

[Title page not for review]

Title: Voice assessment practices of speech and language therapists in Ireland [ICPLA]

Sarah McAlister<sup>1</sup>, Irena Yanushevskaya<sup>1,2</sup>

<sup>1</sup>Discipline of Speech and Language Therapy, NUI Galway

<sup>2</sup>School of Linguistic, Speech and Communication Sciences, Trinity College Dublin, Ireland

Correspondence: Irena Yanushevskaya, Phonetics and Speech Laboratory, Centre for Language and Communication Studies, Trinity College Dublin. Tel.: +353 1 896 1348.

E-mail: [yanushei@tcd.ie](mailto:yanushei@tcd.ie).

ORCID <https://orcid.org/0000-0003-1161-4625>

## ABSTRACT

Evidence supports the need for a multiparametric voice assessment incorporating objective and subjective assessment types. European guidelines and the American Speech-Language-Hearing Association recommend a comprehensive voice assessment protocol; however, currently in Ireland no national standards exist. This study investigates voice assessment practices of speech and language therapists (SLTs) in Ireland, with a particular interest in the use of objective instrumentation. It further elucidates what may act as barriers to the use of instrumental techniques, which has not been addressed in earlier studies. An online questionnaire was distributed to SLTs who work with voice disordered clients, via social media outlets of the Irish Association of Speech and Language Therapy (IASLT) and the Voice Special Interest Group to obtain both qualitative and quantitative data. Forty-five questionnaires were returned; the results of thirty-three completed questionnaires are presented here. The results suggest that subjective measures (auditory assessment protocols) are more commonly used by SLTs in Ireland than instrumental techniques. Limited access to equipment, the cost of equipment and low prioritisation of voice clients in a large caseload were most frequently named as barriers to the use of instrumental assessment. The SLTs acknowledged the need for and expressed interest in more training on the use of instrumental techniques in the assessment of voice disorders. The results provoke discussion surrounding evidence-base practice in voice assessment and have implications for how instrumental techniques are incorporated in the curriculum of SLT training courses and in the continual professional development.

**Key words:** voice assessment, instrumental assessment, assessment practice, Ireland

## **INTRODUCTION**

Voice disorders can be experienced by up to 30% of adults during their life (Roy, Merrill, Gray, & Smith, 2005). Voice disorders can affect a person's health-related quality of life, their occupational functioning, social relationships and emotional state (Cohen, Dupont, & Courey, 2006; Ma & Yiu, 2001; Thibeault, Merrill, Roy, Gray, & Smith, 2004). Therefore, appropriate assessment is imperative for suitable intervention and management. This research aims to investigate current voice assessment practices by speech and language therapists (SLTs) in Ireland, with a particular interest in instrumental methods of assessment and what may act as barriers to their use.

### **Voice assessment: common practices and recommendations**

Although there is currently no national standard for voice assessment in Ireland, current protocols in Europe (Dejonckere et al., 2001), USA (Patel et al., 2018), and the UK (Enderby et al., 2009) recommend incorporating both subjective and objective types of assessment.

Subjective assessment relies on the listener's perception of the voice. Many auditory perceptual scales exist that have been widely used and validated by research e.g. GRBAS (Hirano, 1981), CAPE-V (Zraick et al., 2011) and the Voice Handicap Index (Jacobson et al., 1997). The use of subjective measures alone is typically considered insufficient (Dejonckere, 2010; Speyer, 2008) and their application can be biased by clinical experience of the listener and their exposure to voice disorders (Wolfe, Martin, & Palmer, 2000), the stimulus type (Eadie & Baylor, 2006) and the type of auditory-perceptual rating scale used (Nemr et al., 2012). Despite these issues, subjective assessment of vocal quality is readily available to SLTs and remains an essential aspect of voice assessment.

Objective, reliable and valid assessment of vocal function is provided using instrumentation. The methods of instrumental analysis and assessment of voice are diverse and include

stroboscopy, electroglottography, acoustics, aerodynamics, imaging techniques and electromyography (Baken & Orlikoff, 2000; Dejonckere, 2010; Heuer, Hawkshaw, & Sataloff, 2005; Kent & Ball, 2000; Sataloff, 2005). However, state-of-the-art instrumentation is not always readily available to SLTs and certain methods of instrumental analysis require specialist training and can only be performed under medical supervision. Not all instrumental techniques are equally efficient in diagnosis (Hillenbrand, 2011). Acoustic analysis is non-invasive and easy to perform with freely available software but validity of certain popular measures (like jitter and shimmer) has been questioned (Carding, Wilson, MacKenzie, & Deary, 2009; Heman-Ackah et al., 2003; Kreiman & Gerratt, 2000). Normative acoustic data is difficult to accumulate due to different algorithms used by different analysis software (Buder, 2000; Maryn, Roy, De Bodt, Van Cauwenberge, & Corthals, 2009; Roy et al., 2013) and different types of speech samples (sustained vowels or spontaneous speech) used. Despite these limitations, recent evidence suggests that objective measures should be used in addition to subjective measures (Roy et al., 2013).

In clinical practice, clients should be assessed by an otolaryngologist (ENT) and an SLT (Roy et al., 2013). The ENT is responsible for medical diagnosis whereas the SLT is responsible for assessment of voice production, its underlying physiological function and evaluation of how the voice disorder affects an individual's health related quality of life (Boone, McFarlane, Von Berg, & Zraick, 2014). However, due to the lack of procedural consistencies and unified evidence across voice assessment approaches, it is difficult to report which protocol is considered optimal for the assessment of voice. A systematic review by Roy et al. (2013) concluded that acoustic, laryngeal-based imaging, auditory-perceptual, aerodynamic and functional measures demonstrated the highest level of evidence in detecting the presence of a voice disorder. Conversely, these assessments have been unsuccessful in determining the

nature and severity of voice disorders, resulting in the need for future robust testing to strengthen the evidence base (Roy et al., 2013).

The ‘multidimensional set of minimal basic measurements’ for voice assessment suggested by the European Laryngological Society (Cohen, Wynne, Kubba, & McCartney, 2012; Dejonckere et al., 2001) includes perceptual assessment and subjective self-assessment by the patient, videostroboscopy, acoustic (jitter, shimmer,  $f_0$  range and softest intensity) and aerodynamic (phonation quotient) measures. The protocol suggests that for each patient speech samples should be recorded including sustained [a] vowel at comfortable pitch and loudness and higher as well as connected speech, e.g. a sentence. The recommended process of assessment is similar in the UK (Enderby et al., 2009). The most recent detailed voice assessment protocol by American Speech-Language-Hearing Association (ASHA, 2018) and recommended instrumental assessment tutorial by ASHA expert panel (Patel et al., 2018) also includes instrumental techniques.

Currently, there are no recommended guidelines for voice assessment in Ireland. The Irish Association of Speech and Language Therapists (IASLT), the professional body for SLTs in Ireland do not specify any guidelines regarding voice assessment. This can potentially lead to inconsistencies in voice assessment practices.

### **Voice assessment practices: research evidence**

The use of recommended assessments (or lack thereof) by SLTs working with adult and/or paediatric clients with voice disorders has been explored in the context of evidence-based practice in a number of studies conducted in the US (Behrman, 2005; Hartley, Braden, & Thibeault, 2017) and Ireland (Kenny, 2017). Behrman (2005) investigated common voice assessment practices of SLTs with clients presenting with muscle tension dysphonia. Participants were required to have three years’ experience conducting stroboscopic

examinations and/or reviewing them with ENT. The findings showed a preference for subjective voice assessment, despite participants having access to stroboscopic and acoustic instrumentation. Hartley et al. (2017) conducted a survey on paediatric voice assessment in the US and Australia respectively. The study investigated clinical demographics, employment location, service delivery models, approaches to continual professional development (CPD) and specifics of case management as well as the barriers relating to the use of instrumentation.

