Acquired Velopharyngeal Dysfunction Assessment: Speech-Language Pathologists' Perceived Competence and Proposed Clinical Guideline

by

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Abstract

Purpose: An on-line survey was completed to investigate SLP self-efficacy and knowledge for assessment of acquired velopharyngeal dysfunction (AVPD). It was hypothesized that participants would report limited training and low perceived self-efficacy. Frequency of AVPD clients, availability of instrumentation, and multidisciplinary teams were hypothesized to vary by work setting. A clinical guideline was proposed for planning intervention.

Method: Survey data was collected from 150 practicing clinicians. Descriptive data analyzed clinical protocols and self-efficacy. Correlational statistics related self-efficacy, client experience, level of training, and multidisciplinary teams. A clinical guideline was developed as a questionnaire for determining ratio of implementation among three interventions.

Results: A variety of protocols were provided for AVPD assessment and treatment. Limited training for AVPD was confirmed. Medical-based sites were more likely to have multidisciplinary teams and instrumentation. Higher levels of self-efficacy were reported than anticipated and correlational data varied among self-efficacy sources. Approximately 93% of respondents believed a clinical guideline would be useful.

Conclusions: Clinicians typically feel underprepared when treating AVPD due to limited clinical experience. Variable assessment and treatment protocols result in uncertainty among clinicians. The proposed clinical guideline may assist in determining clinical management for patients with AVPD.

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List of Abbreviations

ALS	Amyotrophic Lateral Sclerosis
AOS	Apraxia of Speech
ASHA	American Speech Language Hearing Association
AVPD	Acquired Velopharyngeal Dysfunction
CAPE-V	Consensus Auditory Perceptual Evaluation of Voice
CCC	Certificate of Clinical Competence
CNS	Central Nervous System
CPAP	Continuous Positive Airway Pressure
CV	Consonant - Vowel
CVA	Cerebral Vascular Accident
HRQL	Health-Related Quality of Life
MG	Myasthenia Gravis
MRI	Magnetic Resonance Imaging
N-RamP	Nasal Ram Pressure
OSMSE-3	Oral Speech Mechanism Screening Examination - Third Edition
PD	Parkinson’s Disease
PWSS	Pittsburgh Weighted Speech Scale
SIG	Special Interest Group
SLP	Speech-Language Pathologist

SSES	Strength Self-Efficacy Scale
TBI	Traumatic Brain Injury
TOSF	Test of Oral Structures and Functions
UMN	Upper Motor Neuron
UUMN	Unilateral Upper Motor Neuron
VELO	VPI Effects on Life Outcomes
VP	Velopharynx/Velopharyngeal
VPD	Velopharyngeal Dysfunction
VPI	Velopharyngeal Insufficiency
VPIQL	Velopharyngeal Insufficiency Quality of Life

Chapter 1

Introduction

Velopharyngeal Dysfunction (VPD) is known as a condition in which the velopharyngeal valve does not function adequately, resulting in errors in closure between the oral cavity and the nasal cavity (Kummer, Marshall, & Wilson, 2015). VPD is best known in individuals with congenital structural disorders, such as cleft palate or submucous cleft palate. Most basic and applied research for VPD has been conducted with the cleft palate population; however, there are fewer resources to guide assessment and clinical management of acquired velopharyngeal dysfunction (AVPD). This population is distinct from congenital VPD and has separate considerations regarding evaluation and clinical management. In particular, persons who have AVPD after typical acquisition of speech production likely have prior experience of balanced resonance and precise articulation. Auditory perceptual judgments and motor planning for clear speech productions were likely well-established secondary to typical structure and function of the velopharyngeal mechanism at an earlier time. Therefore, these individuals have auditory-perceptual and proprioceptive awareness of how their resonance and articulatory productions should sound and feel versus individuals with congenital VPD. Prior experience of balanced resonance and precise articulation may have an impact on the client's perception of communication impairment severity following the acquisition of AVPD.

In addition to having a newly acquired communication disorder, individuals with AVPD may also experience a negative change in their social and vocational experiences secondary to the disorder (Van Demark & Van Demark, 1970). Having lived without the physical effects of velopharyngeal dysfunction for a certain number of years, individuals with AVPD may learn that social opinions are made based off of perception of nasality in speech (Blood & Hyman, 1977; Lallh & Rochet, 2000; McKinnon, Hess, & Landry, 1986; Schilly, 1987). Persons unfamiliar with the causes of resonance disorders may associate the presence of hypernasality and nasal emission with an intellectual deficit, not realizing that the speaker with AVPD may function at a developmentally appropriate cognitive level.

The literature has described listener reactions to nasal speech as negative (Lallh & Rochet, 2000; Schilly, 1987). For instance, Blood and Hyman (1977) discovered that children had negative responses to peers who spoke with nasal resonance, indicating that they did not like the way the other child spoke and they would prefer to not talk to the child with excess nasality. An additional study evaluating college students' reactions towards the perceptual judgment of specific speech disorders (including hypernasality) indicated that listeners associated higher degrees of anxiety and lower amounts of worth with the individuals correlated to the recorded speech disorder samples (McKinnon et al., 1986). Studies found that children with velopharyngeal insufficiency who were given the Velopharyngeal Insufficiency Quality of Life Inventory (VPIQL), developed by Barr, Thibeault, Muntz, and de Serres (2007), rated the category of Speech Limitation as having the highest impact on their quality of life, indicating recognition of atypical speech. Evaluation of participant responses found that the majority of children responded with means of 2.21 for recognition of abnormal speech, 2.24 for recognition of speech being difficult for unfamiliar listeners to understand, and 1.21 for recognition of avoiding talking to strangers (based on a 4-point scale where 0 indicated no impact at all and 4 indicated a large impact (Barr et al., 2007). Emotionally, means of 1.45 indicated children were frustrated because of speech, 1.07 indicated participants were withdrawn socially, 0.93 indicated respondents were angry or depressed due to speech, and 0.90 indicated their speech was made fun of. In an effort to modify the VPIQL instrument, the VPI Effects on Life Outcomes (VELO) was developed with fewer questions and clearer language for both parent and adult participants (Skirko, Weaver, Perkins, Kinter, & Sie, 2012). Results were consistent in finding that children and parents rated worse quality of life towards Speech Limitations. These limitations and opinions associated with the perception of nasality in speech productions apply to AVPD as well, which can also have adverse consequences on an individual's social and vocational lifestyle (Lallh & Rochet, 2000; Schilly, 1987; Van Demark & Van Demark, 1970;). Therefore, thorough assessment of AVPD should include counseling and support for the client as he/she adjusts to these new implications.

Assessment of communication impairment secondary to AVPD requires training via academic and/or continuing education coursework. Aspects of the evaluation process such as instrumentation, auditory-perceptual judgement, and anatomy/physiology of the velopharyngeal mechanism all require adequate instruction in order to gain clinical knowledge and provide competent care for these patients. However, it has been reported that SLP training programs lack the specialized training that is vital in administering adequate clinical management for individuals of the AVPD population (Cohn, 1991; Pannbacker, 2004). If undergraduate and/or graduate institutions do not strive to train the standards needed to treat and assess individuals with AVPD, this heightens the risk of clinicians making inappropriate decisions regarding diagnosis and intervention. Limited training may also negatively impact clinician self-competence and/or self-confidence when approached with such a case. Overall, this can affect the quality of care for AVPD patients (Pannbacker, 2004).

In relation to degree of self-competence, self-efficacy is a social-cognitive concept that refers to how successful an individual believes he/she can perform a task based on his/her abilities (Gillespie & Abbott, 2011). Bandura (1977) asserted that professional's perceived self-efficacy will either result in a positive or negative outcome with regard to whether he/she decides to perform the task, how much effort will be put into it, the expected level of success via performance, and degree of perseverance to complete the task based on its degree of difficulty. In fact, a stronger sense of self-efficacy generally results in greater perseverance for difficult tasks, higher confidence in clinical skills, and a larger possibility that the task will be completed successfully (Bandura, 2006). With increased self-efficacy comes the delivery of adequate, well-rounded care. However, if speech-language pathologists are not receiving the adequate experience with regard to knowledge of AVPD, it is likely that the self-efficacy for clinicians is weak for this population.

Another factor in providing adequate care to patients with acquired velopharyngeal dysfunction is the lack of consensus on assessment and clinical management procedures. As will be discussed in the following literature review, there are multiple methods of evaluating and treating patients with AVPD, each with its own justification and rationale according to the client's etiology and co-occurring characteristics. With such a wide variety of assessment and treatment options, it is important to know which methods are the most appropriate for clients of this population. As is evident by the various recommendations in the literature, there is a lack of consensus on what procedures are the most suitable for clients with AVPD. Therefore, there is a need for an evidence-based clinical guideline to determine the best plan of action with regard to assessment and clinical management protocols for patients with AVPD.

Chapter 2

Literature Review

This chapter highlights the structure and function of the velopharyngeal system, the definition of AVPD, common etiologies, speech characteristics, and the skills needed for a speech-language pathologist to assess and determine clinical management for this population. The theoretical bases for assessing self-efficacy, or clinical confidence, are also described with a rationale for its use in this investigation.

The Structure

In order for a speech-language pathologist to adequately assess, diagnose, and treat a patient with symptoms of acquired velopharyngeal dysfunction (AVPD), it is of utmost importance that the clinician understands the mechanism's structure and function. The velum, also known as the soft palate, is a moveable articulator that functions to separate the nasal cavity from the oral portion of the pharynx. The velum is engaged for many non-speech tasks such as blowing, sucking, and vomiting; however, the focus of this discussion will be its use in communication for balanced resonance and intelligible speech. The pharynx can be described as a tube of muscle that opens into the nasal, oral, and laryngeal cavities (Shprintzen & Bardach, 1995). The velopharynx is made up of the velum, faucial pillars, lateral pharyngeal walls, and the posterior pharyngeal walls (Shprintzen & Bardach, 1995). These elements aid in the valving that separates the oral cavity from the nasal cavity.

Typical velopharyngeal function for intelligible speech is dependent on an intact structure and the competence of the velar and pharyngeal musculature. Anatomically, balanced resonance is maintained when the primary and secondary palates are intact and the velum has sufficient length, strength, range of motion, rate, rhythm, tone, and accuracy of closure. The levator veli palatini occupies the majority of the velum (Kuehn & Kahane, 1990; Seikel, King, & Drumright, 2010), and it plays a crucial role in elevating and retracting the soft palate in order to separate the oropharynx (area of the oral cavity behind the faucial pillars) from the nasopharynx (area of the nasal cavity above the velum; Kuehn & Moller, 2000; Seikel et al., 2010). The musculus uvulae plays an important part in velopharyngeal closure as an intrinsic muscle of the velum. This muscle, which can be seen hanging from the velum during an oral-mechanism examination, adds bulk to the velum and fills the central space between the velum and the posterior pharyngeal wall to establish a tight velopharyngeal seal (Perry, 2011). The palatopharyngeus muscle is another contributor to velopharyngeal function as it narrows the pharyngeal cavity to aid in pharyngeal wall contact with the velum when the palate is lifted, and lowers the velum to open the velopharyngeal port for nasal sounds during phonation (Seikel et al., 2010). An additional muscle that accommodates for pharyngeal wall contact with the soft palate is the superior pharyngeal constrictor. This muscle pulls the pharyngeal wall anteriorly and constricts the overall diameter of the tube to aid in the seal between the oral and nasal cavities, an active contributor in the production of pressure consonants (Hirschberg, 1986; Seikel et al., 2010). The velopharyngeal musculature also includes the palatoglossus and the tensor veli palatini; however, they do not play as large of a role as the levator veli palatini, palatopharyngeus, and superior pharyngeal constrictor muscles in the opening and closing of the acoustic resonator.

Regarding innervation, the glossopharyngeal (IX), vagus (X), and accessory (XI) nerves work together as a nerve complex to supply the pharynx and the soft palate with sensory and motor function (Netter, 1983). The glossopharyngeal (IX) nerves are responsible for conveying general sensory information from the mucous membrane of the pharynx, as well as motor innervation of a portion of the pharyngeal musculature including the stylopharyngeus and the superior constrictor muscle (Duffy, 2013; Netter, 1983; Webster, 1999). The visceral afferent fibers that supply sensory information connect to the central nervous system (CNS) via the nucleus solitarius, and the special visceral efferent (branchial motor) fibers that supply motor information originate in the CNS via the nucleus ambiguus within the medulla (Duffy, 2013; Netter, 1983; Webster, 1999; Wilson-Pauwels, Akesson, Stewart, & Spacey, 2002). The vagus (X) nerves contain special visceral efferent (branchial motor) fibers that also arise from the nucleus ambiguus and function to innervate the majority of the pharyngeal constrictor musculature (Duffy, 2013; Netter, 1983; Seiklel et al., 2010; Webster, 1999; Wilson-Pauwels et al., 2002). Also connecting to the nucleus ambiguus within the medulla is the cranial root of the accessory (XI) nerves (Duffy, 2013; Webster, 1999). The accessory (XI) nerves have an internal branches that communicate with the vagus (X) nerve, forming pharyngeal branches that supply nerve fibers to the muscles of the pharynx and soft palate, specifically all of the muscles aside from the tensor veli palatini, which is innervated by the trigeminal (V) nerves (Netter, 1983; Seikel et al., 2010). Therefore, if damage occurs to any of these cranial nerves, velopharyngeal function may be compromised.

The Function

The structural, neurologic, and motoric functions of the velum and pharynx are important for typical speech resonance, as it is the elevation and tension of these structures that achieves velopharyngeal closure (Boone, McFarlane,Von Berg, & Zraick, 2013). The function of the velopharyngeal mechanism for typical speakers varies across conversational tasks (Yorkston, Beukelman, Strand, & Hakel, 2010) and the different movements of the velopharynx are characterized by the diversity across people in the anatomy of the region (Hixon, Weismer, & Hoit, 2008). Therefore, the velopharyngeal region acts as an articulator based on adjustments within the structure that can affect the degree of nasal/oral coupling either through action of the velum, lateral pharyngeal walls, posterior pharyngeal wall, or a combination of these structures (Hixon et al., 2008).

The movement of the velopharyngeal mechanism is due to combined articulatory engagement known as flap-sphincter action, where the flap refers to velar movement and the sphincter refers to constriction of the pharynx (Hixon et al., 2008). Kummer (2014) describes three types of effective closure that vary across speakers, with certain closure patterns more prevalent than others. The first pattern, coronal, describes velopharyngeal closure that is primarily due to the approximation of the velum against the posterior pharyngeal wall, with little contribution from the pharyngeal walls. Second, sphincter (circular) closure occurs when the velum and the lateral and posterior pharyngeal walls come together, resembling a drawstring on a bag. Lastly, the sagittal pattern occurs when closure is primarily accomplished through medial approximation of the lateral pharyngeal walls with little contribution from the velum (Kummer, 2014; Perry, 2011). All three of these closure patterns are typical in normal speakers and result in balanced resonance.

In a study by Witzel and Posnick (1989), the velopharyngeal mechanisms of 246 individuals were examined using nasopharyngoscopy. From this pool of participants, 68% demonstrated a coronal pattern of closure, 23% demonstrated circular closure, and 4%

demonstrated sagittal closure. A structure that may vary from individual to individual is the presence of Passavant's ridge, a bulge of tissue that extends intermittently from the speaker's posterior pharyngeal wall that may or may not aid in velopharyngeal closure. Passavant's ridge is only evident during dynamic assessment of velopharyngeal function as it is not observed during resting breathing (Perry, 2011). This structure does not typically have a significant function in speakers with balanced resonance; however, it may be observed when closure is atypical (Hirschberg, 1986; Perry, 2011). Witzel and Posnick (1989) found that 5% of their participants used a circular pattern of velopharyngeal closure with presence of Passavant's ridge.

When non-nasal consonants are produced, especially those requiring high intraoral pressure (e.g., fricatives and stops), the velopharyngeal structure functions with greater force to achieve a seal that separates the nasopharynx from the oropharynx (Seikel et al., 2010). This allows for these high-pressure consonants to resonate strictly through the oral cavity. When nasal consonants are produced (e.g., /m/, /n/, /ŋ/), the velopharyngeal port is open to allow the oropharynx and the nasopharynx to join as a primary acoustic resonator (Yorkston et al., 2010). Regarding vowels and semivowels, coarticulatory context will influence whether or not the vowel will be produced with a nasal tone. This is dependent on what consonant the vowel is adjacent to when speaking; for example, "*ban"* has a more nasalized vowel when compared to the articulation of the word *"bat"* (Yorkston et al., 2010). The literature supports that the interpretation of vowels and degree of nasality is affected by the vowel's coarticulatory source (Beddor, 1993; Beddor & Krakow, 1999; Chen, Slifka, & Stevens, 2007). For instance, vowels will be perceived as more nasal when between nasal consonants (e.g., *man*). However, there are reports that nasalization can occur spontaneously in unexpected, non-nasal circumstances (Beddor, 1993). Listeners typically have a more difficult time judging the characteristics of nasal vowels when embedded between two oral consonants (e.g., *bed*) than they do when the vowel is in the anticipatory context of a nasal consonant (e.g., *bend*), which may result in inconsistent judgement of nasal-oral vowels (Beddor, 1993; Chen et al., 2007; Krakow, Beddor, Goldstein, & Fowler, 1988). Also, vowel nasalization may occur due to the height of the vowel (preference for low vowel nasalization), duration of the vowel (preference for long vowel nasalization), and the speaker's linguistic experiences (nasalization of vowels in non-nasal contexts; Beddor, 1993). Determining the coarticulatory effects of nasality can be difficult to target in speech therapy due to variances in nasality according to speech rate and timing, which are more complex to assess due to their rapidity (Chang & Johnson, 2005; Solé, 1992).

It is also important to consider that velopharyngeal function has been shown to differ with phonetic context. Kuehn and Moon (1998) completed a study that measured the degree and force of velopharyngeal closure based on activity of the levator veli palatini muscle in varying phonetic contexts. Their results indicated that high vowels were produced with greater force in velopharyngeal closure than low vowels, dorsal consonants (e.g., /k/) resulted in tighter closure than apical consonants (e.g., /t/), and plosive (e.g., /p/; /d/) and fricative (e.g., /s/; /v/) consonants caused a more constricted seal than nasal consonants (e.g., /n/; /m/; Kuehn & Moon, 1998).

Velopharyngeal Dysfunction Terminology

The term velopharyngeal inadequacy has been used interchangeably with velopharyngeal dysfunction. Velopharyngeal dysfunction (VPD) is typically used as a general term encompassing a number of more specific terms that relate to the various causes and effects of this condition. Kummer and colleagues (2015) and Trost-Cardamone (1989) describe four basic types of velopharyngeal dysfunction: velopharyngeal insufficiency, velopharyngeal incompetence, velopharyngeal incoordination, and velopharyngeal mislearning.

Velopharyngeal insufficiency describes anatomical differences in the velopharyngeal structure that result in insufficient closure. Acquired cases can occur secondary to surgery, growth, injury, etc. (Trost-Cardamone, 1989) and can present as loss of velar mass, insufficient velar length, or increased scarring that inhibits velar mobility (Woo, 2012).

Velopharyngeal incompetence generally refers to a reduction in strength and range of motion of the velum and/or pharyngeal muscles that, despite adequate length and mass, prevents adequate closure of the port. The etiology for velopharyngeal incompetence is often neurological (Woo, 2012) and may present as velar weakness secondary to dysarthria (stable or progressive). Difficulties in motor control are often due to damage of the primary cortical areas (central nervous system), as well as the cranial and spinal nerves (peripheral nervous system; Freed, 2012; Trost-Cardamone, 1989).

Velopharyngeal incoordination is characterized by inconsistent, unpredictable velopharyngeal function despite adequate length and mass of the velum and intact strength and range of motion (e.g., apraxia of speech; ataxic dysarthria). Deficits with motor planning are generally a result of left unilateral cortical (perisylvian) lesions (Freed, 2012; Trost-Cardamone, 1989). More specifically, it has been studied that apraxia of speech is related to lesions affecting the left anterior insula, also referred to as the superior precentral gyrus, and the basal ganglia (Baldo, Wilkins, Ogar, Willcock, & Dronkers, 2011; Dronkers, 1996; Freed, 2012).

The last form of VPD, *velopharyngeal mislearning*, refers to a speech sound disorder that develops due to a learned articulatory behavior where oral speech sounds are produced with an atypical pharyngeal placement, resulting in the detection of nasal airflow and nasal resonance. It is typically developmental and phoneme specific (Woo, 2012), and can result due to deafness or profound sensorineural hearing loss (Trost-Cardamone, 1989) as well as following repair of a cleft palate. Velopharyngeal mislearning is an important articulatory error to consider. However, it is typically identified in children who are in the process of developing speech. Therefore, the scope of velopharyngeal mislearning within this literature review will primarily concern acquired onset of hearing loss.

For our discussion in this study, we will refer to the inadequacies in velopharyngeal function as velopharyngeal dysfunction (VPD) to avoid any confusion regarding terminology. In particular, we are concerned with acquired forms of VPD, specifically referred to as acquired velopharyngeal dysfunction (AVPD). Therefore, this discussion will evaluate acquired structural and neurological causes of VPD, rather than congenital causes such as cleft palate.

Acquired Velopharyngeal Dysfunction Etiologies

Hirschberg (1986) reported that AVPD was the result of a structural disorder in three-fourths of cases where overt cleft palate was absent, while paresis or a neurogenic disorder accounted for one-fourth of AVPD cases. It is crucial that speech-language pathologists know that effects of VPD on resonance and speech can develop over time, without the presence of an overt cleft. Table 1 highlights some of the various causes of AVPD discussed by various researchers.

Table 1 *Causes of Acquired Velopharyngeal Dysfunction (AVPD)*

Structural/Iatrogenic	Neurological	Neurological	Other
	Stable	*Progressive*	
Adenoid Atrophy [f]	*Myopathies (Dependent on Etiology and Severity) [d]	*Myopathies (Dependent on Etiology and Severity) [d]	Acquired Hearing Loss (Severe) [c, d, f]
Adenoidectomy/Irregular Adenoids [b, f, h]	‡Dysarthria (Various Acquired Neurological Etiologies) [a, b, f]	‡Dysarthria (Various Acquired Neurological Etiologies/Progressive Neurological Diseases) [a, b, f]	Use of Inhaled Drugs [g]
Post-Surgical Deep Pharynx [b, f]	*Cranial Nerve Lesions [b, d, f]	‡Amyotrophic Lateral Sclerosis [a, h]	
Hypertrophic Tonsils [f, h]	‡Hypotonia (Dependent on etiology) [b, f]	‡Hypotonia (Dependent on etiology) [b, f]	
Tonsillectomy [b, f]	*Myasthenia Gravis (W/ Treatment) [a, b, d, h]	*Myasthenia Gravis (Severe/Untreated) [a, b, d, h]	
Maxillary Advancement [f]	*Post-Surgical Pain [d]	‡Motor Neuron Diseases (Degenerative) [a, d]	
Oral/Pharyngeal Cavity Tumors (Mass, Resection, or Radiation) [d, f, h]	†Mild Apraxia [a, f, h]	†Severe Apraxia (Evidence of Neurological Disease) [a, f, h]	
Uvulopalatopharyngo-Plasty [e]	†Cranial Trauma (Evidence of Mild Pain and Mild Trauma) [a, b, h]	†Cranial Trauma (Evidence of Severe Pain and Significant Trauma) [a, b, h]	
Velopharyngeal Trauma [d, h]	‡Cerebrovascular Accident [a, h]	‡Cerebrovascular Accident [a, h]	
	‡Infection [a]	‡Infection [a]	
		‡Inflammatory Disease (e.g., myositits, encephalitis) [a, d]	
		†Parkinson's Disease [a]	
		‡Neoplastic Etiology [a, d]	

†Indicates a Central Nervous System Disorder (Brain, Spinal Cord, Upper Motor Neurons).
*Indicates a Peripheral Nervous System Disorder (Spinal Nerves, Cranial Nerves, Brainstem, Lower Motor Neurons).
‡Indicates a disorder that could be classified as either a Central Nervous System Disorder or a Peripheral Nervous System Disorder depending on the etiology.
Adapted from [a]Duffy (2013); [b] Dworkin, Marunick, and Krouse (2004); [c]Hassan et al. (2012); [d]Hirschberg (1986); [e]Katsantonis, Friedman, Krebs, and Walsh (1987); [f]Kummer et al. (2015); [g]Ruscello, Gallaher, and Strasser (2016); [h]Trost-Cardamone (1989).

Neurological Causes of AVPD

When there is a neurophysiological deficit affecting the structures of the velum and the pharynx, this can cause the velum to not fully elevate and the pharynx to not move or constrict appropriately for a full velopharyngeal seal. Various neurologic events affecting the central nervous system such as traumatic brain injury (TBI), cerebral vascular accident (CVA), aneurysm, and trauma can cause damage to the areas of motor planning (e.g., premotor cortex, motor cortex, or insula of the dominant cerebral hemisphere), motor performance (lower motor neurons), and control circuits (e.g., basal ganglia & cerebellum; Altman et al., 2007; Duffy, 2013; Kummer et al., 2015). In addition, acquired neurological or neuromuscular disorders that affect the peripheral nervous system or the central nervous system result in various effects on speech due to difficulties executing and planning activities of motoric function, resulting in disorders such as dysarthria or apraxia of speech (Kummer et al., 2015). Perceived speech characteristics may be one of the first signs of a neurologic event or development of a neurogenic disease (Altman et al., 2007). Also, knowledge of neurologic etiology and perception of speech will allow the clinician to make a more valid diagnosis and clinical management plan with regard to the specific portion of the speech motor system that is compromised.

Dysarthria. When muscles are lacking tone (a condition known as hypotonia) the reduced level of strength results in incomplete closure of the velopharyngeal port, causing evidence of nasality in speech (Kummer et al., 2015). Also, multiple studies have indicated that inadequate velopharyngeal function can be associated with dysarthria. Dysarthria is a label for a number of speech sound disorders that occur due to damage of the central or peripheral nervous systems (Darley, Aronson, & Brown, 1975; Duffy, 2013; Palmer & Enderby, 2007). It is characterized by a weakness, paralysis, or incoordination in the tone of muscles, resulting in a speech disorder that is typically associated with hypernasality, low breath support, inappropriate speech rate, monopitch, and decreased volume (Darley et al., 1975; Dworkin & Johns, 1980; Kummer et al., 2015; Palmer & Enderby, 2007).

Dysarthria can either be stable, in which the cause of the dysarthria is not likely to change, or progressive, where the symptoms of dysarthria typically change over time and/or are associated with a progressive neurological disease (Duffy, 2013; Enderby et al., 2009). When considering dysarthria from an acquired standpoint, AVPD typically occurs after the acquisition of mature speech patterns (Enderby et al., 2009). Following recovery from an acute neurological event, such as traumatic brain injury or cerebrovascular accident (CVA), dysarthria typically stabilizes (Duffy, 2013). On the other hand, dysarthria is usually progressive when it is due to neurological disease, such as amyotrophic lateral sclerosis (ALS) or Parkinson's disease (PD; Duffy, 2013; Enderby et al., 2009). Discerning the difference between stable and progressive dysarthria typically comes with the patient's preceding diagnosis. Gathering this information with regard to the patient's diagnosis will influence the clinical management plan.

Dysarthria may be categorized into seven different classifications due to the nature of the anatomical or neuropathological characteristics associated with it: spastic, flaccid, ataxic, hypokinetic, hyperkinetic, unilateral upper motor neuron, or mixed (Brookshire, 2003; Darley et al., 1975; Duffy, 2013; Enderby et al., 2009). Duffy (2013) emphasizes that the Mayo Clinic classifications undertaken by Darley and colleagues (1969) correlated these seven categories to the following seven groups: pseudobulbar palsy, bulbar palsy, cerebellar lesions, parkinsonism, dystonia, choreoathetosis, and amyotrophic lateral sclerosis. Four of the seven types of dysarthria, (spastic, flaccid, unilateral UMN, and mixed) are frequently characterized by evidence of nasality.

