Manitoba Clinical Guideline

VIDEOFLUOROSCOPIC SWALLOW STUDY – ADULTS

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CONTENTS

SUMMARY

- Speech-language pathologists (S-LPs) have a pivotal role in the assessment and management of dysphagia (swallowing disorders).

- The videofluoroscopic swallowing study (VFSS) is a radiographic assessment of swallowing.

- Dysphagia assessment and intervention is within the scope of practice of S-LPs. (Speech-Language and Audiology Canada, 2016b).

- In Manitoba, S-LPs must achieve advanced competency certification in Videofluoroscopic Assessment of Adult Swallowing Disorders, prior to independently leading videofluoroscopic swallowing studies (College of Audiology and Speech-Language Pathology of Manitoba, 2015).

- A physician's order is required prior to conducting a VFSS.

- It is essential that speech-language pathologists work collaboratively, using a person centred approach when conducting VFSS procedures.

- Team members should use an evidence-based practice approach to the assessment, intervention, and outcome measurement in the provision of VFSS.

- A clinical swallow examination should be conducted prior to administering a VFSS.

- It is acknowledged that the speech-language pathologist may act as clinician, consultant, team manager, educator, and/or researcher in the field of VFSS.

- All clients should, ideally, be examined in the lateral and anterior-posterior positions.

- It is recommended that standardized protocols are developed for VFSS to improve validity and reduce radiation exposure.

- The average effective dose of radiation to clients undergoing VFSS ranges between 0.2mSv to 1.23 mSv (Refer to Section 7.1.1). The mean fluoroscopic time for VFSS may range from 2.5 to 3.7 minutes. VFSS should rarely exceed 5 minutes. If VFSS time exceeds 5 minutes, an explanation of why the study exceeded typical time frame must be documented in the medical record.

- Documentation of technical factors, fluoroscopy time and technologist initials must be included in the patient record. A log of dose and fluoroscopy times specific to VFSS studies is recommended for quality assurance purposes.

- Images acquired should be retained and accessible for review for a minimum of 5 years.

- SL-Ps should receive training in radiation protection prior to independently leading VFSS studies. Refresher training should occur, at a minimum, every 3 years.

- S-LPs should be familiar with, and abide by, workplace occupational health and safety policies, workplace policies and procedures, and other relevant legislation and guidelines with respect to VFSS.

- S-LPs should be aware of the medico-legal implications and the responsibilities of working with clients who have dysphagia.

- S-LPs should work within their scope of practice. Where experience or skills are limited, appropriate advice, mentoring, and peer support should be sought.

- Projects on VFSS should be incorporated into general departmental Quality Improvement or Procedures as appropriate.

EVIDENCE-BASED RECOMMENDATIONS

Speech-language pathology is a scientific and evidence-based profession (Speech Pathology Australia, 2010; Speech-Language and Audiology Canada, 2010). In order to promote evidence-based practice, grading of the evidence for areas where it is available has been provided in the table below. These areas include: standardization of recipes, protocols, scoring and report terminology; radiation safety, and inter-rater reliability. In 2009, the National Health and Medical Research Council of Australia recognized that there was a need to review the literature for: (a) a hierarchy of evidence according to the parameters of research question and research design, and (b) the quality of the study, consistency of the findings across studies, clinical impact of the results, generalizability of the results to the population, and how applicable the results are to the Australian health care setting. The literature reviewed is international in scope, including some Canadian studies, and has relevance for practitioners in Manitoba.

Clinicians may be familiar with Levels of Evidence grading I- IV, where I represents systematic reviews of randomised control trials and IV represents case series with post-test or pre-test/post-test outcomes. The Levels of Evidence address the need for a hierarchy of evidence as outlined above and identified as "(a)". The system that incorporates quality of research "(a)" together with clinical impact "(b)" is described on an A-D grading scale. Under this scale 'A' represents evidence that can be trusted to guide practice whereas 'D' represents evidence where the recommendations are weak and the evidence needs to be applied with caution. The definitions of A-D are provided under the table below.

Current research in speech-language pathology is limited by few randomised control studies and small subject numbers. These factors limit the ability to provide Level I-II evidence and consequently reduce the number of 'A' level recommendations. Where there is insufficient research evidence, but a large body of clinical experience or expert opinion that provides support for the statement, this has been shown as a grading of GP (Good Practice).

The inclusion of evidence-based recommendations in this document also serves to highlight to researchers where further investigations are required to continue the promotion of high levels of evidence-based practice in dysphagia management

Key recommendations described within the document are summarized in the following table:

	Recommendation	Grading
1	VFSS relies on individual clinicians' interpretation of qualitative and quantitative observations. To increase VFSS accuracy, validity and reliability, speech-language pathologists are encouraged to:	
	a) undertake appropriate training in VFSS implementation and interpretation	B (Hind et al., 2009; Scott et al., 1998; Karnell & Rogus 2005; Logemann et al., 2000; Martin-Harris et al., 2008; Perry, 1999; Wooi et al., 2001;)
	b) use systematic protocols to administer the VFSS, including reproducible recipes for barium test materials that aim to replicate mealtime consistencies	D (Cichero et al., 2000; Dantas et al., 1989; Martin-Harris et al., 2008; Popa Nita et al., 2013; Scott et al., 1998; Steele & van Lieshout, 2005)
	c) adopt standardized scoring and report terminology that explicitly defines swallowing parameters observed on VFSS	C (Frowen et al., 2008; Karnell & Rogus, 2005; Kelly et al., 2007; Leonard & McKenzie, 2006; Martin-Harris et al., 2008; Ott, 1998; Stoeckli, et al., 2003;)
	d) consult normative swallow data to make judgements about VFSS results in relation to oral intake decisions, treatment recommendations and prognostic predictions.	C (Daniels et al., 2007; Daggett et al., 2006; Huckabee 2008; Leonard & McKenzie 2006; Martin-Harris et al., 2007,)
2	To facilitate quality images and capacity to review information speech-language pathologists should consider:	
	a) obtaining images at 30pps;	B (Bonilha, et al., 2013;

		Cohen, 2008)
	b) utilizing playback features that have pause; slow motion or frame by frame forward and reverse analysis; and integrated audio recording.	C (Daggett et al., 2006; Karnell & Rogus, 2005; Murray, Johnson & Hockman, 2007)
3	VFSS exposes the client and the speech-language pathologist to radiation. It is therefore important to have appropriate knowledge of:	
	Radiation effects and safety principles Practical training in the x-ray room on specific local radiation issues and safety procedures	GP (Canadian Cancer Society's Advisory Committee on Cancer Statistics, 2016; Canadian Nuclear Safety Commission, 2015; Hayes et al., 2009; Strauss & Kaste, 2006; Mettler, 2008; Warren-Forward et al., 2008)
4	A range of consistencies, volumes and test conditions, including at least two presentations of each bolus should be considered to allow for normal variations in swallow function.	C (Bennett et al., 2009; Butler et al., 2009a; Daniels et al., 2007; Martin-Harris, et al., 2007; Molfenter & Steele, 2011; Molfenter & Steele, 2012; Steele, et al., 2011)
5	The client must have a clinical swallowing assessment prior to a VFSS. The clinical swallowing assessment should be utilized to inform the most appropriate consistencies, volumes, test conditions and swallow strategies or techniques, to minimize radiation exposure and maximize the clinical information obtained	GP (Crary, 2010; Daniels & Huckabee 2008; Martin-Harris & Jones, 2008)

Grading Scale (NHMRC, 2009)

A Body of evidence can be trusted to guide practice

B Body of evidence can be trusted to guide practice in most situations

C Body of evidence provides some support for recommendations(s) but care should be taken in its application

D Body of evidence is weak and recommendation must be applied with caution

GP Good practice based on clinical experience and expert opinion

1. BACKGROUND

1.1 Aim of the clinical guideline

It is the intent of this project to provide VFSS guidelines for Manitoba health practitioners that are based on current best-practice literature. In 2006 the Winnipeg Regional Health Authority (WRHA) Adult Speech-Language Pathology Program approved the document titled: "WRHA Guidelines for Videofluoroscopic Swallowing Studies (VFSS)". It was recognized that new information regarding best practice has emerged since it was written.

The aim of this document is to provide evidenced-based guidelines for the assessment and management of clients with dysphagia using the videofluoroscopic swallowing study. It is intended for S-LPs working with adult populations presenting with oral-pharyngeal dysphagia of any cause and presentation. This clinical guideline has been developed to ensure that comprehensive evidence-based information on VFSS is available as a standard for all speech-language pathology services and practicing clinicians. It is specific to the role of VFSS in dysphagia management. It is not the purpose of this paper to provide information on general dysphagia management. VFSS is one part of the decision making process in dysphagia management and results will need to be interpreted within a person-centred approach alongside other influencing factors.

There are a range of service models that utilize VFSS. Clinicians will need to read the guideline alongside information that is specific to the clinician's caseload in order to make the most appropriate evidenced based decisions.

