited view of the PES or portion of the thoracic esophagus) and there is **not** residual barium that you can see, score: (0) *Complete clearance* and note in your report the finding during a limited examination.
- If you see part of the esophagus and there is clearly residual remaining, score: (1) *Esophageal retention*, and note in your report the finding during a limited examination.
- If you see part of the esophagus with retrograde flow below the PES, score: (2) *Esophageal retention with retrograde flow below the PES* and note in your report the finding during a limited examination.
- If you see part of the esophagus with retrograde flow through the PES, score: (3) *Esophageal retention with retrograde flow above the PES* and note in your report the finding during a limited examination.