Spastic dysarthria is characterized by bilateral damage to the upper motor neurons, affecting both the direct and indirect activation pathways of the central nervous system (Duffy, 2013). Damage in this regard often results in sluggish movements, reduced range of motion, and limited strength that often impacts speech (Duffy, 2013). In fact, the Mayo Clinic Speech Pathology practice states that 7.3% of all dysarthrias are diagnosed as spastic (Duffy, 2013). Hypernasality may be perceived in the speech of individuals with spastic dysarthria as the lesion results in paresis, weakness, or hypotonicity of the velopharyngeal musculature causing the mobility of the velum to be slow, imprecise, or nonexistent (Brookshire, 2003; Duffy, 2013; Dworkin et al., 2004; Freed, 2012). Spastic dysarthria may be acquired via a vascular disorder (e.g., cerebral vascular accident), degenerative disease (e.g., amyotrophic lateral sclerosis; primary lateral sclerosis), trauma (e.g., traumatic brain injury; tumor resection), inflammatory disease (e.g., leukoencephalitis), or toxin (Duffy, 2013; Dworkin et al., 2004; Freed, 2012).

Flaccid dysarthrias are typically due to damage of the lower motor neurons, either unilaterally or bilaterally (Dworkin et al., 2004). Damage to the branches of the pharyngeal plexus that innervate the velopharyngeal structures generally causes the other portions of the lower motor nervous system to not work in harmony. Therefore, if the components of the lower motor nervous system are damaged and cannot regulate the velopharyngeal musculature, it is likely that various extents of velopharyngeal impairment will arise (Dworkin & Johns, 1980). Damage to the lower motor neurons can result in effects of velopharyngeal incompetence due to overall paralysis or paresis to the velum or pharyngeal musculature (Kummer et al., 2015). Due to the damage of one or more cranial or spinal nerves, subtypes of flaccid dysarthria are noted, explaining why the literature refers to this dysarthria classification in a plural sense (Duffy, 2013). Damage to the glossopharyngeal (IX) and vagus (X) cranial nerves often results in a range of severities for resonance disorders as determined by the degree of nerve damage causing weakness or paralysis of the velum (Brookshire, 2003; Duffy, 2013; Dworkin et al., 2004). For example, unilateral damage to the pharyngeal branch of the vagus (X) nerve typically results in mild perceptions of hypernasaility and/or nasal emission, while bilateral damage often results in moderate-severe levels of nasal emission, hypernasality, and/or imprecise pressure consonant articulation (Duffy, 2013; Freed, 2012). Flaccid dysarthrias make up 8.4% of the Mayo Clinic Speech Pathology dysarthria diagnoses and may develop due to iatrogenic and/or non-iatrogenic trauma, degenerative disease (e.g., amyotrophic lateral sclerosis), infection, vascular disease (e.g., brainstem stroke), myasthenia gravis, muscle disease (e.g., muscular dystrophy), and demyelination (Duffy, 2013; Dworkin et al., 2004).

Unilateral upper motor neuron (UUMN) dysarthria is characterized by damage to the upper motor neurons that transmit signals to the cranial and spinal nerves, including those that are essential for speech (Duffy, 2013). UUMN dysarthria has received limited attention and has not been studied with the same depth as the other forms of dysarthria due to its mild nature and tendency to co-occur and become masked by other disorders. Despite the restricted information known about UUMN dysarthria, the Mayo Clinic Speech Pathology practice encounters this form of dysarthria in approximately 8.5% of diagnosed dysarthrias (Duffy, 2013). With regard to resonance, some patients with UUMN dysarthria may speak with a mild degree of hypernasality and/or nasal emission due to weakness, spasticity, or both (Duffy, 2013; Freed, 2012). The focal unilateral neuron damage for patients with UUMN dysarthria typically occurs due to iatrogenic/non-iatrogenic trauma or cerebrovascular accident with deficits isolated to the upper motor neurons (Duffy, 2013; Freed, 2012).

Mixed dysarthria is acquired due to lesions across multiple neuromotor sites, and represents a combination of two or more classes of dysarthria (Brookshire, 2003; Duffy, 2013; Dworkin et al., 2004). Dysarthrias are more commonly classified as mixed due to the tendency of lesions to affect more than one localized region of the motor system, accounting for up to 29.9% of all dysarthria diagnoses classified at the Mayo Clinic Speech Pathology practice (Duffy, 2013). Generally, velopharyngeal dysfunction is evident via hypernasality in cases of mixed dysarthria that are more characterized by symptoms and etiologies related to spastic, flaccid, and unilateral upper motor neuron dysarthria. Due to the complex nature and combination of characteristics related to mixed dysarthria, multiple etiologies may result in a dysarthria with VPD. According to the Mayo Clinic, approximately 78% of mixed dysarthria diagnoses from 1999-2008 were related to degenerative disease (e.g., amyotrophic lateral sclerosis; parkinsonism; multiple systems atrophy), followed by other etiologies such as vascular disease (e.g., cerebral vascular accident), demyelinating disorders (e.g., multiple sclerosis), trauma, toxins, and more (Duffy, 2013). Overall, a combination of neurologic events and/or diseases may be responsible for classifying dysarthria as "mixed" (Brookshire, 2003; Duffy, 2013; Dworkin et al., 2004). Dysarthria's should be assessed and treated with the degree of damage to the specific motor neurons and the stability or the progression of the disorder in mind (Brookshire, 2003).

Though these four dysarthria types are most characterized by hypernasal resonance, this does not mean that atypical resonance is not perceived in other classifications of dysarthria. For example, myoclonus of the pharynx, larynx, and palate is a form of abnormal and involuntary muscle contraction associated with hyperkinetic dysarthria that may result in perceptions of hypernasality or hyponasality due to unpredictable degrees of velopharyngeal movement (Zenga, Harmon, & Ogden, 2015). Also, mild hypernasality may be evident in patients with Parkinson's

Disease (hypokinetic dysarthria) due to degeneration of the dopaminergic system, resulting in difficulties initiating voluntary movement (Duffy, 2013). Taking part in a comprehensive motor speech evaluation will aid in differential diagnosis of neurologic-based AVPD.

Apraxia of speech. Apraxia of speech (AOS) is another motor speech disorder that occurs when neuromotor communication of the oral structures is compromised. The individual will likely have difficulties planning and sequencing their articulators for volitional movement (e.g., speech), characterized by phoneme distortions, prosodic disturbances, inconsistent errors, and more difficulty as the articulatory demands increase (Darley et al., 1975; Duffy, 2013; Freed, 2012; Kummer et al., 2015). With AOS, involuntary and reflexive movements are typically stable and voluntary movements are compromised; however, impairments are not secondary to weakness or incoordination from a motor programming standpoint (Duffy, 2013). Regarding velopharyngeal function, apraxia of speech may result in a mixed resonance disorder, hypernasal resonance due to the velum being lowered for oral pressure consonants, and/or hyponasal resonance when the velum is raised for nasal consonants. Acquired apraxia of speech may occur due to damage to the speech centers of the central nervous system (typically the left perisylvian area) via trauma, traumatic brain injury (TBI), cerebrovascular accident (CVA), demyelinating disorders, or tumor (Duffy, 2013; Freed, 2012). Though possible, it is rare that inflammatory diseases, neurodegenerative diseases, and toxic-metabolic diseases result in apraxia of speech (Duffy, 2013).

Apraxia of speech should not be confused with ataxia of speech (often classified as Ataxic Dysarthria). Ataxia is characteristic of damage to the cerebellum, resulting in poor coordination, and imprecise/jerky movements (Duffy, 2013). Ataxia is a lower level disturbance, directly affecting the motor performance of speech movements. Apraxia of speech is a higher level disorder, as it is characterized by deficits in motor planning and programming of speech due to damage to the language dominant cerebral hemisphere (Duffy, 2013). Apraxia of speech can be classified according to difficulties in rate, articulation, and prosody, along with instable oromotor control (Duffy, 2013). Typically, apraxia of speech can be distinguished from ataxic dysarthric errors by looking for differences in consistency of errors (more consistent with dysarthria), production of alternating and sequential motion rates (alternating motion rates being regular with AOS and irregular with ataxic dysarthria), oral motor examinations (typically normal oral mechanism with AOS alone), and presence of non-verbal oral apraxia symptoms (if present, more likely to be AOS; Duffy, 2013). The literature does not elaborate that hypernasality or hyponasality is characteristic of ataxia of speech, though imprecise articulation (which could affect the function of the velum) is common for patients with this disorder (Duffy, 2013).

Iatrogenic and Structural Causes of AVPD

Adenoidectomy/atrophy. Structural differences that occur post-birth due to growth and development of the velopharynx, or those secondary to a medical procedure (iatrogenic) or trauma may result in AVPD. The presence or absence of adenoids/tonsils has been studied to determine their overall effect on velopharyngeal articulation. In young children, the adenoids typically add structural bulk to the posterior pharyngeal wall, contributing to closure of the velopharyngeal port (Fernandes, Grobbelaar, Hudson, & Lentin, 1996). When an individual without an overt cleft palate has an adenoidectomy, irregular shaped adenoids, or if the adenoids atrophy over the course of typical growth and development, the decrease in size, irregular formation, or bulk of scar tissue may contribute to the development of atypical resonance (Wolford, Perez, Stevao, & Perez, 2012). Khami, Tan, Glicksman, and Husein (2015) stated that the incidence of persistent hypernasality following adenotonsillectomy ranged from 1:1200 to 1:3000, while the incidence of hypernasality was 1:10,000 following adenoidectomy alone, indicating a higher risk of AVPD with combined surgical procedures. The altered posterior pharyngeal wall surface contours or the increase in depth between the posterior pharyngeal wall and the velum may no longer allow a complete seal within the velopharyngeal port, causing a small leakage of air through the nasal cavity (Conley, Gosain, Marks, & Larson, 1997; Fernandes et al., 1996; Kummer et al., 2015; MacKenzie-Stepner, Witzel, Stringer, & Laskin, 1987; Ren, Isberg, & Henningsson, 1995; Wolford et al., 2012).

Typically, evidence of velopharyngeal dysfunction post-adenoidectomy is temporary and will resolve without treatment over the course of a few months when no other structural or neurological conditions are present (Fernandes et al., 1996; Khami et al., 2015; Ren et al., 1995). However, if hypernasality is persistent and present for an extended period of time post-surgery, it is recommended that the patient's velopharyngeal function be further assessed to determine if the velum is physically unable to achieve velopharyngeal closure due to changes in anatomical structure (Khami et al., 2015; Ren et al., 1995).

Hypertrophic tonsils. Though tonsils rarely interfere with function of the velum, severely hypertrophic tonsils may intrude into the pharynx and restrict the movement of the lateral pharyngeal walls. Restriction of velar elevation and medial approximation of the pharyngeal walls may inhibit adequate velopharyngeal seal during phonation and result in hypernasal resonance (Kummer, 2011d; Kummer, Billmire, & Myer, 1993; Ren et al., 1995). Scarring of the posterior faucial pillars or post-operative pain from a tonsillectomy can affect lateral pharyngeal wall movement and result in nasal resonance as well (Gibb & Stewart, 1975; Kummer, 2011d; Kummer et al., 2015). Conversely, any obstruction within the velopharyngeal tract (such as hypertrophic tonsils or adenoids) may result in hyponasal resonance, Eustachian tube deficits, and/or compromised facial growth and development (MacKenzie-Stepner et al., 1987; Wolford et al., 2012).

Maxillary advancement. Maxillary advancement is another iatrogenic cause of acquired velopharyngeal dysfunction. Surgical procedures that reposition the maxilla forward due to difficulties sleeping, malocclusion, or a facial asymmetry also reposition the velum more anteriorly. Once the structure is surgically altered, the velum may not be long enough to adequately reach the area of the pharynx for a complete seal (Kummer et al., 2015; McCarthy, Coccaro, & Schwartz, 1979).

Uvulopalatopharyngoplasty. Uvulopalatopharyngoplasty is a procedure that is done to treat obstructive sleep apnea. This procedure is done by removing portions of the uvula, soft palate, and tonsils to enlarge the oropharyngeal space and reduce the effects of sleep apnea (Franklin et al., 2009). This surgical procedure can cause evidence of velopharyngeal dysfunction due to the wide margin within the velopharyngeal tract and shortened velum following the soft palate resection (Katsantonis et al., 1987).

Tumor. Another form of acquired structural/iatrogenic velopharyngeal dysfunction to be discussed is the presence of a tumor in the oral or pharyngeal cavities. A tumor can interfere with overall function of the velar mechanism, but treatment for the growth may more seriously affect balanced resonance and velar function. Typically, a growth must be resected or radiated for removal. If a tumor is resected, the surgical procedure may affect the overall competence of the velopharyngeal valve (Kummer et al., 2015; Myers & Aramany, 1976). Employing radiation to reduce the size of a tumor may not only shrink the size of the growth, but also that of the surrounding structures (e.g., the velum and pharyngeal walls; Kummer, 2011c). In addition, radiation as a form of treatment for oral, nasopharyngeal, or oropharyngeal cancer may cause the tissues of the pharynx to become fibrotic. This typically results in rigidity and loss of function during actions of speaking and swallowing. In addition, the muscles of the pharynx may become weak, resulting in reduced motion and control (Lazarus et al., 2000; Murphy & Gilbert, 2009). Further, radiation can result in pain during functional use of the radiated tissue, negatively influencing typical muscle function. It is clear to see that surgical procedures around the area of the velum hold a risk of affecting the overall adequacy in separating the oral and nasal cavities for speech.

Trauma. Finally, trauma to the oral cavity and pharynx is another AVPD etiology. Injury to the velopharynx secondary to diffuse or focal trauma results in heterogeneous clinical presentation of velopharyngeal function and resonance balance. The location and extent of tissue loss or muscle damage will be unique for each client. Restoration and maintenance of respiratory and swallowing function are prioritized in this population with communication generally deferred until breathing and swallowing are managed. Therefore, restoration of the oral and pharyngeal structures may be completed with respiration and swallowing as primary and velopharyngeal function for speech as a secondary consideration.

Additional Causes of AVPD

Hearing loss. When speech sounds are produced, appropriate resonance may be monitored via the auditory feedback loop, or via tactile-kinesthetic feedback. The auditory feedback loop is the process of speaking an utterance, listening to what was said, and then analyzing the utterance for correct and/or incorrect productions that need to be addressed in the moment. Tactile-kinesthetic feedback involves touching or physically manipulating the structure to produce appropriate resonance. Since the velum is a difficult articulator to touch, velopharyngeal function for proper resonance is primarily learned via the auditory feedback loop (Hassan et al., 2012; Kummer et al., 2015). With this breakdown in the auditory feedback loop, speakers with hearing loss may have a difficult time monitoring resonance and adjusting the velopharyngeal valve to close adequately for oral pressure phonemes, resulting in hypernasal resonance (Kummer et al., 2015).

A recent study evaluated how nasalance was presented for individuals with post-lingual hearing loss with various age of onsets, ranging from age 15 to 63 years (Hassan et al., 2012). Participants of this study were assessed via nasometric evaluation (Nasometer II) prior to cochlear implantation, as well as at 6, 12, and 24 month increments post-implantation to determine how nasalance scores changed with implantation, and to compare them to control group results. Cochlear implantation serves as a method of re-integrating the auditory feedback loop into the patient's speech routine, overall, improving how an individual monitors his/her resonance. Pre-implantation results indicated that the longer the duration of the participant's hearing loss, the more significant their nasalance rating. Results indicated that for individuals with duration of hearing loss of 3 years or more, participants demonstrated a general improvement in resonance and lower nasalance scores post-implantation at 6, 12, and 24 month increments for production of oral sentences. Individuals with a duration of hearing loss of less than 3 years demonstrated significant changes in nasalance scores at their 24-month, post-implantation evaluation. Changes were noted for these individuals at the 6 and 12-month evaluations; however, the results were not significant. These results highlight how acquired velopharyngeal dysfunction may arise as a form of velopharyngeal mislearning when the auditory feedback loop is compromised for adequate resonance management.

Use of inhaled drugs. When individuals ingest drugs via the nares, the mucosa of the nasal cavity is highly susceptible to damage due to its sensitive vascular nature (Greene, 2005). The interconnection between the nasal cavity and pharynx (nasopharynx) results in the soft palate and posterior pharyngeal wall being prone to structural damage when certain drugs are inhaled (e.g., cocaine, OxyContin, acetaminophen, hydrocodone, heroin; Alexander, Alexander, & Valentino, 2012). This has become an increasing problem as drug use/abuse has grown over the years, resulting in an incidence rate that is probably higher than the 4.8% of nasal and sinus deficits secondary to inhalation of drugs reported in the U.S. during the 1960's (Alexander et al., 2012; Greene, 2005; Schweitzer, 1986). Studies have shown that inhalation of these substances may cause palatal perforation, chronic irritation, inflammation, perforation of the septum, tissue necrosis, and injury to the posterior pharyngeal wall (Alexander et al., 2012; Greene, 2005; Ruscello et al., 2016). Compromise of the velopharyngeal structure may result in hypernasality and/or nasal emission, as the velum and pharynx cannot obtain a complete velopharyngeal seal due to perforation or loss of structural mass and/or sensory feedback (Ruscello et al., 2016). Atypical resonance and articulatory patterns such as these often adversely impact intelligibility of a client's speech. More research is needed to confirm incidence and characteristics of nasality for this client population.

Assessing Patients with AVPD

When speech-language pathologists assess a client with suspected velopharyngeal dysfunction, the goals of the assessment process are to characterize the extent and severity of the disorder, determine if behavioral intervention is warranted and sufficient, and decide if behavioral intervention is recommended in combination with medical interventions (Shipley & McAfee, 2009). Table 2 summarizes the clinical characterization of AVPD across a range of etiologies. By evaluating the client across a variety of procedures, the clinician will discern the strengths and weaknesses of the client's speech productions, the presence of a communicative disorder, and the clinical plan that would best benefit the client's quality of life (Shipley & McAfee, 2009). Regarding patients with AVPD, assessment procedures will be specialized for their needs and concerns, using methods that will recognize any impairments, barriers, or limitations that are causing the client's respective symptoms.

The American Speech-Language-Hearing Association (ASHA), has established a set of practice patterns along with various rules and regulations that indicate clinicians are to conduct diagnostic evaluations with professional integrity in accordance to the World Health Organization's International Classification of Functioning, Disability, and Health framework (American Speech-Language-Hearing Association [ASHA], 2004). In general, the diagnostic plan would include 1) a detailed case history, 2) a review of cognitive, motor, visual, and auditory status, 3) use of perceptual and instrumental measures (e.g., standardized perceptual measures, videofluoroscopy, endoscopy, aerodynamic measures), and 4) evaluation of articulatory structure and function related to impaired velopharyngeal function (ASHA, 2004; Shipley & McAfee, 2009).

Table 2 *Clinical Characterization of AVPD*

Structural/Iatrogenic	**Neurological - Stable**	**Neurological - Progressive**
Clinical observation (perceptual and instrumental) of the following characteristics on a *temporary* and/or *consistent* basis:	Clinical observation (perceptual and instrumental) of the following characteristics on a *temporary* and/or *consistent* basis:	Clinical observation (perceptual and instrumental) of the following characteristics on a *changing* and/or *inconsistent* basis:
1) Altered contour of posterior pharyngeal wall (affects adequate VP closure). [a, d, e, f, g]	1) Hypernasality, with stable degree of severity varying from mild to severe. [c, g]	1) Hypernasality, with degree of severity progressively getting worse. [b, c, g]
2) Limited lateral pharyngeal wall movement in the presence of post-surgical pain. [e, f, g]	2) Low breath support. [b, c, g]	2) Extreme, progressive weakness in the VP musculature resulting in incomplete VP closure. [b, c]
3) Nasal emission (degree affected by size of post-surgical velopharyngeal gap). [d, f, g]	3) Variable loudness. [b, c, g]	3) Low breath support. [b, c, g]
4) Reduced size of the soft palate (affects adequate VP closure). [a, e]	4) Stable, slow rate of VP movement (may affect timing of VP mechanism). [b, c]	4) Variable loudness. [b, c, g]
5) Hypernasality (degree affected by size of post-surgical velopharyngeal gap). [a, d, f, g]	5) Mild incoordination of the VP mechanism. [b, c, g]	5) Progressive decrease in rate of VP movement (greatly affects timing of the VP mechanism). [b, c]
6) Rigidity of VP mechanism (affects adequate VP closure; due to radiation or post-surgical scarring). [e, f, g]	6) Limited degree of nasal emission. [b]	6) Severe incoordination of the VP mechanism. [b, c, g]
7) Hyponasality (due to bulk of scar tissue, hypertrophic tonsils, or presence of growth prior to surgical removal). [c, e]		7) Significant degree of nasal emission. [b]
		8) May experience nasal regurgitation when swallowing food or liquid. [b, e]

Adapted from: [a]Conley et al. (1997); [b]Duffy (2013); [c]Dworkin et al. (2004); [d]Fernandes et al. (1996); [e]Katsantonis et al. (1987); [f]Khami et al., 2015; [g]Kummer et al. (2015).

Case history. It is of utmost importance that the clinician begin the assessment process by gaining information about the client via a detailed case history record. The case history should query the extent of the patient's problem, what previous treatment or consultations they have encountered, past medical histories, as well as statements regarding the patient's concerns. Questions that are important to ask the client during the initial assessment interview are listed in Table 3.

Table 3 *Case History Questions*

Initial Assessment Interview
1. When were the resonance issues first noted?
2. Is the problem getting worse, staying the same, or getting better?
3. What other medical diagnoses are present (evidence of up-to-date medical history)?
4. What surgical/medical procedures has the client undergone as part of their medical history?
5. What medications is the client currently taking?
6. How has the issue of velopharyngeal dysfunction affected the client's daily routine and quality of life?
7. What symptoms have been noted?
8. What urged the client to come for a speech evaluation at this present time?
9. Is the client currently involved or were they previously involved in other forms of therapy/treatment for this condition or any concomitant diagnoses?
10. How does the client perceive their own voice (severity)?
11. What are the patient's main concerns for future treatment?

Adapted from Shipley and McAfee, 2009; Boone et al., 2013.

Oral-mechanism/oral-motor examination. It is vital for the speech-language pathologist to complete an oral-mechanism examination to observe the velum at work and at rest, the relative size of the oral/palatal structures, symmetry of the velopharynx and facial structures, the overall condition of the oral mechanism, and any other behaviors that could indicate a neuromuscular, articulatory, or structural deficit (Boone et al., 2013; Duffy, 2013). The clinician will need to have an adequate understanding of the anatomic, physiologic, and neurologic bases regarding the oral-facial mechanism, with training in how to conduct an oral-facial examination (Shipley & McAfee, 2009).

Initial impressions about the client's resonance, voice, facial structures, etc. can be noted during an informal conversation between the client and the clinician (Buckendorf & Gordon, 2002). Further evaluation will need to take place using a standardized oral-mechanism examination checklist. Formal clinical assessments include the Oral Speech Mechanism Screening Examination - Third Edition (OSMSE-3; St. Louis & Ruscello, 2000), the Test of Oral Structures and Functions (TOSF; Vitali, 1986), and the Dworkin-Culatta Oral Mechanism Examination (Dworkin & Culatta, 1980). The oral-mechanism examination will provide limited information regarding the degree of velopharyngeal function because the actual closure of the mechanism is out of sight, superior to the lower border of the soft palate, rendering the oral view insufficient (Boone et al., 2013). Therefore, speech-language pathologists must take advantage of additional methods of evaluation to obtain a complete diagnostic impression of the client's resonant abilities.

Auditory-perceptual assessment. The initial evaluation begins with a perceptual evaluation of the client's speech. This diagnostic procedure is most commonly used by speech-language pathologists when assessing velopharyngeal closure in order to determine diagnosis and further treatment recommendations (Kummer, 2011b; Pannbacker et al., 1984). To assess a patient using measures of auditory-perceptual judgement, the speech-language pathologist must be trained and experienced in methods of diagnosing velopharyngeal dysfunction. By listening to the client's connected speech productions, the clinician can determine if the patient demonstrates evidence of hypernasality, hyponasality, mixed resonance, nasal emission, or other articulatory errors. Certain practices such as pinching the client's nose during connected speech samples/vowel productions, using a “listening tube,” reading sentences loaded with certain pressure consonants, and employing published rating scales are typically used in perceptual diagnostic evaluations for patients with suspected velopharyngeal deficits (Haynes & Pindzola, 2012). Though not speech specific, the clinician may also ask the patient to hold air in his/her mouth with cheeks puffed out in order to hear any leakage of air through the nasal cavity, or to protrude the tongue while puffing their cheeks out to determine if the client is using the dorsum or root of the tongue to compensate for a weak velum (Duffy, 2013).

The use of articulation tests such as The Templin Darley Tests of Articulation (Iowa Pressure Articulation Test; Templin & Darley, 1969) and Bzoch Error Patterns Diagnostic Articulation Test (Bzoch, 1979) may also be useful in testing suspected AVPD clients, as they are sensitive to productions of high pressure consonants during the evaluation process if the test is age-appropriate for the respective client (Demark, Kuehn, & Tharp, 1975; Kummer, 2011b; Kummer & Lee, 1996; Morris, Spriesterbach, & Darley,1961). In addition, standardized tools may be used to quantify results of perceptual speech assessments, such as the Pittsburgh Weighted Speech Scale (PWSS) that allows the clinician to numerically rate the client’s speech based on grimace, nasality, nasal air escape, and compensatory misarticulations (McWilliams & Philips, 1979; Purcell & Sie, 2013).

By analyzing resonance via a speech sample, the clinician can ask the patient to produce a sentence loaded with nasal phonemes to make judgements of hyponasal speech, or the patient may produce a sentence loaded with oral pressure consonants to make judgements of hypernasal speech (Boone et al., 2013). Voiceless, high pressure consonants are evaluated due to the need for the client to build up substantial intraoral pressure and oral air flow to produce them in speech, examining the efficiency of velopharyngeal closure as nasal emission and/or hypernasality may be noted if the valve is not sealing adequately (Garrett & Deal, 2002). Syllables containing high or low vowels along with a pressure consonant can help to determine small deviances in velopharyngeal competence and if a resonance issue is phoneme-specific (e.g., /pa, pa, pa/ or /ki, ki, ki/; Garrett & Deal, 2002; Kummer, 2014). Counting from 60 to 70 challenges the velopharyngeal mechanism due to the presence of plosives, high vowels, and the /s/ phoneme, which will allow the clinician to evaluate how the mechanism functions when taxed (Garrett & Deal, 2002; Kummer, 2014). Evaluation of connected speech is typically advantageous due to increase of functional demand on the velopharyngeal mechanism (Kummer & Lee, 1996; Sell, 2005).

A clinician-centered auditory perceptual measure that includes resonance as a parameter while standardizing the speech tasks is the Consensus Auditory Perceptual Evaluation of Voice (CAPE-V; Kempster, Gerratt, Abbott, Barkmeier-Kraemer, & Hillman, 2009). The CAPE-V incorporates a visual analog scale that the clinician uses to rate the client's overall severity, roughness, breathiness, strain, pitch, and loudness, along with a section for grading additional vocal attributes that are present such as nasal resonance (Karnell et al., 2006; Kempster et al., 2009). To evaluate Health-Related Quality of Life (HRQL) in patients with velopharyngeal dysfunction, certain measures have been formulated by researchers, but few have been clinically published. The VPI Effects on Life Outcomes (VELO) instrument has been used to assess quality of life in children and their caregivers in accordance to the Pediatric Quality of Life Inventory, Version 4.0 (Skirko et al., 2012; Varni, Seid, & Kurtin, 2001). There is a need for a clinical quality of life instrument for patients with AVPD, as there is a lack of these instruments across multiple age ranges.

While auditory-perceptual evaluation is the first step to determining a problem with velopharyngeal function, there are limitations that must be considered during the assessment process (Yorkston et al., 2010). For example, listener judgements are difficult to calibrate as different listeners may fail to agree on the severity of the issue (Yorkston et al., 2010). Boone and colleagues (2013) explained that though clinicians can typically determine that there is a nasal quality about an individual's speech, few examiners are able to reliably differentiate between the degree and type of nasality by a speech sample alone. In addition, perception of certain sound elements may differ depending on loudness level, dialect, or the cause of velopharyngeal dysfunction (Yorkston et al., 2010). Kuehn (1982) also highlighted that there were no set standards for typical resonance patterns. Henningsson et al. (2008) developed a plan for determining speech outcomes for individuals of the cleft palate population that could be used internationally. Before this article was published, there had been multiple protocols written within the literature, but few that were standardized on a universal level. While this article is useful for the cleft palate population and protocols for reporting nasality may be modified for individuals with non-congenital resonance disorders, it is not a universal method for reporting speech outcomes of individuals with acquired forms of velopharyngeal dysfunction. Auditory-perceptual assessment for velopharyngeal dysfunction should be conducted prior to instrumental measures as a means to determine which instrumentation would be most suitable.