This clinical guideline should be read in conjunction with other core provincial and national documents including, but not limited to:

- CASLPM General Regulation (College of Audiologists and Speech-Language Pathologists of Manitoba, 2013)
- CASLPM Code of Ethics (College of Audiologists and Speech-Language Pathologists of Manitoba, 2012)
- CASLPM Advanced Competency Certification for Videofluoroscopic Assessment of Adults: Program of Study and Training Summary Form (College of Audiologists and Speech-Language Pathologists of Manitoba, 2015)
- Manitoba Diagnostic Imaging Standards (Manitoba Quality Assurance Program, 2014)
- The Regulated Health Professions Act C.C.S.M. R117 (Manitoba Government, 2009)
- SAC Position Statement: The Role Speech-Language Pathologists in Dysphagia (Speech-Language and Audiology Canada, 2017)
- SAC Scope of Practice for Speech-Language Pathology (Speech-Language and Audiology Canada, 2016b)

1.2 Terminology to describe videofluoroscopic assessments

The College of Audiologists and Speech-Language Pathologists of Manitoba (CASLPM) has established competencies in order to independently conduct fluoroscopic swallowing studies. The terminology used to describe the CASLPM Advanced Competency Certification in this area is "Videofluoroscopic Assessment of Adult Swallowing Disorders" (VFAS-A) (College of Audiologists and Speech-Language Pathologists of Manitoba, 2015). VFSS has also been referred to as a Modified Barium Swallow (MBS). VFSS is the most widely used title in professional and academic settings. To reflect this practice, this clinical guideline uses the term "Videofluoroscopic Swallow Study". The use of "Modified Barium Swallow" (MBS) and "Videofluoroscopic Assessment of Adult Swallowing" (VFAS-A) will only occur in this document when referring to other authors' or organizations' publications.

1.3 Definition of the videofluoroscopic swallow study

The VFSS is a radiographic instrumental assessment of swallowing. It originated from the barium swallow study, a radiographic technique used to examine the esophageal phase of swallowing. Logemann (1983) first described modifying the barium swallow study in order to objectively assess the oral and pharyngeal phases of swallowing. Since that time, VFSS has been widely accepted and is often referred to as the 'gold standard' for the assessment of oral-pharyngeal dysphagia (Swigert, 2007). In contrast to the barium swallow, the VFSS is performed by a speech-language pathologist and medical radiological technologist, with or without the presence of a radiologist. Its success relies on comprehensive evaluation, consistent and replicable assessment procedures, expertise of evaluating clinicians and specialist knowledge of normal and abnormal swallowing and its treatment (Martin-Harris et al., 2008).

1.4 Aim of the videofluoroscopic swallow study

The aim of VFSS is to:

- evaluate biomechanical and physiologic function and dysfunction of the oral, pharyngeal and upper esophageal swallow;
- determine swallow safety and efficiency;
- identify effects of compensatory strategies;
- determine the appropriate diet textures;
- assist in the planning of dysphagia rehabilitation (Crary, 2010; Daniels & Huckabee, 2008; Martin-Harris & Jones, 2008); and
- in some cases, screening for esophageal clearance.

Instrumental assessment of swallowing function may be indicated when a clinical swallowing examination identifies or the clinician suspects an oral-pharyngeal dysphagia (or impaired esophageal clearance which impacts on pharyngeal phase), and when more information is required to diagnose the swallowing difficulty, determine the physiologic cause for the dysphagia, and recommend intervention (Martin-Harris, Logemann et al., 2000). Choosing

whether and when to carry out an instrumental assessment requires consideration of the client's clinical presentation, including their medical history and dysphagia symptoms within the context of their current overall health status.

VFSS and fibre-optic endoscopic evaluation of swallowing (FEES) are the two most common instrumental assessments available for the evaluation of oral-pharyngeal dysphagia. Both VFSS and FEES have been shown to be valid in the comprehensive assessment of dysphagia (Kelly et al., 2006; Kelly, Drinnan & Leslie, 2007; Wu et al., 1997); however, each has both benefits and limitations. Clinicians may refer to FEES Position Papers (Royal College of Speech and Language Therapists, 2015; Speech Pathology Australia, 2007) for a description of the FEES assessment, and its benefits and limitations for use.

Other instrumental examinations are available for assessment of dysphagia and may be more appropriate, depending on the symptoms of dysphagia and the clinical question to be answered. Where esophageal dysphagia is suspected for disorders such as reflux, esophageal achalasia, strictures, or esophagitis; assessments such as esophagoscopy, barium esophagram (traditional barium swallow), esophageal manometry, or pH monitoring will be more useful. This should be directed by the managing medical team or appropriate gastroenterologist.

The appropriate instrumental assessment should be selected to deliver the highest diagnostic yield relating to the individual client's swallowing issues (Martin-Harris & Jones 2008). The benefits of instrumental assessment should outweigh the potential risks. Clinicians should also consider the risks of *not* carrying out the instrumental assessment, (e.g., failing to detect a covert cause of dysphagia or selecting a compensatory technique which is not therapeutic based on clinical swallow examination).

Benefits of VFSS:

- It is a dynamic study in real time, allowing continuous visualization of the bolus passage in relation to movement of the oral, pharyngeal, laryngeal and upper esophageal structures (American Speech and Hearing Association, 2000; Martin-Harris et al., 2008).
- It enables observation and measurement of movement of anatomical structures such as velum, hyoid, larynx, and epiglottis to judge swallow speed, strength, symmetry and coordination (Crary, 2010).
- It is more accurate than the clinical dysphagia assessment in identifying the occurrence and cause of aspiration including the amount, severity, and timing of aspiration in relation to the swallow (Mann & Hankey, 2000).
- It provides immediate feedback on the effects of modified food/fluids and the impact of compensatory strategies upon swallow function and safety and may prevent 'trial and error' management of dysphagia.
- It provides information on the impact of rehabilitative techniques on overall swallow function to document change over time.
- It can be recorded to allow later review and analysis, client/caregiver/team education, and comparison of changes in swallowing over time.

Limitations of VFSS:

- It is a 'snapshot' of the swallow and is not necessarily indicative of how a client routinely performs, and it may not reflect the range of a client's swallow function throughout the day.
- It is conducted in an artificial swallowing environment (i.e., X-ray suite utilizing fluoroscopy). The results therefore may not be indicative of a client's typical swallow due to:
    i. absence of social distractions (i.e., TV, mealtime conversation etc.);
    ii. positioning (e.g., the client may be positioned more optimally than their typical eating/drinking posture);
    iii. bolus presentation (volume, rate, utensils being controlled by the speech-language pathologist);
    iv. the unfamiliar environment (the client may feel hesitant, nervous or anxious about their new surroundings); and
    v. limited physical support (head control, jaw closure) able to be given to the client during the swallow, due to radiation exposure to the person providing support.
- It requires food and fluid to be mixed with a contrast agent (see Section 5.4), which alters the taste, consistency and viscosity of the food and fluid, and may be unpleasant for some clients. Therefore it may not be a true indication of how a client would perform when swallowing the same food/fluid without a contrast agent added (Cichero et al, 2000).
- Variable inter- and intra-rater reliability has been found between speech-language pathologists in their implementation, interpretation and documentation of VFSS (Karnell & Rogus, 2005; Kuhlemeier et al, 1998; McCullough et al., 2000; Scott, Perry & Bench 1998).
- Accurate interpretation requires the speech-language pathologist to possess specific skills and experience related to dysphagia and the VFSS procedure (Logemann et al., 2000; Murray 2009; Murray et al., 2007) (See Sections 2 and 8).
- Its location in the medical imaging setting may limit accessibility to clients in rural and remote settings and/ or those with limited mobility.
- Any examination using ionizing radiation requires medical justification; therefore VFSS should not be used as a routine monitoring procedure.

Indications for VFSS may include (Crary, 2010; McKenzie & Leonard, 2008; Perlman, Lu & Jones, 2003; Martin-Harris et al, 2008):

- providing objective information regarding swallow anatomy and physiology with the view to direct management;
- evaluating the presence, frequency and severity of aspiration and/or the severity of residue;
- defining the physiological cause underlying the swallow symptoms to develop a therapy plan that targets this pathophysiology;

- ascertaining the safest and most efficient oral intake consistencies and swallow positions/techniques;
- evaluating a change in swallowing function following treatment or changes with disease progression;
- providing objective information and education to client, family/caregivers and the multidisciplinary team about swallowing function and dysphagia management; and
- assisting in identifying etiology of swallow symptoms (particularly if swallow presentation is not explained by the clinical diagnosis).

VFSS may be contraindicated when (Crary, 2010; McKenzie & Leonard, 2008; Perlman et al., 2003):

- the client is medically unstable (e.g. respiratory or cardiac issues, unhealed wounds in alimentary tract);
- the client is unable to cooperate with the assessment tasks due to reduced responsiveness, agitation or behavioural difficulties;
- the client is unable to be adequately positioned for assessment;
- uncontrolled body movements prevent adequate imaging of the swallow;
- the size or weight of the client prevents adequate imaging of the swallow or exceeds the limit of equipment;
- during clinical assessment, a client is unable to consume adequate volumes of food or fluid to allow for adequate assessment in VFSS;
- the management outcome for the client is unlikely to change such as in the case of advanced health care directives, end-of-life situations, some chronic conditions, when a patient expresses that they will not change eating patterns regardless of the outcome, or when dysphagia symptoms have resolved;
- the risk of radiation exposure outweighs the benefit of performing the VFSS (client groups to consider are those who have had repeated studies; paediatric cases; pregnant or breastfeeding woman);
- the potential distress caused by travel to and examination in the x-ray suite outweighs the likely benefits from VFSS; and
- a client has an allergy to barium.

1.5 Changes and trends

Recent years have seen changes in VFSS practice with advances in technology and significant increase in the evidence base which influences speech-language pathology practice for this procedure. These improvements have resulted in changes to radiological equipment, models of practice, accuracy of conducting the VFSS assessment, interpretation and scoring, knowledge of radiation safety, education and training and maintenance of professional standards.

Advances in technology have improved the process of capturing and recording the fluoroscopy image. The evolution of new technology has allowed for fluoroscopic images to be captured with greater clarity, providing the opportunity for more accurate diagnosis with reduced

radiation dose (Hayes 2009; Justino, 2006). Furthermore, research into the speed of image capture to ensure visualization of swallowing movements during VFSS has positively influenced study protocols (Bonilha et al, 2013; Cohen, 2009).