As mentioned earlier, no standardised procedure of voice assessment currently exists in Ireland. In a recent survey-based study, Kenny (2017) explored the voice assessment practices by SLTs working in Ireland with (hyper-)functional voice disorders, muscle tension dysphonia, organic and psychogenic voice disorders, to establish how comprehensive these assessment practices are and to what extent they comply with the guidelines of the European Laryngological Society. In terms of instrumental assessment, he investigated what equipment SLTs had access to and what types of instrumental assessment they felt competent using. The results of his study suggest that while SLTs use comprehensive non-instrumental evaluation of voice and the same or similar protocols appear to be used nationally, the therapists reported limited access to instrumentation and lack of training in instrumental assessment techniques. Kenny (2017) provides valuable information about voice assessment practices by SLTs in Ireland, but his study did not explore how frequently SLTs are likely to use instrumentation or, what is more important, what may act as barriers to the use of instrumentation.

This study investigates voice assessment practices by SLTs in Ireland. The aims of this study are:

1. To investigate what voice assessment protocols are used currently by practicing SLTs in Ireland with voice disordered clients, with particular focus on the use of instrumental assessment.
2. To identify barriers to the use of instrumental methods of assessment such as videostroboscopy, electroglottography, acoustic and aerodynamic methods.

## **METHODOLOGY**

### **Design**

The study employed a descriptive, prospective survey design using a mixed-based (quantitative and qualitative) online questionnaire as the data collection tool (see Appendix). A web-based survey was selected rather than traditional paper-and-pencil methods due to the efficiency of web surveys in the collection of large amounts of data within a limited time frame (Lefever, Dal, & Matthíasdóttir, 2007).

### **Questionnaire**

Firstly, general topics reflecting the objectives of the research were considered and the previous studies exploring voice assessment practices (Behrman, 2005; Hartley et al., 2017; Kenny, 2017) were analysed. The questionnaire was then designed loosely based on these surveys, with permission granted from both A. Behrman and C. Kenny to adapt question items to fulfil the aims of the current study. Since the design of the survey involved a comprehensive review of the literature and topic identification, a degree of validity was reached for questionnaire design (Hicks, 2009).

Question types included closed-ended and open-ended questions. Closed-ended questions aimed to collect information on demographics (e.g. years of experience, service setting, caseload type) and types of voice assessments used by SLTs in Ireland. Dichotomous

(yes/no) questions allowed to elicit information about (1) whether voice disorders were a clinical interest of theirs; (2) whether the SLT felt competent in carrying out a voice assessment; (3) whether the SLT worked in a dedicated voice service and (4) whether the SLT had attended any CPD course in relation to voice assessment.

Participants were asked multiple-choice questions to investigate the different types of voice assessments being used. The importance of assessment types was rated using a Likert scale ranging from 1 'Very unimportant' to 5 'Very important'.

Additional questions to identify the barriers to the use of instrumental methods were included. The importance of the barriers was rated by the participants on a Likert scale ranging from 1 'Very unimportant' to 5 'Very important'. Common barriers included in the questionnaire were: (1) not having access to appropriate equipment; (2) limited knowledge in use/interpretation of results of objective assessments; (3) shortages of CPD events in the use of objective assessments; (4) lack of time; (5) low priority of voice disorder assessment in larger caseloads. Open-ended questions were also included to allow the participants to indicate options not already listed (e.g. 'Other: please specify').

Following analysis of the literature, an initial draft of the survey was constructed and implemented online using the KwikSurveys software (freely available at <https://kwiksurveys.com/>). The survey was piloted with SLT students, modified based on their feedback and then piloted again with a specialist SLT in voice disorders with further feedback-based modifications subsequently made. The version of the survey finalised for online administration took approximately fifteen minutes to complete.



## **Participants**

Participants were recruited according to the following inclusion criteria: (1) SLTs working in Ireland in either part-time or full-time positions who work directly with an adult, adolescent and/or paediatric caseload; (2) The SLTs must have had voice disordered clients on their current caseload at time of survey completion. Student or volunteer SLTs and SLTs who do not have any voice disordered clients on their caseload were not included in the study. These criteria were chosen to recruit participants from various clinical settings, varied clinical experiences and academic achievements, working with a broad spectrum of voice disorders.

## **Procedure and data collection**

A gatekeeper was recruited to provide access to the Voice Special Interest Group. The gatekeeper distributed a link to the survey along with an information leaflet to members of the Voice SIG. Correspondence was made with the IASLT who distributed the survey on their social media websites, i.e. Facebook and Twitter and the IASLT member page. One month was provided for responses to be made and a reminder email was sent to the gatekeeper one month after initial contact was made. The link containing the survey enabled participants to submit their responses online, with KwikSurveys acting as the data collection tool. Each participant was automatically assigned a code, ensuring anonymity, and the data was stored online, password protected and only accessible to the researchers.

The study was granted ethical approval by the College of Medicine, Nursing and Health Sciences Research Ethics Committee (CMNHS REC). As the questionnaire did not collect any personally identifying information, anonymity of the participants was ensured. The SLTs who participated were not known to the researchers. Each participant was automatically coded by the KwikSurveys software, further ensuring anonymity.

Forty-five participants responded to the survey. On inspection, 12 questionnaires were only partially completed and so were excluded from the analysis. Here we present the analysis of 33 completed questionnaires.

### **Data analysis**

The data was analysed using SPSS (IBM Corp., 2016). Nominal data was represented as frequency counts. Measures of central tendency such as mean and standard deviation were calculated for continuous data, i.e. years of experience. Open-ended questions required participants to provide a text response regarding additional barriers to the use of instrumentation. As the data set was rather limited, the qualitative data was analysed manually using thematic analysis. Thematic analysis involves the use of a data-coding system in which units of data that present similar features are assigned a shared code (Hennink, Bailey, & Hutter, 2011).

## **RESULTS**

### **Demographic information**

The participants' clinical experience with voice disorders ranged from one to 42 years ( $M = 11.2$ ,  $SD = 9.5$ ). 16/33 (48.5%) worked with disordered population for 1-5 years, 7/33 (21.2%) for 6-10 years and 10/33 (30.3%) worked with voice disordered clients for over 10 years.

The majority of participants – 24/33 (72.7%) indicated BSc as their highest degree, 8/33 (24.2%) held an MSc, and 1/33 (3%) – a PhD. Most of them - 27/33 (81.8%) – studied Speech and Language Therapy in the Republic of Ireland; 6/33 (18.1%) in other countries (UK, USA, Australia). Years since graduation varied from 1 to 43 (mean 11.24,  $SD 10.01$ );

6/33 (18.2%) graduated less than 5 years prior, 17/33 (51.5%) graduated 5-10 years prior, and 10/33 (30.3%) graduated over 10 years prior completion of the survey

Figure 1 illustrates the variety of settings in which the participant SLTs worked. 8/33 (24.2%) of the participants indicated that they work in more than one clinical setting ('multiple settings'). In terms of geographic location of the participants' workplace, majority of participants 22/33 (66.7%) work in Leinster, 6/33 (18.2%) work in Connacht, 3/33 (9.1%) work in Ulster and 2/33 (6.1%) in Munster.