Instrumental visual assessment of AVPD. Once a speech-language pathologist documents auditory-perceptual evidence of velopharyngeal incompetence, instrumental measures can be employed to further evaluate the issue. Visualization of the pharynx and velopharyngeal valve can be accomplished via static and dynamic methods with the use of instrumentation to provide more quantitative and qualitative measures of velopharyngeal function (Conley et al., 1997; Lam et al., 2006). Instrumental assessment is typically done via endoscopy and/or radiographic instrumentation that either provides a still image or one in motion.

Endoscopic assessment. One of the most commonly used visual probe instruments employed in evaluating velopharyngeal closure is the endoscope. The oral endoscope (either flexible or rigid) is used by placing the body of the endoscope into the oral cavity, extending it just above the tongue, and placing the viewing tip where it lies below the uvula within the oropharynx (Boone et al., 2013). Oral endoscopy provides an inferior observation of the velum, while also viewing the lateral pharyngeal walls and the posterior pharynx (Boone et al, 2013). While the oral endoscope may be used, its main disadvantage is that the speech-language pathologist can only examine the client’s speech on single vowel, single consonant, or consonant-vowel combinations due to the fact that the endoscope invades the oral cavity and does not allow for proper articulation of connected speech (Boone et al., 2013). To evaluate connected speech samples and examine the velopharyngeal structure from a superior view, a flexible nasal fiberoptic endoscope (also known as nasoendoscopy or nasopharyngoscopy) is preferred. With regard to clinical terminology, published literature may discuss nasoendoscopy as visual evaluation of the anterior nasal cavity, while nasopharyngoscopy involves passing the scope further to visualize the pharyngeal walls (Watterson & Grames, 2014). The flexible endoscope is advanced through the nares into the posterior nasal cavity where the structure and function of the velopharyngeal port can be visualized, allowing the clinician to see the various degrees of velopharyngeal closure during conversational speech samples (Boone et al., 2013; Lowit & Kent, 2011). This dynamic assessment of velopharyngeal function is best conducted as the client produces standard words, phrases, or sentences filled with pressure consonants

(Mandulak, Baylis, & Thurmes, 2011). Examples of pressure consonant targets are listed in Table 4.

Table 4 *Consonant Sentence Targets*

Target Examples
1. Pass the pepper.
2. Give it here.
3. Fred carefully fed his calf.
4. Baby’s tub.
5. Terry took the top hat.
6. Chip reached for the teacher’s watch.
7. Give Kate the cake.
8. I see Suzy.
9. Take it out.
10. Pet the puppy.
11. Sixty, sixty, sixty, sixty.
12. Buy baby a bib.
13. Popeye plays in the pool.
14. I see the sun in the sky.
15. Zip up your zipper.

Adapted from Kummer, 2014; Shipley and McAfee, 2009.

Nasendoscopic assessment of velopharyngeal function has distinct advantages that include, but are not limited to, the ability to assess the velopharyngeal mechanism during connected speech and phoneme-specific contexts; to determine size, shape, cause, and location of the velar gap to determine client’s native velopharyngeal closure pattern (e.g., coronal or sphincter); to confirm and expand on client symptom reports (consistency of velopharyngeal closure, signs of obstructions, degree of velopharyngeal movement, etc.); to use as a visual feedback tool during intervention; to plan medical management; and to be used by a trained professional with minimal risks/limitations (Bettens, Wuyts, & Van Lierde, 2014; Bunton, Hoit, & Gallagher, 2011; Carding et al., 2008; Kummer, 2014; Lowit & Kent, 2011; Mandulak et al., 2011). Disadvantages of using a nasoendoscope as a visual assessment instrument include the possibility of low patient tolerance (very young children or individuals with cognitive impairment), health risks due to the intrusiveness of the procedure, presence of only one viewing angle, poor view of the length of the velum, and extra training required of the speech-language pathologist (Bettens et al., 2014; Carding et al., 2008; Kummer, 2014; Mandulak et al., 2011).

Multiview videofluoroscopy. An additional assessment method for visualization of the velopharyngeal structure and function includes multiview videofluoroscopy. Multiview videofluoroscopy provides a two-dimensional digital image of the client's velopharyngeal structure with concurrent audio recording as they produce standard phrases (Conley et al., 1997, Kummer, 2014). The speech-language pathologist is able to obtain images of the velopharyngeal mechanism from multiple viewpoints (e.g., lateral, frontal, basal), along with additional articulators, as the patient speaks in connected utterances such as syllable repetitions, counting, or sentences loaded with pressure consonants (Bettens et al., 2014; Kummer, 2014; Lam et al., 2006). It also views the entire length of the posterior pharyngeal wall and the length of the velum, which provides the clinician with a clear image of whether or not the velum is achieving adequate velopharyngeal contact (Kummer, 2014). The differential diagnosis of short velum versus a dynamic velum is a particularly important aspect of this instrumental assessment, as well as clinicians use established symbols on images to quantify elements of velopharyngeal function (Lam et al., 2006). Videofluoroscopy can play a critical role in planning clinical management for a patient with VPD (Bunton et al., 2011). Disadvantages of this approach include: reduction of three-dimensional anatomy to a two-dimensional image, exposure to radiation, compliance during the procedure for young children or cognitively impaired individuals, and presence of shadows on final images (Bettens et al., 2014; Kummer, 2014; Lipira et al., 2011; Silver et al., 2011).

Magnetic resonance imaging (MRI). Magnetic resonance imaging (MRI) is advancing as a beneficial mode of VPD assessment as it offers imaging of the soft tissue of the velum and pharynx, as well as activity of the levator veli palatini, with the absence of radiation and the presence of a two- or three-dimensional image of the structure (Conley et al., 1997; Haynes & Pindzola, 2012; Kummer, 2014). The multiple planes that MRI can view during assessment provide information regarding the length, movement, closure, and structure of the velopharyngeal mechanism. Also, advances in technology are being made to allow for MRI videos to be combined with auditory samples of phonation for a dynamic evaluation of speech and velopharyngeal function (Maturo et al., 2012). Limitations to using MRI for AVPD evaluation are the high cost of the equipment, difficulty assessing young children and individuals who are claustrophobic or cognitively impaired, and the static manner of the image (Bettens et al., 2014; Kummer, 2014; Silver et al., 2010).

Lateral cephalometric x-ray. Lateral cephalometric x-rays are typically used in a dentist, orthodontist, or oral surgeon office. These x-rays provide a still radiographic image that can be taken to evaluate the velum and surrounding structures during phonation (e.g., vowel production; prolonged /s/; Kummer, 2014). Through this imaging technique authorized professionals can measure the distances and angles that correspond between important landmarks in the oral cavity (e.g. hard palate, velum at rest, velum during phonation, posterior pharyngeal wall) via a static radiographic image of the cranium’s midsagittal plane (Kummer, 2014). This method of visualization is especially helpful in viewing the nasopharyngeal adenoid tissues to determine if structure is assisting or compromising adequate velopharyngeal closure, as well as it helps identify individuals that may be at risk for atypical speech following a nasopharyngeal surgical procedure (Wolford et al., 2012). Advantages of this approach include images that allow the clinician to see the patient's velum and corresponding structures, as well as the patient's cervical spine, cranial base, and features of the facial skeleton that may point to anomalies affecting velopharyngeal function. Disadvantages of this approach include limited view of only the midsagittal plane of the cranium, lack of evaluation of dynamic speech movement, exposure to radiation, difficult analysis, and poor detection of small openings due to poor velopharyngeal closure (Lowit & Kent, 2011).

Aerodynamic and acoustic assessment. Further assessment of velopharyngeal closure can be completed via aerodynamic and acoustic instrumentation. Aerodynamic measures involve measuring the levels of intraoral air pressure and nasal airflow that are emitted from the oral and nasal cavities during speech. Typical peak intraoral air pressures for speech production range from 4 to 12 cmH_2O, with higher rates of intraoral pressure when producing voiceless plosives (/pi/) compared to producing voiceless fricatives /fi/ (Arkebauer, Hixon, & Hardy, 1967; Johns, Rohrich, & Awada, 2003; Klusek, 2008; Subtelny, Worth, & Sakuda, 1966;). Measures of intraoral air pressure aid in confirmation of speech sound productions and affect perception of clear speech as pressures change according to the movement of the articulators (Klusek, 2008; Ruscello et al., 2016). For nasal airflow rates, studies have shown there is rarely evidence of nasal airflow when oral consonants are produced (Kummer, 2011a; Lubker, 1973; Lubker & Moll, 1965; Thompson & Hixon, 1979). However, even when velopharyngeal closure is complete, it is possible that a slight amount of air will escape through the nasal cavity when producing pressure consonants (Lubker, 1973; Lubker & Moll, 1965; Thompson & Hixon, 1979).

Aerodynamic measures can be assessed via the use of pressure transducers or pneumotachometers and accelerometers (Boone et al., 2013; Lowit & Kent, 2011; Yorkston et al., 2010). Estimations of the size of the velopharyngeal gap in the case of hypernasal resonance or the extent of airway obstruction in the case of hyponasal resonance can be achieved via aerodynamic instrumentation (Bunton et al., 2011; Kummer, 2014). The simultaneous measure of flow and pressure is converted into an electric signal that allows for comparisons of the data, as well as information regarding air leakage through the nose at inappropriate moments (Boone et al., 2013). Pneumotachometers assess nasal airflow during speech with the help of a nasal continuous positive airway pressure (CPAP) mask. This form of assessment correlates well with perceptual judgements of hypernasality. However, the mask may negatively impact speech activity due to lack of sensory feedback and restricted range of motion of certain articulators (e.g., lips), especially in the case of a full face mask (Bettens et al., 2014; Bunton et al., 2011; Dotevall, Ejnell, and Bake, 2001). Aerodynamic assessment may be difficult for young children or cognitively impaired individuals (Bunton et al., 2011). Due to the cumbersome nature of placing a large mask on clients for aerodynamic measures, research has been evaluating other methods of detecting pressure change. Bunton and colleagues (2011) found success with a nasal ram pressure (N-RamP) method of assessment, where a two-pronged nasal cannula connected to a pressure transducer is inserted into the nares of the patient and a microphone is taped to forehead of the patient to gather acoustic signal. With the N-RamP method, researchers believe that negative pressures reveal nasal inspiration, positive pressures reveal nasal expiration, and neutral pressure (zero) reveals no airflow. This method is advantageous as it can determine when the velopharynx is open during speech, and movements of the head during data collection do not compromise the signal as they often due with a face mask approach (Bunton et al., 2011).

The Nasometer (PENTAX Medical, Montvale, NJ) is an acoustic instrument used to evaluate the ratio of nasal acoustic energy to total oral-nasal acoustic energy, called nasalance.

By using a Nasometer, the speech-language pathologist can collect measures of oral-to-nasal acoustic energy that are present during a client's connected speech sample (Boone et al., 2013). The Nasometer places a microphone near the nasal cavity and one near the oral cavity through placement on a baffle plate that rests on the face between these two regions (Lowit & Kent, 2011). The microphones will then collect data regarding oral and nasal sound intensities that will be posted as visual feedback on a computer screen (Boone et al., 2013). The oral and nasal acoustic values measured will be converted into a nasalance score that can range from 0 to 100% (Bettens et al., 2014; Lowit & Kent, 2011). Standardized CV repetition, carrier phrases, and reading passages are available for use in order for scores to be compared to normative data for purposes of evaluation (Kummer, 2014). In general, nasalance scores less than of 26% are perceived by the listener as balanced resonance, scores between 30 and 40% are considered mild hypernasality, and scores above 40% are considered significantly hypernasal (Smith & Kuehn, 2007). Use of the Nasometer has typically proved beneficial because it is non-invasive, is relatively easy to interpret, has good reliability, and is a possible method of biofeedback in treatment (Bettens et al., 2014; Watterson & Lewis, 2006). However, due to different methods and cutoff criteria, it is often difficult to compare sensitivity and specificity across results (Bettens et al., 2014; Brancamp, Lewis, & Watterson, 2010; Watterson, Lewis, & Deutsch, 1998). Both the aerodynamic and the acoustic procedures are important assessment measures that can be used as biofeedback and progress tools in treatment.

Determination of Clinical Pathway for Patients with AVPD

The American Speech-Language-Hearing Association (ASHA; 2004) indicated that intervention is to be provided by a certified and trained speech-language pathologist for individuals that are diagnosed with velopharyngeal dysfunction and resonance disorders.

Treatment should aim to improve intelligibility, collaborate with an interdisciplinary team, and increase the client's participation in activities that will improve his/her quality of life (ASHA, 2004). Implications for treatment are dependent on many factors: the etiology, the extent of the client's velopharyngeal dysfunction, other concomitant health conditions, local or regional resources, family support, and client motivation to name a few. A clinical pathway can be sorted into three categories: behavioral intervention, surgical intervention, or prosthetic intervention. These three categories can be used individually or in combination and are further explained below.

Behavioral intervention. Determining candidacy for behavioral intervention is an important component of the assessment process. Speech therapy is typically employed in cases where individuals show evidence of mild or mild-moderate velopharyngeal dysfunction due to atypical function and evidence of stimulability for improved intelligibility during the assessment. Table 5 lists possible indications for optimal use of behavioral intervention strategies when treating patients with AVPD. It is important to note that speech therapy is generally recommended when the cause of hypernasality, nasal emission, etc. is not due to abnormal structure, but rather is due to inadequate velopharyngeal articulation (Kummer, 2011c). Peña-Brooks and Hegde (2007) indicated that if an individual cannot physically achieve velopharyngeal closure independently, the speech-pathologist's efforts to treat hypernasality or nasal emission through articulation or resonance therapy may be unsuccessful.

Behavioral intervention strategies may include tasks such as slowing rate of speech, over-articulation strategies, traditional motor learning of errored phonemes, and altering effort of speech (Kummer, 2014; Yorkston et al., 2001). Resistance training to strengthen the velopharynx has been implemented using continuous positive airway pressure (CPAP) while imitating words and phrases loaded with vowels, nasals, and obstruents (Kollara, Schenck, & Perry, 2014; Kuehn, Moon, & Folkins, 1993; Kuehn et al., 2002; Yorkston et al., 2001). Feedback to assist in monitoring correct phoneme productions may be implemented. Examples of feedback include visual (e.g., nasometer, mirror test, See Scape), tactile (e.g., gestural cues, feeling air flow on side of nose), and auditory (e.g., tape recording, listening tube) methods. Use of non-speech oral motor exercises such as blowing, sucking, gagging, etc. have controversial research support. Due to the lack of speech specificity, non-speech oral motor exercises are not generally recommended in behavioral intervention, although a rationale exists for cases of substantial weakness (Kummer, 2014; Lof, 2003; Yorkston et al., 2001).

If the clinician is uncertain as to whether or not their patient can structurally/functionally achieve velopharyngeal closure, Air, Wood, and Neils (1989) recommended that speech-language pathologists' conduct a trial period of behavioral intervention to determine the therapy's level of effectiveness. Periods of trial intervention for velopharyngeal dysfunction are usually limited to a length of 3 months or less in order to determine if the intervention was or was not sufficient in alleviating the evidence VPD (Peña-Brooks & Hegde, 2007). However, it is noted that speech therapy can be used in isolation as a treatment method, before or after the implementation of surgical or prosthetic intervention, or as a complementary method alongside another treatment procedure (Hirschberg, 1986; Kummer, 2011a; Marsh, 2003). Overall, as long as progress occurs, the patient should remain in speech therapy (Kummer, 2011c). If progress is limited, the patient may need to be referred for further evaluation in order to consider the benefit of surgical or prosthetic intervention (Kummer & Lee, 1996).

Table 5 *Possible Indications for Use of Behavioral Intervention for Patients with AVPD*

Possible Indications
1. The client does not have velopharyngeal insufficiency due to surgical or other acquired cause that results in inability of the velum and/or pharynx to achieve adequate closure between the oral and nasal cavities. [c, e, f]
2. The client is cognitively and medically stable to attend to directions, implement suggested strategies, comprehend communication, etc.
3. The client is taking part in surgical or prosthetic intervention that requires implementation of articulatory or behavioral strategies in order to communicate with increased intelligibility and efficiency. [c]
4. The client does not have a progressive neuromotor disorder (e.g., amyotrophic lateral sclerosis; dysarthria), characterized by weakening musculature over time, poor prognosis for coordinated speech movements, and a decline in productivity of behavioral intervention strategies. [a, b, e]
5. The client's degree of nasality is due to inadequate posture of the velopharyngeal mechanism, requiring the implementation of articulatory strategies into the client's daily routine. [c, d]
6. The client has a mild degree of velopharyngeal dysfunction. [b, f]
7. The client is motivated and has good caregiver support.

Adapted from [a]Duffy, 2013; [b]Dworkin and Johns, 1980; [c]Kummer, 2014; [d]Marsh, 2003; [e]Noll, 1982; [f]Yorkston et al., 2010

Surgical intervention. Surgical intervention may be appropriate when there is a structural deficit in the velopharyngeal mechanism (Woo, 2012) or when the client has a stable neurological disorder causing AVPD. Table 6 lists possible indications for the optimal use of surgical intervention when treating patients with AVPD. Particular surgical treatment methods include pharyngeal flap, unilateral/bilateral sphincter pharyngoplasty, and posterior pharyngeal wall injections. The choice of surgical procedure may be a matter of surgeon preference for one surgical procedure over the other. Some surgeons are trained in both procedures and will match the procedure to the native closure pattern of the individual's velopharyngeal port. Surgical intervention may be considered when the AVPD is persistent and of moderate to profound severity, there are anatomical deficits in the velopharyngeal structure, and/or there is a poor prognosis for improvement via speech therapy (Hirschberg, 1986; Hirschberg, 2012; Marsh, 2003). The decision to pursue surgical management of AVPD is best made with a team approach that includes input from both the speech language pathologist and the surgeon.

Table 6 *Possible Indications for Use of Surgical Intervention for Patients with AVPD*

Possible Indications
1. The client has hypernasal resonance that is moderate-profound, too severe to benefit from speech therapy.
2. The client does not have any other medical conditions that label him/her as inoperable, or if he/she does they have been stabilized to the point that the surgical risk is minimal (e.g., heart disease; severe respiratory distress; unstable upper airway). [d]
3. The client has an acquired structural impairment that negatively impacts adequate velopharyngeal closure. [d, f]
4. The client has a neurological deficit that is stable enough for the surgical procedure to be beneficial and of minimal risk. [a, c, d, e]
5. The client has no association with the following conditions: significant airway obstruction, progressive neurological condition, significant cognitive disability, severe hearing loss, previous oropharyngeal radiation, bleeding disorder, medialized carotid artery in the pharyngeal wall. [a, b, c, d]
6. The client has good caregiver support. [d]
7. The client demonstrates low teachability and no success with speech therapy over a trial period. [b]

Adapted from [a]Duffy, 2013; [b]Hirschberg, 2012; [c]Kummer, 2014; [d]Marsh, 2003; [e]Noll, 1982; [f]Woo, 2012.

Prosthetic intervention. Prosthetic interventions are typically associated with structural or neurological deficits in the velopharyngeal mechanism. The use of a prosthetic device, typically a palatal lift or an obturator, will allow assistance in velopharyngeal closure, especially in instances where the velum is too short for proper closure (obturator) or there is motoric weakness in the velum or pharynx (palatal lift) that does not allow for adequate function (Marsh, 2003; Noll, 1982; Woo, 2012; Yorkston et al., 2010). Table 7 lists possible indications for the optimal use of prosthetic intervention when treating patients with acquired velopharyngeal dysfunction.

An oral obturator is a prosthetic device that is typically recommended for individuals who have a deficiency in their anatomy due to tumor resection or traumatic injury to the palate. It consists of an acrylic or metal plate that covers the palate and accommodates for the lack of anatomical structure. Nasal obturators are inserted into the nares to occlude the cavity and reduce the amount of air exiting the nasal cavity inappropriately (Yorkston et al., 2010). Obturators can be used as a short-term or a long-term treatment device (Woo, 2012). Oral obturators can be permanently fixed in place or can be removed during meals to improve deglutition. Obturators can also be removed prior to rest to prevent obstruction during sleep.

In comparison, the prosthetic device known as the palatal lift is generally optimal for individuals that cannot achieve velopharyngeal closure due to poor mobility of the velopharyngeal mechanism despite adequate length of the velum (Woo, 2012). The palatal lift consists of an oral component for stabilization and a pharyngeal component that extends into the oropharynx to displace the velum for compensatory function. Because they are generally removable, palatal lifts are appropriate for both short and long-term use. Yorkston and colleagues (2001) conducted a literature review of intervention studies and found that most reports of palatal lift intervention for individuals with dysarthria were positive, with results of improved resonance, articulation, and intelligibility.

Regarding AVPD, clients with muscular weakness due to dysarthria may be able to achieve proper velopharyngeal closure with the help of a prosthetic device (Duffy, 2013; Yorkston et al., 2001; Yorkston et al., 2010). A prosthetic device is removable, and its structure allows for a main component to extend into the pharynx in order to allow for separation of the oropharynx and nasopharynx when needed to balance the acts of the velopharyngeal sphincter (Bohle et al., 2005). The use of a palatal lift, obturator, or palatal training device has proved useful for clients that demonstrate a consistent inability to achieve velopharyngeal closure, whether used as the sole source when no other treatment procedure is implemented or when used as a temporary method alongside speech therapy or other management options (Sell, Mars, & Worrell, 2006; Yorkston et al., 2010). The use of prostheses are helpful for individuals who are medically unstable for surgery, yet still have a good prognosis for benefiting from treatment. This form of physical management is typically a more successful treatment method than speech therapy in cases of acquired neurophysiological deficits that result in significant velopharyngeal dysfunction (Duffy, 2013; Kummer et al., 2015).

Table 7 *Possible Indications for Use of Prosthetic Intervention for Patients with AVPD*

Possible Indications
1. The client is unstable and has additional medical conditions (e.g., heart disease) that would make surgery dangerous as a method of treatment. [c, e, f]
2. The client has a neurological condition that is stable. [h]
3. The client has a neurological condition that is unstable (progressing slowly), indicating that surgery would be an unsuitable form of treatment for velopharyngeal dysfunction. [c, e, f, h, i]
4. The client has a structural deficit due to surgery or additional acquired cause, or he/she has a neuromotor deficit affecting proper closure of the velopharyngeal port. [d, g, h]
5. The client is cognitively stable, has adequate manual dexterity, or has an effective care provider present in order to implement the use of the prosthetic device appropriately and consistently into his/her daily routine. [a, c, e, i]
6. The client has the appropriate anatomical structure and secondary function available in order to attach the prosthetic device to the client's teeth, gums, dental appliance, and/or hard/soft palate and to use it properly (e.g., good prognosis for velar/pharyngeal movement). [a, i]
7. The client has no evidence of sensory intolerance for the prosthesis to be in his/her mouth (e.g., no evidence of high gag reflex; no evidence of sensory processing disorder, etc.). [a, b, i]
8. The client's degree of velopharyngeal dysfunction is consistent and the error is relatively isolated (when a client has an etiology that results in a dynamic condition or there are multiple speech errors accompanying the evidence of velopharyngeal dysfunction, the client will have to be seen for multiple follow-up appointments to make sure the prosthetic device is serving the client properly). [b, h, i]
9. The client is able to voluntarily participate in phonation. [b, h]
10. The client's VP mechanism is weak, with limited spasticity. [h, i]

Adapted from [a]Duffy, 2013; [b]Dworkin and Johns, 1980; [c]Kummer, 2014; [d]Kummer et al., 2015; [e]Marsh, 2003; [f]Purcell and Sie, 2013; [g]Woo, 2012; [h]Yorkston et al., 2001; [i]Yorkston et al., 2010.

Skill Set Required for Speech-Language Pathologists Working With the AVPD Population

Given the complexity and heterogeneity of this population, it is clear that a speech-language pathologist's skill set must be extensive. An SLP should take part in additional training and experience before using instruments such as an endoscope or Nasometer (Watterson & Grames, 2014). They must gain experience in the auditory-perceptual task of evaluating resonant qualities of adequate, hypernasal, and hyponasal speech. This may be done through undergraduate or graduate curriculum, or via continuing education courses and training conferences. The American Speech-Language-Hearing Association (ASHA; 2012) requires that graduate programs implement training that will allow students to acquire and demonstrate knowledge regarding the etiologies, anatomy/physiology, cultural correlates, and characteristics (acoustic, psychological, developmental, linguistic) of voice and resonance. A 16-item survey was developed from Pannbacker, Lass, and Stout (1990) to determine the characteristics of practicing speech-language pathologists in assessing and treating individuals with velopharyngeal insufficiency (VPI). This survey also described where clinicians received VPI training. Results indicated that out of 173 speech-language pathologists, over half (53.8%) received experience with VPI training at the undergraduate level, 96% received VPI training at the graduate level, and 86.7% received additional training via continuing education sources (data did not reflect the respondents' highest degree of instruction). As advances in the field continue to be made, clinicians must continue taking the necessary actions to be qualified to assess and treat individuals with AVPD.

Degrees of education, training, clinical experience, abilities, and proficiency will vary among speech-language pathologists. For instance, results from the above mentioned survey also found that more than 40% of respondents had been practicing in the field of speech-language pathology for over 20 years, while 40% had been practicing for only 11-20 years (Pannbacker et al., 1990). Clinical experience varied among participants as 44% of practicing speech-language pathologists treated less than 25 patients with VPI on a yearly basis, and approximately 20% had advanced experience with this population by treating more than 100 patients each year (Pannbacker et al., 1990). However, it is the responsibility of all SLPs to provide competent services to clients based on their post-baccalaureate degree and continued education training as they remain up-to-date on the continuously developing profession. When treating a client with

AVPD, speech-language pathologists should determine if their level of experience via education, clinical practice, and continuing education courses is competent and specialized enough to provide adequate services regarding assessment and behavioral intervention (ASHA, 2007).

Schneider and Shprintzen (1980) conducted a survey to evaluate the multidisciplinary team approach used in treating individuals with velopharyngeal inadequacy and cleft. In this survey, information was gathered regarding evaluation and treatment procedures, as well as the educational background of speech-language pathologists who were involved in managing velopharyngeal inadequacy. Results from 592 returned questionnaires revealed that 54% of the responding population no longer implemented the same procedures that they were taught in their educational training (Schneider & Shprintzen, 1980). In a later report, Shprintzen (1995) stated that the variation in training based on institutions, personnel, and more had an effect on the evaluation and treatment methods/recommendations that speech-language pathologists were implementing. Watterson & Grames (2014) discussed how staying up-to-date with current literature is important for organizing evaluation and intervention protocols, interpreting clinical characteristics, and rationalizing clinical decisions. If clinicians are failing to educate themselves on the most current principles, education and training programs may be compromised (Watterson & Grames, 2014). Overall, it is clear to see that over the years and across various training methods, advances in the field cause certain methods to become outdated and no longer accepted when treating the AVPD population.

In a response to the work of Dixon-Wood, Williams, & Seagle (1991) discussing the acceptance of speech-language pathologist’s recommendations in treatment for velopharyngeal insufficiency, Cohn (1991) pointed out that graduate training programs often do not provide the in-depth, specialized training that SLPs need to provide adequate clinical management for individuals with AVPD. For instance, learning the protocols for videofluoroscopic and nasoendoscopic instrumentation is advanced and the hands-on training is typically not taught in graduate curriculum. Therefore, if the SLP does not have this experience, it may not be suitable to place him/her in the position to provide sole professional care.