Research into the effect of barium on food and fluids has directed the development of standardized recipes and recommendations for VFSS (Popa Nita, Murith, Chisholm & Engmann, 2013). Refer to the Appendix for recipe resources. Standardization of food texture and fluid consistency limits the variation within and between assessments and promotes replication, thereby improving the accuracy of swallowing performance for barium items within VFSS (Dantas, Dodds, Massy, & Kern, 1989; Popa Nita et al., 2013). The development of protocols for conducting VFSS provides the opportunity to standardize practice, limit radiation exposure and develop processes for comparative analysis across VFSS studies (Martin-Harris, et al., 2008). Furthermore, there have been an increased number of standardized measures developed for reporting VFSS, reflecting the importance of measuring performance objectively to quantify patient outcomes (Daniels & Huckabee, 2008; Martin-Harris et al., 2008; Rosenbek et al., 1996). Increased awareness of radiation safety issues when conducting VFSS have also been reported in the literature (Hayes, 2009; Warren-Forward et al., 2008). Consequently, there is now greater impetus for practical and theoretical training to protect patients and clinicians in conducting VFSS (Warren-Forward et al., 2008).

CASLPM has developed competencies to obtain Advanced Competency Certification in Videofluoroscopic Assessment of Adult Swallowing Disorders (CASLPM, 2015). Certified clinicians are required to meet standards for continued certification.

With advances in technology, telehealth has the potential to enhance speech-language pathology practice. The application of telehealth in VFSS has been documented in a few studies (Malandraki et al., 2011, Malandraki et al., 2013; Perlman & Witthawaskul, 2002); however, further research is required to establish adequate validity and reliability. It has been suggested that VFSS recorded images transferred via telehealth have the potential to support clinical decisions, inter-rater reliability, and education (ASHA, 2005; Mashima & Doarn, 2008). However, it is important to ensure that telehealth infrastructure supports the delivery of high definition, high resolution images to each site to facilitate accurate visualization and interpretation of swallowing function. This is an area for further research.

2. SCOPE OF PRACTICE

2.1 General principles

VFSS is an objective, instrumental assessment of oral-pharyngeal swallowing function and esophageal clearance. VFSS results depend upon the subjective interpretation of the clinician. Standardization of procedures for training, barium recipes, terminology, scoring and reporting will facilitate more objective interpretations. Speech-language pathologists working with VFSS should have competent skills in the management of dysphagia, knowledge of the wider issues

in dysphagia and understanding of VFSS literature in order to evaluate the results of the VFSS in a manner appropriate to their specific client population.

2.2 Complex vs. non-complex cases

The differentiation of complex cases for VFSS versus non-complex cases will be influenced by a number of factors:

- The complexity of the client. This may include clients with behavioural, physical or cognitive disability or clients that require radiation exposure to be minimized.
- The complexity of the dysphagia. The complexity may be influenced by several factors including:
    - multiple causes of dysphagia such as head and neck cancer with a neurological disease, or normal aging processes in addition to a pre-existing physical disability
    - variations from normal anatomy post-surgery or due to congenital syndromes
    - a client who is known to aspirate who will require significant problem solving utilizing a variety of swallow techniques, manoeuvres and positions for a successful outcome
- The complexity of medical or associated conditions. This may include clients with tracheostomy and/or assisted mechanical ventilation, clients with unstable or chronic medical conditions that may directly impact swallowing or change the threshold for respiratory complications.
- The complexity of positioning or attachments for the client (e.g. specialized seating, positioning equipment, oxygen tanks, IV poles).
- The complexity of the ethical issues pertaining to a client's swallowing management decisions.

Complexity of a case may become apparent during the VFSS that was not suspected from initial clinical swallow assessment or referral information.

2.3 The team

VFSS examinations are usually conducted by a speech-language pathologist, a medical radiological technologist, and in some cases a radiologist. Examinations may be supported by associated health care professionals. Multiple skills are required to conduct VFSS examinations that achieve appropriate diagnostic and therapeutic outcomes while minimizing medical and radiation related risk. The team conducting the VFSS should therefore be composed of professionals who are qualified to:

- ensure the client is positioned appropriately and their physical and medical safety is maintained during the procedure;
- operate the fluoroscopy equipment to safely use ionizing radiation and yield optimum quality images;
- identify on the radiographic image, the anatomical structures and the physiological swallow events to assess and diagnose dysphagia;

- select and evaluate swallowing compensatory techniques, positions or manoeuvres; and
- make recommendations regarding safe oral intake and any further investigations required.

The team members undertaking these roles vary in different settings and will need to be negotiated and agreed upon prior to performing VFSS. The roles of each team member will depend upon the service provider's policy, provincial legislation, and staffing availability at each medical imaging facility. The S-LP is an essential team member; it is the S-LP who has the specific knowledge and competencies related to oral-pharyngeal swallowing movement patterns and the therapeutic regimens to treat particular disorders and improve swallow safety and efficiency (Logemann, 1998).

2.3.1 Imaging equipment operator

The Radiation Protection Department at CancerCare Manitoba is the regulatory authority in Manitoba. It requires that all operators of diagnostic and interventional x-ray equipment hold current authorization to operate the equipment to irradiate another person for a diagnostic or therapeutic procedure. An x-ray worker of the Diagnostic Imaging Department (e.g. radiologist or medical radiological technologist) must be present during VFSS to operate the fluoroscopy equipment. They are specifically trained to safely use ionizing radiation and manipulate the fluoroscopy equipment to obtain diagnostic images (Manitoba Radiation Protection Act).

2.3.2 Other professionals on the VFSS team

The speech-language pathologist may liaise and collaborate with other professionals, such as respiratory therapists, occupational therapists, nursing staff, dietitians, rehabilitation assistants, and specialist consultants (e.g. gastroenterologists and otolaryngologists). The contribution of other professionals will provide valuable assistance and expertise with transfers, positioning, suctioning, and nutritional needs. Other professionals are also crucial for management of specific gastroenterological or head and neck abnormalities that impact swallowing. Caregivers may be part of the team to facilitate feeding and/or optimize behaviour and participation of clients.

2.3.3 Private/external providers on the VFSS team

Private or external speech-language pathologists may facilitate referral of a client to a health care facility for VFSS or they may conduct the VFSS in the role of a visiting clinician. In these situations, it is imperative that clear processes are followed to ensure transfer of relevant clinical information between the treating private/external speech-language pathologist and the VFSS team. Appropriate orientation and governance procedures should be in place to ensure that the visiting clinician(s) have the required knowledge and skills to conduct the VFSS, including their Advanced Competency Certification in Videofluoroscopic Assessment of Adult Swallowing Disorders. They must also adhere to the facility's policy and procedures, and comply with all provincial legislation. They must also ensure that a physician's order for a VFSS has been obtained and documented on the medical record.

3. MODELS OF PRACTICE

3.1 Collaborative speech-language pathology-radiology VFSS service

Historically, radiologists attended the VFSS with speech-language pathologists to collaboratively evaluate swallow function. Radiologists are qualified to make a medical diagnosis and "have the expertise to identify structural abnormalities" (Lu & Jones, 2003; p.153, Perlman et al., 2003) or anatomical deviations contributing to dysphagia, while speech-language pathologists contribute their specialist knowledge of the function of the [swallow] mechanism. "The combination of skills of the two professionals results in optimum diagnosis and management decisions" (p.180 Logemann, 1998). As the consulting medical practitioner in this setting, the radiologist also oversees any adverse events that may occur during the VFSS procedure. Having a radiologist present/available may alleviate the need for additional imaging and/or expedite a diagnosis in cases where structural anomalies are suspected or identified during VFSS. It is acknowledged that not all work sites have access to a radiologist to perform the procedure together. As a result, speech-language pathology-led service has become the more common model of practice, and is the norm in Manitoba.

3.2 Speech-pathology led VFSS service

In the absence of a radiologist, a speech-language pathologist experienced in VFSS conducts the study with the medical radiological technologist. In this practice model, a clinical risk assessment should be undertaken and guidelines developed between speech-language pathology and medical imaging departments to ensure that the VFSS is conducted safely and any potential risks are minimized. These guidelines should include, but not be limited to:

- a process to ensure a physician-signed diagnostic imaging order has been obtained;
- a process to determine if radiologist assessment of the esophagus is warranted either during or after the study (e.g. if anatomical/physiological deficit is suspected/identified requiring urgent medical assessment (e.g. tracheoesophageal fistula));
- agreed protocols for conducting the VFSS to achieve optimal images for medical interpretation (i.e. planes of view, image resolution, and bolus administration);
- criteria and process for urgent medical attention during the VFSS due to change or deterioration in the client status (e.g. adverse respiratory deterioration following aspiration, agitated/aggressive client); and
- documentation of VFSS dosage and time, as per facility and regional policies.

4. PRE-ASSESSMENT FOR VFSS

A clinical swallow examination should be conducted prior to referring a client for VFSS (Crary, 2010). The purpose of the clinical swallow examination is to identify the signs and symptoms of dysphagia in order to form a hypothesis regarding the swallowing difficulties. This assists in determining if further investigation utilizing VFSS is indicated in order to ascertain the presence, cause, and extent of dysphagia as well as treatment options (Daniels & Huckabee, 2008). Additionally, it determines whether feasibility criteria are satisfied for the client to proceed to

VFSS (i.e. ability to be positioned safely, ability to use clients own seating, ability to cooperate physically and cognitively during the procedure and/or lack of medical contraindications). There are a number of documents that describe the components of the clinical assessment (Speech Pathology Australia, 2012, Winnipeg Regional Health Authority, 2006a). Based on the outcome of the clinical assessment, the clinician plans the format and sequence of the VFSS study. The S-LP will select appropriate food, fluids, and compensatory techniques that will assist in achieving optimal clinical information while limiting radiation exposure (Crary, 2010). A referral for VFSS should be completed adhering to local facility medical imaging and speech-language pathology department guidelines.