[Insert figure 1 about here]

### **Clinical information, self-perceived competence, specialisation, interest in voice**

Only 9/33 (27.3%) participants reported working specifically with voice disordered clients on a daily basis. The majority - 24/33 (72.7%) reported that voice disordered population made 25% or less of their caseload; 6/33 (18.2%) work with disordered clients 25-50% of the time; and 3/33 (9%) reported that voice disordered population made 50% of their caseload or more.

31/33 (93.9%) of participants consider themselves competent in carrying out voice assessment. 25/33 (75.8%) described voice as clinical interest; 23/33 (69.7%) attended a CPD event related to voice assessment.

29/33 (87.9%) stated that the service they provide is comprised of different patients and voice happens to be one of them; only 4/33 (12%) work in a dedicated voice service. 26/33 (78.8%) work with adults, 10/33 (30%) work with a paediatric/adolescent caseload and 7/33 (21.2%) work with a mixed caseload.

### **General awareness/how informed SLTs are about assessment protocols**

25/33 (75.8%) participants consider ENT referral essential, 2/33 (6.1%) desirable and 3/33 (9.1%) case dependent. Using the 'other: please specify' option of the questionnaire, 3/33 (9.1%) of SLTs indicated that they may do an initial assessment prior to ENT involvement, but do not proceed with further treatment until ENT assessment is completed.

18/33 (54.5%) participants indicated that they were not familiar with ELS protocol (Dejonckere et al., 2001); while the remaining 15/33 (45.5%) were familiar with it.

### **Frequency of use of subjective and objective methods of voice assessment**

The frequency of use of voice assessment techniques by participant SLTs is shown in figure 2. Similar to the findings in Kenny (2017), there is a clear preference for the use of subjective methods.

[Insert figure 2 about here]

Although observation of body movement and position and the ability to modify voice are not included in a comprehensive voice assessment (ASHA, 2018; Dejonckere et al., 2001; Enderby et al., 2009), almost all participants of this study reported using them all of the time. As these are simple additions to an SLT's assessment procedure, their frequent use is perhaps not surprising.

In terms of objective measures, aerodynamic assessment was reported as the most commonly used, with 29/33 (87.8%) of SLTs always using it. This most likely stems from the fact that frequently used maximum phonation time (MPT) and s/z ratio measures are often referred to as aerodynamic measures (e.g. Awan, Novaleski, & Yingling, 2013; Barsties & De Bodt, 2015), although they do not require sophisticated instrumentation compared to aerodynamic

measures proper (e.g. subglottal pressure or intraoral pressure). Acoustic assessment was often/always used by 5/33 (15.1%) participants. There is limited use of laryngoscopy and videostroboscopy. Only one participant reported using electroglottography often.

### **Subjective methods of assessment**

Responses investigating the different types of both auditory-perceptual and client self-perception rating scales used in voice assessment show that all of participant SLTs use some form of subjective assessment when analysing voice disordered clients. 26/33 (78.7%) rated auditory assessment as very important, 7/33 (21.2%) important.

The most commonly used auditory-perceptual assessment tool is the GRBAS scale (Hirano 1981), used by 32/33 (96.9%) participants. Cape-V (Kempster, Gerratt, Verdolini Abbott, Barkmeier-Kraemer, & Hillman, 2009) is used by 7/33 (21.2%), and 5/33 (15.2%) use VoQS (Ball, Esling, & Dickson, 2017). Note that participants could select more than one auditory assessment tool. In addition to validated auditory perception scales, ‘own verbal descriptors’ are used by 31/33 (93.9%) participants. These findings again mirror those in Kenny (2017).

All participants reported using some form of client self-perception scale in voice assessment; all indicated this form of assessment as very important 21/33 (63.6%) or important 12/33 (36.4%). Table 1 shows the frequency of use of self-perception rating scales in voice assessment. The Voice Handicap Index – VHI and VHI-10 (Jacobson et al., 1997) was the most popular form of self-perception rating scale in adults, and the Paediatric VHI (Zur et al., 2007) was the most popular paediatric assessment choice. The Reflux Symptom Index (Belafsky, Postma, & Koufman, 2002) was the third most popular type of self-perception rating scales used by SLTs. This is appropriate considering that voice disorders occur with laryngopharyngeal reflux at a reported prevalence of 50% (Koufman, Amin, & Panetti,

2000). Note again that the same SLT may use more than one scale suggesting that multiple assessment tools provide complementary information.

[Insert table 1 about here]

### **Audio recording practices**

Results show that 20/33 (60.6%) of participants routinely record their client's voices. The most popular device is digital voice recorder (Dictaphone) used by 14/33 (42.4%) followed by mobile phone 7/33 (21.2%). Digital video camera is used by 2/33 (6.1%), cassette recorder – by 1/33 (3%), iPad – by 1/33; and minidisc recorder - by 2/33 (6.1%).

23/33 (69.7%) of participants routinely record [a] vowel, 28/33 (84.8%) record a read passage; spontaneous speech is recorded by 22/33 (66.7%). Other speech samples sometimes recorded include CAPE-V words and sentences, s/z ratio, speech samples of varying loudness and pitch. 3/33 (9.1%) participants do not make recordings.

Most participants use device in-built microphone 21/33 (63.6%), 2/33 (6.1%) use hand-held microphone, and 1/33 uses high quality external microphone. While head-mounted microphones are recommended, none of the participants reported using them.

The majority of SLTs (70% of participants and higher) indicated quality of equipment, quality of microphone, microphone placement relative to the speaker, level of ambient noise, correct recording level setting and eliciting a speech sample representative of a client's voice as important or very important considerations during a recording session for voice assessment, with the latter considered very important by 26/33 (78.7%) of participants.

## **Instrumental methods of assessment**

### *Videostroboscopy*

Results show that only 3/33 (9.1%) routinely perform videostroboscopy; 7/33 (21.2%) routinely evaluate results from a videostroboscopy. This is reflected in the evaluation of videostroboscopy as important/very important by 15/33 (45.4%) participants and as neutral by 17/33 (51.5%). Similar findings were reported in previous studies: for example, 55% of SLTs report never performing videostroboscopy with paediatrics in the US (Hartley et al., 2017).

### *Electroglottography*

None of the participants reported using EGG routinely; 20/33 (60.6%) rated its importance as neutral, 6/33 (18.2%) consider it unimportant, and 7/33 (21.2%) consider it very important. This again is similar to findings in previous research: Hartley et al. (2017) and Behrman (2005) report electroglottography use by only 4% and 6% of SLTs respectively.

### *Acoustic analysis*

15/33 (45.4%) of SLTs reported using some form of acoustic analysis as part of their voice assessment. 10/33 (30.3%) consider it important or very important for voice assessment; 17/33 (51.5%) are neutral and 6/33 (18.3%) consider it unimportant or very unimportant. Among the SLTs using acoustic analysis, 7/15 (46.7%) consider it important or very important and the remaining 8/15 (53.3%) are neutral.

Frequency of use of the various types of acoustic measures routinely carried out by SLTs in their assessment of voice is shown in table 2. Mean speaking intensity, mean speaking  $f_0$  and habitual  $f_0$  range appear to be the most popular measures; some also use perturbation measures (jitter and shimmer); CPP – cepstral peak prominence (Fraile & Godino-Llorente,

2014; Hillenbrand, Cleveland, & Erickson, 1994) currently recommended by ASHA as a robust indicator of dysphonia (Patel et al., 2018) is not used by any of the participants.