Various studies have indicated that SLP training in both undergraduate and graduate curriculum does not meet the standards needed to treat and assess individuals with velopharyngeal dysfunction, whether this is based on lack of instrumental knowledge, perceptual training, or quality experience (Pannbacker, 2004; Strauss, 1998, Watterson & Grames, 2014). With inadequate training comes a higher risk that speech-language pathologists will make inappropriate decisions regarding AVPD diagnostic and intervention recommendations, affecting the overall quality of care for the patient (Pannbacker, 2004; Watterson & Grames, 2014). Pannbacker (2004) discussed how speech-language pathologists' provision in assessing and treating velopharyngeal dysfunction may range from poor to excellent depending on educational and clinical experience. Therefore, she recommended that speech-language pathologists remain up-to-date on current knowledge and methodology regarding VPD patient care through continuing education courses, professional assemblies, and literature reviews (Pannbacker, 2004). However, Mandulak & Baylis (2014) discussed how not only are the academic programs training our upcoming clinicians lacking in methods of preparation, but training opportunities for current practicing clinicians seeking to develop expertise in the area of VPD need advanced guidelines as well.

Pannbacker (2004) highlighted how a set of skills must be established for speech-language pathologists in order to determine competency for providing VPD services. Watterson & Grames (2014) proposed a draft of a necessary skill set for evaluating velopharyngeal dysfunction to members of Special Interest Group 5 (Craniofacial and Velopharyngeal Disorders). Mandulak & Baylis (2014) also developed examples of goals and objectives for clinicians to have in mind during periods of training to ensure clinical competency for evaluation and management of VPD. Though these were not validated guides, they are clear examples of the extensive education, training, and skill set that should be established as the foundation for providing adequate care to patients with velopharyngeal dysfunction. Also, the fact that there is not a standardized, published document concerning the knowledge and skills necessary for SLPs to guide evaluation and management of VPD may be a hindrance to the consistency of knowledge across education programs and the lack of preparedness of practicing clinicians following training (Mandulak & Baylis, 2014; Watterson & Grames, 2014).

Self-Efficacy of Speech-Language Pathologists

While level of training affects a clinician's skill set, it also plays a role in the speech-language pathologist providing adequate clinical services to patients (ASHA, 2010) within the AVPD population. For instance, as indicated by ASHA's standards, post-baccalaureate training and continuing education courses are necessary to stay up-to-date with the dynamic nature of the field of communication disorders. If the clinician lacks the experience to competently assess and treat the client with AVPD, then the clinician is obligated to refer the client to another service provider with the necessary skillset. However, what if a speech-language pathologist does not have adequate training to provide sufficient services to a client? There are additional factors that play a role in the clinician's provision of services.

Self-efficacy is a social-cognitive theory that refers to how successfully an individual believes he/she can perform a task based on his/her abilities (Gillespie & Abbott, 2011). Self-efficacy theory is indicative of how confident individuals are in their performance (not their luck or self-worth), as well as the diverse sources of information that can affect their behavior (Bandura, 1977; Bandura, 2006; Sherer et al., 1982). Bandura (1977) asserted that this theory is powerful because an individual's personal perception of self-efficacy will determine if he/she decides to perform the task, how much effort he/she will put into it, the expected level of success to come from his/her performance, and if he/she will persevere to complete the task based on its degree of difficulty. In fact, self-efficacy is thought to be a more potent predictor of behavior than an individual's expectations of performance or his/her past performances (though these continue to play a role in successful task completion), and it will likely result in more over carry to other areas of behavior (Bandura, 1977). Overall, an individual must believe that he/she can perform a task before any change in behavior or performance can be indicated, as well as personal variances will result in differences of general self-efficacy and expectations of mastery in novel situations (Betz, 2007; Sherer et al., 1982).

Self-efficacy is not a global, all-purpose measure (Bandura, 2006). Rather, self-efficacy is conditional and individual-specific, dependent on factors such as level of training, past experiences, support, work environment, perceived self-worth, and more. Perceived self-efficacy, known as the judgement of capability to perform a task, affects human functioning in that it impacts direct behavior as well as secondary areas of conduct such as goals, opportunities, outcome expectations, etc. (Bandura, 2006). Bandura (2006) indicated that performance of tasks or behaviors is affected by the degree of challenge the task presents. Therefore, the stronger the individual's level of self-efficacy, the greater his/her perseverance regarding difficult tasks and the higher the possibility that the task/behavior will be completed successfully (Bandura, 2006). When speech-language pathologists increase their degree of self-efficacy, they will generally provide more competent, well-rounded services.

Just as self-efficacy is not a set standard for an entire population, speech-language pathologists are all individuals in their varying areas of interest, levels of training, degrees of experience, and more. Perceived self-efficacy measures will vary from clinician to clinician; however, the overall target is for speech-language pathologists to have enough training, mentoring, resources, and self-confidence to demonstrate strong self-efficacy behaviors in order to competently assess and treat referred clients. Overall, establishing a strong sense of self-efficacy is important for speech-language pathologists because low levels of efficacy may cause clinicians to develop negative behaviors, poor clinical techniques, and inadequate service provision, which could result in evaluation of ethical performance and standards in accordance to the American Speech-Language-Hearing Association's Code of Ethics (ASHA, 2010). Currently, the literature lacks studies that highlight how self-efficacy of practicing clinicians affects the service provision for patients with AVPD. However, general knowledge with regard to the theoretical construct of self-efficacy can be adapted for relation to this population. Treating individuals without proper training or with false efficacy may affect the clinician and the client ethically, financially, and/or clinically. Therefore, it is vital for clinicians to receive sufficient experience to develop a strong sense of self-efficacy and confidence to effectively serve clients with AVPD. If the clinician is not efficacious in their assessment and treatment protocols for this population, he/she should find experienced resources that can be used as a point of referral for clients with this condition.

Individuals establish and train self-efficacy beliefs based on four sources of information: mastery experience, vicarious experience, verbal persuasion, and physiological/affective state (Bandura, 1977). Mastery experience refers to when individuals determine their capabilities based on directly performing the desired behavior or task. Determining self-efficacy through mastery experience requires the individual to perform the task, monitor his/her performance, and develop his/her own beliefs about personal self-efficacy regarding the task (Smith & West, 2006). Individuals who implement mastery experiences as a source of increasing their self-efficacy beliefs tend to attribute failure to strategy rather than poor abilities (Smith & West, 2006). A review of empirical studies has found that mastery experience is the most powerful of the four sources of information in enhancing self-efficacy, especially in students (van Dinther, Dochy, & Segers, 2011). To implement self-efficacy growth using mastery experiences, the clinician will need to take part in extensive practice (van der Bijl & Shortridge-Baggett, 2001; van Dinther et al., 2011). Since tasks are made up of multiple skills that have to be mastered, the goal is for the clinician to practice therapy techniques that are easy, and then target more complex methods as he/she masters the targeted concepts until the entire task is learned. The clinician can also strive to set goals for mastery and skill learning, increasing his/her motivation through the self-efficacy process (Bandura, 1977; Smith & West, 2006; van Dinther et al., 2011).

The second form of self-efficacy information is vicarious experience, where an individual's beliefs about his/her abilities are based on the observations of other people (Smith & West, 2006; van Dinther et al., 2011). When implementing strategies of vicarious experiences, the individual compares his/her capabilities to those of another person that models the targeted behavior or task. To increase self-efficacy beliefs based off of this method, the clinician will want to evaluate the performance of multiple peers that are considered as equals (e.g., same age, gender, profession, etc.; Smith & West, 2006). Clinicians can observe the model as he/she performs the selected task and then imagine how they would implement it, what changes they would make, what potential problems may arise, etc. in order to determine their ability to perform the behavior.

Next, verbal persuasion is another factor used to increase self-efficacy beliefs and it involves words of affirmation. Verbal persuasion encompasses a person hearing that he/she has the capabilities to complete a task from a reliable, loyal, knowledgeable source (Shortridge-Baggett, 2001; van Dinther et al., 2011). Individuals that find their self-efficacy beliefs to be increased from acts of verbal persuasion typically work harder and set higher goals for themselves (Bandura, 1977; Smith & West, 2006). To increase self-efficacy beliefs using methods of verbal persuasion a clinician should surround themselves with supportive influences that will supply them with positive, realistic feedback.

Lastly, physiological and affective states are a source of self-efficacy that involves judging performance based off of the body's physiological and emotional reactions (Smith & West, 2006). If an individual completes a task well, it is expected that the body will respond with positive reactions, rather than anxiety, nervousness, regret, or anger (Smith & West, 2006). When an individual has positive emotional states after completing a task, he/she associates it with higher self-efficacy beliefs (Smith & West, 2006; van Dinther et al., 2011). Clinicians can implement methods to enhance their self-efficacy appraisals, such as determining why a negative emotion occurred, taking breaks when participating in difficult tasks, completing tasks in a calm/comfortable atmosphere, and allowing sufficient time to complete a task (Smith & West, 2006). These four sources along with their methods and strategies can be implemented on an individual clinician basis to increase degree of performance in assessment and management of individuals with acquired velopharyngeal dysfunction, as well as they can be taught and shared with clients to enhance their self-efficacy beliefs regarding recovery and abilities in therapy.

Based on this review of the literature, it is clear that methods of assessment and determination of the clinical pathway for AVPD are highly specialized. A vital part of the assessment is determination of the etiology and any co-occurring health conditions that may influence clinical management of the condition. The majority of the literature that addresses VPD focuses on individuals of the cleft palate population. While there are resources regarding assessment for patients with AVPD, the sources and consensus regarding these strategies are limited. Overall, there is a gap in the clinical literature regarding specialized assessment for individuals with AVPD, as evidenced by the limited variety of scholarly articles for this population, as well as the restricted portions within textbooks that train our current and up-and-coming speech-language pathologists. Also, SLPs must have the necessary training and self-efficacy to properly assess and manage clients of this population. Therefore, there is a need to further analyze current clinical protocols, training, and self-efficacy of practicing clinicians when working with AVPD. Evaluating these factors will aid in determining up-to-date evidence-based clinical recommendations and areas of future supplemental knowledge and skill within the field with regard to AVPD.

Chapter 3

Manuscript:
Acquired Velopharyngeal Dysfunction Assessment: Speech Language Pathologists' Perceived Competence and Proposed Clinical Guideline

Introduction

Velopharyngeal Dysfunction (VPD) is an umbrella term that characterizes a nasal resonance disorder in which the velopharyngeal valve functions inadequately and causes errors in closure between the oral cavity and the nasal cavity (Kummer, Marshall, & Wilson, 2015). VPD is most commonly associated with congenital structural disorders, such as cleft palate or submucous cleft palate. Most published research has focused assessment and treatment pathways on the cleft palate population. VPD that is unrelated to congenital craniofacial disorders or neuromuscular disorders diagnosed at birth is generally referred to as acquired velopharyngeal dysfunction (AVPD). Fewer evidence-based resources are available to guide assessment and clinical management of AVPD. Literature regarding congenital velopharyngeal dysfunction is being applied to patients of the acquired population, despite the fact that AVPD is distinct in many ways including, but not limited to, psychosocial and vocational aspects of a change in functional communication after having prior experience with intact speech and resonance (Blood & Hyman, 1977; Lallh & Rochet, 2000; McKinnon, Hess, & Landry, 1986; Schilly, 1987; Van Denmark & Van Denmark, 1970). This distinction may require different clinical decisions when determining the most appropriate assessment and clinical management protocols. This gap within the literature calls these considerations into question when determining a management plan for patients with AVPD.

Individuals with AVPD have prior auditory-perceptual and proprioceptive awareness of how speech sounds and feels when resonance is balanced and articulation is precise. This prior experience with competent communication skills may impact the patient's perception of impairment severity as individuals are faced with new psychosocial, emotional, and vocational aspects of this resonance disorder. Hypernasality and nasal emission due to VPD are often associated with an intellectual deficit and uncomfortable listener reactions (Lallh & Rochet, 2000; Schilly, 1987). Studies have shown that children and adults alike respond adversely to individuals with speech sound disorders such as hypernasality, indicating that the impaired speech made the speakers appear of less worth and made the listeners feel anxious (Blood & Hyman, 1977; McKinnon, Hess, & Landry, 1986; Van Demark & Van Demark, 1970). Patients with acquired velopharyngeal dysfunction (AVPD) are affected by these consequences similarly to individuals with congenital VPD socially, emotionally, and vocationally as speech partners often ignore them, become impatient or uncomfortable with their speech, and/or make insensitive comments with regard to how they talk (Lallh & Rochet, 2000; Schilly, 1987; Van Demark & Van Demark, 1970). However, the difference between AVPD and congenital VPD lies in the way perceptual characteristics are interpreted. The need for specialized counseling and support for clients with AVPD who have knowledge of typical speech and resonance differs from the assistance that is needed for the congenital population, as they have no prior experience with typical speech and resonance.

Acquired velopharyngeal dysfunction etiologies. Hirschberg (1986) reported that AVPD was the result of a structural disorder in three-fourths of cases where overt cleft palate was absent, while paresis or a neurogenic disorder accounted for one-fourth of AVPD cases. Neurological causes of AVPD may be reflective of damage to the central nervous system such as traumatic brain injury (TBI), cerebral vascular accident (CVA), aneurysm, and/or trauma that impacts areas of motor planning and control (e.g., premotor cortex, motor cortex, or insula of the dominant cerebral hemisphere; control circuits) and motor performance (lower motor neurons; Duffy, 2013; Kummer et al., 2015). Also, acquired neurological or neuromuscular disorders that affect the peripheral nervous system and/or the central nervous system result in various effects on speech due to difficulties executing and planning activities of motoric function, resulting in disorders such as dysarthria or apraxia of speech (Altman et al., 2007). In fact, four of the seven classifications of dysarthria, (spastic, flaccid, unilateral upper motor neuron, and mixed) are typically characterized by evidence of nasality (Brookshire, 2003; Darley, Aronson, & Brown, 1975; Duffy, 2013; Dworkin, Marunick, & Krouse, 2004; Freed, 2012). Velopharyngeal incompetence (i.e., lack of VP strength and range of motion with adequate structure) and velopharyngeal incoordination (i.e., inconsistent errors with adequate VP strength, range of motion, and structure) are two terms additionally used in regard to neurological etiologies affecting closure of the velopharyngeal mechanism.

Iatrogenic and structural causes of AVPD discussed in the literature include adenoidectomy/atrophy (Conley, Gosain, Marks, & Larson, 1997; Fernandes, Grobbelaar, Hudson, & Lentin, 1996; Khami, Tan, Glicksman, and Husein, 2015; MacKenzie-Stepner, Witzel, Stringer, & Laskin, 1987; Ren, Isberg, & Henningsson, 1995), hypertrophic tonsils (Gibb & Stewart, 1975; Kummer, 2011d; Kummer, Billmire, & Myer, 1993), maxillary advancement (Kummer et al., 2015; McCarthy, Coccaro, & Schwartz, 1979), uvulopalatopharyngoplasty (Franklin et al., 2009; Katsantonis, Friedman, Krebs, & Walsh, 1987), tumor (resection/radiation;

Kummer, 2011c; Lazarus et al., 2000; Murphy & Gilbert, 2009), and trauma. Additional etiologies of AVPD may include acquired hearing loss (Hassan et al., 2012) or use of inhaled drugs (Alexander, Alexander, & Valentino, 2012; Greene, 2005). Velopharyngeal insufficiency a term highlighted in the literature with regard to deficits in VP structure that impact adequate closure. Refer to Table 1 on page 13 of this thesis for a further breakdown of the acquired forms of velopharyngeal dysfunction discussed in the literature.

Assessment methods. There are multiple methods for evaluating and treating patients with acquired velopharyngeal dysfunction (AVPD), each with its own justification and rationale according to the client's etiology and co-occurring characteristics. When speech-language pathologists assess a client with suspected AVPD, the goals of the assessment process are to characterize the extent and severity of the disorder, determine if behavioral intervention is warranted/sufficient, and decide if speech therapy is recommended in combination with medical interventions (Shipley & McAfee, 2009). In general, the diagnostic plan should include review of a detailed case history; analysis of cognitive, motor, visual, and auditory status; implementation of perceptual and instrumental measures (e.g., standardized perceptual measures, videofluoroscopy, nasoendoscopy, aerodynamic measures, nasometry); and evaluation of articulatory structure and function related to impaired velopharyngeal function (ASHA, 2004; Shipley & McAfee, 2009).

Case history and evaluation of oral-motor structure/function. A detailed case history should query the extent of the patient's problem, what previous treatment or consultations they have encountered, past medical histories, as well as statements regarding the patient's concerns in order to guide clinical management. In addition, an oral mechanism examination will gather initial observations of the client's articulators, facial structures, and resonance characteristics

(Buckendorf & Gordon, 2002; Duffy, 2013). However, due to velopharyngeal closure being out of sight, AVPD cannot be diagnosed from the oral view alone during an oral mechanism/oral motor examination (Boone, McFarlane, Von Berg, & Zraick, 2013). Therefore, additional instrumental assessment is recommended in order to gain a complete diagnostic impression.

Perceptual measures. Auditory-perceptual assessment of a client's speech is the most commonly used diagnostic procedure and is recommended as the first method of all VPD evaluations to determine which additional assessment protocols are warranted (Kummer, 2011b; Pannbacker et al., 1984). While auditory-perceptual evaluation is typically the initial step in determining a problem with velopharyngeal function, verifying degree and type of nasality by speech sample alone is difficult as there are currently no set standards for typical resonance patterns (Boone et al., 2013; Kuehn, 1982; Yorkston, Beukelman, Strand, & Hakel, 2010).

To determine if the patient demonstrates evidence of hypernasality, hyponasality, imbalanced nasal resonance, or nasal emission, any of the following practices may be implemented: pinching the client's nose during connected speech samples/vowel productions to listen for resonance change, using a plastic "listening" tube (one open end placed at the nares & one open end placed at the ear canal) to auditorally perceive leakage of air through the nose on oral phonemes/vowels, reading sentences loaded with certain pressure consonants (e.g., voiceless high pressure consonants such as /s/ require substantial build-up of oral pressure and airflow), asking the client to hold air in his/her mouth while keeping the cheeks puffed out (may also add tongue protrusion) to hear leakage of air through nasal cavity and determine if the client compensates velar weakness with use of the dorsum/root of tongue, administering standardized articulation tests to quantify perceptual results (e.g., Iowa Pressure Articulation Test or Bzoch Error Patterns Diagnostic Articulation Test; Bzoch, 1979; Demark, Kuehn, & Tharp, 1975;

Garrett & Deal, 2002; Kempster, Gerratt, Abbott, Barkmeier-Kraemer, & Hillman, 2009; Kummer & Lee, 1996; McWilliams &Philips, 1979; Morris, Spriesterbach, & Darley,1961; Purcell & Sie, 2013; Templin & Darley, 1969).

Instrumental measures. Visualization of the velopharyngeal valve can be accomplished via static and dynamic methods with the use of instrumentation to provide more quantitative and qualitative measures of velopharyngeal function (Conley et al., 1997; Lam et al., 2006). Table 8 highlights the advantages and disadvantages of these instrumental assessment methods.

Table 8 *Advantages and Disadvantages of Visual Instrumentation*

Method of Instrumentation	Advantages	Disadvantages
1) Nasal Endoscope [a, b, c,, f, i, j]	▪ Evaluates connected speech. ▪ Provides superior view of the velum. ▪ Provides dynamic evaluation of various degrees of VP closure. ▪ Determines size, shape, cause, and location of velar gap. ▪ Used as a visual feedback tool during intervention. ▪ Minimal risks.	▪ Low patient tolerance for young children & individuals with cognitive impairment. ▪ Intrusive procedure. ▪ Only one viewing angle. ▪ Poor view of the length of the velum. ▪ Extra training required of SLP.
2) Multiview Videofluroscopy [a, d, f, g, h, l]	▪ Examines VP mechanism from multiple viewpoints. ▪ Views additional articulators during speech tasks. ▪ Assesses connected speech. ▪ Provides view of the entire length of the posterior pharyngeal wall and velum.	▪ Reduction of three-dimensional anatomy to a two-dimensional image. ▪ Exposure to radiation. ▪ Presence of shadows on final images. ▪ Low patient tolerance for young children & individuals with cognitive impairment.
3) Magnetic Resonance Imaging [a, d, e, f, k, l]	▪ Images the soft tissue of the velum and pharynx. ▪ Views activity of the leavtor veli palatini. ▪ No exposure to radiation. ▪ Provides a two - or three-dimensional image. ▪ Provides images of multiple planes within the VP mechanism. ▪ May be combined with auditory samples.	▪ High cost of equipment. ▪ Low patient tolerance for young children & individuals with claustrophobia or cognitive impairment. ▪ Static nature of the image.
4) Lateral Cephalometric X-Ray [f, i]	▪ Provides view of velum and surrounding structures, including the cervical spine, cranial base, and features of the facial skeleton.	▪ Limited view of the midsagittal plane of the cranium. ▪ Poor evaluation of dynamic speech ▪ movements. ▪ Exposure to radiation. ▪ Difficult to analyze. ▪ Poor detection of small VP openings.

Adapted from [a] Bettens, Wuyts, & Van Lierde, 2014; [b] Boone et al., 2013; [c] Carding et al., 2008; [d] Conley et al.., 1997; [e] Haynes & Pindzola, 2012; [f] Kummer, 2014; [g] Lam et al., 2006; [h] Lipira et al., 2011; [i] Lowit & Kent, 2011; [j] Mandulak, Baylis, & Thurmes, 2011; [k] Maturo et al, 2012; [l] Silver et al., 2010.

Further assessment of velopharyngeal closure can be completed via aerodynamic and acoustic instrumentation. Aerodynamic instruments involve measuring the levels of intraoral air pressure and nasal airflow that are emitted from the oral and nasal cavities during speech which aids in confirmation of speech sound productions as pressures change with movement of the articulators (Klusek, 2008). Aerodynamic measures can be assessed via the use of pressure transducers or pneumotachometers and accelerometers (Boone et al., 2013; Lowit & Kent, 2011). Oral-to-nasal acoustic energy of speech can be evaluated via use of a Nasometer, where measures of nasal sound intensity and oral sound intensity are measured and converted to a nasalance score (Lowit & Kent, 2011; PENTAX Medical, Montvale, NJ). Standardized CV repetitions, carrier phrases, and reading passages are available for use in order for scores to be compared to normative data (Kummer, 2014). The Nasometer has typically proved beneficial during VPD/AVPD assessment due to its noninvasive nature, easy interpretation, good reliability, and biofeedback capabilities during intervention (Bettens et al., 2014; Watterson & Lewis, 2006). However, due to different methods and cutoff criteria, it is often difficult to compare sensitivity and specificity across nasalance results (Bettens et al., 2014; Brancamp, Lewis, & Watterson, 2010; Watterson, Lewis, & Deutsch, 1998).

Determination of a clinical pathway. Intervention for acquired velopharyngeal dysfunction (AVPD) can be sorted into three categories: behavioral, surgical, or prosthetic (Yorkston et al., 2001). These three forms of treatment may be used individually, or in conjunction with one another as is deemed fit for the client's etiology, severity, concomitant health conditions, and environmental support. No matter the intervention method used, treatment should aim to improve intelligibility and increase the client's participation in activities that will improve his/her quality of life (ASHA, 2004).

Behavioral intervention. Speech therapy (behavioral intervention), is typically employed in cases where individuals show evidence of mild or mild-moderate velopharyngeal dysfunction due to atypical articulation and evidence of stimulability for improved intelligibility (Dworkin & Johns, 1980; Yorkston et al., 2010). However, speech therapy may also be implemented before or after surgical or prosthetic interventions as needed (Hirschberg, 1986; Kummer, 2011a). Behavioral intervention strategies may include tasks such as slowing rate of speech, over-articulation strategies, traditional motor learning of errored phonemes, altering effort of speech, resistance training via continuous positive airway pressure (CPAP), or feedback (Kollara, Schenck, & Perry, 2014; Kuehn, Moon, & Folkins, 1993; Kuehn et al., 2002; Kummer, 2014; Yorkston et al., 2001).

Surgical intervention. This treatment method may be appropriate when the patient has persistent VPD of a moderate to profound severity secondary to either a structural deficit to the VP mechanism or a stable neurological etiology (Hirschberg, 2012; Marsh, 2003). Progressive neurological conditions are contraindicated for surgical intervention due to lack of predictability of the mechanism across time, possibility of unstable medical status, change in speech condition as the disease progresses, and poor prognosis for effect of management (Marsh, 2003). Surgical methods of treatment include procedures such as pharyngeal flap, unilateral/bilateral sphincter pharyngoplasty, and posterior pharyngeal wall injections that are implemented based on surgeon preference and presentation of the velopharyngeal mechanism.

Prosthetic intervention. Use of a prosthesis is typically associated with structural or neurological deficits in the velopharyngeal mechanism. Prostheses may be used to restore the function of the mechanism for both stable and progressive neurological conditions, as the removable device allows supplementation of the mechanism without permanent action.

Prostheses may be selected over surgery depending on the competency of the client's airway, the lack of predictability of the speech disorder over time, and poor medical stability (Marsh, 2003). In instances of severe progressive neurological disorders (e.g., ALS), SLPs may consider use of an augmentative communication device to supplement functional communication. The use of a prosthetic device, typically a palatal lift or an obturator, will allow assistance in velopharyngeal closure, especially in instances where the velum is too short for proper closure (obturator) or there is motoric weakness in the velum or pharynx (palatal lift) that does not allow for adequate function (Marsh, 2003; Noll, 1982; Woo, 2012; Yorkston et al., 2001). Refer to Tables 5-7 within Chapter Two of this thesis for a breakdown of the indications for treatment using these three clinical pathway approaches.

Effect of training and self-efficacy on clinical competence. Given the complexity and heterogeneity of this population, it is clear that a speech-language pathologist's skill set must be extensive. It is necessary for SLPs to take part in scholarly education, in addition to external training and experience. The American Speech-Language-Hearing Association (ASHA; 2012) requires that graduate programs implement training that will allow students to acquire and demonstrate knowledge regarding the etiologies, anatomy/physiology, cultural correlates, and characteristics (acoustic, psychological, developmental, linguistic) of motor speech productions (e.g., phonation, resonance, articulation).

A survey developed by Pannbacker, Lass, and Stout (1990) gathered data regarding where clinicians received training of velopharyngeal insufficiency (VPI). Results from this survey indicated that out of 173 speech-language pathologists, over half (53.8%) received VPI training at the undergraduate level, 96% received VPI training at the graduate level, and 86.7% received additional training via continuing education sources. In a response to the work of

Dixon-Wood, Williams, & Seagle (1991) discussing the acceptance of speech-language pathology recommendations in treatment for VPI, Cohn (1991) pointed out that though graduate education programs are where most training takes place, this coursework alone often does not provide the in-depth, specialized training that SLPs need to provide adequate clinical management for individuals with VPD. Other studies have also indicated both undergraduate and graduate curriculums do not meet the standards needed to treat and assess individuals with VPD, whether this is based on lack of instrumental knowledge, perceptual training, or quality experience (Pannbacker, 2004; Strauss, 1998). AVPD may be discussed in a variety of courses (e.g., cleft palate, voice, motor speech disorders, dysphagia, articulation), due to the fact that this disorder is not seen with as high of a frequency as other disorder types but does come up across various client populations. This piecemeal type of education may explain why standard skills and knowledge or specialty credentialing are needed for working with AVPD.

Pannbacker (2004) highlighted how a set of skills must be established for speech-language pathologists in order to determine competency for providing VPD services. Watterson & Grames (2014) proposed a draft of a necessary skill set for evaluating velopharyngeal dysfunction to members of Special Interest Group 5 (Craniofacial and Velopharyngeal Disorders). Mandulak & Baylis (2014) also developed examples of goals and objectives for clinicians to have in mind during periods of training to ensure clinical competency for evaluation and management of VPD. Though these were not validated guides, they are clear examples of the extensive education, training, and skill set that should be established as the foundation for providing adequate care to patients with velopharyngeal dysfunction. Also, the fact that there is not a standardized, published document concerning the knowledge and skills necessary for SLPs to guide evaluation and management of VPD may be a hindrance to the consistency of knowledge across education programs and the lack of preparedness of practicing clinicians following training (Mandulak & Baylis, 2014; Watterson & Grames, 2014).

In addition, advances in the field cause certain methods to become outdated and no longer acceptable in treating the AVPD population such as non-speech oral motor exercises, surgical procedures, and instrumentation. This indicates the need for current education regarding evaluation and treatment protocols. Schneider and Shprintzen (1980) conducted a survey to gather information regarding evaluation and treatment procedures, as well as the educational background of speech-language pathologists who were involved in managing VPD. Results from 592 returned questionnaires revealed that 54% of the responding population no longer implemented the same procedures that they were taught in their educational training (Schneider & Shprintzen, 1980). It is likely that new procedures have been implemented in the thirty-seven years since this study was published. With updated data, there is still lack of standardized protocols. Therefore, there is a need for more current analysis and establishment of SLP knowledge and skills in regard to VPD, especially AVPD.