5. THE VIDEOFLUOROSCOPY SWALLOW STUDY

5.1 Equipment considerations

The VFSS procedure is conducted using fluoroscopic imaging equipment that produces dynamic images of the oropharynx, trachea and esophagus using ionizing radiation. S-LPs require a basic understanding of how fluoroscopy units function in order to work collaboratively with medical radiology technologists and/or radiologists operating the equipment. This will ensure that the captured VFSS images are of optimum quality while minimizing radiation exposure to patients and clinicians. Equipment used to record and play back radiographic images is also critical to the image quality, and thus the clinical utility of the VFSS (Peladeau-Pigeon & Steele, 2013). Positioning equipment, medical and accessory equipment also need to be considered for optimal patient imaging and safety.

5.1.1 Medical imaging equipment

The radiographic images are obtained from the fluoroscopy system and transmitted to the viewing monitor and recording devices. These images need to be of sufficient quality to visualize swallow movements and track the location of fast moving and even trace amounts of barium contrast. The capability of fluoroscopy units to produce high quality images is dependent on a complex interaction of multiple factors including: the design of the fluoroscopy unit; the settings of the fluoroscopy unit; and patient-specific factors such as position, posture, and size. Aging equipment may produce degraded image quality, which then requires higher radiation doses (Justino, 2006; Hayes, 2009). The mode of operation of the fluoroscopy unit can be manipulated on an individual basis in order to influence image quality. Some of these settings may be automatically adjusted by the fluoroscopy unit, or they may be manually changed by the medical radiological technologist. A balance must be achieved between maximizing image quality and minimizing radiation doses so that patient care is not compromised at either end of the spectrum (i.e. excessive radiation exposure or insufficient diagnostic information) (Justino, 2006; Bonilha et al., 2013; Government of Canada, 2008).

One option to reduce radiation dose is the use of pulsed fluoroscopy, where the x-ray beam is emitted at 30, 15 or fewer pulses per second (pps), as opposed to continuous delivery of radiation. While continuous fluoroscopy was previously used, all current fluoroscopy units

should have the capability for pulsed radiation and use of continuous fluoroscopy is now uncommon. Pulsed radiation limits radiation exposure during VFSS (Hayes et al., 2009). Lowering the pulse frequency rate reduces radiation dose proportionally, although lower frequency pulses produce images that appear jerky (Justino, 2006). Consequently, lower pulse rates may not capture a momentary event such as transient penetration of fast moving contrast. Cohen (2008) reported that "full depth" laryngeal penetration seen in 10 children was visible for as few as 1-2 frames, captured with 30pps pulsed fluoroscopy and that using a pulse rate lower than 30 would potentially result in non-detection of liquid barium penetration. Bonilha et al., (2013) found differences in clinician ratings for overall impairment scores, penetration-aspiration scores, and treatment recommendations when viewing the same swallow events on VFSS using 30pps compared with a simulated 15pps mode. A 30 pulse per second (pps) fluoroscopy emission rate during VFSS is believed to allow for greater visual resolution and accuracy in the assessment of swallowing function compared to lower pulse rates. An enhanced videofluoroscopic image may improve accuracy and reliability in detecting the degree of aspiration or penetration and avoid the need for repeat VFSS in cases where image quality is insufficient to capture diagnostically significant swallow events.

Before and during the VFSS, the radiologist or medical radiology technologist will adjust other fluoroscopy settings such as filtration, collimation, magnification, and patient position, in order to reduce radiation dose or improve image clarity. Ongoing dialogue is necessary between the S-LP and the fluoroscopy operator to communicate the required aspect of the swallow to be visualized for various bolus trials, and to negotiate adjustments to obtain the optimal image to meet diagnostic needs.

5.1.2 Audio-visual equipment

VFSS images should be recorded and stored at an appropriate quality to enable optimal review and accurate interpretation of anatomical structures and swallow events. The type and modality of the audio-visual recording equipment used impacts the quality of the images obtained (Geise, 2001). When there is inadequate equipment for viewing the VFSS during the initial study or during playback of an archived exam, the viewing process can be corrupted, resulting in interpretation errors (Murray, 2009; Murray, Johnson & Hockman, 2007).

Options for recording the VFSS:

1. Digital recordings using a DVD recorder, a hard drive or an integrated swallowing system (e.g. Tims DICOM System, Tims Medical) may be employed.
2. The Medical Imaging Department's digital imaging recording system (e.g. PACS) can also store images, although audio recording and/or storage of larger file size typically seen in VFSS are not always possible.

Depending on the recording system used, the quality and compatibility of the monitor, electric AV cables, microphone, and speakers can also impact image and sound quality.

VFSS studies should be recorded with relevant client identification data consistent with Manitoba RHA guidelines. Numbering and/or lettering (either computer character generated or metallic) should be used to display client details, allowing easy patient identification. This can

also be used for identification of textures/consistencies assessed on the study. A counter timer often incorporated within the recording equipment is useful for later timing analysis of swallowing movements (Daggett, Logemann, Rademaker & Pauloski, 2006). A microphone connection to record clinician instructions and audible client responses (cough; throat clear; voice quality) can differentiate between cued and spontaneous compensations (Goldsmith, 2003; Palmer, Kuhlemeier, Tippett & Lynch, 1993) and assist with VFSS playback and interpretation by audio recording pertinent information relating to instructions or the bolus presentation.

For optimum image interpretation and acceptable inter- /intra-rater reliability, controlled image playback options are required. Pause, frame by frame, slow motion, and reverse playback are recommended by many researchers in VFSS to enable accurate interpretation and increased inter-rater and intra-rater reliability (Hind et al., 2009; Murray, Johnson & Hockman, 2007; Peladeau-Pigeon & Steele, 2013; Palmer et al., 1993; Scott et al., 1998) including objective and accurate analysis of displacement of anatomical structures (Leonard & McKenzie, 2006), greater accuracy in identification of laryngeal penetration and subsequent sensori-motor responses (Daggett et al., 2006), and less interpretation errors (Murray, Johnson & Hockman, 2007).

Software programs may be used to play DVD recordings on a personal computer. Each program has different capabilities and limitations with regard to pause, reverse, and slow-motion functions. Furthermore, image quality may be compromised in the recording process. Speech-language pathologists are strongly advised to work with their local medical imaging department in determining optimal recording and playback of VFSS images.

VFSS studies are part of the medical record and the audio visual recording should be archived appropriately adhering to local health facility medical documentation guidelines. Studies should be retained for a minimum of 5 years.

5.1.3 Client mobilizing and positioning equipment

For the adult patient, the ideal position for VFSS is sitting upright, with symmetrical and neutral alignment (neck neither too flexed nor extended) (Leonard & McKenzie, 2008). Even small changes in head, neck, and trunk alignment or symmetry can alter swallow biomechanics. Abnormal head, body and trunk position can adversely affect swallowing performance by altering muscle tone and ease of movement (Davies, 1994). Furthermore, head and neck muscle tone may also increase with poor balance or fatigue, which may occur when standing or sitting unsupported for the duration of the VFSS.

To achieve optimal patient positioning, the VFSS suite should utilize seating options that enable adequate posture and position of trunk, limbs, and head for swallowing. Some individuals with neurological impairment or physical disability require specialized chairs to compensate for poor head, neck or trunk control; reduced sitting tolerance; and decreased endurance, all of which hinder safe/effective swallowing (Cox & Petty, 1991, Palmer et al., 1993). Commercially available VFSS chairs, developed to be accommodated within the fluoroscopy machine, can be

adjusted to provide posture support and reclined flat for patient transfers (e.g. TransMotion Videofluoroscopy Swallow Study chairs). Alternatively, some clients may be examined in their own customised wheelchair if appropriate. The speech-language pathologist needs to know the dimensions of the fluoroscopy unit and its capacity to accommodate large chairs, such as motorized wheel chairs, high level support chairs, and bariatric chairs. Some patients may exceed the weight limit for the fluoroscopy table or the VFSS chair. Where the patient cannot be accommodated within the fluoroscopy unit, other options may be considered, such as an alternative fluoroscopy suite or referral for FEES where appropriate.

Hoist, patient slide, foam wedges, straps, seat belts and other client transfer and positioning equipment should be available and utilized within the VFSS suite to ensure safe manual handling practices that are consistent with local facility workplace health and safety guidelines.

5.1.4 Accessory and medical equipment

Food preparation equipment and consumables required to conduct the VFSS include:

- food and fluid samples of various consistencies in line with the national descriptors of diet modification (Atherton, et al., 2007) as well as any food/fluids that the client has particular difficulty with, if indicated;
- food preparation equipment (e.g., measuring cups, spoons, scales, jugs, whisks);
- feeding equipment (e.g., cups, spoons, straws, cut away cups, long handled spoons, bowls);
- other supportive equipment (e.g., tissues/facial wipes, gloves, clothing protectors, towels); and
- contrast agents.

These items should be handled and stored in accordance with local facility infection control guidelines. In the case of medical complications (e.g., aspiration) or a medical emergency, relevant equipment should be available (e.g. suctioning, supplementary oxygen) and procedures followed as per local facility guidelines. A description of personal protective equipment required for VFSS is described in section 7.13.

5.2 Radiographic view

The VFSS begins with the client in the lateral view. The lateral view provides visualization of the oral and pharyngeal anatomy and swallow physiology, as well as a clear delineation between the airway and the esophagus. It is ideal for judging movements that generate pressures and open and close critical valves during swallowing (Martin-Harris, 2008). The field of view should include the lips anteriorly, the posterior pharyngeal wall and cervical spine posteriorly, the nasopharynx superiorly and the esophageal segment and C7 inferiorly (Goldsmith, 2003).