[Insert table 2 about here]

Following Behrman (2005), information was collected about awareness of the SLTs working with acoustic data of the suitability of recorded speech sample for acoustic analysis (see discussion in Behrman (2005) of Titze's three types of voice signals (Titze, 1995) and the appropriate analysis that can be applied to each type). When working with a patient with a severely irregular (rough) or breathy voice, 5/15 (33.3%) of participants demonstrated awareness of suitability of periodicity-related measures in the analysis of dysphonic voice: they either select quasiperiodic segment (1/15); omit measures that rely on quasiperiodicity (2/15) or try to elicit the most regular voice sample. 10/15 (66.6%) of SLTs using acoustic analysis reported obtaining the data in the usual fashion and allowing the measures to reflect the irregularities in voice production.

The use of acoustic analysis software appears to be limited: 2/15 use CSL and VisiPitch (Kay Elemetrics), 3/15 use Praat (Boersma & Weenink, 2017). This contradicts the reported use of acoustic assessment by 15 participant SLTs. One likely explanation is that SLTs use mobile phone apps rather than specialised acoustic software. The questionnaire allowed the participants free answer to this question, but the option of mobile phone app was not included explicitly.

#### *Aerodynamic assessment*

The most commonly used forms of aerodynamic assessment were Maximum Phonation Time and s/z ratio. These simple non-invasive measures of respiratory support that do not require complex/calibrated instrumentation are used by 32/33 (96.9%) of participants. Instrumental



measures such as laryngeal resistance (3/33, 9%) glottal flow rate (2/33, 6.1%) and mean subglottal pressure (1/33, 3%) are much less extensively used. Most of the participants - 30/33 (90.9%) consider these measures important or very important for voice assessment.

### **Barriers to the use of instrumentation**

Figure 3 summarises what participant SLTs indicated as important barriers to the use of instrumental methods of voice assessment. Access to equipment was named as the most important barrier affecting the use of videostroboscopy, electroglottography and acoustic assessments. That access to acoustic analysis equipment was named as an issue suggests limited awareness of existing freely available applications like Praat (Boersma & Weenink, 2017) or Speech Analyser (<https://software.sil.org/speech-analyzer/>). Shortage of CPD courses was rated as the second most important barrier affecting the use of acoustic and EGG methods followed by limited knowledge of the use of instrumentation. Limited knowledge was second most important barrier to the use of stroboscopy. Lack of time and a low priority of voice disordered clients in caseload were rated as important by fewer participants. These barriers appear to affect the use of aerodynamic assessment to a much lesser degree. Most likely, the term aerodynamic assessment was understood by the participants mainly to mean non-invasive measures like Maximum Phonation Time and s/z ratio, which are relatively simple and do not require complex calibrated instrumentation used to measure aerodynamics of speech (Baken & Orlikoff, 2000; Heuer et al., 2005).

[Insert figure 3 about here]

The participants were also given an option to provide text responses for what they considered as barriers affecting their use of instrumentation in voice assessment. These responses were analysed using thematic analysis (Hennink et al., 2011) and are summarised below.

*Theme 1: Training.* The first theme that emerged was *Training*, where SLTs described the lack of training, lack of clinical knowledge, limited experience in using instrumentation and limited research evidence supporting the use of these instruments. One therapist reported a ‘*limited understanding of the need for electroglottography*’ and several SLTs expressed concerns regarding a ‘*lack of training*’. This theme is concurrent with the importance placed on ‘*limited knowledge in interpretation and use of instrumentation*’, and ‘*shortages of CPD courses*’ options included in this questionnaire as potential barriers.

*Theme 2: Association with ENT.* Association with ENT emerged as a prominent theme relating to use of videostroboscopy. Issues arose with ‘*lack of teamwork/liaising with ENT services*’ and with limited access to ENT services, who in turn may not always have access to videostroboscopy equipment. This theme would not have been addressed had the option for own text responses not been made available to the SLTs in the survey.

*Theme 3: Issues with equipment.* Issues with equipment were identified as an additional theme. The SLTs referred to funding and cost of equipment, limited access to equipment and the clinical environment, having no rooms with ‘*appropriate acoustics*’ and limited ‘*space to carry out procedures*’.

*Theme 4: Caseload.* Although the participants acknowledged importance of the use of instrumentation, they also expressed concerns regarding their caseload, namely a low occurrence of voice disordered clients, resulting in the emergence of *Caseload* as a theme. For example, a participant reported: ‘*We don't see enough people with voice disorders to make this a priority*’. SLTs questioned the feasibility of investing in equipment due to this factor.

## **Future practice**

In relation to future practice, 25/33 (75.7%) of participants stated that they were interested or very interested in a CPD event relating to the use of instrumental assessment of voice. Over 50% of SLTs - 17/33 (51.5%) - indicated that they were most interested in a CPD event on stroboscopy or videostroboscopy, with aerodynamics and acoustic analysis ranked equally as the second most popular choice (12/33, 36.3%).

The SLTs were invited to include any other comments regarding instrumentation at the end of the survey. SLTs once again expressed a need for/interest in specialist training, interest in self-teaching and learning, but pointed out that this may not be feasible in a busy working environment with a fairly low proportion of voice disordered clients. Certain types of instrumentation will not be possible to use with pediatric population. The themes identified as barriers reoccurred again, i.e. equipment issues, caseload implications.

*It would be great to have access to more instrumental techniques that can be used relatively easily in the clinic setting. It can be difficult to know which techniques to prioritise when thinking about limited CPD days and funding for equipment/ resources.*

## **DISCUSSION**

### **General discussion**

This study looked at common voice assessment practices used by the participating SLTs in Ireland with particular focus on instrumental methods and barriers to their use. The findings provide additional information to the recent study by Kenny (2017) by identifying the barriers to the use of instrumental assessment.

Findings of this study suggest that subjective methods of voice assessment are preferred by SLTs, in comparison with objective methods. Similar findings are reported in Kenny (2017) – not surprising, perhaps, as he worked with the sample of SLT in Ireland, - and in the study by Hartley et al. (2017) where preference of subjective assessment was also noted.

However, *'most common practice does not equal best practice'* (Behrman, 2005, p. 468). Subjective measures alone do not constitute a comprehensive voice assessment (Roy et al., 2013; Speyer, 2008). In complying with the recommended voice protocols (ASHA, 2018; Dejonckere et al., 2001; Enderby et al., 2009), there is clear evidence to support the use of both subjective and objective measures in the assessment of voice (Roy *et al.* 2013). On the other hand, it cannot be simply stated that SLTs do not use objective instrumentation out of preference. Previous research (Hartley et al., 2017) and the findings of this study show that there are factors that may potentially impact its use.

This study showed some inconsistencies in the use of validated and non-validated methods of auditory-perceptual assessment. The two most frequently used voice assessments were observations of a client's body position and movement and their ability to modify voice in response to direction. These methods of assessment are non-validated, subjective and do not feature among recommendations in the literature on comprehensive voice assessment or in the systematic review of evidence-based voice assessment (Roy *et al.* 2013). On the other hand, the GRBAS (Hirano, 1981), which demonstrates high reliability (Nemr et al., 2012) and ease of use clinically (Maryn, Corthals, Van Cauwenberge, Roy, & De Bodt, 2010), was the most commonly used auditory-perceptual assessment tool. SLTs reported frequently using 'own verbal descriptors', a non-validated tool of auditory-perceptual assessment. This finding may suggest potential lack of evidence-based practice in the assessment of voice (Dollaghan, 2007) and has implications for clinical practice as non-validated voice

assessments may be unreliable. On the other hand, addition of own verbal descriptors may also suggest inadequacy (e.g. insufficient level of detail) of popular validated tools for specific cases.