With insufficient training, what does this mean for clinical practice with regard to evaluation and management of acquired velopharyngeal dysfunction (AVPD)? Shprintzen (1995) stated that the variation in training based on factors such as type of institution and training personnel had an effect on the evaluation and treatment methods that speech-language pathologists were implementing. In other words, lack of standardized training protocols leads to training institutions implementing AVPD education in various ways. While some institutions may cover this population in-depth via a variety of courses, others may touch briefly on the topic. Level of training plays a role in SLPs providing adequate clinical services to patients (ASHA, 2010) within specialty populations, such as AVPD. Supporting this assertion is the concept of perceived self-efficacy and its relation to performance. Self-efficacy is a social-cognitive theory that refers to how successfully an individual believes he/she can perform a task based on his/her confidence in his/her abilities (not luck or self- worth) and the diverse forms of information that affect personal behavior (Bandura, 1977; Bandura, 2006; Gillespie & Abbott, 2011; Sherer et al., 1982). Bandura (1977) asserted that this theory is powerful because an individual's personal perception of self-efficacy will determine if he/she decides to perform a task, how much effort he/she will put into it, the expected level of success to come from his/her performance, and if he/she will persevere to complete the task adequately based on its degree of difficulty.

Clinically, establishing a strong sense of self-efficacy is important for speech-language pathologists because low levels of efficacy may cause clinicians to develop negative behaviors, poor clinical techniques, and inadequate service provisions. Therefore, treating individuals without proper training or with low efficacy may affect the clinician and the client ethically, financially, and/or clinically (ASHA, 2010). Though speech-language pathologists vary in their perception of self-efficacy due to multiple factors (Betz, 2007; Sherer et al., 1982; Smith & West, 2006), the overall target is for clinicians to have enough training, mentoring, resources, and self-confidence to demonstrate strong self-efficacy behaviors in order to successfully and competently assess and treat referred clients. This may be why many SLPs prefer to specialize, as receiving extensive training in a certain disorder type likely increases self-efficacy with regard to assessment and treatment for that clinical population. Bandura (1977) indicated four sources of information that aid in determining and training self-efficacy beliefs: mastery experience, vicarious experience, verbal persuasion, and physiological and affective state. These methods and strategies can be implemented on an individual clinician basis to increase degree of performance in assessment and management of individuals with acquired velopharyngeal dysfunction (AVPD), as well as they can be taught and shared with clients to enhance their self-efficacy beliefs regarding recovery and abilities in therapy.

In this population, lack of consensus on what procedures are the most suitable for clients with AVPD is evident due to the lack of standardized care protocols and limited current specialized literature recommendations to guide clinical management decisions. Moreover, it appears that cleft palate literature carries over into the recommendations for AVPD due to the lack of specialized literature available. This brings cause for concern, as the AVPD population is specialized and not all aspects of cleft palate training are likely to suffice for the recommendations of clinical management for AVPD. In addition, when clinicians do not have established knowledge or skills in regard to clinical tasks due to factors such as limited training or high complexity, their self-efficacy may be lowered or misjudged. Therefore, when clinicians act on low self-efficacy or misinterpretations of knowledge, they are at a higher risk of making inappropriate decisions that may have adverse consequences for the client and impact the overall quality of care for the patient (Bandura, 1997; Stajkovic & Luthans, 1998). ASHA's practice patterns (2004) with regard to resonance and nasal airflow assessment and intervention have provided a foundation on which clinicians may build knowledge and skills of VPD services. However, the complexity and uncertainty of AVPD population indicates that a set of standard skills should be identified for speech-language pathologists in order to determine competency for providing AVPD services (Mandulak & Baylis, 2014; Pannbacker, 2004; Watterson & Grames, 2014). Overall, there is a need for an evidence-based clinical guideline to determine the best plan of action with regard to diagnostic recommendations for patients with AVPD.

The goal of this investigation was to administer an internet-based survey to practicing speech-language pathologists to gather data with regard to the following areas: level of training, assessment protocols, clinical management protocols, and level of self-efficacy related to clinical practice and the AVPD population. It was hypothesized that survey participants would report limited training for assessment and clinical management of AVPD, which would correlate strongly with reports of low self-efficacy in relation to this population. With regard to self-efficacy, lower reports were anticipated for individuals with fewer client experiences and absence of a multidisciplinary team in their workplace. Also, it was hypothesized that participants would report a variety of assessment and intervention protocols with lack of consensus across the field. Respondents with numerous cases of AVPD, use of instrumentation, and presence of a multi-disciplinary team were hypothesized to correlate with medical-based clinic settings. The survey findings in company with the evidence currently available in the literature were used to propose a clinical guideline for AVPD diagnostic recommendations that could be used as a functional resource within the clinical field.

Methods

Participants. Speech-language pathologists practicing in the United States were recruited for this survey. Inclusion criteria were as follows: a master's degree or higher education, certificate of clinical competence (CCC), and a license to practice speech-language pathology in his/her respective state.

Following IRB approval (see Appendix A), four different methods were used to gather a large sample of survey participants and validate randomization of the selected speech-language pathologist population based off of the methods of Ofe, Plumb, & Plexico (2016). For three of the four outreach approaches, survey participants were contacted via email lists of the following groups: 1) the members of ASHA affiliated Special Interest Groups with a focus on Neurophysiology and Neurogenic Speech and Language Disorders (SIG 2), Voice and Voice Disorders (SIG 3), Craniofacial and Velopharyngeal Disorders (SIG 5), and Swallowing and Swallowing Disorders (SIG 13); 2) the first 50 and the last 50 members for all 50 states in the U.S. via the ASHA Community Directory; 3) the speech-language-hearing associations from the two most populous states of each geographic region of the U.S. (Northeast, Southeast, Southwest, Midwest, and West). The members of the aforementioned groups received an initial email from the researchers containing a web link for the Qualtrics survey and an introductory statement regarding the justification for the survey (see Appendix B). The fourth method of survey outreach took place on ASHA's Facebook and Community boards, where the researchers posted the survey link and a short statement to the respective social media sites with the intention that a more detailed justification of the survey would be available for participant review upon selection of the web link.

Survey procedures. A questionnaire designed to survey speech-language pathologists' degree of training, experience, and self-efficacy in evaluation and management of clients with AVPD was distributed through Qualtrics, a secure online software program that allows for survey development, administration, and data collection. The format of the survey allowed for a mixture of simple fixed-response questions and a few open-ended text selections to allow for easy analysis of responses, as well as personal dialogue from participants. Clinician self-efficacy responses were calculated on a 100-point scale, ranging in 10-unit intervals from 0 (indicating "cannot do at all"), through intermediate levels of assurance approximately around the level of 50 (indicating "moderately confident"), to complete assurance at the level of 100 (indicating "highly certain can do"; Bandura, 2006). This larger scale was used to avoid responses of extreme positions, as is common with smaller range scales, allowing for a more authentic response (Bandura, 2006). The development of the confidence questions was based on the scaling format of the Strength Self-Efficacy Scale (SSES; Tsai, Chaichanasakul, Zhao, Flores, & Lopez, 2014), and the preliminary rating example was adapted from Bandura (2006) to orient the participant to the task at hand. Survey questions were classified as "optional response" to allow for comfortable participation and increased chance of survey completion. See Appendix C for a review of the survey questions.

Multiple recommendations from the literature of Dillman, Smyth, and Christian (2014) were employed to allow for optimal survey results. Such practices included: providing indication of benefit of survey participation to the field of interest, allowing participants to save responses and return to survey as is convenient for the responder, distributing survey links at early morning hours (7:00am - 9:00am) and late evening hours (8:00pm - 10:00pm) for participants to receive the questionnaire information via email at the beginning of the work day, sending reminder messages to ASHA internet databases in two-three week increments, developing the survey for compatibility across multi-media devices, and reassuring the participant of the confidentiality and anonymity of survey responses.

Validity of the survey was established using construct measures, where survey questions were evaluated based on peer and literature reviews. Survey questions were approved and edited via pilot testing prior to survey activation. Survey questions were constructed from similar surveys within scholarly articles based on the clinical hypotheses drafted from the researchers' reviews of the literature (Pannbacker et al.,1990; Schneider & Shprintzen, 1980; Tsai, et al., 2014).

Data analyses. The Qualtrics survey database filtered questions for completion and calculated average percent of occurrence for each possible response based on number of participants. Descriptive statistics were used to summarize the assessment protocols, management recommendations, levels of training, and general levels of self-efficacy for practicing clinicians when working with patients with AVPD (Bandura, 1977). Data were transferred to an Excel spreadsheet to analyze correlational statistics via SAS statistical software. Results for SAS outcomes were analyzed as statistically significant at the $\alpha<0.05$ level. Also, strength of the Pearson Correlation Coefficient was determined based on the following guidelines: $r \geq 0.70$ as strong correlation, $0.30 \leq r < 0.70$ as moderate correlation, and $r < 0.30$ as weak correlation (Sheskin, 2004). Correlational analyses evaluated the relationships between perceived confidence responses and frequency of AVPD assessment, overall numbers of patients, proximity to a multi-disciplinary team, and level of training. General levels of self-efficacy were gathered by calculating the sum of responses for three of the Bandura information sources (mastery experience, vicarious experience, verbal persuasion). The fourth Bandura source, physiological and affective state, was compared separately to evaluate how level of self-efficacy and the correlated variable resulted in feeling positive or negative emotions. Work setting was evaluated further to determine the relationship between place of employment and the frequency of cases of AVPD, use of nasoendoscopic and videofluoroscopic instrumentation, and presence of a multi-disciplinary team.

Results

Participants. A total of 162 speech-language pathologists participated in this survey data collection. Ten of these respondents were not licensed within the United States and one participant obtained the maximum of a bachelor's degree education, therefore, these respondents were excluded from data analyses. A total of 151 speech-language pathologists who met participant criteria attempted the survey with 134 participants completing the questionnaire in its entirety. Due to anonymous responses, numbers of participants per recruitment method could not be completely determined. Two separate surveys were developed: one for emails/messages and one for social media sites. No responses were initiated through the social media survey. Therefore, all participants initiated the survey through one of the three email recruitment strategies provided in the methods section. Percentages within the following demographic analysis are reflective of 151 participant responses. Demographic information within the questionnaire indicated participation from 46 out of 50 states within the United States. Ages of participants ranged from 20-79 years (mean age range=30 - 49), with 94.70% (n=143) female respondents and 5.30% (n=8) male respondents. With regard to years in clinical practice, 39.07% (n=59) reported more than 20 years of experience. Smaller numbers were reported across additional years of experience: <1 year (1.99%, n=3), 1-5 years (19.21%, n=29), 6-10 years (13.25%, n=20), 11-15 years (11.92%, n=18), and 16-20 years (14.57%, n=22).

In addition, survey participants reported working at a multitude of sites such as public schools (25.17%, n=38), hospitals (21.85%, n=33), skilled nursing facilities (12.58%, n=19), private practices (7.28%, n=11), university hospitals (6.62%, n=10), craniofacial clinics (4.66%, n=7), university speech & hearing clinics (3.97%, n=6), early intervention services (1.99%, n=3), home care agencies (1.32%, n=2), and other institutions (14.57%, n=22). For the 22 participants that indicated they were employed at "other" institutions, eight worked at an outpatient rehabilitation facility, three indicated that they were employed at more than one facility, two worked in an inpatient rehabilitation facility, two were involved with university research, two were employed at acute rehabilitation centers, two worked in private/specialized school systems, one was a PhD student, one was a stay-at-home mother, and one worked on a PRN basis. A breakdown of SLP employment responses is provided in Table 9. Across employment settings, 61.59% (n=93) of sites implemented a multi-disciplinary team when clinically assessing and managing the AVPD population, while the remaining 38.41% (n=58) of work facilities did not.

Table 9 *Employment Representation of Responding Speech-Language Pathologists*

Place of Employment	Response Count (n; N = 151)	Percentage (%)
Craniofacial Clinic	7	4.66%
Early Intervention Services	3	1.99%
Home Care Agency	2	1.32%
Hospital	33	21.85%
Public School	38	25.17%
Private School	11	7.28%
Skilled Nursing Facility	19	12.58%
University Speech & Hearing Clinic	6	3.97%
University Hospital	10	6.62%
Other	22	14.57%

Note. N = total number of respondents. n = number of respondents per place of employment. % = percentage of respondents based on 151 respondents.

Clinical practice. Descriptive analyses reviewed methods of assessment and treatment, level of AVPD training, need for the development of a clinical guideline, general levels of self-efficacy, and effectiveness of the four sources of self-efficacy for AVPD assessment.

Assessment protocols. Participants were asked to select all assessment methods implemented when evaluating clients of the AVPD population (see Table 10). Data from 151 participant responses revealed that the majority of participating SLPs relied on non-instrumental measures to evaluate AVPD: oral-mechanism examination (92.05%, n=139), perceptual judgements (82.78%, n=125), and standardized articulation assessments (70.86%, n=107). Instrumental methods of evaluation included nasoendoscopy (43.05%, n=65), Nasometer (39.07%, n=59), videofluoroscopy (37.75%, n=57), acoustic assessment (33.77%, n=51), air flow/aerodynamic instrumentation (33.77%, n=51), oral endoscopy (13.91%, n=21), magnetic resonance imaging (4.64%, n=7), and lateral cephalometric x-ray (2.65%, n=4). For the 13 participants (8.61%) that responded with "other" methods of evaluation, eight recommended referral to a specialist (e.g., ENT, craniofacial clinic, pediatrician, etc.), three elaborated on the structure of their assessment protocol, one recommended Iowa Oral Pressure Instrument (IOPI), and one encouraged a palatal motion study.

Table 10 *Assessment Method Survey Results*

Assessment Method	Response Count (n; N = 151)	Percentage (%)
Acoustic Assessment	51	33.77%
Airflow/Aerodynamic Instrumentation	51	33.77%
Lateral Cephalometric X-Ray	4	2.65%
Magnetic Resonance Imaging (MRI)	7	4.64%
Nasoendoscopy	65	43.05%
Nasometer	59	39.07%
Oral Endoscopy	21	13.91%
Oral-Mechanism Examination	139	92.05%
Perceptual Judgement(s)	125	82.78%
Standardized Articulation Assessment	107	70.86%
Videofluoroscopy	57	37.75%
Other	13	8.61%

Note. N = total number of respondents. n = number of respondents per assessment method. % = percentage of respondents based on 151 respondents.

Treatment protocols. Participants were asked to select all treatment methods that they would recommend for clients with AVPD and 147 participants responded, as summarized in Table 11. Speech therapy was recommended by the largest number of speech-language pathologists (84.35%, n=124). Other treatment procedures recommended were as follows: palatal prosthesis/obturator (51.70%, n=76), oral-motor exercises (46.26%, n=68), pharyngeal flap surgery (42.86%, n=63), pharyngeal injection (24.49%, n=36), pharyngeal sphincter surgery (19.73%, n=29), and CPAP (10.88%, n=16). For the 26 participants (17.69%) who responded with “other” treatment recommendations, twelve indicated they would refer to a specialist (e.g., surgeon, ENT, specialized SLP, craniofacial clinic, etc.), six indicated that their recommendations would be case dependent, four elaborated on the specific method of intervention provided in their response, two indicated they do not work with this population regularly enough to make adequate recommendations, one recommended Expiratory Muscle Strength Training (EMST), and one recommended swallowing therapy if nasal regurgitation was present.

With regard to referral patterns of 150 participating SLPs, the majority of referrals were directed towards otolaryngologists (87.33%, n=131) and speech-language pathologists with specialized VPD experience (76.67%, n=115). Additional referral patterns included plastic surgeon (27.33%, n=41), oral surgeon (18%, n=27), general physician (16%, n=24), other specialist (18.67%, n=28), audiologist (10%, n=15), and radiologist (3.33%, n=5). The twenty-eight “other” referral recommendations included the following: prosthodontist (n=10), cleft-palate/craniofacial clinic (n=7), genetics (n=2), respiratory therapist (n=1), personal clinic group (n=1), dentist (n=1), un-specified specialist (n=1), parent (n=1), neurologist (n=1), etiology dependent (n=1), and lack of referral recommendation due to work-place protocol (n=1; one participant selected “other” without providing a text-response).

In relation to behavioral intervention, the majority of the 151 participating SLPs (82.78%, n=125) indicated that trial therapy should be implemented for 3 months or less, with 25 respondents (16.56%) indicating that they would implement trial therapy for 3 to 6 months, and 1 participant (0.66%) recommending trial therapy for 6 months to 1 year. Based on 151 participants, the majority of respondents stated that the following characteristics would classify an individual as a good candidate for behavioral intervention: mild hypernasality (80.13%, n=121), moderate hypernasality (56.29%, n=85), intermittent ability to achieve velopharyngeal closure (87.42%, n=132), cognitive stability (89.40%, n=135), and diagnosis of a stable neuromotor disorder (70.86%, n=107). A smaller number of respondents indicated behavioral intervention would be warranted for clients demonstrating inadequate closure of the velopharyngeal mechanism (34.44%, n=52), severe hypernasality (31.13%, n=47), diagnosis of a progressive neuromotor disorder (31.13%, n=47), and cognitive compromise (20.53%, n=31).

Table 11 *Treatment Method Survey Results*

Treatment Method	Response Count (n; N = 147)	Percentage (%)
CPAP	16	10.88%
Palatal Prosthesis/Obturator	76	51.70%
Pharyngeal Flap Surgery	63	42.86%
Pharyngeal Injection	36	24.49%
Pharyngeal Sphincter Surgery	29	19.73%
Oral-Motor Exercises	68	42.26%
Speech Therapy	124	84.35%
Other	26	17.69%

Note. N = total number of respondents. n = number of respondents per treatment method. % = percentage of respondents based on 147 respondents.

Clinical training. Training data were analyzed based on 151 participant responses. With regard to training, 86.09% (n=130) of respondents received a maximum of a Master's level education, while 13.91% (n=21) of participants were trained at the Doctorate level (Ph.D.). As part of their training process, 62.25% (n=94) of respondents indicated that on-the-job experience was most helpful in preparing them for clinically managing clients of the AVPD population, followed by continuing education courses (41.72%, n=63), mentoring (40.40%, n=61), graduate curriculum (39.07%, n=59), graduate practicum (18.54%, n=28), clinical fellowship supervision (13.91%, n=21), and undergraduate curriculum (2.65%, n=4). Nineteen respondents (12.58%) stated that they received no helpful training at all in relation to AVPD. For the 16 respondents

(10.60%) that received ideal training from sources other than the ones provided, seven SLPs engaged in self-study via published literature, three gathered insight from outside professionals (e.g., surgeon, physician, etc.), three elaborated that they did not have adequate training in the area of AVPD, two took part in clinical research, and one specifically indicated their placement at a cleft/craniofacial clinic was helpful. Based on trainings, Figure 1 illustrates the spread of responses regarding preparedness for working with the AVPD population. Results emphasized that the largest number of participants felt they were not well prepared (35.76%, n=54), followed by feeling slightly prepared (31.79%, n=48), moderately prepared (23.18%, n=35), and extremely prepared (9.27%, n=14).

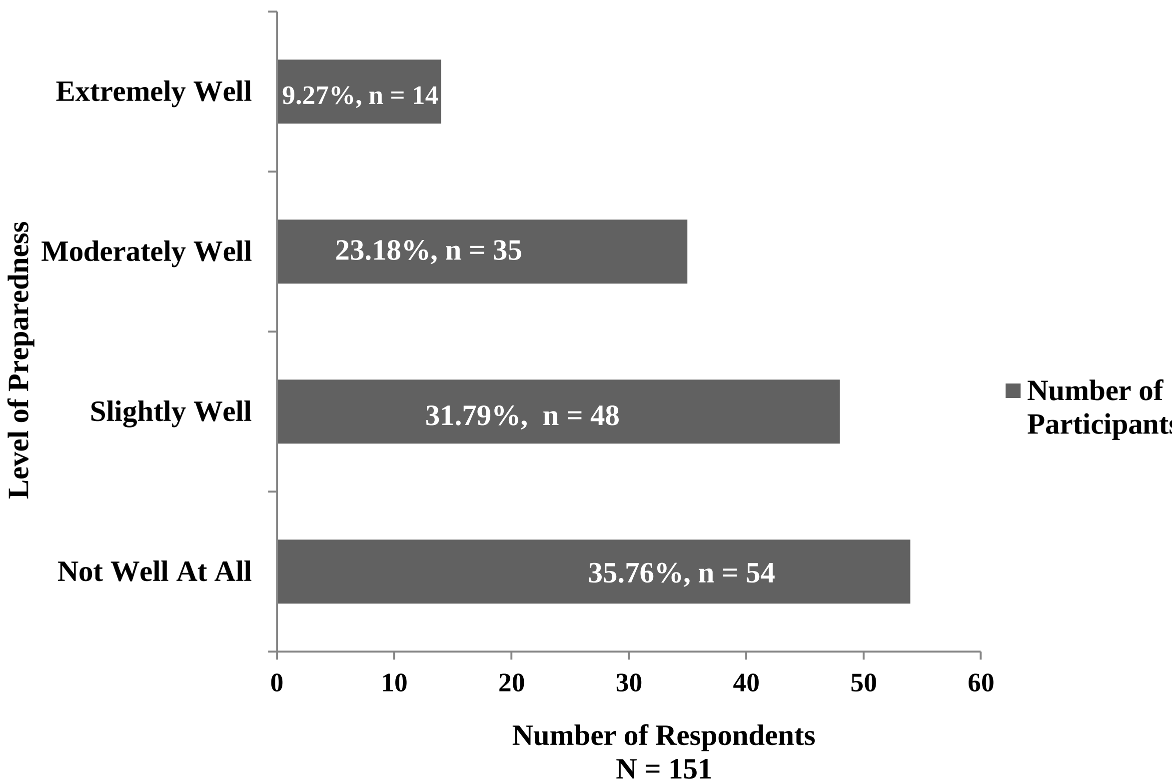

Figure 1. Outcome of training for AVPD population survey results. Survey participants' levels of preparedness for working with the AVPD population varied based on perception of training. *Note*: N = total number of respondents, n = number of respondents per level of preparedness.

Also, based on 150 participant responses, 56.67% (n=85) of speech-language pathologists have maintained the same protocols for assessment and intervention that they were taught during their initial training, while the remaining 43.33% (n=65) have modified their methods since their AVPD education. Figure 2 illustrates how clinical assessment and treatment methods that clinicians received adequate training in were generally more likely to be implemented in clinical practice. However, methods that clinicians indicated they needed additional training in were not implemented with as high of frequency (with a few exceptions). Overall, 93.38% (n=141) of the 151 total participants advocated for the development of a clinical guideline for assessment and clinical management of AVPD and only 10 respondents (6.62%) indicated its development would be unnecessary.

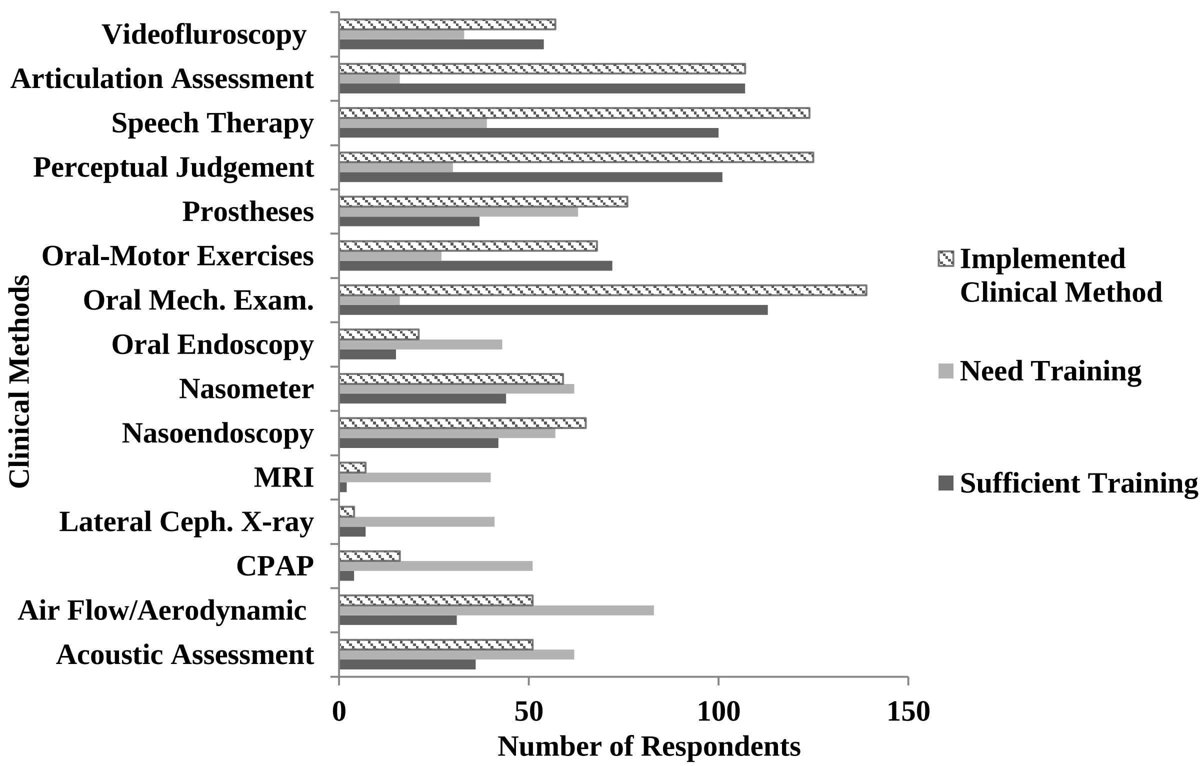

Figure 2. Relation between level of training and implementation of clinical methods. Implementation of assessment and treatment protocols is typically reflective of sufficient training.

Self-efficacy ratings. Perceived levels of self-efficacy were interpreted according to the linear nature of the text anchors along the visual analog scale, resulting in measures of low (0-20), low-moderate (21-35), moderate (36-65), moderate-high (66-80), and high (81-100) self-efficacy ratings. This scale was established due to the likelihood that respondents would bias their responses based on the specific position of the text anchors and that the symmetrical layout of the anchors would encourage ratings across the entire length of the analog scale (Nagle, Helou, Solomon, & Eadie, 2014; Scott & Huskisson, 1976). Therefore, percentages are based on the 453 combined responses across three of the four questions relating to Bandura information sources (mastery experience, vicarious experience, verbal persuasion). Results revealed that the largest number of self-efficacy responses fell within the 81 - 100 range (44.62%, n=199), which was classified as high perception of self-efficacy when assessing the AVPD population. The remaining self-efficacy ratings resulted in the following levels: moderate (20.31%, n=92), moderate-high (14.57%, n=66), low (11.48%, n=52), low-moderate (8.17%, n=37), and no response (1.55%, n=7). Evaluating three Bandura information sources (mastery experiences, vicarious experiences, verbal persuasion) revealed that higher levels of perceived confidence were reported when working alongside an experienced speech-language pathologist as a mentor in AVPD practices (47.24%; n=94), in comparison to receiving words of affirmation from colleagues (29.65%; n=59) and working independently (23.12%; n=46; illustrated in Figure 3).

The data for the fourth information source, physiological and affective state, was analyzed based on the response of 151 speech-language pathologists. Analysis revealed a variety of emotions: feeling calm (42.38%, n=64), comfortable (39.07%, n=59), confident (29.14%, n=44), doubtful (27.15%, n=41), nervous (25.83%, n=39), and anxious (17.22%, n=26) when working with the AVPD population. For the 23 responses (15.23%) that classified as "other" emotions, four participants indicated they would feel uncertain, four believed they would be excited and enjoy the assessment, three stated their emotional state would depend on external factors (e.g., assessment protocol, etiology, etc.), three would feel comfortable getting a second opinion from another specialist, two felt unqualified, and two believed that they would feel more comfortable/confident with assessment than clinical management. Additional one-time responses included feeling concerned, respectful, focused, nervous as well as calm (for the patient's sake), and sure that making the specific diagnosis would be difficult.