Clients may also benefit from being examined in an anterior-posterior (AP) position (Martin-Harris, 2008). The AP view provides visualization of chewing function, symmetry of muscular contraction, bolus residue, bolus transit and laryngeal function. The field of view should include the palate superiorly, and the vocal folds and tracheal column inferiorly (Goldsmith, 2003). The

AP view is important in diagnosing disorders such as unilateral pharyngeal paresis (and evaluation of compensatory strategy such as head rotation to reduce unilateral residue) and esophageal clearance (Crary, 2010). It also assists in the diagnosis of anatomical disorders such as pouches (Martin-Harris & Jones, 2008). Some parameters are best visualized in the lateral view and others in anterior-posterior. In some instances, screening the client in the oblique position may also be of benefit. Such instance may include the confirmation of structural deformity or if there is limited visualization in the lateral plane due to high shoulder position or scoliosis.

<table>
<tr><th>Lateral view</th><th>Anterior-posterior view</th></tr>
<tr><td>Oral parameters:
Lip closure
Tongue control
Bolus preparation/mastication
Tongue to palate contact
Bolus transport/lingual motion
Oral residue
Premature spillage</td><td>Oral parameters:
Alignment of teeth
Formation and containment of the bolus
Symmetry and location of oral residue</td></tr>
<tr><td rowspan="2">Pharyngeal parameters:
Initiation of the pharyngeal swallow
Velopharyngeal closure
Posterior tongue movement
Epiglottic movement
Laryngeal elevation
Anterior and superior hyoid movement
Laryngeal vestibule closure
Pharyngeal stripping wave
Tongue base retraction
Pharyngeal residue
Pharyngeal-esophageal segment opening</td><td>Pharyngeal parameters:
Pharyngeal contraction (symmetry)
Symmetry of bolus flow
Symmetry of valleculae & pyriform sinus residue
Medial laryngeal movement
Vocal cord movement</td></tr>
<tr><td>Esophageal parameters:
Esophageal clearance</td></tr>
</table>

5.3 VFSS procedure

5.3.1 VFSS protocols

“Following a standard protocol is highly recommended for the fluoroscopic study…. [this] increases consistency and reproducibility of the examination… [and] does not preclude individual variations that may be required for specific patients or problems.” (Crary, 2010 p.196)

A standardized protocol is believed to limit the need for repeated VFSS and the associated increased radiation exposure (Bonilha et al., 2012). A well-designed protocol provides a systematic framework to define the limits of the swallow system by testing a range of food and fluid consistencies, bolus volumes, and compensatory strategies. The protocol should elicit optimum swallow performance (the least restrictive diet consistency, safely ingested with or

without compensatory strategies) as well as reveal any deficits hypothesised to be present (indicated by the medical diagnosis, client self-report, or presentation on clinical swallow exam). The VFSS clinician directs the protocol to observe symptoms, ascertain the potential cause, and evaluate whether compensatory strategies improve swallowing safety and efficiency.

Fatigue and its associated impact on swallowing function and safety is an important symptom to be aware of during the VFSS assessment. Signs of fatigue may include but are not limited to delayed swallow initiation, patient perception of increased effort required to swallow and increased number of swallows per bolus. The VFSS protocol should enable evaluation of baseline function vs. a fatigued state. Studies have demonstrated that the act of eating a meal can diminish tongue strength and endurance in young and older clients (Kays, Hind, Gagnon & Robbins, 2010). This should be considered when conducting VFSS in order to elicit an assessment that is representative of meal-time behaviour. For example, if fatigue is suspected in a person with a neuromuscular disease or in the elderly, this could be induced by multiple bolus trials. To reduce radiation exposure, the client can take some boluses without live fluoroscopy and then fluoroscopy may be resumed once fatigue becomes evident, to determine its impact on swallow physiology. Some authors have suggested performing VFSS on frail clients before and after a meal (e.g., Logemann, 1998). Alternatively, if a client is suspected of being fatigued after an arduous journey to x-ray or a long wait, a rest period prior to commencing VFSS may enable some recovery from fatigue. A variety of protocols have been reported in the literature for conducting VFSS with adults. Logemann (1983) was among the first to publish a VFSS protocol. More recent protocols include the Modified Barium Swallow Impairment Tool – MBSImp (Martin-Harris et al., 2008) and the Videofluoroscopic Dysphagia Scale (Han et al., 2008). These two tools include protocol and scoring systems that have been standardized and validated (Crary, 2010). The use of protocols assessing multiple trials of various consistencies has the potential to increase radiation exposure; however, Bonilha et al., (2012) reported that the use of the MBSImp standardized protocol did not increase radiation time and effective radiation doses beyond the levels reported in the literature.

Clinicians may elect to implement a non-standardized protocol and instead administer a VFSS procedure tailored to the client. These individualize individualized protocols use foods, fluids and utensils familiar to the client, with the aim of eliciting swallowing behaviours that are representative of mealtimes. However, this decreases the consistency and reproducibility of the VFSS within and between clients. An alternative may be to use a hybrid approach where a standardized protocol is used for the initial test boluses, followed by individualized components to observe specific boluses or to evaluate compensatory strategies when the swallow is seen to be unsafe or inefficient.

5.3.2 Bolus consistencies used in VFSS

VFSS protocols include information on the bolus consistencies, number of trials, and the sequence for delivery. Researchers have begun to evaluate the specific bolus consistencies and volumes tested in VFSS that contribute the most salient information about swallow function. Martin-Harris et al. (2008) maintain that the most salient consistencies in contributing to the

overall impression of dysphagia are the 5 ml thin and 5 ml "nectar" (mildly thick) boluses. Frowen, Cotton & Perry (2008) examined different VFSS evaluation tools and found that swallow function differs according to the consistency being assessed and that different components of the swallow vary when assessed on liquid vs. semi-solid boluses. They propose that reliability and validity of VFSS measures vary as a function of bolus consistency and that the VFSS protocol should evaluate a range of bolus consistencies across a minimum set of measures which are known to be valid for the specific consistency for the specific patient group. The principle underpinning VFSS protocols should be to deliver the minimum number of boluses to comprehensively yet efficiently evaluate the swallow across consistencies, to reduce radiation exposure and maximize accuracy, reliability and validity.

5.3.3 Sequence of bolus presentation

The sequence for bolus presentation is decided based on balancing clinical information and local protocols. Consideration needs to be given to the following:

- Commencing with thin fluids will not obstruct the airway if aspirated, and is less likely to remain in the pharynx post swallow.
- Commencing with thicker consistencies may result in residue in the pharynx, which may impact the evaluation of thin fluids and represent an aspiration risk.

In planning the VFSS procedure, the speech-language pathologist must utilize information from the clinical examination to predict swallow performance and select appropriate techniques to prevent these confounding variables.

Lazarus et al. (1993) recommended that two to three trials of each bolus be conducted to achieve a general view of bolus management. Some clients need a 'warm up' period where swallowing improves after the first or second swallow, while others demonstrate fatigue with repeated swallows. Frowen et al. (2008) reported variations in swallow measurements across trials of the same bolus in VFSS studies with head and neck cancer clients. They found that swallows one and three of each bolus trial varied more than swallow two, and that stability of measures for semisolid boluses was poorer than that of liquid boluses. For this reason repeated trials of the same volume and consistency may be warranted to establish a realistic view of swallowing function (Daniels et al., 2006).

5.3.4 Ceasing the VFSS

Ceasing the VFSS early may occur due to:

- equipment failure;
- a client's deteriorating medical condition;
- reduced client compliance;
- identification of tracheo-esophageal fistula or leakage of contrast into the mediastinum; or
- compromised respiratory status due to uncompensated aspiration.

It is important to consider that the presence of aspiration should not be the sole reason for ceasing the procedure. In the presence of aspiration, the decision to continue the procedure may depend upon the degree of aspiration, the ability of the client to cough and clear the aspiration, the possibility to assess additional strategies that may avoid further aspiration during swallowing, and the client's medical status and well-being.

5.4 Contrast agents

Contrast agents are used during the VFSS in order to visualize the bolus during swallowing. Barium is most commonly used with clients who are at risk of aspiration as it is relatively benign if aspirated. Reports of morbidity and mortality associated with barium are in cases where large volumes of barium have been aspirated during a barium swallow study rather than VFSS (Gray, Sivaloganathan & Simpkins, 1989; Kaira, Takise, Goto, Horie & Mori, 2004; McAlister & Siegel 1984). Barium during VFSS is administered in small volumes. When aspiration occurs, various techniques, positions or consistencies are used to avoid further aspiration (Crary, 2010). There is no evidence for the use of other contrast agents due to aspiration risk. Water soluble contrast agents are only recommended if there is a suspected gastrointestinal perforation. In this case, low osmolarity (non-ionic) water soluble agents can be used. High osmolarity (ionic) water soluble agents are contraindicated in clients at risk of aspiration, as aspiration of high osmolarity contrast agents can cause pulmonary oedema (American College of Radiologists, 2012). Consult a radiologist if a non-barium contrast agent appears to be indicated.

It is widely acknowledged that the viscosity of foods and fluids mixed with barium does not match their non-barium counterparts (Baron & Alexander, 2003; Cichero et al., 2000; Costa, de Almeida, Sant Anna, & Pinheiro, 2007; Fink & Ross, 2009; Steele & van Lieshout, 2005; Strowd et al., 2008; Stuart & Motz, 2009). This is because barium is a solid and thus by its nature will alter both the viscosity and density of the food and fluid with which it is mixed. An increase in viscosity may cause a liquid to flow slower, thus potentially masking some difficulties that faster flowing liquids may cause, such as aspiration before the swallow. An increase in density will require more force and may lead to increased residue, thereby appearing to worsen symptoms such as poor pharyngeal clearance. It is therefore important to understand and standardize the weight per volume of barium (by weighing barium and using standardized recipes) in order to reliably measure and interpret swallowing physiology (Dantas et al., 1989). If recipes are not standardized, swallow physiology may appear either better or worse than it is.