Hartley et al. (2017) report that over half of SLTs in their American study do not use videostroboscopy. According to this study, 80% of SLTs report never using videostroboscopy (it is understood that sampling limitations must be taken into consideration in generalisation of this statement). Videostroboscopy is typically recommended in a comprehensive voice assessment (e.g., ASHA, 2018). This study identifies *Access to equipment* and *Association with ENT* as barriers to the compliance with these recommendations. This may need further investigation in terms of setting-specific exploration of voice assessment, i.e. acute hospital vs. primary care centres.

Electroglottography was found in this study to be used by only one SLT routinely. Similar results were reported by Kenny (2017), Hartley et al. (2017) and Behrman (2005). *Shortages of CPD events* was identified as a common barrier affecting its use. Despite evidence supporting its use clinically (Ma & Yiu, 2011; Somanath & Mau, 2016), this method for analysis of phonatory patterns does not feature commonly in recommended voice protocols as part of comprehensive voice assessment (Dejonckere *et al.* 2001), nor was it included in the recommendations of the recent systematic review (Roy *et al.* 2013).

Acoustic assessment features as a component of each of the analysed voice assessment protocols (ASHA, 2018; Dejonckere et al., 2001; Enderby et al., 2009). Our findings, however, suggest that its use clinically is rather limited (15/33, 45.4% reported using some form of acoustic analysis). These findings are different to what was reported for American clinicians in Behrman (2005) and Hartley *et al.* (2017), where 75% and 65% of SLTs respectively were found to be using acoustic analysis. In this study, the SLTs indicated access

to equipment, limited knowledge in use and interpretation of acoustic data and a shortage of CPD events related to acoustic analysis as barriers. It is possible, and worthy of further investigation, that more emphasis is placed on acoustic assessment in training of American SLTs compared with SLT students in Ireland. Sample size limitations must be considered before making generalisations.

None of the participant SLTs in this study reported using Cepstral Peak Prominence (CPP) as part of their voice assessment. CPP is currently recommended as a more robust, compared to jitter and shimmer, measure of voice dysphonia, reflecting the degree of periodicity and noise component in the voice signal in a comprehensive voice assessment. Evidence shows its use clinically in the differentiation of normal from dysphonic voice using either sustained vowels or connected speech (Watts & Awan, 2011) and it can be obtained using Praat (Watts, Awan, & Maryn, 2017). However, the measure is not necessarily easy to interpret and there is not sufficient normative data available on how it varies across phonation types.

Aerodynamic measures of vocal function were found to be frequently used by the SLTs, however this finding cannot be regarded as truly reflecting the use of instrumental methods of assessment. The most commonly used maximum phonation time (MPT) and s/z ratio do not require sophisticated instrumentation. As mentioned earlier, it is likely that the SLTs associate aerodynamic assessment mainly with MPT and s/z ratio as these measures referred to as such frequently in the literature, e.g. Dejonckere (2010), which also explains why there was limited emphasis placed on barriers restricting their use. The questionnaire used in this study did not specify any types of aerodynamic instrumentation, such as Pentax Medical Phonatory Aerodynamic System (PAS) or Rothenberg mask. In general, aerodynamic instrumentation is unlikely to be routinely used by SLTs; Kenny (2017) reported only one

participant using aerodynamic assessment tools. Further work is required to establish the extent of use of instrumental and non-instrumental aerodynamic assessment.

### **Clinical application**

The participants demonstrate an adherence to a comprehensive voice assessment by utilising both subjective and objective practices, though showing a preference to the former. *Access to equipment* was the main barrier to the use of instrumental methods identified by this study, with additional factors such as *Association with ENT* and *Training* also limiting their use. The majority of the SLTs expressed an interest in attending a CPD event regarding the use of instrumentation, with stroboscopy and videostroboscopy being the most desirable.

The findings have implications for future education of SLT students. Currently, speech sciences and instrumental phonetics are included as part of the curriculum of Speech and Language Therapy university courses in Ireland. However, if there is limited access to instrumentation, and no opportunity to practice instrumental (typically, non-invasive acoustic) methods of analysis, these clinical skills acquired in university may be lost. Furthermore, it may be viable to raise awareness of freely available software such as Praat, Speech Analyser or WaveSurfer as a solution to the 'equipment issues' which impede the use of objective methods of assessment (albeit for acoustic analysis only). Since easy to use reliable mobile tools are desirable in clinical practice, it is worth exploring the use of mobile phone apps, e.g. Grillo, Brosious, Sorrell, and Anand (2016).

Barriers identified in this research need further investigation. The comprehensiveness of voice assessment protocols adapted by SLTs in Ireland have potential to improve and abide by evidence-based practice. Future qualitative research may be necessary, such as interviews/focus groups exploring practices of SLTs working in varied clinical settings, thus providing a deeper understanding of what acts as barriers to the use of instrumentation and

how best to overcome them. Furthermore, there is a need for a nationally accepted protocol for voice assessment.

### **Strengths and limitations**

This study succeeded in recruiting participants working from a variety of clinical settings, with different experience and different education and explored and identified barriers to the use of instrumental techniques in voice assessment, something not addressed in an earlier study by Kenny (2017). Although the number of returned questionnaires were comparable to Kenny (2017), the number of completed questionnaires was rather low (33 completed vs. 45 returned). This could potentially be the result of using electronic online survey and the fact that the participants could not save and resume incomplete questionnaire at a later stage. Unexpected events like a dropped internet connection may have been a factor.

Bryman (2012) states that the convergent validity of a data collection method can be established by comparing it to measure of the same concept derived from an alternative method, for example, focus groups. The questionnaire lacks this form of validity. The use of pilot trials on SLT in training and expert SLT reflects an attempt to address validity. Furthermore, the adapted questions from published research utilising surveys as the data collection tool (Kenny 2017; Behrman 2005). However, a particular interest of the authors in instrumental methods of voice assessment and barriers to their use might have introduced researcher bias; thus the questions may not adequately reflect the experiences of SLTs in Ireland and their use of voice assessments.

The length of the questionnaire (48 items) might have implications for data reliability as length can influence the participant's interest prior to questionnaire completion (Lefever et al., 2007). No statistical determination of internal consistency was completed prior to survey administration, i.e. Cronbach's alpha ( $\alpha$ ) for rating scales or Kuder-Richardson 20 for binary



questions (Black 2005). Issues of validity were of concern; however, steps were undertaken to ensure face validity, such as using previously published survey questions and analysis of literature of the general topic (Hicks, 2009).

## **CONCLUSION**

The current study has implications for clinical practice, as there appears to be a preference of subjective use of voice assessment by Irish SLTs and use of non-validated auditory-perceptual assessment despite the recommended voice assessment protocols. By examining qualitative and quantitative data, this study identified barriers to the use of instrumental methods of assessment. SLTs described *Access to equipment*, *Limited knowledge in use and interpretation* and *Shortages of CDP events* as barriers to their clinical use of instrumentation. Barriers identified using thematic analysis included *Training*, *Association with ENT*, *Caseload implications* and *Equipment issues* concurred with previous research on this topic and explained why subjective measures are most commonly used by the participating Irish SLTs. Importantly, further education in the form of CPD events and raising awareness regarding freely available software or reliable mobile phone apps may provide ways to overcome the barriers identified by this research.

## **DECLARATION OF INTEREST**

The authors report no conflicts of interest.