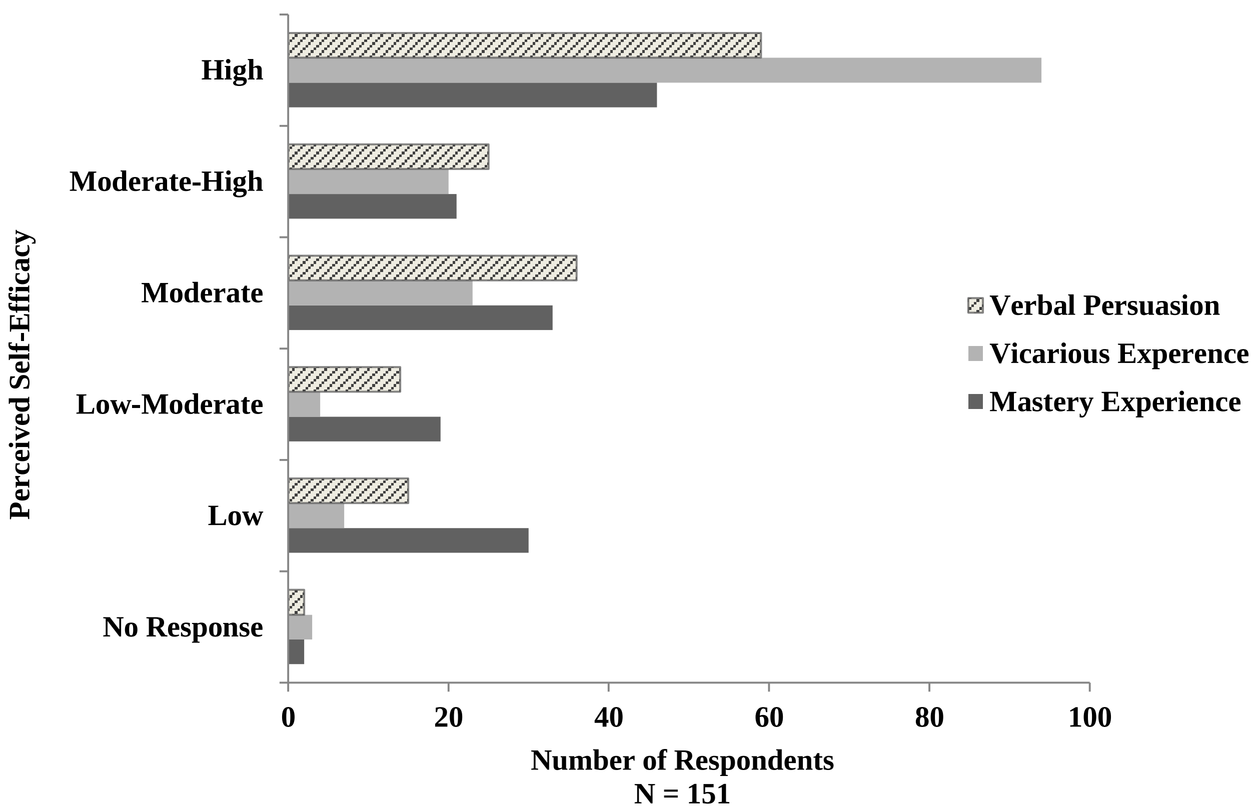

Figure 3. Perceived self-efficacy ratings per Bandura's three information sources. Perceived self-efficacy ratings varied among survey participants depending on which information source from Bandura's literature was referenced.

Note: N = total number of respondents.

Correlational statistics. Correlational analyses evaluated the relationship between general levels of self-efficacy and the following variables: presence of a multi-disciplinary team, total number of clients throughout career, level of training, and current frequency of AVPD clientele. The presence of multi-disciplinary teams, instrumentation, and frequent AVPD cases were analyzed to determine their relationship with site of employment. Correlation strength was established using the following parameters: $r \geq 0.70$ as strong correlation, $0.30 \leq r < 0.70$ as moderate correlation, and $r < 0.30$ as weak correlation (Sheskin, 2004). Statistical significance was noted at the level of $p < 0.05$.

Presence of a multidisciplinary team was evaluated to determine its relationship with general self-efficacy ratings of respondents (see Table 12). Results indicated that there was a moderate correlation between perceived positive emotions and presence of a multidisciplinary team ($r=0.32$; $p=<0.0001$). There was statistical significance ($\alpha=<0.05$), but weak correlation among presence of a multidisciplinary team and the remaining self-efficacy variables: vicarious experience, verbal persuasion, general self-efficacy level. Statistical significance and weak correlation was also noted among lack of a multidisciplinary team and a negative emotional state.

Table 12 *Correlational Data for Presence of Multidisciplinary Team & Perceived Self-Efficacy*

Pearson Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations	Multidisciplinary Team Not Present	Multidisciplinary Team Present
Mastery Experience	-0.28 p=0.0005** N=149	0.28 p=0.0005** N=149
Vicarious Experience	-0.17 p=0.0450** N=148	0.17 p=0.0450** N=148
Verbal Persuasion	-0.20 p=0.0126** N=149	0.20 p=0.0126** N=149
General Self-Efficacy Level	-0.24 p=0.0036** N=151	0.24 p=0.0036** N=151
Positive Emotions	-0.32* p<0.0001** N=147	0.32* p<0.0001** N=147
Negative Emotions	0.23 p=0.0056** N=147	-0.23 p=0.0056** N=147

Note: * = Moderate correlation. **=Statistically significant.

Perceived self-efficacy was correlated with the total number of clients with AVPD seen across respondents' careers (see Table 13). Correlational statistics revealed that there was a negative moderate relationship between general level of self-efficacy and no client experience with AVPD (r= -0.45, p=<0.001). A negative correlation represents an indirect relationship, indicating that as one variable changes in one direction, the other variable decreases in the opposite direction. Negative moderate correlations were also found for responses representing three Bandura information sources and no client experience with AVPD: mastery experience (r=

-0.43, p=<0.001), vicarious experience (r= -0.33, p=<0.001), and verbal persuasion (r= -0.44, p=<0.001). A moderate correlation was evaluated between no client experience with AVPD and having negative emotions towards the assessment process (r=0.33, p=<0.0001). There was statistical significance (α=<0.05), but weak correlation between multiple self-efficacy and experience variables. Due to the numerous variable combinations, these relationships are solely noted in Table 13.

Table 13 *Correlational Data for Client Experience with AVPD & Perceived Self-Efficacy*

Pearson Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations							
	No Clients	1-10 Clients	11-50 Clients	51-100 Clients	101-150 Clients	151-200 Clients	>200 Clients
Mastery Experience	-0.43* p<0.0001** N=149	-0.24 p=0.0028** N=149	0.17 p=0.0363** N=149	0.20 p=0.0169** N=149	0.13 p=0.1108 N=149	0.21 p=0.0106** N=149	0.28 p=0.0005** N=149
Vicarious Experience	-0.33* p<0.0001** N=148	-0.15 p=0.0713 N=148	0.16 p=0.0502 N=148	0.15 p=0.0723 N=148	0.07 p=0.4320 N=148	0.11 p=0.1704 N=148	0.19 p=0.0189** N=148
Verbal Persuasion	-0.44* p<0.0001** N=149	-0.13 p=0.1095 N=149	0.10 p=0.2081 N=149	0.19 p=0.0190** N=149	0.11 p=0.1708 N=149	0.16 p=0.0588 N=149	0.27 p=0.0008** N=149
General Self-Efficacy Level	-0.45* p<0.0001** N=151	-0.17 p=0.0416** N=151	0.17 p=0.0389** N=151	0.21 p=0.0103** N=151	0.12 p=0.1289 N=151	0.11 p=0.1798 N=151	0.23 p=0.0041** N=151
Positive Emotions	-0.29 p=0.0005** N=147	-0.14 p=0.0915 N=147	0.10 p=0.2192 N=147	0.14 p=0.0949 N=147	0.02 p=0.8217 N=147	0.19 p=0.0237** N=147	0.18 p=0.0274** N=147
Negative Emotions	0.33* p<0.0001** N=147	0.23 p=0.0051** N=147	-0.21 p=0.0123** N=147	-0.18 p=0.0261** N=147	-0.04 p=0.6300 N=147	-0.14 p=0.0829 N=147	-0.22 p=0.0081** N=147

Note: * = Moderate correlation. **=Statistically significant.

Perceived self-efficacy was correlated with the adequacy of respondents' trainings with regard to evaluating and managing clients of the AVPD population (see Table 14). When training preparedness was compared to the three Bandura information sources, analyses revealed a moderate positive correlation between feeling extremely well prepared and working independently ($r=0.37$, $p=<0,0001$), as well as when working with consistent verbal affirmation ($r=0.34$, $p=<0,0001$). When analyzing perceived emotions, correlational statistics revealed a moderately positive relationship between moderate levels of training and positive emotions ($r=0.31$, $p=0.0001$). There was also a moderate positive relationship between feeling not well prepared and negative emotions when managing a client with AVPD ($r=0.30$, $p=0.0002$). In addition, when participants responded that they were not well trained, multiple negative relationships of moderate strength were evaluated among the following self-efficacy levels: mastery experience ($r= -0.36$, $p=<0.0001$), verbal persuasion ($r= -0.35$, $p=<0.0001$), general self-efficacy level ($r= -0.32$, $p=<0.0001$), and positive emotions ($r= -0.32$, $p=<0.0001$). Though correlational strength was weak, statistical significance was met ($\alpha=<0.05$) among numerous self-efficacy and training variables. Due to the multitude of variable combinations, these relationships are solely noted in Table 14.

Table 14 *Correlational Data for Level of AVPD Training & Perceived Self-Efficacy*

Pearson Correlation Coefficients
Prob > |r| under H0: Rho=0
Number of Observations

	Not Well Trained At All	Slightly Well Trained	Moderately Well Trained	Extremely Well Trained
Mastery Experience	-0.36* p<0.0001** N=149	-0.09 p=0.2674 N=149	0.25 p=0.0024** N=149	0.37* p<0.0001** N=149
Vicarious Experience	-0.18 p=0.0277** N=148	-0.12 p=0.1337 N=148	0.19 p=0.0183** N=148	0.23 p=0.0054** N=148
Verbal Persuasion	-0.35* p<0.0001** N=149	-0.05 p=0.5088 N=149	0.23 p=0.0048** N=149	0.33* p<0.0001** N=149
General Self-Efficacy Level	-0.32* p<0.0001** N=151	-0.07 p=0.4011 N=151	0.24 p=0.0031** N=151	0.29 p=0.0003** N=151
Positive Emotions	-0.35* p<0.0001** N=147	-0.07 p=0.4082 N=147	0.31* p=0.0001** N=147	0.23 p=0.0049** N=147
Negative Emotions	0.30* p=0.0002** N=147	0.12 p=0.1498 N=147	-0.28 p=0.0005** N=147	-0.26 p=0.0016** N=147

Note: * = Moderate correlation. **=Statistically significant.

The last correlation evaluated with regard to the variable of perceived self-efficacy was its relationship with the respondents' current frequencies of clients with AVPD (see Table 15). Analysis revealed moderately strong negative correlation between general self-efficacy rating and never working with clients of the AVPD population (r= -0.47, p=<0.0001). Never assessing or managing clients with AVPD also had a negative moderate relationship with three Bandura information sources: mastery experience (r= -0.46, p=<0.0001), vicarious experience (r= -0.39, p=<0.0001), and verbal persuasion (r= -0.45, p=<0.0001). With regard to emotions, positive emotions had a moderately strong indirect relationship with no frequency of clientele (r= -0.35, p=<0.0001), while negative emotions had a moderately strong direct relationship with no AVPD experience (r=0.46, p=<0.0001). Statistically significant (α=<0.05) yet weak relationships were noted between many self-efficacy and client frequency variables. Due to the numerous variable combinations, these relationships are noted solely in Table 15.

Table 15 *Correlation Data for Current Frequency of AVPD Clientele & Perceived Self-Efficacy Ratings*

Pearson Correlation Coefficients
Prob > |r| under H0: Rho=0
Number of Observations

	Never	Rarely	Yearly	Every Few Months	Monthly	Weekly
Mastery Experience	-0.46* p<0.0001** N=149	-0.17 p=0.0435** N=149	0.13 p=0.1150 N=149	0.16 p=0.0479** N=149	0.22 p=0.0065** N=149	0.25 p=0.0025** N=149
Vicarious Experience	-0.39* p<0.0001** N=148	-0.04 p=0.6313 N=148	0.10 p=0.2186 N=148	0.16 p=0.0550 N=148	0.16 p=0.0561 N=148	0.08 p=0.3079 N=148
Verbal Persuasion	-0.45* p<0.0001** N=149	-0.13 p=0.1190 N=149	0.10 p=0.2438 N=149	0.15 p=0.0662 N=149	0.20 p=0.0140** N=149	0.25 p=0.0020** N=149
General Self-Efficacy Level	-0.47* p<0.0001** N=151	-0.12 p=0.1545 N=151	0.14 p=0.0963 N=151	0.13 p=0.1039 N=151	0.20 p=0.0126** N=151	0.24 p=0.0035** N=151
Positive Emotions	-0.35* p<0.0001** N=147	-0.14 p=0.1014 N=147	0.19 p=0.0188** N=147	0.13 p=0.1124 N=147	0.06 p=0.4968 N=147	0.21 p=0.0095** N=147
Negative Emotions	0.46* p<0.0001** N=147	0.10 p=0.2319 N=147	-0.10 p=0.2387 N=147	-0.23 p=0.0050** N=147	-0.15 p=0.0703 N=147	-0.19 p=0.0232** N=147

Note: * = Moderate correlation. **=Statistically significant.

Place of employment was analyzed alongside presence of a multidisciplinary team to determine if interdisciplinary teams were more common in medical sites (see Table 16). Correlational statistics found a moderate direct relationship between the presence of a multidisciplinary team and job sites such as craniofacial clinics, hospitals, university speech & hearing clinics, and university hospitals (r=0.30, p=0.0002), or a moderate direct relationship between lack of a multidisciplinary team and non-medical job sites such as public schools, early intervention services, and private practices (r=0.30, p=0.0002).

Table 16 *Correlational Data for Presence of Multidisciplinary Team & Place of Employment*

Pearson Correlation Coefficients, N = 151 Prob > |r| under H0: Rho=0		
	Multidisciplinary Team Not Present	Multidisciplinary Team Present
Medical-Based Job Site	-0.30* p=0.0002**	0.30* p=0.0002**
Non-Medical-Based Job Site	0.30* p=0.0002**	-0.30* p=0.0002**

Note: * = Moderate correlation. **=Statistically significant.

Place of employment was also evaluated to determine if there was a relationship between workplace and availability of assessment instrumentation (see Table 17). There was moderate positive correlation between medical-based place of employment (craniofacial clinic, hospital, university speech and hearing clinic, and university hospital) and presence of nasoendoscopy (r=0.37, p=<0.0001) and videofluoroscopy instrumentation (r=0.39, p=<0.0001). When non-medical-based place of employment was evaluated, nasoendoscopy and videofluoroscopy instrumentation resulted in moderate negative correlations. Though correlation was low, statistical significance was met (α=<0.05) between medical-based place of employment, oral endoscopy instrumentation, and acoustic instrumentation. Relationships between medical-based job sites and other forms of instrumentation (airflow/aerodynamic assessment, lateral cephalometric x-ray, magnetic resonance imaging, and nasometer) were of weak correlation and no statistical significance.

Table 17 *Correlational Data for Instrumentation & Place of Employment*

Pearson Correlation Coefficients, N = 151 Prob > |r| under H0: Rho=0	Medical-Based Job Site	Non-Medical-Based Job Site
Acoustic Assessment	0.29 p=0.0003**	-0.29 p=0.0003**
Airflow/Aerodynamic Instrumentation	0.15 p=0.0598	-0.15 p=0.0598
Lateral Celphalometric X-Ray	0.13 p=0.1131	-0.13 p=0.1131
Magnetic Resonance Imaging	0.16 p=0.0546	-0.16 p=0.0546
Nasoendoscopy	0.37* p<0.0001**	-0.37* p<0.0001**
Nasometer	0.15 p=0.0578	-0.15 p=0.0578
Oral Endoscopy	0.17 p=0.0406**	-0.17 p=0.0406**
Videofluoroscopy	0.39* p<0.0001**	-0.39* p<0.0001**

Note: * = Moderate correlation. **=Statistically significant.

The last correlation with place of employment was with current frequency of clients with AVPD (see Table 18). Analysis revealed no note of moderate or strong correlations among data. A weak positive relationship with statistical significance (α=<0.05) was noted between medical-based place of employment (craniofacial clinic, university speech & hearing clinic, hospital, university hospital) and assessing AVPD on an every few months to monthly basis. Weak positive correlation with statistical significance (α=<0.05) was also found between non-medical-based workplace (early intervention, home care agencies, public schools, private practices) and having no therapeutic contact with the AVPD population. Weak negative correlation with statistical significance (α=<0.05) was found between medical-based place of employment and never assessing AVPD. On the other hand, weak negative correlation with statistical significance was noted between non-medical based workplace and assessing AVPD on an every few month to monthly basis. Correlations between frequency of AVPD patients and medical-based job sites (craniofacial clinic, university speech & hearing clinic, hospital, university hospital) revealed weak relationships of no statistical significance for sites taking in patients rarely, yearly, and weekly.

Table 18 *Correlational Data for Current Frequency of AVPD Clientele & Place of Employment*

Pearson Correlation Coefficients, N = 151 Prob > |r| under H0: Rho=0						
	Never	Rarely	Yearly	Every Few Months	Monthly	Weekly
Medical-Based Job Site	-0.28 p=0.0005**	-0.14 p=0.0931	-0.07 p=0.3870	0.23 p=0.0051**	0.25 p=0.0017**	0.12 p=0.1528
Non-Medical-Based Job Site	0.28 p=0.0005**	0.14 p=0.0931	0.07 p=0.3870	-0.23 p=0.0051**	-0.25 p=0.0017**	-0.12 p=0.1528

Note: * = Moderate correlation. †= Statistically significant.

Discussion

The purpose of this investigation was to survey SLP experiences with the AVPD population with regard to training, assessment protocols, management protocols, and degree of self-efficacy for clinical service provision. Survey questions evaluating current assessment and intervention protocols for AVPD were hypothesized to result in a lack of consensus among respondents due to the variety of protocols implemented among clinicians. Higher frequency of AVPD cases, use of instrumentation, and presence of a multidisciplinary team were hypothesized by the researchers to be in higher occurrence at medical-based clinics. It was also hypothesized that survey data regarding speech-language pathologists' levels of AVPD training would result in reports of limited overall preparedness for working with this population. In addition, perceived self-efficacy ratings for assessing patients with AVPD were hypothesized to be low, with strong relationships between perceived self-efficacy and the following three factors: extent of clinical experience (lack of experience correlated with lower self-efficacy), level of training (poor training correlated with lower self-efficacy), and presence of a workplace multidisciplinary team (lack of multidisciplinary team correlated with lower self-efficacy).

Assessment and treatment methods. As hypothesized, the recommendations for assessment and treatment varied, indicating a lack of consensus for what procedures to implement clinically. The variability reported may have been dependent on site of employment and availability of equipment. The frequent recommendation for oral motor exercises was unexpected given the recent effort to clarify the role of non-speech oral motor exercises and the lack of evidence to support use of these exercises to improve speech production (Lof, 2003). The general lack of clinical consensus among respondents affirms the need for the development of an evidence-based clinical guideline.

Responses on the survey indicated that the use of non-instrumental methods of evaluation, such as oral-mechanism examination, auditory perceptual judgement, and standardized articulation assessment were more prevalent than instrumental assessment methods. This was likely due to their pervasive use during assessment of other speech disorders, accessibility, and low-cost. When a facility or clinician had access to instrumentation, the most common evaluation methods reported were nasoendoscopy, nasometry, and videofluoroscopy. These are all methods that have been encouraged within the most current literature for their input into differential diagnosis (Bettens et al., 2014; Bunton, Hoit, & Gallagher, 2011; Kummer, 2014; Watterson & Grames, 2014). Lateral cephalometric x-ray and magnetic resonance imaging likely had low implementation due to the majority of their use within research studies or specialized clinics (e.g., cleft palate/craniofacial clinic, nasopharyngeal surgery, etc.).

With regard to treatment, the majority of respondents agreed that speech therapy was appropriate for the AVPD population; however, candidacy for speech therapy was not generally agreed upon. Questions regarding candidacy for behavioral intervention resulted in general agreement with the literature for clients with characteristics of mild hypernasality, stable neuromotor disorder, and cognitive stability. However, approximately 30% of respondents reported that behavioral intervention would be appropriate for patients with severe hypernasality and progressive neuromotor disorder, both characteristics which are contraindicated within the literature for behavioral intervention alone (Duffy, 2013; Dworkin and Johns, 1980; Noll, 1982). Also, over half of respondents indicated that speech therapy would be appropriate for patients with intermittent velopharyngeal closure. Though the literature states that speech therapy is not ideal for all patients (especially those with a structural or neurologic etiology), behavioral intervention may have been indicated in certain unpredictable circumstances due to implementations of trial therapy or intervention sessions pre-/post-prosthesis or surgery (Kummer, 2014). Many clinicians implemented oral-motor exercises (OMEs) into the behavioral treatment of AVPD. This was surprising as current scholarly articles indicate that the lack of speech specificity behind OMEs has caused them to be contra-indicated for use in treatment of velopharyngeal dysfunction (Duffy, 2013; Kummer, 2014; Lof, 2003). This further supports why

SLPs should stay up-to-date with the current literature recommendations for evidence-based practice; although, approximately half of respondents indicated that they did not update such protocols on a regular basis. This may be due to preference of earlier learned protocols, lack of initiative in reviewing current literature, or disagreement with updated literature recommendations.

Participants recommended implementation of prosthetic management more frequently than surgical intervention. Clinicians also indicated preference for pharyngeal flap surgery over pharyngeal injection and pharyngeal sphincter procedures. Pharyngeal flap surgery was likely preferred due to the fact that it acts in the same manner as a prosthetic palatal lift device (Kummer, 2014). Decisions between palatal lift and pharyngeal flap surgery are typically based on the patient's medical and airway stability (i.e., prosthesis more likely with less stability), as well as specialist's preference due to previous experiences and accessibility to a prosthetic team. Prosthodontists that build such prosthetic devices are becoming more specialized with time, and locating a team that constructs VPD prosthetics may be difficult. Also, SLPs are likely to be more comfortable recommending referral to a medical professional for further confirmation of treatment rather than recommendation of a specific surgical procedure unless currently trained on a specialized VPD team. Preference for prosthetic management and pharyngeal flap surgery suggest that many of the participants may not work closely with a craniofacial team, the members of which would likely recommend a wider variety of medical solutions for AVPD.

Over three-fourths of the responders agreed that clients with AVPD should be referred to an otolaryngologist (ENT) and a speech-language pathologist with specialized VPD experience. When referring to an otolaryngologist, SLP's must remember the importance of confirming that the ENT has experience treating speech and resonance disorders such as AVPD when referring for adequate clinical care (Kummer, 2014). Also, it was unexpected that only six of the 150 participants specified that they would refer a client with AVPD to a cleft palate/craniofacial clinic, given that these teams are most familiar with VPD assessment and management procedures. However, some speech-language pathologists with special expertise in AVPD may be employed in a number of clinical settings, not limiting specialized clinicians to cleft palate/craniofacial institutions. This implication may have influenced the response for this question, as participants may have had a general interest in AVPD to complete the survey. Also, clinicians may have been reluctant to refer to a cleft palate clinic due to the number of professionals on a cleft team who are not pertinent to the client with AVPD. Other common referrals included prosthodontist or plastic surgeon. It may be that in communities without a local craniofacial team, other clinical pathways for treatment of AVPD have been developed based on local resources. The existence and efficacy of alternate clinical pathways has not been previously well described in the literature.

Characteristics of job site. Medical-based job sites such as cleft palate/craniofacial centers, hospitals, and university speech & hearing clinics were found to be moderately more likely to have a multi-disciplinary team present, as was hypothesized by the researchers. Presence of a team at these facilities may be able to explain the increase in perceived confidence ratings of respondents, as having access to specialized professionals assists in providing competent clinical care. With regard to assessment, though medical-based job sites were not more likely to have access to all forms of instrumentation, they were moderately more likely to have access to nasoendoscopy and videofluoroscopy equipment. These results supported the study hypothesis and the popularity of these assessment methods when accessible.

Though medical-based employment was a factor that affected the presence of multidisciplinary teams and instrumentation, job site did not have the same impact on frequency of AVPD assessment. Having limited to no contact with this population over the course of a year resulted in a weak relationship with non-medical job sites, indicating that job site did not necessarily affect the frequency of working with this population. This may be because AVPD is generally not a high incidence disorder. This is supported by the report of over half of survey participants indicating that they have rarely or never worked with this population over their entire career. Overall, the hypothesis that SLPs who work in a medical setting would be more likely to assess individuals with AVPD was not supported by data outcomes.

Training. The lack of training and direction for updated AVPD protocols reported by over half of responding clinicians supported the researchers' hypothesis and further verified the need for clear clinical practice patterns for this population. Limited training may have been due to the lack of focus for this particular population in undergraduate or graduate curriculum, especially since courses are more likely to focus on congenital forms of velopharyngeal dysfunction (e.g., cleft palate, submucous cleft), and even then coursework in cleft palate related disorders is not required in university SLP curriculums (Vallino, Lass, Bunnell, & Pannbacker, 2008). Also, clients with AVPD are not clinically managed as often as other disordered populations. Therefore, if the most helpful training typically comes from hands-on experience and the likelihood of working with a client presenting symptoms of AVPD is small, clinicians may not receive the on-the-job training or mentoring that has been indicated as most beneficial. Most on-the-job training will likely come from cleft-palate/craniofacial clinics specializing in all forms of velopharyngeal dysfunction. Current knowledge and proposed outlines for standards regarding velopharyngeal dysfunction are encouraging for the development of validated training protocols in the future (Mandulak & Baylis, 2014; Watterson & Grames, 2014).

Overall, hands-on experience post-graduate school was indicated as the most helpful form of AVPD training among respondents. On-the-job experience often involves a qualified SLP mentor and helpful members of a multidisciplinary team that would enhance the training opportunity. All respondents had at least a master's level education with regard to academic training. Survey results indicated a lack of specialized AVPD training in university curriculums, as has been stated in the literature (Mandulak & Baylis, 2014; Pannbacker, 2004; Watterson & Grames, 2014). Undergraduate and graduate practicums may have not been provided experience with this population, limiting training among respondents. However, it should be noted that approximately 65% of survey participants had been working in the field for over 10 years. Therefore, this may not reflect current changes in undergraduate and graduate curriculums. Although no standardized protocol regarding SLP knowledge and skill set has been published, the benefit of continuing education courses for approximately 42% of respondents suggests growing awareness of the necessity for further training with regard to AVPD clinical assessment and management.

Despite the number of possible training outlets, over half of the respondents felt that they were not well trained or only slightly well trained for working with the AVPD population. Due to this lack of training, many clinicians have not updated their methods of evaluation or intervention, despite the ever-changing literature and technology within the field. Also, if training was received, then variables of time post-graduation or post-workshop must be taken into consideration when determining if implemented protocols are based on the most current research or not. In fact, implementation of current clinical protocols was supported based on areas of sufficient training, while methods that require additional instruction were not typically used by respondents (see Figure 2). This supported how training affects the currency and specificity of assessment and treatment methods exercised by practicing clinicians. If clinicians are not trained with regard to the most current, evidence-based protocols, then it is not likely that new strategies will be implemented. With updated training, clinicians may be more prone to update their strategies to a methodology that is based around the most current research.

Perceived self-efficacy. With regard to three of the four Bandura information sources of self-efficacy (mastery experience, vicarious experience, verbal persuasion), most participants reported higher confidence levels via vicarious experience. This finding supported the earlier concept that the most helpful training develops from hands-on experience (e.g., clinical fellowship, mentorship, or professional practice). Therefore, working with a mentor and receiving valuable experience with the AVPD population likely improves quality of patient care as high self-efficacy and adequate training directly affects clinician performance. Mentorships should be encouraged; however, access to mentors specializing in VPD may be limited, further explaining low reports of adequate training. Clinicians who specialize in the assessment and treatment of AVPD should consider developing and offering mentor opportunities during or post-graduate education to help meet the need reported in this study's findings. The difficulty of training all areas of speech-language practices into a two-year graduate education curriculum is recognized. Therefore, specialty tracks for AVPD training during or post-graduate education is another option for supplementing the need for more training and hands-on experience.