Many recipes use 40% w/v (weight of solute per volume of solution) in their composition but there is also a recipe for 22% w/v. Fink and Ross (2009) claim that 40% w/v may not represent true thin fluids. They found that 50% of their clients who didn't aspirate on Varibar thin barium (40% w/v), did aspirate when it was diluted to lower (22%w/v) density. Therefore, 22% w/v should be considered for those who do not aspirate higher density preparations of barium and results of higher density preparations should be interpreted with this in mind. Furthermore, in the years since Varibar was developed, imaging has improved and 20% w/v is now considered reliably visible. The value of minimizing the concentration to 20-25% reduces the possibility that the barium itself is leading to coating or to thickening of the stimulus. For research

purposes the Steele Swallowing lab is now using 20% as a standard for all consistencies (Steele, 2016). Catriona Steele's lab has attempted to replicate barium preparations of varying consistencies, in order to standardize density for every examination (Steelesswallowinglab.ca).

5.5 Scoring and interpretation

It is important to establish a core set of swallowing parameters that are pertinent to assess when evaluating dysphagia (Frowen et al., 2008). Suggested parameters to be assessed during VFSS are outlined in the table in section 5.2. Speech-language pathologists should identify and interpret the impact of abnormal swallowing physiology. Interpretation of VFSS involves knowledge of anatomical structures and analysis of physiology during the oral and pharyngeal stages of the swallow, as well as during esophageal clearance. This includes:

- the cause, timing, approximate percentage, frequency, or severity, of penetration, aspiration and/or residue;
- sensory awareness and reaction to residue (e.g. re-swallow);
- reaction to penetration / aspiration (e.g. spontaneous cough, throat clear, second swallow);
- the effectiveness of the reaction to residue, penetration, and/or aspiration (e.g., reduction in amount or percentage of residue, and effectiveness of expectoration of material from airway);
- effectiveness of compensatory techniques, postures, manoeuvres, sensory enhancements, and bolus modifications; and
- the impact of any suspected anatomic (e.g. trachoesophageal fistula, cricopharyngeal bar, diverticulum) and/or physiologic abnormalities of the esophagus on swallow physiology.

Different ways of interpreting VFSS have been described and include descriptions of dysfunction, binary ratings and the use of rating scales to describe the degree of impairment. A number of standardized scoring methods may be used. These may include published rating methods such as NZIMES (Daniels & Huckabee, 2008) or MBSImp (Martin-Harris et al., 2008) or locally developed protocols. Standardized scoring systems aim to avoid potential inaccuracies and ambiguous reporting of results and assist in selection and assessment of management strategies, thereby improving inter- and intra- rater reliability (Martin-Harris et al., 2008). The penetration-aspiration scale (Rosenbek, Robbins, & Roecker, 1996) is regarded as a measure with good inter-rater reliability (Stoecki et al., 2003); however, its use in isolation may be limited. In addition, computer software is available to make detailed temporal, distance, and biomechanical measures of swallowing physiology from VFSS (Dyer, Leslie & Drinnan, 2008).

Accurate analysis requires video freeze-frame and slow motion (Martin-Harris, 2008). Where possible, the procedure should be rated by two speech-language pathologists (Murray, Johnson & Hockman, 2007; Murray, 2009). Scoring each bolus will enhance inter-rater reliability.

5.5.1 Swallowing measures

Swallow physiology is measured against what researchers have shown us is normal. There is ongoing data emerging regarding normal swallow physiology. Some measures, such as hyoid and laryngeal excursion, laryngeal penetration, and delay in initiation of the pharyngeal swallow, are being challenged. Molfenter and Steele (2011) note that the literature reports variability of hyoid and laryngeal displacement during swallowing. Variability may be due to sample size, measurement techniques and bolus size. They suggest that clinicians should recognize this variability when making management decisions based on patient performance in VFSS. Additionally, Steele et al. (2011) suggest that when measuring hyoid and laryngeal movement, measurements should consider the individual differences in cervical neck height for measurements to be relevant.

Martin-Harris et al. (2007) suggest that a delay in the initiation of the pharyngeal swallow may not be an indicator of swallow dysfunction without coexisting impairments of swallow physiology. Additionally, penetration can be normal, particularly in the elderly or when sequentially drinking (Butler, Stuart, Markley & Rees 2009b; Daggett et al., 2006).

The speech-language pathologist should consider instructions such as 'hold the bolus until I say swallow' or 'take a sip'. These variables will alter the swallow physiology. The instruction to hold the bolus in the mouth induces a higher trigger position (Daniels et al., 2007) and bolus size is reduced when given instruction to 'take a sip' (Bennett et al., 2009).

Ultimately, the speech-language pathologist will have to consider the swallow physiology in light of the materials used and instructions given to evaluate the impact of certain physiology on the functional swallow. It is more relevant to look at swallow physiology in terms of its functional impact rather than structural movements of the pharynx and larynx in isolation.

5.6 Documentation of results

The VFSS report is a written medical record of the procedure. The following information is recommended in a VFSS report (Daniels & Huckabee, 2008; Cichero & Murdoch, 2006):

- The date the procedure was conducted;
- The reason for the VFSS procedure;
- The consistencies of fluid/food assessed;
- The views in which the images were obtained (e.g. lateral, A-P, oblique);
- Mode of food/fluid delivery (i.e. independent, assisted, cup, spoon etc.);
- Detailed description of swallowing function linking symptoms to the underlying anatomical/pathophysiological cause including:
    - the presence and impact of any anatomical abnormalities on swallowing efficiency and safety;
    - description of oropharyngeal swallow physiology including:
        - timing, symmetry and flow of the bolus including presence and location of residue and client's response to residue (e.g. clearing swallow);

        - effectiveness of airway protection, including the presence or absence of laryngeal penetration/aspiration, timing of airway invasion (pre/during/post swallow) and presence and effectiveness of client's response to airway invasion;
    - Recommendations regarding additional investigations, as warranted;
- Any compensatory strategies assessed and their impact on swallowing function;
- Summary of the swallowing deficits linked to the underlying medical condition/diagnosis if appropriate;
- Management recommendations for safe and efficient oral intake (if possible), with details including consistencies of food and fluids, therapeutic manoeuvres or strategies, and postural modifications. Details should also include suggested rehabilitation exercises/plan referral to other agencies (if required) and follow up speech-language pathology details.

The report should be completed in a timely manner, sent to the referring medical practitioner and filed in the medical record as per facility/regional documentation guidelines.

To avoid ambiguities and misinterpretations, efforts should be made to agree upon and standardize terminology and define parameters of swallowing measures (Murray, 2009).

As per Manitoba Diagnostic Imaging Standards (2014), documentation of technical factors, fluoroscopy time and technologist initials must be included in the patient record. A log of dose and fluoroscopy times specific to VFSS studies is recommended for quality assurance purposes. Images acquired should be retained and accessible for review for a minimum of 5 years.

6. CLIENT MANAGEMENT

6.1 Referral to other professionals

It is widely recognized that dysphagia is best managed collaboratively within a multidisciplinary team (SPA Dysphagia Clinical Guidelines, 2012; Speech-Language and Audiology Canada, 2007; Speech-Language and Audiology Canada, 2017). It is common for clients to be referred to other members of the dysphagia team for further assessment and/or management, if it is warranted, according to the outcome of the VFSS procedure. These professionals can include allied health professionals (e.g. dietitians, occupational therapists, physiotherapists, respiratory therapists), medical practitioners (e.g., ear, nose and throat surgeon), and dental practitioners (e.g., prosthodontics).

6.2 Education and counselling

The client and/or caregiver should receive adequate education prior to the VFSS, including rationale for the assessment and how the procedure contributes to swallowing management. The speech-language pathologist should provide a description of the procedure, including textures to be trialled, how the food and fluid will taste when mixed with contrast, the process

taken to minimize aspiration risk and limit radiation exposure, as well as any effects of ingesting the contrast (Cichero & Murdoch, 2006). Clients with cognitive/behavioural issues should have the opportunity to familiarize themselves with the medical imaging suite. Caregivers should also be encouraged to bring in feeding implements/utensils that they regularly use and, if possible, practice the feeding technique prior to the examination (Cichero & Murdoch, 2006). Alternative assessments (e.g. FEES) may need to be discussed if the patient is unwilling to consent for the VFSS (Cichero & Murdoch, 2006; Logemann, 1993). Following the examination, the speech-language pathologist should review the study with the patient and/or caregiver, providing an explanation of the key features observed, the client's safety for oral intake, and the types of food and fluids recommended.

7. SERVICE MANAGEMENT

7.1 Issues and risk management

7.1.1 Radiation considerations

VFSS uses ionizing radiation in order to visualize swallowing function via x-ray. Ionizing radiation is the term used to describe the transfer of energy through, in this case, people, in the form of electromagnetic waves that are capable of causing ionization by removing or adding electrons. This can cause damage to the cells. It is therefore important to limit exposure to ionizing radiation.