## REFERENCES

- ASHA. (2018). Voice Disorders: Assessment(24/01/2019). Retrieved from <https://www.asha.org/PRPSpecificTopic.aspx?folderid=8589942600&section=Assessment>
- Awan, S. N., Novaleski, C. K., & Yingling, J. R. (2013). Test-retest reliability for aerodynamic measures of voice. *Journal of Voice*, 27(6), 674-684. doi:<https://doi.org/10.1016/j.jvoice.2013.07.002>
- Baken, R. J., & Orlikoff, R. F. (2000). *Clinical Measurement of Speech and Voice* (2 ed.). San Diego: Thomson Learning.
- Ball, M. J., Esling, J. H., & Dickson, B. C. (2017). Revisions to the VoQS system for the transcription of voice quality. *Journal of the International Phonetic Association*, 1-7. doi:10.1017/S0025100317000159
- Barsties, B., & De Bodt, M. (2015). Assessment of voice quality: Current state-of-the-art. *Auris, Nasus, Larynx*, 42(3), 183-188. doi:<http://dx.doi.org/10.1016/j.anl.2014.11.001>
- Behrman, A. (2005). Common practices of voice therapists in the evaluation of patients. *Journal of Voice*, 19(3), 454-469. doi:10.1016/j.jvoice.2004.08.004
- Belafsky, P. C., Postma, G. N., & Koufman, J. A. (2002). Validity and reliability of the reflux symptom index (RSI). *Journal of Voice*, 16(2), 274-277.
- Boersma, P., & Weenink, D. (2017). *Praat: doing phonetics by computer*.
- Boone, D. R., McFarlane, S. C., Von Berg, S. L., & Zraick, R. I. (2014). *The Voice and Voice Therapy* (9 ed.): Pearson.
- Bryman, A. (2012). *Social Research Methods*. Oxford: Oxford University Press.
- Buder, E. H. (2000). Acoustic analysis of voice quality: a tabulation of algorithms 1902-1990. In R. D. Kent & M. J. Ball (Eds.), *Voice Quality Measurement* (pp. 119-244): Singular Publishing Group.

- Carding, P. N., Wilson, J. A., MacKenzie, K., & Deary, I. J. (2009). Measuring voice outcomes: state of the science review. *The Journal of Laryngology & Otology*, *123*(8), 823-829. doi:10.1017/S0022215109005398
- Cohen, S. M., Dupont, W. D., & Courey, M. S. (2006). Quality-of-life impact of non-neoplastic voice disorders: a meta-analysis. *Annals of Otology, Rhinology and Laryngology*, *115*(2), 128-134. doi:10.1177/000348940611500209
- Cohen, W., Wynne, D. M., Kubba, H., & McCartney, E. (2012). Development of a minimum protocol for assessment in the paediatric voice clinic. Part 1: evaluating vocal function. *Logoped Phoniatr Vocol*, *37*(1), 33-38. doi:10.3109/14015439.2011.638670
- Dejonckere, P. H. (2010). Assessment of voice and respiratory function. In M. Remacle & H. E. Eckel (Eds.), *Surgery of Larynx and Trachea* (pp. 11-26). Berlin Heidelberg: Springer-Verlag.
- Dejonckere, P. H., Bradley, P., Clemente, P., Cornut, G., Crevier-Buchman, L., Friedrich, G., . . . Woisard, V. (2001). A basic protocol for functional assessment of voice pathology, especially for investigating the efficacy of (phonosurgical) treatments and evaluating new assessment techniques. Guideline elaborated by the Committee on Phoniatics of the European Laryngological Society (ELS). *European Archives of Otorhinolaryngology*, *258*(2), 77-82.
- Dollaghan, C. A. (2007). *The Handbook of Evidence-Based Practice in Communication Disorders*. Baltimore, MD: Paul H. Brookes Publishers.
- Eadie, T. L., & Baylor, C. R. (2006). The effect of perceptual training on inexperienced listeners' judgments of dysphonic voice. *Journal of Voice*, *20*(4), 527-544. doi:10.1016/j.jvoice.2005.08.007

- Enderby, P., Pickstone, C., John, A., Fryer, K., Cantrell, A., & Papaioannou, D. (2009). *Resource manual for commissioning and planning services for SLCN*. Retrieved from RCSLT:
- Fraile, R., & Godino-Llorente, J. I. (2014). Cepstral peak prominence: A comprehensive analysis. *Biomedical Signal Processing and Control*, 14, 42-54.  
doi:<http://dx.doi.org/10.1016/j.bspc.2014.07.001>
- Grillo, E. U., Brosious, J. N., Sorrell, S. L., & Anand, S. (2016). Influence of smartphones and software on acoustic voice measures. *Int J Telerehabil*, 8(2), 9-14.  
doi:10.5195/ijt.2016.6202
- Hartley, N. A., Braden, M., & Thibeault, S. L. (2017). Practice patterns of speech-language pathologists in pediatric vocal health. *American Journal of Speech-Language Pathology*, 26(2), 281-300. doi:10.1044/2016\_AJSLP-15-0057
- Heman-Ackah, Y. D., Heuer, R. J., Michael, D. D., Ostrowski, R., Horman, M., Baroody, M. M., . . . Sataloff, R. T. (2003). Cepstral peak prominence: a more reliable measure of dysphonia. *Annals of Otology, Rhinology and Laryngology*, 112(2), 324-333.  
doi:<http://dx.doi.org/10.1177/000348940311200406>
- Hennink, M., Bailey, A., & Hutter, I. (2011). *Qualitative research methods*. London: Sage Publications.
- Heuer, R. J., Hawkshaw, M. J., & Sataloff, R. T. (2005). The clinical voice laboratory. In R. T. Sataloff (Ed.), *Clinical Assessment of Voice* (pp. 33-71): Plural Publishing.
- Hicks, C. M. (2009). *Research methods for clinical therapists: Applied project design and analysis* (5 ed.). Edinburgh: Churchill Livingstone.
- Hillenbrand, J., Cleveland, R. A., & Erickson, R. L. (1994). Acoustic correlates of breathy vocal quality. *Journal of Speech and Hearing Research*, 37(August), 769-778.  
doi:<http://dx.doi.org/10.1044/jshr.3704.769>

- Hillenbrand, J. M. (2011). Acoustic analysis of voice: a tutorial. *SIG 5 Perspectives on Speech Science and Orofacial Disorders*, 21(2), 31-43.  
doi:<http://dx.doi.org/10.1044/ssod21.2.31>
- Hirano, M. (1981). *Clinical Examination of Voice*. New York: Springer Verlag.
- IBM Corp. (2016). IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp.
- Jacobson, B. H., Johnson, A., Grywalski, C., Silbergleit, A., Jacobson, G., Benninger, M. S., & Newman, C. W. (1997). The Voice Handicap Index (VHI). *American Journal of Speech-Language Pathology*, 6(3), 66-70. doi:doi:10.1044/1058-0360.0603.66
- Kempster, G. B., Gerratt, B. R., Verdolini Abbott, K., Barkmeier-Kraemer, J., & Hillman, R. E. (2009). Consensus auditory-perceptual evaluation of voice: development of a standardized clinical protocol. *American Journal of Speech-Language Pathology*, 18(2), 124-132. doi:10.1044/1058-0360(2008/08-0017)
- Kenny, C. (2017). Assessment practices of Irish speech and language therapists in the evaluation of voice disorders. *Logoped Phoniatr Vocol*, 42(1), 12-21.  
doi:10.3109/14015439.2015.1121291
- Kent, R. D., & Ball, M. J. (2000). *Voice Quality Measurement*: Singular Publishing Group.
- Koufman, J. A., Amin, M. R., & Panetti, M. (2000). Prevalence of reflux in 113 consecutive patients with laryngeal and voice disorders. *Otolaryngology and Head and Neck Surgery*, 123(4), 385-388. doi:10.1067/mhn.2000.109935
- Kreiman, J., & Gerratt, B. R. (2000). Sources of listener disagreement in voice quality assessment. *Journal of the Acoustical Society of America*, 108(2), 1867-1876.  
doi:<http://dx.doi.org/10.1121/1.1289362>