Many SLPs also reported being less affected than anticipated with regard to Bandura's physiological and affective self-efficacy source, as more positive emotions were indicated. Respondents stated that they often felt calm and comfortable when working with clients diagnosed with AVPD, though low confidence ratings and more negative emotions were hypothesized by the researchers. Based on participant's comments, more positive emotions may have been reported due to the clinicians' beliefs that they would assess in a confident manner as to develop proper rapport and encourage the client.

Overall, the largest number of respondents indicated high perception of self-efficacy when working with clients of the AVPD population. Though reports of low levels of self-efficacy were anticipated via the study hypotheses, various factors may have had an impact on higher levels of perceived self-efficacy. First, participants that responded to this survey may have had a general interest with this population that could account for over-estimates in confidence numbers. Second, since the self-efficacy questions were targeted primarily toward AVPD assessment, clinicians may have felt more confident evaluating the characteristics of this speech disorder versus treating the impairment. As auditory-perceptual evaluation stands as the "gold standard" in assessing a speech or resonance disorder, knowing that they could hear evidence of hypernasality, hyponasality, nasal emission, short phrase length, and/or distorted pressure consonants/vowels could have been a strength in determining clinicians' perceived clinical confidence. However, determining the etiology and correct method of treatment from speech alone may lower perceived self-efficacy ratings for clinical management of AVPD. In fact, certain respondents indicated within open text responses that they believed treating AVPD would be difficult. Therefore, if an additional question was added to the questionnaire to determine perceived self-efficacy when managing clients of the AVPD population, ratings may have been lower as anticipated. In addition, more moderate correlations may have resulted due to many aspects of the assessment process being a routine part of multiple other evaluation protocols. Therefore, higher levels of self-efficacy were reported due to confidence in basic aspects of the assessment process. Also, due to the high level of academic training that speech-language pathologists undergo and the competitive nature with regard to acceptance into core programs, SLPs may have more self-efficacy and confidence in general. Perhaps the relationships were more moderate due the confidence that the field instills into clinicians from the beginning of curriculum training. Lastly, when clinicians did not feel competent in their abilities to treat a patient, they often referred to a more specialized professional. Therefore, the surprisingly high levels of perceived self-efficacy among clinicians may have been due to their confidence in knowing that they would assess and refer the client to an appropriate specialist.

Correlations between self-efficacy ratings and reported employment on a multi-disciplinary team, degree of experience, and level of training were varied. The hypotheses for a strong correlations among these variables were not supported. Stronger correlations may have been observed with a larger number of participants. To illustrate the variety in self-efficacy correlation reports, presence of a multi-disciplinary team increased the likelihood of feeling positive emotions when working with the AVPD population, but had a weaker impact on influencing general self-efficacy responses. When working with members of multiple disciplines, data analyses indicated that emotional confidence increased due to the insight and experience that the SLP could rely on for guidance within the team. Levels of self-efficacy may have had a weak correlation with presence of a multi-disciplinary team due to the high number of participants (~61%) that indicated they did not have a team within their workplace. Therefore, if only around 38% of respondents were able to reliably interpret their perceived self-efficacy levels based on presence of a multi-disciplinary team, this may have limited strength of correlational outcomes.

Degree of client experience and perceived self-efficacy levels had more correlational strength than the previous measure within this discussion. Overall, a moderate, indirect relationship was found between confidence ratings and having no client experience with AVPD. In other words, there was a linear relationship between no client experience and lower ratings of self-efficacy. Consistent with this finding, most individuals indicated more negative emotions when having no experience with AVPD. Perhaps a moderate relationship was associated with no client interaction due to the importance that hands-on clinical experience plays in training and feeling prepared for assessing a speech disorder. However, relationships were not strong, and therefore did not support the researchers' hypothesis. Relationships between self-efficacy ratings and clinicians that manage AVPD on a regular basis may not be as evident due to the small number of participants that met this criterion in comparison to the large number of participants that rarely worked with this population. Overall, more participants may have impacted stronger correlational outcomes.

With regard to training, there were moderate negative correlations with mastery experience, verbal persuasion, positive emotions, and general self-efficacy ratings when respondents felt that they were not well prepared. This indicated that when responses reporting poor training increased, perceived self-efficacy levels decreased (or vice versa). Moderate positive relationship was found between feeling poorly prepared and having negative emotions towards AVPD assessment. On the other hand, when feeling extremely well prepared, respondents demonstrated moderate positive relationships with mastery experience and verbal persuasion ratings. Further, data emphasized that more client experience with AVPD supported feeling confident without mentor assistance, but morale and efficacy were strengthened when encouraged from outside sources. Also, a moderate relationship was noted between feeling positive emotions and moderate preparedness via training. Therefore, this indicates that feeling prepared increases the likelihood of feeling calm, comfortable, and confident during the assessment process. Though all of these results were anticipated, they do not support the initial hypotheses for strong correlations. Stronger correlations may have been observed with a larger participant pool. Also, though general report of training was low and self-efficacy was high, this difference in data may be explained by variables such as greater confidence levels with areas of assessment versus treatment or proficient referrals.

Clinical guideline development. Following data analysis and review of the literature to confirm current assessment and intervention practices, a clinical guideline was developed as an inquiry form aimed at guiding decision making for appropriate diagnostic recommendations in the AVPD population. The development of a clinical guideline with regard to assessment and clinical management of the AVPD population was encouraged by approximately 93% of survey respondents. In addition, multiple factors from our data analysis emphasized the importance of the development of a clinical guide for AVPD. For instance, the lack of consensus with regard to assessment and treatment protocols supported the thought that a functional guide would be beneficial for stream-lining recommendation of services, even for etiology-specific AVPD cases. Also, treatment recommendations not supported within the literature further indicated that having a tool to aid in the clinical management for this population would assist in encouraging evidence-based practices. Finally, the relative consensus that training with regard to AVPD was limited indicated that this guide may be able to aid in future training directives.

The proposed clinical guideline was developed via extensive review of treatment literature for AVPD with regard to behavioral, surgical, and prosthetic means (see Tables 5, 6, & 7). The researchers reviewed the literature via online periodicals/databases (e.g., PubMed, PsychInfo, GoogleScholar, etc.) and textbooks focused on voice/resonance disorders, motor speech disorders, and cleft palate (due to possible carry-over of discussion) to find pertinent standards for clinical management of AVPD. Intervention criteria from the literature were included in the guideline if supported by more than one clinical researcher, or discussed by one clinical researcher and viewed as an important deciding factor among researchers of this study. Citations of literature sources were arranged within the guideline to provide clinicians with verification of evidence-based support for clinical reasoning.

The document was termed a “clinical guideline” rather than a “clinical pathway” due to it serving more as confirmation of clinical judgement and recommendation of clinical management instead of a standardized step-wise sequence of care/goals (De Bleser, et al., 2006; Campbell, Hotchkiss, Bradshaw, & Porteous, 1998). The guideline itself was developed as a ratio calculation, taking into account factors such as functional communication ability, severity of the resonance disorder, co-occurring disease/disorder, etiology of AVPD, personal anatomy/physical structure, stimulability, and contraindications. To allow for ease of ratio/percentage calculation without use of a calculator, initial intervention criteria were narrowed to 10 diagnostic statements within each intervention category that were pertinent to determining plan of care. In order to decide which statements added unique, vital information to the guideline, a factor study was completed to find which diagnostic statements changed outcomes (and needed to stay within the guideline) and which did not alter outcomes (and could be removed from the guideline) against case studies (discussed below). Development intended for easy comprehension and decision-making in order to assist SLPs in determining the best evidence-based recommendation for clients presenting with symptoms of AVPD.

The clinical guideline was developed based on literature findings in order to improve efficiency of care, minimize assessment/treatment variation (with regard to implementation of evidence-based vs. non-evidence-based protocols), reduce patient complications, and encourage cost-effectiveness (De Bleser et al., 2006; Rotter et al., 2010). The following instructions explain use of the clinical guideline:

> First, complete a thorough assessment of the patient to gather relevant information regarding speech concerns and histories (e.g., medical, social, vocational, etc.). Following evaluation, respond in each behavioral, surgical, and prosthetic referral section by circling a *1* if the diagnostic statement can be answered with a *yes* or *0* if it can be answered with a *no.* Once all questions have been answered, add the total raw score in each intervention section and write it in the blank provided to the right of each intervention section. Divide the raw score by 10 and calculate the percent of implementation for each intervention plan. Compare all three management plans to determine which percentage of implementation is larger and indicates further treatment development.

Validation was not within the scope of this investigation; however, to evaluate initial efficacy of this clinical guideline for the AVPD population, the questionnaire was evaluated against three case studies described in the literature. Cases were selected via literature review. The graduate researcher searched online periodicals, databases, and textbooks (e.g., PubMed; PsychInfo; GoogleScholar; Duffy, 2013; Kummer, 2014; etc.) for case studies discussing acquired nasality and specific treatment protocol. Search engine keywords/phrases included *acquired velopharyngeal dysfunction, behavioral intervention/speech therapy, surgical intervention,* and *prosthetic intervention/palatal lift.* The three cases chosen were selected based on thoroughness of case study content so that the majority of the guideline's diagnostic statements could be addressed, and clarity of treatment recommendation for one of the three intervention categories to determine level of effectiveness for guideline outcomes against literature outcomes. The case studies were not all inclusive for each diagnostic statement; therefore, inferences were made with regard to typical patterns/behaviors associated with respective diagnoses. The clinical guideline was analyzed across case studies and results were confirmed by the graduate researcher as well as a Ph.D. certified speech-language pathologist.

The first case study was a client presentation and video sample from a well-regarded craniofacial disorders text (Kummer, 2014). The client was described to have phoneme-specific nasal emission for all sibilant sounds due to substitution of posterior nasal fricative. This pattern was described as velopharyngeal mislearning, indicating that the speech disorder was a learned behavior in the absence of remarkable structural, iatrogenic, or neurological medical history. Via video assessment, the client was noted to have consistent errors on all sibilant phonemes with mild severity and was stimulable for correct production of errored phonemes. Using this information to address diagnostic statements within the clinical guideline, the following scores were gathered: 90% (9/10) for behavioral intervention, 50% (5/10) for surgical intervention, and 20% (2/10) for prosthetic intervention. Use of the clinical guideline for this case example indicated a strong preference for behavioral intervention versus referral for surgical or prosthetic management. This was consistent with the recommendation of speech therapy described in the text.

The second case was evaluated against a case study described by Kummer et al., (2015) discussing non-cleft etiologies for velopharyngeal dysfunction (VPD). The client's medical history was significant for traumatic brain injury secondary to a motorcycle accident. Following

20 months of extensive speech therapy to implement an AAC system, the client's speech was re-evaluated. Secondary assessment revealed appropriate mobility of extremities (e.g., grasping, walking, etc.), cognition, and expressive language skills with evidence of dysarthria. His speech was remarkable for severe hypernasality, slow rate (affecting multiple articulators), low volume, and poor breath support (secondary to increased nasal airflow). Within the framework of the proposed clinical guideline, the following scores were gathered: 40% (4/10) for behavioral intervention, 90% (9/10) for surgical intervention, and 60% (6/10) for prosthetic intervention. The clinical guideline suggests referral for possible surgical intervention. This outcome is consistent with the recommendations described by Kummer and colleagues (2015).

The third case was gathered from Gonzalez and Aronson (1970). The client's medical history was significant for diagnosis of Myasthenia Gravis (MG). One month post-thymectomy surgery, a speech and resonance assessment indicated dysarthria characterized by severe hypernasality, nasal emission, breathiness, and poor articulatory coordination. Due to gradual muscle weakness, as is typical with MG, the client's intelligibility declined after a period of speaking. Using this information to apply the clinical guideline, the following scores were gathered: 30% (3/10) for behavioral intervention, 50% (5/10) for surgical intervention, and 80% (8/10) for prosthetic intervention. Therefore, referral for prosthetic management could be further explored as an intervention option for this client. This outcome was supported by the recommendation of palatal lift for this patient by Gonzalez and Aronson (1970).

While all of the cases against which the guideline was analyzed resulted in a clear preference for a particular intervention recommendation, it is acknowledged that this may not always be the case. If the clinician feels that two percentages of implementation are too close to make a definite decision with the guide alone, the client's presentation, concerns, and goals for speech intervention should be taken into consideration and best clinical judgment should guide such management decisions. To view the clinical guideline in its entirety, please refer to Appendix D.

The advantages of this clinical guideline include the ease of implementation and scoring with an average/ratio format. By simply adding the sum of each section, an easier percentage or ratio of implementation is gathered with 10 questions in each section. Additionally, the guideline was developed following extensive review of the published evidence and typical clinical practice patterns for management of AVPD (as noted by citations provided on the guideline), all of which were distilled into a single page clinically-useful guide. Areas of improvement for this clinical guideline include validating it. Though the guideline was evaluated against three cases from the literature, two were from the same expert and one was outdated or possibly not reflective of the most current medical recommendations. Future research should aim to validate the guide against multiple cases from a range of clinical sources. Validation will confirm clinical-appropriateness of the guideline. Lastly, this document guides the clinician's decision as to who is appropriate for what form of intervention, but not what to do once an intervention method has been selected. This allows for flexibility and adaptability to account for practice pattern differences and availability of services.

Critiques and future directions. One advantage of this study included survey response rate, as the researchers anticipated 100 responses and were able to obtain over 150 completed questionnaires. Study results were further supported by widespread geographical representation. Forty-six of the fifty U.S. states participated in this survey, allowing for adequate clinician portrayal among geographical regions. Also, many of the survey outcomes supported what has been stated within the review of the most current literature. One of the most important benefits of this research is the potential clinical impact of the literature review and survey to distill the literature into a clinically useful guideline for this special population. This effort provided evidence regarding limited specialized AVPD training, lack of consistent assessment and treatment protocols, and limited AVPD experiences. The need for a cohesive clinical guide for the AVPD population was supported.

It is acknowledged that the self-efficacy scale within the questionnaire lacked validation. Question development may have been interpreted as vague by survey respondents. Given that there was no readily available questionnaire validated for this population at the time of survey development, the adaptation of existing questions was a reasonable start to this line of inquiry. Additionally, future efforts at survey development should include specific response choices that may have impacted outcomes within the current survey (e.g., option of selecting craniofacial clinic for referral recommendations; clarification of *non-speech* oral motor exercises). This limitation was offset by provision of an open text response option.

Future directions for this line of inquiry could include a review of current graduate program coursework to provide more explicit data on curriculum-based training regarding AVPD. For instance, it is not explicit where students receive the majority of this training in school, as our study found that clinicians learned about AVPD in classes such as cleft palate/craniofacial disorders, voice and resonance disorders, motor speech disorders, and more. Also, survey input from more recent graduates may be insightful of updated clinical protocols and training patterns. Since only around 20% of respondents had 5 or less years of experience in the field, different outcomes for training and clinical protocols may result if newer graduates are targeted in future surveys as they are taught the most current evidence-based curriculum. Another area of interest due to the low number of referrals of clients with AVPD to cleft palate/craniofacial clinics involves further research to determine prevalence of cases in these settings. Prevalence data has not been reported as of yet with regard to AVPD cases. Therefore, analyzing diagnostic codes and gathering input from clinicians in cleft palate/craniofacial centers would be an excellent place to begin to record prevalence of this disorder within the field of speech-language pathology.

Conclusion

Acquired Velopharyngeal Dysfunction (AVPD) is a disorder that requires specialized training, assessment protocols, and intervention guidelines. While there are numerous publications with regard to congenital forms of VPD, knowledge and skills with regard to AVPD have not been established. Therefore, clinicians typically feel underprepared and less confident when treating this client population due to limited training and lack of hands-on clinical experience. Assessment and treatment protocols are generally variable among clinicians with lack of consensus with regard to best plan of action when VPD is due to acquired structural, iatrogenic, or neurological etiology. Development of a proposed clinical guideline may be a functional tool within clinical settings when evaluating and determining plan of care for patients with AVPD. Though research has begun to determine the importance of acquired etiologies of VPD, further studies are encouraged to standardize knowledge and skill sets for training purposes, as well as to agree upon best evaluation and intervention plans.

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Appendix A

Institutional Review Board Research Approval

AUBURN UNIVERSITY INSTITUTIONAL REVIEW BOARD for RESEARCH INVOLVING HUMAN SUBJECTS

REQUEST FOR EXEMPT CATEGORY RESEARCH

For Information or help completing this form, contact: **THE OFFICE OF RESEARCH COMPLIANCE**, 115 Ramsay Hall
Phone:334-844-5966 **e-mail**: IRBAdmin@auburn.edu **Web Address**:http://www.auburn.edu/research/vpr/ohs/index.htm

Revised 2/1/2014 **Submit completed form to IRBsubmit@auburn.edu or 115 Ramsay Hall, Auburn University 36849.**

Form must be populated using Adobe Acrobat I Pro 9 or greater standalone program (do no! fill out in browser). Hand written forms will not be accepted.

Project activities may not begin until you have received approval from the Auburn University IRB.

1. **PROJECT PERSONNEL & TRAINING**

PRINCIPAL INVESTIGATOR (PI):

Name Kelsey Boman **Title** Graduate Student **Dept/School** CMDS

Address 1199 Haley Center **AU Email** kab0088@auburn.edu

Phone (205) 712-3994 **Dept. Head** Nancy Haak, Ph.D.

FACULTY ADVISOR (if applicable):

Name Mary Sandage, Ph.D. **Title** Assistant Professor **Dept/School** CMDS

Address 1199 Haley Center

Phone (334) 844-9646 **AU Email** sandamj@auburn.edu

KEY PERSONNEL: **List Key Personnel (other than PI and FA).** Additional personnel may be listed in an attachment.

Name	Title	Institution	Responsibilities
Kelsey Boman, B.S.	Graduate Student	Auburn University	Survey development, monitoring survey, data analysis, manuscript prep
Mary Sandage, Ph. D.	Assistant Profess.	Auburn University	Faculty advisor, monitoring survey, data analysis, manuscript prep

KEY PERSONNEL TRAINING: **Have all Key Personnel completed CITI Human Research Training (including elective modules related to this research) within the last 3 years?** ☒ **YES** ☐ **NO**

TRAINING CERTIFICATES: **Please attach CITI completion certificates for all Key Personnel.**

2. **PROJECT INFORMATION**

Title: Acquired Velopharyngeal Dysfunction Assessment: Speech Language Pathologists' Perceived Competence and Proposed Clinical Pathway

Source of Funding: ☐ **Investigator** ☐ **Internal** ☐ **External**

List External Agency & Grant Number: N/A

List any contractors, sub-contractors, or other entities associate with this project.
N/A

List any other IRBs associated with this project including those involved with reviewing, deferring, or determinations).
N/A

FOR ORC OFFICE USE ONLY

DATE RECEIVED IN ORC: ______ by ______
DATE OF R
DATE OF O

APP
APP
INTE

Add this approval information in sentence form to your electronic

The Auburn University Institutional Review Board has approved this Document for use from 07/23/2016 to 07/22/2019

Protocol # 16-264 EX 1607

3. PROJECT SUMMARY

a. Does the research involve any special populations?

- ☐ YES ☒ NO Minors (under age 19)
- ☐ YES ☒ NO Pregnant women, fetuses, or any products of conception
- ☐ YES ☒ NO Prisoners or Wards
- ☐ YES ☒ NO Individuals with compromised autonomy and/or decisional capacity

b. Does the research pose more than minimal risk to participants? ☐YES ☒NO

Minimal risk means that the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests. 42 CFR 46. 102(Q

c. Does the study involve any of the following?

- ☐ YES ☒ NO **Procedures subject to FDA Regulation** Ex. Drugs, biological products, medical devices,
- ☐ YES ☒ NO **Use of school records of identifiable students or information from instructors about specific students.**
- ☐ YES ☒ NO **Protected health or medical information when there is a direct or indirect link that could identify the participant.**
- ☐ YES ☒ NO **Collection of sensitive aspects of the participant's own behavior, such as illegal conduct, drug use, sexual behavior, or use of alcohol.**
- ☐ YES ☒ NO **Deception of participants.**

If you checked "YES" to any response in Question #3 STOP. It is likely that your study does not meet the "EXEMPT" requirements. Please complete a PROTOCOL FORM for Expedited or Full Board Review.
You may contact /RB Administration for more information. {Phone: 334-844-5966 or Email: IRBAdmin@aubum. edu)

4. **PROJECT DESCRIPTION**

a. Subject Population (Describe, include age, special population characteristics, etc.)

Speech-language pathologists recruited for this survey must possess at least a graduate level education, a license to practice speech-language pathology in his/her respective state, and may or may not have previous experience assessing and/or treating patients with acquired VPD. Participants will not be narrowed based on factors such as age range, race, client caseload, years of professional experience, working environment, or clinician area of expertise in order to allow for the responses to be genuinely random, without any sway of a particular population or experimenter bias.

b. Describe, step by step, all procedures and methods that will be used to consent participants.

☐ **N/A (Existing data will be used)**

Potential participants will directly receive via email or have on-line access to an information letter describing the nature of the study with assurance of anonymity. Interested participants will then indicate their agreement for participation by accessing the link embedded in the information letter and continuing past the introductory statement of the survey. A copy of the introduction letter and consent statement is attached to this IRB request.

c. Brief summary of project. (Include the research question(s) and a brief description of the methodology, including recruitment and how data will be collected and protected.)

The purpose of this study is twofold: 1) investigate the professional training and clinical practices of speech-language pathologists regarding evaluation and clinical management of acquired VPD; and 2) query the overall perceived self-efficacy of clinicians when confronted with clients of this population. For this study, 100 or more state-certified speech-language pathologists within the United States of America with at least a graduate level education will be recruited to participate in an anonymous, on-line survey. Participants will be recruited from various ASHA Special Interest Groups, members of each state's ASHA Community membership directory, ASHA's Community and Facebook public sites, and state professional speech/language/hearing associations via an electronic information letter. The information letter and corresponding web-link to the web-based survey will be sent via email and/or public post to social media internet sites. The on-line survey will be conducted via Qualtrics, an Auburn University-approved survey management software. The data will be anonymous, password-protected, and only accessible by the key personnel listed above. Data gathered via Qualtrics will be transferred to an Excel file, coded in an anonymous manner, for subsequent data analyses. The Excel file data will be maintained on Dr. Sandage's password protected share drive on her research computer which is located in her locked laboratory, 1221 Haley Center. All data collected and maintained will be completely anonymous and will not in any way be linked to the participants' identity.

d. Waivers. Check any waivers that apply and describe how the project meets the criteria for the waiver.

☒ **Waiver of Consent (Including existing de-identified data)**

☒ **Waiver of Documentation of Consent (Use of Information Letter)**

☒ **Waiver of Parental Permission (for college students)**

This research project involves a nationwide on-line survey to collect anonymous data regarding the aims of this study. There will be no locations for personal identification available on the survey form, de-identifying survey responses. This survey is limited to speech-language pathologists with at least a master's degree, placing the average participant at 23 years or older, meeting the State of Alabama requirement for parental exemption.

e. **Attachments.** Please attach Informed Consents, Information Letters, data collection instrument(s), advertisements/recruiting materials, or permission letters/site authorizations as appropriate.

Signature of Investigator Kelsey Byma Date 6/27/16

Signature of Faculty Advisor Mary J Sandage Date 6/27/16

Signature of Department Head [signature] Date 6/29/16

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COURSEWORK REQUIREMENTS REPORT*

*NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- Name: Mary Sandage (ID: 970228)
- Institution Affiliation: Auburn University (ID: 964) 334-
- Phone: 844-1479

- Curriculum Group: IRB Additional Modules
- Course Learner Group: Biomedical Research
- Stage: Stage 1 - Basic Course
- Description: Choose this group to satisfy CITI training requirements for Investigators and staff involved primarily in biomedical research with human subjects •

- Report ID: 19359698
- Completion Date: 05/18/2016
- Expiration Date: 05/18/2019
- Minimum Passing: 80
- Reported Score*: 96

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
Avoiding Group Harms - U.S. Research Perspectives (ID: 14080)	05/18/16	3/3 (100%)
Populations in Research Requiring Additional Considerations and/or Protections (ID: 16680)	05/18/16	5/5 (100%)
Belmont Report and CITI Course Introduction (ID: 1127)	05/18/16	3/3 (100%)
Students in Research (ID: 1321)	05/18/16	4/5 (80%)
History and Ethical Principles - SBE (ID: 490)	05/18/16	5/5 (100%)
Basic Institutional Review Board (IRB) Regulations and Review Process (ID: 2)	05/18/16	5/5 (100%)
Informed Consent (ID: 3)	05/18/16	5/5 (100%)
Social and Behavioral Research (SBR) for Biomedical Researchers (ID: 4)	05/18/16	4/4 (100%)
Records-Based Research (ID: 5)	05/18/16	3/3 (100%)
Vulnerable Subjects - Research Involving Children (ID: 9)	05/18/16	3/3 (100%)
Internet-Based Research - SBE (ID: 510)	05/18/16	5/5 (100%)
Research and HIPAA Privacy Protections (ID: 14)	05/18/16	4/5 (80%)
Vulnerable Subjects - Research Involving Workers/Employees (ID: 483)	05/18/16	4/4 (100%)
Auburn University (ID: 12239)	05/18/16	No Quiz

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing Institution identified above or have been a paid Independent Learner.

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COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COURSEWORK TRANSCRIPT REPORT**

** NOTE: Scores on this Transcript Report reflect the most current quiz completions, including quizzes on optional (supplemental) elements of the course. See list below for details. See separate Requirements Report for the reported scores at the time all requirements for the course were met.

- Name: Mary Sandage (ID: 970228)
- Institution AfflllatIon: Auburn University (ID: 964)
- Phone: 334-844-1479

- Curriculum Group: IRB Additional Modules
- Course Learner Group: Biomedical Research
- Stage: Stage 1 - Basic Course
- Description: Choose this group to satisfy CITI training requirements for Investigators and staff involved primarily in biomedical research with human subjects.

- Report ID: 19359698
- Report Date: 05118/2016
- Current Score**: 93

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informed Consent (ID: 3)	05/18/16	5/5 (100%)
History and Ethical Principles - SBE (ID: 490)	05/18/16	5/5 (100%)
Social and Behavioral Research (SBR) for Biomedical Researchers (ID: 4)	05/18/16	4/4 (100%)
Belmont Report and CITI Course Introduction (ID: 1127)	05/18/16	3/3 (100%)
Records-Based Research (ID: 5)	05/18/16	3/3 (100%)
Vulnerable Subjects - Research Involving Children (ID: 9)	05118116	313 (100%)
Vulnerable Subjects - Research Involving Pregnant Women, Human Fetuses, and Neonates (ID: 10)	07122/13	313 (100%)
Group Harms: Research With Culturally or Medically Vulnerable Groups (ID: 11)	*08107108*	213 (67%)
Research in Public 8ementary and Secondary Schools - SBE (ID: 508) International	07/22113	3/4 (75%)
Studies (ID: 971)	07/22/13	213 (67%)
Internet-Based Research - SBE (ID: 510) Research	05/18/16	5/5 (100%)
and HIPAA Privacy Protections (ID: 14)	05/18/16	4/5 (80%)
Vulnerable Subjects - Research Involving Workers/Employees (ID: 483)	05/18/16	4/4 (100%)
Avoiding Group Harms - U.S. Research Perspectives (ID: 14080)	05/18/16	3/3 (100%)
Basic Institutional Review Board (IRB) Regulations and Review Process (ID: 2)	05/18/16	5/5 (100%)
Populations in Research Requiring Additional Considerations and/or Protections (ID: 16680)	05/18/16	5/5 (100%)
Auburn University (ID: 12239)	05/18/16	No Quiz

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COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COURSEWORK REQUIREMENTS REPORT"

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- Name: Mary Sandage (ID: 970228)
- Institution Affiliation: Auburn University (ID: 964) 334-
- Phone: 844-1479

- Curriculum Group: CITI Conflicts of Interest
- Course Leamer Group: Conflicts of Interest
- Stage: Stage 1 - Stage 1

- Report ID: 9694887
- Completion Date: 02107/2013
- Expiration Date: 02107/2017
- Minimum Passing: 80
- Reported Score*: 84

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
CITI Conflict of Interest Course - Introduction (COi-Basic) (ID: 15177)	02107/13	No Quiz
Financial Conflicts of Interest: Overview, Investigator Responsibilities, and COi Rules (COi-Basic) (ID: 15070)	02107/13	8/10 (80%)
Institutional Responsibilities as They Affect Investigators (COi-Basic) (ID: 15072)	02107/13	4/5 (80%)
Conflicts of Commitment and Conscience (COi-Basic) (ID: 15073)	02107/13	*414* (100%)

For this Report to be valid, the learner identified above must have had a valld afflllatlon with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

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COURSEWORK TRANSCRIPT REPORT**

** NOTE: Scores on this Transcript Report reflect the most current quiz completions, including quizzes on optional (supplemental) elements of the course. See list below for details. See separate Requirements Report for the reported scores at the time all requirements for the course were met.