The following tables identify risks associated with ionizing radiation and may be useful as references for comparison. (Canadian Cancer Statistics, 2016; Canadian Nuclear Safety Commission, 2015; ICPR, 2007; Mettler, 2008)

Dose	Limit or Health Effect
50 mSv	Annual radiation dose limit for nuclear energy workers[1]
7 mSv	Chest CT[2]
4.1 mSv	Average annual background dose in Winnipeg, Manitoba[1]
1.8 mSv	Average annual Canadian background dose[1]
1 mSv	Annual public radiation dose limit[1]
0.1-0.12 mSv	Dose from lung X-ray[1]
0.01 mSv	Dose from dental X-ray[1]
0.01 mSv	Average annual dose due to air travel[1]

ICRP 103 Risk Coefficients (% per Sv)

Exposed Population	Cancer	Heritable Effects	Total
Whole	5.5	0.2	5.7
Adult	4.1	0.1	4.2

Health Risks Arising From Low Doses of Ionizing Radiation		
Effect	**Risk**	**Normal Incidence**
Risk of cancer from 1 mSv of radiation	1 in 18,000	53 in 10,000
Risk of severe hereditary effect from 1 mSv of radiation	1 in 500,000	1,770 in 77,000

The average effective dose of radiation to clients undergoing VFSS has been reported to range between 0.2mSv to 1.23mSv (Chau & Kung, 2009; Crawley et al., 2004; Kim, Choi & Kim, 2012; Zammit-Maempel, Chappel & Leslie, 2007). A dose of 0.85mSv represents a low associated risk, mainly of cancer induction, of about 1 in 16000 (Crawley et al., 2004). Using ICRP 103 Risk Coefficient for adult population, the associated risk works out to about 1 in 28,700

Representative fluoroscopic times for VFSS have been reported to range from 2.5 – 3.7 minutes (Chau & Kung, 2009; Hayes et al., 2009; Kim, et al., 2012; McLean, Smart, Collins & Varas, 2006; Moro & Cazzani, 2006; Weir et al., 2004; Wright, Boyd & Workman, 1998; Zammit-Maempel, Chapple & Leslie, 2007). Average length of VFSS calculated at 5 sites in the Winnipeg Regional Health Authority in 2014 ranged from 1.7 minutes to 3.3 minutes. Using a standardized procedure, Bonilha (2012) showed that mean fluoroscopic time was 2.9 minutes with an effective dose of 0.44mSv.

7.1.2 Monitoring

The service provider is responsible for providing an approved personal monitoring device to each occupationally exposed person who is likely to be exposed to ionizing radiation in the x-ray suite (Safety Code 35, 2.2.6, Government of Canada, 2008).

All operators of X-ray equipment, together with personnel (i.e. speech- language pathologists) who routinely participate in radiological procedures, likely to receive a radiation dose in excess of $1/20^{th}$ of the dose limit to radiation workers, must be declared radiation workers and monitor their radiation exposures with the use of a personal dosimeter.

Personal dosimeters must be worn and stored according to the recommendations of the dosimetry provider.

7.1.3 Limiting radiation exposure

Speech pathologists can limit their radiation exposure by considering time, distance and shielding of radiation. SL-Ps should receive training in radiation protection prior to independently leading VFSS studies. Refresher training should occur, at a minimum, every 3 years.

Time
Limiting screening time reduces radiation exposure. See above (section 7.1.1) for indications of reported screening times for VFSS. Efforts should be made to keep screening within the time ranges reported in the literature.

Distance
The intensity of the scattered radiation decreases rapidly with increasing distance from the client. For example by moving away from the radiation source by 1 metre radiation is reduced to a quarter of the original. Personnel must, at all times, keep as far away from the X-ray beam as practicable. Direct radiation exposure of personnel by the primary X-ray beam must never be allowed (Safety Code 35 2.1.3, Government of Canada, 2008).

Shielding
Only team members whose presence is necessary should be present in the screening room during the VFSS. Personal protective equipment including lead aprons and thyroid shields must be available and worn by everyone present in the screening room. This includes all team members, students and caregivers. The S-LP should ensure that the equipment is well fitted and worn correctly. Lead aprons, thyroid shields, and other personal protective devices should meet minimum design criteria, as outlined in the Winnipeg Regional Health Authority X-Ray Safety Manual (2013) and Health Canada Safety Code 35 (Government of Canada, 2008). For interventional procedures, where no other protective devices are used, full wrap around type protective gowns of 0.50 mm lead (Pb) in the front panels and 0.25 mm Pb in the back panels are recommended. Thyroid collars are to be worn, with a recommended equivalent of 0.50 mm Pb. In addition, protective gloves are to be worn if there is a likelihood that the hand may come into contact with the direct beam. Protective gloves or gauntlets must possess at least a 0.25 mm Pb equivalency. These protections must be provided throughout the glove, including fingers and wrist.

7.1.4 Pregnancy
Health Canada Safety Code 35 (Government of Canada, 2008) states that radiation can cause damage to the unborn fetus. The fetus should be given the same level of protection as is required for a member of the public (i.e. the dosage must not exceed the public effective dose limit of 1mSv per year). It is usually not necessary to modify work practices during pregnancy (Health Canada Safety Code 35, Government of Canada, 2008). Special consideration also needs to be given to pregnant clients and caregivers who are present for the procedure. All female clients of childbearing age must be asked if they are pregnant. Where possible, pregnant clients should be offered other forms of dysphagia/instrumental assessment and pregnant caregivers should not be involved in the procedure. In the instances where a client is pregnant or it is unavoidable for a pregnant caregiver to be present during screening, consultation with a radiologist is required. The patient or caregiver should be informed of the risks associated with radiation exposure to the fetus. If the procedure is conducted, the client or caregiver is recommended to wear personal protective equipment (e.g., lead apron of highest lead content available) and exposure time should be kept to a minimum.

7.2 Orientation

Orientation specific to the facility's VFSS service should be completed prior to a speech-language pathologist working with VFSS in accordance with Manitoba provincial legislation and Regional Health Authorities' policies. It should include education regarding radiation safety and associated mandatory training. The Manitoba Radiation Protection Act requires that the Radiation Protection Director, or their appointee, must deliver training to other professional groups (such as speech-language pathologists) who direct studies using ionizing radiation. SL-Ps should receive refresher training in radiation safety at a minimum of every 3 years.

Training should include the following 'core of knowledge':

- the responsibility of the individual in maintaining a safe workplace;
- risk-benefit analysis of using ionizing radiations;
- the importance of good clinical examination prior to exposure;
- the importance of previous examination results;
- alternatives to using ionizing radiations;
- the key features of the relevant x-ray and ancillary equipment;
- radiographic interpretation (where relevant);
- risk factors such as age and the tissue type being irradiated;
- measurement of radiation dose;
- knowledge of the magnitude of typical doses from different examinations;
- methods of reducing radiation doses during radiological examinations;
- minimizing the occupational hazards arising from the use of radiological equipment;
- occupational dose limits;
- image storage for review; and
- the ALARA principle ("As Low As Reasonably Achievable")

Information covered within the facility's VFSS procedure guideline should also include, but not be limited to:

- referral and appointment booking processes for VFSS;
- systems and processes for communicating with the medical imaging staff ;
- roles and responsibilities of staff in the local VFSS team;
- use and storage of accessory equipment;
- recipes and preparation of food and fluids used in VFSS;
- disposal of barium impregnated food products;
- infection control procedures between each client and at the end of each VFSS procedure;
- checklists for scoring, rating and online interpretation; and
- roles and processes for reporting and documenting VFSS exams and formatting and storage of radiographic images

Further orientation is likely to include facility specific mandatory training required by the employer, including Manual Handling, Infection Control, and Emergency Procedures (i.e., Fire

Training/Cardio-Pulmonary Resuscitation, Medical Documentation) which are applicable to VFSS.

7.3 Infection control

7.3.1 Infectious diseases

The speech-language pathologist should adhere to regional and facility-specific infection control policies. Transmission of infectious conditions may occur between clients or from client to clinician. As some clients who require a VFSS may have infectious conditions (e.g., C. Difficile, MRSA, chicken pox, tuberculosis etc.), all reasonable precautions must be taken to prevent cross infection.

7.3.2 Food safety practices

The speech-language pathologist should adhere to regional and facility-specific food safety policies and procedures. Food safety practices including hygiene, handling, preparation, and storage of food should be adhered to when preparing food/fluids for the procedure.

8. EDUCATION AND TRAINING

8.1 Student education

Speech-language pathology students may attend VFSS procedures in order to gain exposure to the procedure and an introduction to the processes involved. They may observe and participate in various elements of the VFSS procedure, for example, completing referral documentation, assisting in VFSS interpretation, and contributing to management recommendations following VFSS; however, the supervising speech-language pathologist will retain the duty of care for the client and will remain actively involved in all stages of the VFSS process. Speech-language pathology students should not be expected to conduct, interpret, or report on VFSS independently. Some facilities prevent students from feeding clients in VFSS, due to radiation protection and training issues. Local policies should be followed.

8.2 Credentialing

S-LPs practicing in Manitoba must be members of the College of Audiologists & Speech-Language Pathologists of Manitoba, and must meet their criteria and abide by their regulations.

8.3 Competency

To independently conduct a VFSS, speech-language pathologists in Manitoba must hold an Advanced Competency Certification in Videofluoroscopic Assessment of Adult Swallowing Disorders. This reflects a minimum entry-to-practice level competency in VFSS. In addition, S-LPs should be guided by other professional documents such as this VFSS clinical guideline, operational policies, and current literature. Employing organizations should have established governance and accountability structures which ensure clinical safety.

In response to variable inter-rater reliability in VFSS scoring in the literature, researchers have recommended more clearly defined methods and amounts of training in VFSS implementation and interpretation (Hind et al., 2009; Karnell & Rogus, 2005; Perry, 1999; Scott et al., 1998; Wooi, Scott, Perry & Bench 2001). Logemann et al. (2000) reported that even speech-language pathologists experienced in VFSS increased their accuracy in identifying x-ray anatomy and interpreting VFSS following a targeted four hour training course. Pre-training, errors were made even by clinicians who had several years VFSS experience and had attended previous VFSS workshops.