- Lefever, S., Dal, M., & Matthíasdóttir, Á. (2007). Online data collection in academic research: advantages and limitations. *British Journal of Educational Technology*, 38(4), 574-582. doi:doi:10.1111/j.1467-8535.2006.00638.x
- Ma, E. P., & Yiu, E. M. (2001). Voice activity and participation profile: assessing the impact of voice disorders on daily activities. *Journal of Speech, Language, and Hearing Research*, 44(3), 511-524.
- Ma, E. P., & Yiu, E. M. L. (2011). *Handbook of Voice Assessments*. San Diego: Plural Publishing.
- Maryn, Y., Corthals, P., Van Cauwenberge, P., Roy, N., & De Bodt, M. (2010). Toward improved ecological validity in the acoustic measurement of overall voice quality: combining continuous speech and sustained vowels. *Journal of Voice*, 24(5), 540-555. doi:<http://dx.doi.org/10.1016/j.jvoice.2008.12.014>
- Maryn, Y., Roy, N., De Bodt, M., Van Cauwenberge, P., & Corthals, P. (2009). Acoustic measurement of overall voice quality: a meta analysis. *Journal of the Acoustical Society of America*, 126(5), 2619-2634. doi:<http://dx.doi.org/10.1121/1.3224706>
- Nemr, K., Simões-Zenari, M., Ferro Cordeiro, G., Tsuji, D., Ogawa, A. I., Tibério Ubrig, M., & Moreira Menezes, H. (2012). GRBAS and Cape-V scales: high reliability and consensus when applied at different times. *Journal of Voice*, 26(6), 812.e817-812.e822. doi:10.1016/j.jvoice.2012.03.005
- Patel, R. R., Awan, S. N., Barkmeier-Kraemer, J., Courey, M., Deliyski, D., Eadie, T., . . . Hillman, R. (2018). Recommended protocols for instrumental assessment of voice: American Speech-Language-Hearing Association expert panel to develop a protocol for instrumental assessment of vocal function. *American Journal of Speech-Language Pathology*, 27(3), 887-905. doi:10.1044/2018\_AJSLP-17-0009

- Roy, N., Barkmeier-Kramer, J., Sivasankar, M., Eadie, T., Mehta, D., Paul, D., & Hillman, R. E. (2013). Evidence-based clinical voice assessment: a systematic review. *American Journal of Speech-Language Pathology*, 22, 212-226.
- Roy, N., Merrill, R. M., Gray, S. D., & Smith, E. M. (2005). Voice disorders in the general population: prevalence, risk factors, and occupational impact. *Laryngoscope*, 115(11), 1988-1995. doi:10.1097/01.mlg.0000179174.32345.41
- Sataloff, R. T. (2005). *Professional voice: the science and art of clinical care* (3 ed.). San Diego, CA: Plural Publishing, Inc.
- Somanath, K., & Mau, T. (2016). A measure of the auditory-perceptual quality of strain from electroglottographic analysis of continuous dysphonic speech: Application to adductor spasmodic dysphonia. *Journal of Voice*, 30(6), 770.e779-770.e721. doi:10.1016/j.jvoice.2015.11.005
- Speyer, R. (2008). Effects of voice therapy: a systematic review. *Journal of Voice*, 22(5), 565-580. doi:10.1016/j.jvoice.2006.10.005
- Thibeault, S. L., Merrill, R. M., Roy, N., Gray, S. D., & Smith, E. M. (2004). Occupational risk factors associated with voice disorders among teachers. *Annals of Epidemiology*, 14(10), 786-792. doi:10.1016/j.annepidem.2004.03.004
- Titze, I. R. (1995). *Workshop on acoustic voice analysis: summary statement*. Retrieved from Iowa City, IA:
- Watts, C. R., & Awan, S. N. (2011). Use of spectral/cepstral analyses for differentiating normal from hypofunctional voices in sustained vowel and continuous speech contexts. *Journal of Speech, Language, and Hearing Research*, 54(6), 1525-1537. doi:10.1044/1092-4388(2011/10-0209)

Watts, C. R., Awan, S. N., & Maryn, Y. (2017). A comparison of cepstral peak prominence measures from two acoustic analysis programs. *Journal of Voice*, *31*(3), 387.e381-387.e310. doi:10.1016/j.jvoice.2016.09.012

Wolfe, V. I., Martin, D. P., & Palmer, C. I. (2000). Perception of dysphonic voice quality by naive listeners. *Journal of Speech, Language, and Hearing Research*, *43*(3), 697-705.

Zraick, R. I., Kempster, G. B., Connor, N. P., Thibeault, S., Klaben, B. K., Bursac, Z., . . . Glaze, L. E. (2011). Establishing validity of the Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V). *American Journal of Speech-Language Pathology*, *20*(1), 14-22. doi:[http://dx.doi.org/10.1044/1058-0360\(2010/09-0105\)](http://dx.doi.org/10.1044/1058-0360(2010/09-0105))

Zur, K. B., Cotton, S., Kelchner, L., Baker, S., Weinrich, B., & Lee, L. (2007). Pediatric Voice Handicap Index (pVHI): a new tool for evaluating pediatric dysphonia. *International Journal of Pediatric Otorhinolaryngology*, *71*, 77-82.



## APPENDIX. QUESTIONNAIRE

### 1. INTRODUCTION

This survey aims to gather information about voice disorder assessment practices of Speech and Language Therapists in Ireland, with a particular interest in instrumental methods of assessment. The survey can be completed by any Speech and Language Therapist (SLT) working with any voice disorder as part of their caseloads. This includes SLTs working on a full-time or part-time basis, but does not include SLTs who are on a student placement or volunteering. The SLT does not have to work exclusively with voice, but must have voice disordered clients on their caseload.

#### PLEASE NOTE

- By completing this survey in full you are consenting to take part in this study.
- All responses are completely anonymous.
- If you change your mind during the survey and decide you no longer wish to take part, simply close the questionnaire and your data will not be analysed.
- Only completed surveys will be used for data analysis.
- The entire survey takes approximately 10 minutes.
- If you have already completed the survey, please do not complete it again.

Thank you very much for your participation!

### 2. Clinical Information

1. Please indicate if you have obtained the following in your professional Speech and Language Therapy career:
  - A. Bachelor of Science (BSc in Speech and Language Therapy)
  - B. Masters (MSc)
  - C. Doctorate (PhD)
2. Where did you study to become a Speech and Language Therapist?
3. Please state which year you graduated as a Speech and Language Therapist:
4. Please indicate the number of years which you have been working with a voice disordered population:
5. Please indicate the province in Ireland in which you work:
  - A. Ulster
  - B. Connacht
  - C. Leinster
  - D. Munster

6. Which clinical setting best describes the area in which you work? Choose all that apply:
  - A. Acute Care Hospital
  - B. Community Care (Adults)
  - C. Community Care (Paediatrics)
  - D. Rehabilitation Hospital
  - E. Intellectual Disability
  - F. Physical Disability
  - G. Private Practice
  - H. Teaching/Lecturing
  
7. Do you work specifically with voice disordered clients on a daily basis?
  - A. Yes
  - B. No
  
8. What percentage of your caseload relates to voice disorders? Please enter a percentage value between 1 and 100.
  
9. What population of voice disordered clients you typically work with? Choose all that apply:
  - A. Paediatrics
  - B. Adolescents
  - C. Adults
  
10. Would you consider yourself to be competent in carrying out a voice assessment?
  - A. Yes
  - B. No
  
11. Would you describe voice disorders as a clinical interest?
  - A. Yes
  - B. No
  
12. Have you attended any continual professional development (CPD) events related to voice assessment?
  - A. Yes
  - B. No
  
13. Please indicate which of the following statements best describes your service:
  - A. The service I provide is a dedicated voice service. For example, a therapy service specifically for ENT (ear, nose and throat) or a post as part of a dedicated service plan for ENT patients.
  - B. The service I provide is comprised of a variety of different patients and voice happens to be one of them.