- Name: Mary Sandage (ID: 970228)
- Institution Affiliation: Auburn University (ID: 964)
- Phone: 334-844-1479

- Curriculum Group: CITI Conflicts of Interest
- Course Learner Group: Conflicts of Interest
- Stage: Stage 1 - Stage 1

- Report ID: 9694887
- Report Date: 06/27/2016
- Current Score-: 84

REQUIRED, ELECTIVE, AND-SUPPLEMENTAL MODULES	MOSTECENT	sqbRE
cm conflict of ltrest Course - Introduction (COi-Basic) (ID: 15177)	02/07/13	No Quiz 8/10
Financial Conflicts of Interest: Overview, Investigator Responsibilities, and COi Rules (COi-Basic) (ID: 15070)	02/07/13	(80%)
Institutional Responsibilities as They Affect Investigators (COi-Basic) (ID: 15072)	02/07/13	4/5 (80%)
Conflicts of Commitment and Conscience (COi-Basic) (ID: 15073)	02107/13	*414* (100%)

For this Report to be valid, the learner identified above must have had a valid affllatlon with the cm Program subscribing Institution identified above or have been a paid Independent Learner.

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COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COURSEWORK REQUIREMENTS REPORT*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- Name: Kelsey Boman (ID: 5224408)
- Email: haaknan@aubum.edu Auburn
- Institution Affiliation: University (ID: 964) Communication
- Institution Unit: Disorders 334-844-9600
- Phone:

- Curriculum Group: IRB Additional Modules
- Course Leamer Group: Basic Institutional Review Board (IRB) Regulations and Review Process
- Stage: Stage 1- Basic Course

- Report ID: 17967627
- Completlon Date: 11/30/2015
- Expiration Date: 11/30/2018
- Minimum Passing: 80
- Reported Score*: 100

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
Basic Institutional Review Board (IRB) Regulations and Review Process (ID: 2)	11/30/15	5/5 (100%)

For this Report to be valid, the learner identified above must have had a valid affiliatlon with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

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COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COURSEWORK REQUIREMENTS REPORT*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores. including those on optional (supplemental) course elements.

- Name: Kelsey Boman (ID: 970228)
- Institution Affilliation: Auburn University (ID: 954) 334-
- Phone: 844-1479

- Curriculum Group: Responsible Conduct of Research for Biomedical
- Course Learner Group: Biomedical Sciences RCR
- Stage: Stage 1 - RCR
- Description: This course is for investigators, staff and students with an interest or focus in Biomedical Research. This course contains text, embedded case studies AND quizzes.

- Report ID: 17967618
- Completion Date: 12110/2015
- Expiration Date: 1.2110/2020
- Minimum Passing: 80
- Reported Score*: 96

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
Authorship (RCR-Basic) (ID: 16597) Collaborative	12107/15	5/5 (100%)
Research (RCR-Baslc) (ID: 16598) Conflicts of	12108/15	5/5 (100%)
Interest (RCR-Basic) (ID: 16599) Data	12/08/15	5/5 (100%)
Management (RCR-Basic) (ID: 16600) Mentoring	12/08/15	*515* (100%)
(RCR-Baslc) (ID: 16602)	12/08/15	*515* (100%)
Peer Review (RCR-Baslc) (ID: 16603) Research	12/08/15	4/5 (80%)
Misconduct (RCR-Baslc) (ID: 16604) Plagiarism	12/08/15	5/5 (100%)
(RCR-Basic) (ID: 15156)	12110/15	4/5 (80%)
Using Animal Subjects In Research (RCR-Basic) (ID: 13301)	12110/15	*515* (100%)
Research Involving Human Subjects (RCR-Basic) (ID: 13566)	12/10/15	*515* (100%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

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COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COURSEWORK TRANSCRIPT REPORT**

** NOTE: Scores on this Transcript Report reflect the most current quiz completions, including quizzes on optional (supplemental) elements of the course. See list below for details. See separate Requirements Report for the reported scores at the time all requirements for the course were met.

- Name: Kelsey Boman (ID: 970228)
- Institution Affiliation: Auburn University (ID: 964)
- Phone: 334-844-1479

- Curriculum Group: Responsible Conduct of Research for Biomedical
- Course Leamer Group: Biomedical Sciences RCR
- Stage: Stage 1 - RCR
- Description: This course is for investigators. staff and students with an interest or focus In Biomedical Research. This course contains text, embedded case studies AND quizzes.

- Report ID: 17967618
- Report Date: 06/27/2016
- Current Score**: 96

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	12 10115. ·..·:;- '"·-	5/5"(100%)"
ising Animarsi];d;; 1r,· R:es'earcti (Rc {-sasic> cl'o: 13301>	12/10/15	5/5 (100%)
Research Involving Human Subjects (RCR-Basic) (ID:	12110/15	415 (80%)
13566) Plagiarism (RCR-Basic) (ID: 15156)	12107/15	515 (100%)
Authorship (RCR-Basic) (ID: 16597)	12108/15	5/5 (100%)
Collaborative Research (RCR-Basic) (ID: 16598)	12/08/15	5/5 (100%)
Conflicts of Interest (RCR-Baslc) (ID: 16599)	12/08/15	515 (100%)
Data Management (RCR-Basic) (ID: 16600)	12/08/15	5/5 (100%)
Mentoring (RCR-Basic) (ID: 16602)	12108/15	415 (80%)
Peer Review (RCR-Basic) (ID: 16603)		
Research Misconduct (RCR-Basic) (ID: 16604)	12108/15	515 (100%)

For this Report to be valid, the learner Identified above must have had a valid affiliation with the CITI Program subscribing Institution Identified above or have been a paid Independent Leamer

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COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COURSEWORK REQUIREMENTS REPORT*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- Name: Kelsey Boman (ID: 970228)
- Institution Affiliation: Auburn University (ID: 964)
- Phone: 334-844-1479

- Curriculum Group: IRB Additional Modules
- Course Learner Group: Conflicts of Interest in Research Involving Human Subjects
- Stage: Stage 1- Basic Course

- Report ID: 17967620
- Completion Date: 12/17/2015
- Expiration Date: 12/17/2018
- Minimum Passing: 80
- Reported Score*: 100

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE 5/5
Conflicts of Interest in Research Involving Human Subjects (ID: 488)	12/17/15	(100%)

For this Report to be valid, the learner identified above must have had a valid affillatlon with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

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COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COURSEWORK REQUIREMENTS REPORT*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- Name: Kelsey Boman (ID: 970228)
- Institution Affiliation: Auburn University (ID: 964)
- Phone: 334-844-1479

- Curriculum Group RB Additional Modules
- Course Learner Group: History and Ethics of Human Subjects Research
- Stage: Stage 1 - Basic Course

- Report ID: 17967623
- Completion Date: 01/10/2016
- Expiration Date: 01/10/2019
- Minimum Passing: 80
- Reported Score*: 100

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
History and Ethics of Human Subjects Research (ID: 498)	01/10/16	*717* (100%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing Institution identified above or have been a paid Independent Learner.

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COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COURSEWORK REQUIREMENTS REPORT*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- Name: Kelsey Boman (ID: 970228)
- Institution Affiliation: Auburn University (ID: 964)
- Phone: 334-844-1479

- Curriculum Group RB Additional Modules
- Course Learner Group: Internet Research - SBE
- Stage: Stage 1 - Basic Course

- Report ID: 17967616
- Completion Date: 01/10/2016
- Expiration Date: 01/10/2019
- Minimum Passing: 80
- Reported Score*: 80

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE 4/5
Internet-Based Research - SBE (ID: 510)	01/10/16	(80%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing Institution identified above or have been a paid Independent Learner.

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Appendix B

Information Letter for Research Survey Participants

Subject: Help Auburn University Gain Insight on Current Acquired Velopharyngeal Dysfunction Practice Patterns.

Hello,

The Department of Communication Disorders at Auburn University is looking to gain knowledge regarding current practice patterns for assessing and clinically managing clients with acquired velopharyngeal dysfunction.

Acquired Velopharyngeal Dysfunction (VPD) is defined as a condition in which the velopharyngeal valve does not function adequately due to non-congenital causes, resulting in errors in closure between the oral cavity and the nasal cavity.

After extensive review of the literature, we have discovered that there is a gap in published research regarding assessment and clinical management of the acquired VPD population. Much of the applied and basic research at this time has been completed for the cleft-palate population. While there are instances where recommendations and practice patterns may overlap for these two populations, individuals with acquired VPD are distinct and have separate considerations regarding evaluation and treatment than those with congenital causes of VPD.

Therefore, graduate researcher Kelsey Boman (Guyton) along with assistance of Mary J. Sandage, PhD, at Auburn University developed a survey to gain insight on the current practices regarding training methods, assessment techniques, and clinical management for patients with acquired VPD, as well as self-efficacy ratings of practicing clinicians. Your participation in this 10-minute survey is greatly appreciated as this questionnaire is only sent to a limited number of professionals, and evidence from your responses will be beneficial to the field of speech-language pathology. All answers will be kept confidential, remain anonymous, and shall be used for research purposes only. The Auburn University Institutional Review Board has approved this document for use from July 23, 2016 to July 22, 2019 (Protocol #16-264 EX 1607).

Please click the link below to access this survey. By selecting the link, you consent to voluntary participation in this survey research:

https://auburn.qualtrics.com/SE/?SID=SV_6WlfEWmdtNGiBBX

Thank you for your time and consideration!

Warmest Regards,
Kelsey Boman (Guyton), B.S., Graduate Researcher
Dr. Mary Sandage, CCC-SLP, Assistant Professor

Appendix C

Acquired Velopharyngeal Dysfunction Survey Questions

Acquired Velopharyngeal Dysfunction (VPD) is defined as a condition in which the velopharyngeal valve does not function adequately due to non-congenital causes, resulting in errors in closure between the oral cavity and the nasal cavity. Individuals within this population are distinct and have separate considerations regarding evaluation and treatment than those with congenital causes of VPD, such as cleft palate. The following survey is designed to provide research information about current practices regarding training methods, assessment techniques, and clinical management for patients with acquired VPD. Please read all questions carefully and answer to the best of your ability. An optional comment section is provided on certain questions for further explanation regarding your respective response. All answers will be kept confidential, remain anonymous, and shall be used for research purposes only. Your response on this 10-minute survey is greatly appreciated as this questionnaire is only sent to a limited number of professionals, and evidence from your responses will be beneficial to the field of speech-language pathology. The Auburn University Institutional Review Board has approved this document for use from July 23, 2016 to July 22, 2019 (Protocol #16-264 EX 1607). By selecting the continue icon, you consent to voluntary participation in this survey research.

1. Please indicate the state in which you are licensed (For Geographic Use Only):

- ❍ Not Licensed in the U.S.
- ❍ Alabama
- ❍ Alaska
- ❍ Arizona
- ❍ Arkansas
- ❍ California
- ❍ Colorado
- ❍ Connecticut
- ❍ Delaware
- ❍ Florida
- ❍ Georgia
- ❍ Hawaii
- ❍ Idaho
- ❍ Illinois
- ❍ Indiana
- ❍ Iowa
- ❍ Kansas
- ❍ Kentucky
- ❍ Louisiana
- ❍ Maine
- ❍ Maryland
- ❍ Massachusetts
- ❍ Michigan
- ❍ Minnesota
- ❍ Mississippi
- ❍ Missouri
- ❍ Montana
- ❍ Nebraska
- ❍ Nevada
- ❍ New Hampshire
- ❍ New Jersey
- ❍ New Mexico
- ❍ New York
- ❍ North Carolina
- ❍ North Dakota
- ❍ Ohio
- ❍ Oklahoma
- ❍ Oregon
- ❍ Pennsylvania
- ❍ Rhode Island
- ❍ South Carolina
- ❍ South Dakota
- ❍ Tennessee
- ❍ Texas
- ❍ Utah
- ❍ Vermont
- ❍ Virginia
- ❍ Washington
- ❍ West Virginia
- ❍ Wisconsin
- ❍ Wyoming

2. Please indicate your sex below:
- ❍ Female
- ❍ Male

3. Please indicate your age below:
- ❍ 20-29
- ❍ 30-39
- ❍ 40-49
- ❍ 50-59
- ❍ 60-69
- ❍ 70-79
- ❍ 80+

4. Which of the following best describes your present employment?
- ❍ Craniofacial Clinic
- ❍ Early Intervention Services
- ❍ Home Care Agency
- ❍ Hospital
- ❍ Public School
- ❍ Private Practice
- ❍ Skilled Nursing Facility
- ❍ University Speech & Hearing Clinic
- ❍ University Hospital
- ❍ Other (Please indicate in the space provided.) ____________________

5. What is your terminal degree?
- ❍ Associate's Degree
- ❍ Bachelor's Degree
- ❍ Master's Degree
- ❍ Doctoral Degree

6. How long have you worked as a speech-language pathologist (after completion of your degree)?
- ❍ Less than 1 year
- ❍ 1 - 5 years
- ❍ 6 - 10 years
- ❍ 11 - 15 years
- ❍ 16 - 20 years
- ❍ More than 20 years
- ❍ No Response

7. Please indicate how often you see patients with symptoms of acquired velopharyngeal dysfunction.
- Weekly
- Monthly
- Every Few Months
- Yearly
- Rarely
- Never

8. Please indicate approximately how many patients with acquired velopharyngeal dysfunction you assess each year.
- None
- 1 - 5
- 6 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 50 +

9. Please indicate approximately how many patients with acquired velopharyngeal dysfunction you have assessed in your entire career.
- None
- 1 - 10
- 11 - 50
- 51 - 100
- 101 - 150
- 151 - 200
- 200 +

10. Which term corresponds with the following form of velopharyngeal dysfunction: Anatomical differences in the velopharyngeal structure that cause inadequate closure (e.g., loss of velar mass due to surgery)?
- Soft Palate Inadequacy
- Velopharyngeal Incompetence
- Velopharyngeal Inconsistency
- Velopharyngeal Incoordination
- Velopharyngeal Insufficiency
- Velopharyngeal Mislearning
- Velar Impairment

11. Which term corresponds with the following form of velopharyngeal dysfunction: Inconsistent, unpredictable velopharyngeal function despite adequate length, mass, strength, and range of motion of the velum (e.g., apraxia of speech)?

- Soft Palate Inadequacy
- Velopharyngeal Incompetence
- Velopharyngeal Inconsistency
- Velopharyngeal Incoordination
- Velopharyngeal Insufficiency
- Velopharyngeal Mislearning
- Velar Impairment

12. Which term corresponds with the following form of velopharyngeal dysfunction: A reduction in strength and range of motion of the velum and/or pharyngeal muscles that, despite adequate length and mass, prevents adequate closure of the velopharyngeal port (e.g., dysarthria)?

- Soft Palate Inadequacy
- Velopharyngeal Incompetence
- Velopharyngeal Inconsistency
- Velopharyngeal Incoordination
- Velopharyngeal Insufficiency
- Velopharyngeal Mislearning
- Velar Impairment

13. Which term corresponds with the following form of velopharyngeal dysfunction: A developed articulatory behavior characterized by atypical pharyngeal placement (e.g., phoneme-specific nasal resonance)?

- Soft Palate Inadequacy
- Velopharyngeal Incompetence
- Velopharyngeal Inconsistency
- Velopharyngeal Incoordination
- Velopharyngeal Insufficiency
- Velopharyngeal Mislearning
- Velar Impairment

14. Please indicate the assessment methods that you have in your "clinical toolbox" that you may use and/or recommend for a patient with acquired velopharyngeal dysfunction. (Check all that apply)

- ❑ Acoustic Assessment
- ❑ Air Flow/ Aerodynamic Instrumentation
- ❑ Lateral Cephalometric X-ray
- ❑ Magnetic Resonance Imaging (MRI)
- ❑ Nasoendoscopy
- ❑ Nasometer
- ❑ Oral Endoscopy
- ❑ Oral-Mechanism Examination
- ❑ Perceptual Judgement(s)
- ❑ Standardized Articulation Assessment
- ❑ Videofluoroscopy
- ❑ Other (Please indicate in the space provided.) ____________________

15. Please indicate the treatment procedures you have in your "clinical toolbox" that you may use and/or recommend for a patient with acquired velopharyngeal dysfunction. (Check all that apply)

- ❑ CPAP
- ❑ Palatal Prosthesis/Obturator
- ❑ Pharyngeal Flap Surgery
- ❑ Pharyngeal Injection
- ❑ Pharyngeal Sphincter Surgery
- ❑ Oral-Motor Exercises
- ❑ Speech Therapy
- ❑ Other (Please indicate in the space provided.) ____________________

16. Whom of the following, would be good candidates for speech therapy? (Check all that apply)

- ❑ Client presents with Mild hypernasal resonance
- ❑ Client presents with Moderate hypernasal resonance
- ❑ Client presents with Severe hypernasal resonance
- ❑ Client is diagnosed with a progressive neuromotor disorder
- ❑ Client is diagnosed with a stable neuromotor disorder
- ❑ Client demonstrates inadequate closure of the velopharyngeal mechanism
- ❑ Client demonstrates intermittent ability to achieve adequate velopharyngeal closure
- ❑ Client is cognitively stable
- ❑ Client is cognitively compromised

17. Does your work facility employ the use of a multidisciplinary team when assessing and/or treating patients with acquired velopharyngeal dysfunction?

- ❍ Yes
- ❍ No

18. To whom would you refer patients with acquired velopharyngeal dysfunction following your clinical assessment? (Check all that apply)

- ❑ Audiologist
- ❑ General Physician
- ❑ Oral Surgeon
- ❑ Otorhinolaryngologist (ENT)
- ❑ Plastic Surgeon
- ❑ Radiologist
- ❑ Speech-Language Pathologist with Specialized Experience in VPD
- ❑ Other (Please indicate in the space provided.) ____________________

19. How long would you implement trial therapy sessions before referring to a multidisciplinary team?

- ❍ 3 months or less
- ❍ 3 - 6 months
- ❍ 6 months - 1 year
- ❍ Greater than 12 months

20. Please indicate where you believe you received the most helpful training with regard to acquired velopharyngeal dysfunction. (Check all that apply)

- ❑ Continuing Education Courses/Workshops
- ❑ Clinical Fellowship Training/Supervision
- ❑ Graduate Curriculum
- ❑ Graduate Practicum
- ❑ Mentoring from a more experienced speech-language pathologist
- ❑ On the Job Experience
- ❑ Undergraduate Curriculum
- ❑ Did not receive any training
- ❑ Other (Please indicate in the space provided.) ____________________

21. Which class listed below best corresponds with the title of the course that provided the majority of your training with regard to acquired velopharyngeal dysfunction?

- ❍ Anatomy and Physiology
- ❍ Articulation/Phonology
- ❍ Cleft Palate/Craniofacial Disorders
- ❍ Motor Speech Disorders
- ❍ Resonance Disorders
- ❍ Voice Disorders
- ❍ Other (Please indicate in the space provided.) ____________________

22. Please indicate how well you believe your training prepared you for working with the acquired velopharyngeal dysfunction population.

- ❍ Extremely well
- ❍ Moderately well
- ❍ Slightly well
- ❍ Not well at all

23. Do you believe you use the same methods regarding assessment and treatment of acquired velopharyngeal dysfunction you were taught during your training?

- ❍ Yes
- ❍ No

24. Please indicate which areas you have had sufficient training in for assessment and clinical management of acquired velopharyngeal dysfunction. (Check all that apply)

- ❑ Acoustic Assessment
- ❑ Air Flow / Aerodynamic Instrumentation
- ❑ CPAP
- ❑ Lateral Cepahlometric X-ray
- ❑ Magnetic Resonance Imaging
- ❑ Nasoendoscopy
- ❑ Nasometer
- ❑ Oral Endoscopy
- ❑ Oral-Mechanism Examination
- ❑ Oral-Motor Exercises
- ❑ Palatal Prostheses / Obturators
- ❑ Perceptual Judgement(s)
- ❑ Referral Patterns
- ❑ Speech Therapy (Behavioral Intervention)
- ❑ Standardized Articulation Assessment
- ❑ Videofluroscopy
- ❑ Other (Please indicate in the space provided) ____________________

25. Please indicate which areas would be of clinical benefit for you as a speech-language pathologist to have additional information/training with regard to the acquired velopharyngeal dysfunction population. (Check all that apply)

- ❑ Acoustic Assessment
- ❑ Air Flow / Aerodynamic Instrumentation
- ❑ CPAP
- ❑ Lateral Cephalometric X-ray
- ❑ Magnetic Resonance Imaging
- ❑ Nasoendoscopy
- ❑ Nasometer
- ❑ Oral Endoscopy
- ❑ Oral-Mechanism Examination
- ❑ Oral-Motor Exercises
- ❑ Palatal Prostheses / Obturators
- ❑ Perceptual Judgement(s)
- ❑ Referral Patterns
- ❑ Speech Therapy (Behavioral Intervention)
- ❑ Standardized Articulation Assessment
- ❑ Videofluoroscopy
- ❑ Other (Please indicate in the space provided) ____________________

26. Would it be of clinical value for you to have a developed clinical pathway available to use when assessing and/or managing patients with acquired velopharyngeal dysfunction?

- ❍ Yes
- ❍ No

Self-efficacy refers to how confident individuals are in their performance of a task (not their own luck or self-worth). The following questions are designed to provide research information regarding clinicians' beliefs in performance when assessing clients with acquired velopharyngeal dysfunction. The sliding scale provided for each question ranges from 0 (indicating "Cannot do at all"), through intermediate levels of assurance approximately around the level of 50 (indicating "Moderately confident can do"), to complete assurance at the level of 100 (indicating "Highly certain can do"). Please respond to each question honestly with respect to your current clinical abilities, and not according to how you would like to perform or believe you should perform when approached with a client within the acquired velopharyngeal dysfunction population. Once again, all responses will remain anonymous, be kept confidential, and shall be used for research purposes only.

Note: For all questions requiring a response via a sliding scale, please be sure to click on the marker and move it to your desired answer for EVERY question. Even if your response is at the far left of the scale where the marker is already positioned, it will be recorded as No Response if the marker is not clicked and moved by the respondent.

Before completing the self-efficacy questions, please familiarize yourself with the rating form by completing this preliminary practice item.

On the sliding scale below, please determine, to the best of your abilities, how competent you **currently** feel when asked to independently lift each of the weighted objects described below.

	Cannot Do At All				Moderately Confident Can Do			Highly Certain Can Do			
	0	10	20	30	40	50	60	70	80	90	100
Lift a 10 pound object											
Lift a 50 pound object											
Lift a 100 pound object											

On the sliding scale below, please determine, to the best of your abilities, how competent you **currently** feel when having to assess a patient with acquired velopharyngeal dysfunction at the following levels.

	Cannot Do At All				Moderately Confident Can Do			Highly Certain Can Do			
	0	10	20	30	40	50	60	70	80	90	100
When working independently, without assistance of co-workers or other professionals.											
When working alongside a mentor who has advanced experience in assessing patients with velopharyngeal dysfunction.											
When working with professionals who are confident in your abilities (based on words of affirmation).											

30. Please indicate below how you respond emotionally when having to assess a patient with acquired velopharyngeal dysfunction. (Check all that apply)

- ❑ Anxious
- ❑ Calm
- ❑ Comfortable
- ❑ Confident
- ❑ Doubtful
- ❑ Nervous
- ❑ Other (Please indicate in the space provided.) ____________________

Appendix D

Acquired Velopharyngeal Dysfunction Clinical Diagnostic/Referral Guideline

BEHAVIORAL REFERRAL	YES	NO	
1. The client's etiology of velopharyngeal insufficiency <u>does not</u> prohibit the ability to achieve adequate velopharyngeal closure between the oral and nasal cavities. [a, b, d, g, k]	**1**	**0**	
2. The client is cognitively stable to attend to directions and implement suggested strategies.	**1**	**0**	
3. The client is medically stable to implement suggested strategies and attend regular therapy sessions.	**1**	**0**	
4. The client is taking part in surgical or prosthetic intervention, requiring adjunctive speech therapy to optimize the outcome. [d]	**1**	**0**	
5. The client demonstrates inadequate posture/placement of the velopharyngeal mechanism during speech, characterizing velopharyngeal mislearning or an articulation error. [d, f]	**1**	**0**	**___%**
6. The client's velopharyngeal dysfunction is of mild severity. [b, k]	**1**	**0**	
7. The client is motivated. [d]	**1**	**0**	
8. The client is stimulable (teachable) for improvement of velopharyngeal dysfunction. [c]	**1**	**0**	
9. The client's resonance errors are phoneme-specific. [d, f]	**1**	**0**	
10. The client's resonance errors are consistent over time.	**1**	**0**	
SURGICAL REFERRAL			
1. The client's velopharyngeal dysfunction is of moderate to profound severity. [c, f]	**1**	**0**	
2. The client has an acquired structural impairment of the velopharyngeal mechanism that negatively impacts adequate closure. [f, i]	**1**	**0**	
3. The client has a <u>stable</u> neuromotor disorder. [a, d, f, g]	**1**	**0**	
4. The client's medical history is <u>clear</u> of any conditions that indicate surgical risk purview of SLP or MD referral. [a, c, f, g]	**1**	**0**	
5. The client is not stimulable for improvement of velopharyngeal dysfunction. [c]	**1**	**0**	**___%**
6 The client is cognitively appropriate for surgery. [a, c, d, f]	**1**	**0**	
7. The client's velopharynx is of adequate strength/tone (no muscle weakness).	**1**	**0**	
8. The client's resonance errors are consistent and persistent over time.	**1**	**0**	
9. The client's errors <u>lack</u> phoneme-specificity. [d, f]	**1**	**0**	
10. The client <u>does not</u> have severe hearing loss. [a, c, d, f]	**1**	**0**	
PROSTHETIC REFERRAL			
1. The client is medically <u>unstable</u>, maximizing risk of surgery (e.g., heart disease, previous oropharyngeal radiation, bleeding disorder, etc.). [d, f, h]	**1**	**0**	
2. The client has a neuromotor disorder that is <u>stable</u> and/or <u>slowly progressive</u>. [d, f, h, j, k]	**1**	**0**	
3. The client has a structural deficit of the velopharyngeal mechanism due to acquired cause (e.g., iatrogenic, growth, etc.). [e, i, j]	**1**	**0**	
4. The client is cognitively capable of implementing strategies for prosthesis properly. [a, d, f, j, k]	**1**	**0**	
5. The client has adequate manual dexterity or good caregiver support to remove and care for a prosthesis. [d, f, j]	**1**	**0**	**___%**
6. The client has the potential to tolerate an intraoral prosthesis (e.g., limited gag reflex, no sensory processing disorder, etc.). [a, j, k]	**1**	**0**	
7. The client's resonance errors are changing or worsening over time. [j]	**1**	**0**	
8. The client's velopharyngeal dysfunction is of moderate to profound severity. [a, c, f]	**1**	**0**	
9. The client's errors <u>lack</u> phoneme-specificity. [d, f]	**1**	**0**	
10. The client is not stimulable for improvement of velopharyngeal dysfunction. [c]	**1**	**0**	

[a]Duffy, 2013; [b]Dworkin and Johns, 1980; [c]Hirschberg, 2012; [d]Kummer, 2014; [e]Kummer et al., 2015; [f]Marsh, 2003; [g]Noll, 1982; [h]Purcell and Sie, 2013; [i]Woo, 2012; [j]Yorkston et al., 2001; [k]Yorkston et al., 2010.