Martin-Harris et al., (2008) describe a process of training speech-language pathologists to use their specific MBSImp scoring tool. This involved eight hours of group training, 4 hours of independent study, and 10 hours of practicing rating 38 VFSS exams, prior to undergoing inter-rater reliability testing against the standard scores set by the "expert" clinician. When 80% inter-rater agreement was achieved, the speech-language pathologist was deemed consistent and accurate in using this tool to score VFSS.

More clearly defined methods and amounts of training in VFSS implementation and interpretation, and concordance of explicit competency standards will underpin improved accuracy, validity, and reliability of VFSS results.

8.4 Expectations of entry level clinicians

CASLPM requires a minimum of one year clinical experience with a relevant population prior to commencing the mentoring process required to obtain Advanced Competency Certification in Videofluoroscopic Assessment of Adult Swallowing Disorders. Implementing and interpreting VFSS is considered complex because of the multiple skills required to be simultaneously deployed under time pressure in the x-ray suite, with the added layers of clinical risk associated with aspiration and radiation exposure. Bonilha et al. (2012) reported that radiation exposure times are longer in VFSS studies performed by novice clinicians compared with exposure times in VFSS performed by experienced clinicians, despite both groups utilizing a standardized VFSS protocol. Bryant, Finnegan & Berbaum (2012) describe differences between novice and expert clinicians in the methods of perceptual processing utilized to interpret radiographic images. Efficient and accurate "real-time" interpretation underpins decision-making during VFSS regarding boluses to trial and therapeutic strategies to utilize to safely elicit optimal swallowing performance.

"Clinicians achieve competence in complex areas of practice through experience and repeated exposure to patterns and features of disorders…. it is essential that the entry level speech-language pathologist has supervision from a senior speech-language pathologist when working with complex cases to ensure clinical standards are maintained. If supervision and / or mentoring cannot be provided, the entry level speech-language pathologist should not be working in areas of complex clinical practice" (p.9, Speech Pathology Australia, 2011, updated 2017).

Speech-Language and Audiology Canada's (2016) Code of Ethics states that members shall "engage only in the provision of services that fall within their professional competence, considering their level of education, training, experience and/or their access to professional supervision and assistance from qualified colleagues."

8.5 Knowledge and skills required for VFSS

Knowledge and skills required to implement and interpret VFSS are described below:

General dysphagia knowledge and skills:

- Knowledge of normal versus abnormal anatomy and physiology at the oral, pharyngeal and esophageal stages of the swallow, and how this changes from birth through to ageing adults.
- In-depth knowledge and experience with dysphagia evaluation and management pertinent to the current clinical caseload and VFSS caseload.
- Familiarity with relevant CASLPM documents.
- Knowledge of alternative instrumental dysphagia assessment tools (e. g. FEES) and the indications/contraindications for their use.

Additional knowledge required for VFSS:

- Familiarity with the content of the Manitoba Clinical Guideline: Videofluoroscopic Swallow Studies (2017).
- Understanding of current literature/research pertinent to VFSS.
- Theoretical and practical knowledge of radiation safety and equipment used in VFSS.
- Familiarity with relevant radiation legislative requirements and policies/clinical guidelines of local facility where VFSS procedure is conducted.
- Knowledge of protocols for implementing VFSS.

Additional skills required for conducting, interpreting and documenting the VFSS procedure:

- Ability to visualize anatomical and physiological features of swallowing, on radiographic images.
- Ability to accurately identify and describe swallowing abnormalities in relation to underlying cause (i.e. swallow pathophysiology).
- Ability to select and evaluate the effectiveness of compensatory techniques or positions appropriate to the observed pathophysiology and the client's overall presentation.
- Ability to design and implement a VFSS protocol (i.e. appropriate selection of bolus type/characteristics and compensatory strategies) that answers the clinical questions pertinent to the individual client.
- Timely on-line interpretation and decision making during VFSS, incorporating the above elements.
- Ability to develop an appropriate dysphagia management plan in accordance with the interpreted VFSS results.

- Ability to make appropriate recommendations for client management based on VFSS results (e.g. further instrumental dysphagia assessment, referral to other professionals such as a gastroenterologist or neurologist).
- Ability to provide timely written report integrating clinical information, VFSS results, and recommendations for client's swallowing management and rehabilitation, as appropriate.

In addition, Murray (2009) recommends attending continuing education classes or participating in competency based programs to accumulate knowledge and develop interpretive skills for VFSS.

8.6 Continuing professional development

Speech-language pathologists who conduct VFSS procedures should ensure that their knowledge and skills are maintained through Continuing Professional Development. At a minimum they must adhere to minimum maintenance requirements specified by the regulatory body (CASLPM Continuing Competency Program). Examples include:

- frequent conducting, analysis and reporting of VFSS examinations;
- actively seeking to improve inter- and intra- reliability when conducting, interpreting and documenting VFSS procedures through peer analysis and review;
- attendance at courses/workshops to develop and maintain competency;
- participation in quality improvement activities (e.g. audits);
- participation in literature reviews, evidence-based practice groups, journal clubs;
- routine collaboration with other disciplines to ensure consistent training and continued development (e.g. conjoint radiation safety training with medical radiological technologists and Radiation Protection Department of CancerCare Manitoba); and
- work shadowing with colleagues at own facility or at other VFSS facilities.

8.7 Leadership and supervision

It is beneficial for speech-language pathologists undertaking VFSS training to be strongly linked to a mentor with considerable expertise and/or to a speech-language pathology department with specialty in this area, to ensure competency in VFSS is achieved and maintained. The supervisory role in VFSS should be undertaken by speech-language pathologists with acknowledged experience, skill and training in VFSS. This person may provide:

- direct training and evaluation of competence in conducting and interpreting VFSS;
- consultative advice regarding clinical VFSS queries;
- direction on VFSS policy and procedural issues; and
- leadership in research, quality improvement and audit activities and disseminating new evidence.

9. ETHICAL ISSUES

There are a number of occasions in VFSS where decisions are made regarding client care. Decisions should be based on the ethical principles that underpin all aspects of speech-language pathology clinical practice (Code of Ethics, CASLPM, 2012; Code of Ethics, SAC, 2016b; Position Statement: Role of the S-LP in End-of-Life Care, SAC, 2016a). These include the principles of: (a) beneficence and non-maleficence, (b) truth, (c) fairness, (d) autonomy, and (e) professional integrity. In addition, S-LPs must ensure that client consent has been obtained prior to providing assessment or treatment of swallowing.

Special consideration of ethical principles should be used when considering VFSS in the following situations:

- When a palliative approach has been agreed upon by the client/family and medical team, or when medical assistance in dying has been requested. This may change the analysis of risk vs. benefit when considering a VFSS.
- When a client or medical team may refuse to adhere to recommendations made from the outcome of the VFSS.

10. CODE OF CONDUCT

Speech-language pathologists should adhere to the CASLPM Code of Ethics (2012) and to any codes, policy and procedures relevant to their employing body.

11. MEDICO-LEGAL ISSUES

Medico-legal issues are beyond the scope of this document. It is the responsibility of individual practitioners to be aware of, and comply with, relevant legislation and policies in the jurisdictions in which they practice. This includes, but is not limited to: the Regulated Health Professions Act; privacy legislation; freedom of information legislation; relevant reserved acts; by-laws of one's professional college; relevant clinical standards; workplace health and safety regulations; infection control policies; policies surrounding obtaining informed consent; and Resident Bill of Rights. Practitioners should also ensure that they have professional indemnity and liability insurance.

12. FUTURE DIRECTIONS

The use of VFSS is likely to grow in line with the prevalence of dysphagia associated with an increasing and aging population. Training and competency must be maintained by regular practice and supervision.

A greater body of research is needed on the pulse per second (pps) rate required to accurately diagnose dysphagia and recommend appropriate treatment, and avoid excluding important clinical data. It is unclear whether 30 pps is required for all consistencies of food/fluids or

whether lower pulse rates can be used for slower flowing consistencies without affecting diagnostic information or timing of swallow events.

With the ever changing world of technology, it is likely that VFSS scoring and reporting will become computerized. We must ensure that programs are designed to accommodate the latest evidence based knowledge and apply results according to patient specific variables and functional outcomes, rather than a series of structural movements or swallow events with no clinical implication. It must be remembered that VFSS continues to be an assessment of swallow function at a point in time that may not represent swallowing on all occasions or under all conditions. It must be considered a tool to assist in the management of dysphagia, not a tool in isolation.

13. CONCLUSIONS

The practice of VFSS has evolved over the years since it was initially described by Logemann (1983). Although often described as the 'gold standard' of dysphagia assessment, it is reliant on a number of factors to ensure its robustness. These include using a standardized protocol and barium recipes, standardizing scoring and report terminology, maintaining adequate clinician training and practice, appropriate recording and playback of studies, and established governance systems. Speech-language pathologists are encouraged to continue efforts to increase reliability and validity of VFSS through these methods; however, limitations of VFSS need to be acknowledged. VFSS is a collaborative approach to objective dysphagia assessment and therefore speech-language pathologists need to be orientated and knowledgeable about radiation safety and how to minimize exposure to both the patient and themselves.

The VFSS clinical guideline provides current information relating to the areas of scope of practice, service management, ethical considerations, and legal issues.

Future directions for VFSS should continue to address reliability and validity issues through standardizing terminology, establishing competencies, improving scoring and reporting, and supporting services through telehealth.

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APPENDIX A: USEFUL RESOURCES

- Manitoba Radiation Protection Act.
- Radiation Protection Service CancerCare Manitoba
- Diagnostic Imaging Medical Physics CancerCare Manitoba
- The Radiation Emitting Devices Act.
- Catriona Steele's recipes for barium preparations
- http://www.steeleswallowinglab.ca/Barium_Recipes.php