14. How often do you use the following assessment procedures with your clients?

	Never	Rarely	50% of the time	Often	Always
Videostroboscopy (SLT performed)					
Videostroboscopy (review of ENT video)					
High speed laryngoscopy					
Aerodynamic assessment (e.g., Maximum Phonation Time)					
Acoustic assessment (e.g., f0, jitter, shimmer etc.)					
Electroglottographic assessment					
Patient self-perception assessment (e.g., Voice Handicap Index)					
Auditory-perceptual assessment (e.g., GRBAS)					
Observation of client's body movement and position					
Observation of client's ability to modify voice production in response to direction and/or modelling					

15. If your client has not been referred by an otolaryngologist (ENT), how important do you consider an ENT referral prior to completing a voice assessment?

- A. Essential
- B. Desirable
- C. Case dependent
- D. Not required
- Other (Please specify)

16. Are you familiar with the basic protocol for functional assessment of voice pathology as outlined by the European Laryngeal Society (ELS) (e.g., Dejonckere et al 2001, 2003)?

- A. Yes
- B. No

### 3. Subjective Assessments

#### 4. AUDITORY-PERCEPTUAL ASSESSMENT

17. Please select which auditory-perceptual assessment(s) you routinely use in assessing your client's voice. Choose all that apply:

- A. GRBAS
- B. CAPE-V
- C. Buffalo Voice Profile
- D. VoQS: Voice Quality Symbols
- E. Own verbal descriptors (e.g., breathiness, weakness)
- F. None
- Other (Please specify)

18. Please indicate how important you consider auditory-perceptual assessment(s) in the assessment of voice disorders:

Very unimportant	Unimportant	Neutral	Important	Very important
------------------	-------------	---------	-----------	----------------

## 5. SELF-PERCEPTION RATING SCALES

19. Please indicate which of the following self-perception rating scales you routinely use to assess your client's voice. Choose all that apply:

- A. Voice Handicap Index (VHI)
  - B. Voice Handicap Index - 10 (VHI-10)
  - C. Pediatric Voice Handicap Index
  - D. Voice-Related Quality of Life (V-RQOL)
  - E. Pediatric Voice-Related Quality of Life
  - F. Voice Outcome Survey
  - G. Pediatric Voice Outcome Survey
  - H. Voice Symptom Scale (VoiSS)
  - I. The Reflux Symptom Index (RSI)
  - J. Vocal Tract Discomfort Scale (VTD)
  - K. Vocal Performance Questionnaire
  - L. None
- Other (Please specify)

20. Please indicate how important you consider self-perception rating scales in the assessment of voice disorders:

Very unimportant	Unimportant	Neutral	Important	Very important
------------------	-------------	---------	-----------	----------------

## 6. AUDIO RECORDING

21. Do you routinely record your client's voice during a voice assessment?

- A. Yes
- B. No

22. What kind of equipment do you routinely use for the recording?

- A. Cassette recorder
  - B. Minidisc recorder
  - C. Digital Audio Tape (DAT) recorder
  - D. Digital voice recorder (e.g., Dictaphone)
  - E. Directly on your PC/Mac or laptop
  - F. Mobile phone
  - G. None
- Other (Please specify)

23. What kind of speech samples do you routinely record during a voice assessment? Please select all that apply.

- A. Sustained [a] vowel
- B. A short read passage, e.g., The Rainbow Passage

- C. Spontaneous speech  
 D. None  
 Other (Please specify)

24. What kind of microphone do you use for recording audio speech samples for voice assessment?

- A. Hand-held microphone  
 B. Head mounted microphone  
 C. Device in-built microphone  
 D. None  
 Other (Please specify)

25. In your opinion, how important are the following factors during the recording session for voice assessment?

	Very unimportant	Unimportant	Neutral	Important	Very important
Quality of recording equipment					
Quality of microphone					
Microphone placement relative to the speaker					
Level of ambient noise					
Correct recording level setting					
Eliciting speech sample representative of the client's speaking voice					

## 7. VIDEOSTROBOSCOPY

26. Do you routinely perform videostroboscopy during the assessment of voice with your client?

- A. Yes  
 B. No

27. If you do not routinely perform videostroboscopy, do you routinely evaluate results from a videostroboscopy?

- A. Yes  
 B. No

28. In your clinical experience, how important have you found videostroboscopy (performing or evaluating) for the assessment of voice disorders?

Very unimportant	Unimportant	Neutral	Important	Very important

29. Please rate your perceived importance of what acts as barriers in using videostroboscopy in the assessment of voice:

	Very unimportant	Unimportant	Neutral	Important	Very important
Not having access to appropriate					

equipment					
Limited knowledge in the use of videostroboscopy					
Limited knowledge in the interpretation of videostroboscopy evaluations					
Shortage of Continual Professional Development courses in videostroboscopy					
Lack of time					
Low priority of voice disorder assessment in a larger caseload					

30. Please state any reasons other than the above which may be acting as barriers to the use of videostroboscopy in the assessment of voice disorders:

### 8. ELECTROGLOTTOGRAPHY

31. Do you routinely use electroglottography in the assessment of voice disorders?

- A. Yes
- B. No

32. In your clinical experience, how important have you found electroglottography for the assessment of voice disorders?

Very unimportant	Unimportant	Neutral	Important	Very important
------------------	-------------	---------	-----------	----------------

33. Please rate your perceived importance of what acts as barriers in using electroglottography in the assessment of voice:

	Very unimportant	Unimportant	Neutral	Important	Very important
Not having access to appropriate equipment					
Limited knowledge in the use of electroglottography					
Limited knowledge in the interpretation of electroglottography evaluations					
Shortage of Continual Professional Development courses in electroglottography					
Lack of time					
Low priority of voice disorder assessment in a larger caseload					

34. Please state any reasons other than the above which may be acting as barriers to the use of electroglottography in the assessment of voice disorders:

## 9. ACOUSTIC ANALYSIS

35. Please indicate which types of acoustic measures you routinely carry out during a voice assessment. Please select all which apply:

- A. Mean speaking f0
- B. Physiological f0 range
- C. Habitual f0 range
- D. Mean speaking intensity
- E. Physiological intensity range
- F. Habitual intensity range
- G. Jitter
- H. Shimmer
- I. Harmonics-to-Noise ratio
- J. Cepstral Peak Prominence
- K. None
- Other (Please specify)

36. Regarding the use of acoustic measures, which statements are most consistent with your practice in the case of a patient with a severely irregular (rough) or breathy voice (i.e. not quasiperiodic):

- A. I obtain the data in the usual fashion (e.g. recording) and allow the measure to reflect the irregularities.
- B. I examine the acoustic data and select only a quasiperiodic segment for analysis.
- C. I try to elicit the most regular (quasiperiodic) voice sample as possible.
- D. I omit those acoustic measures that rely on quasiperiodicity.

37. In your clinical experience, how important have you found acoustic analysis for the assessment of voice disorders?

Very unimportant	Unimportant	Neutral	Important	Very important
------------------	-------------	---------	-----------	----------------

38. Do you routinely use acoustic software in the analysis of voice disordered clients?

- A. Yes
- B. No

39. Please indicate the type of acoustic software you routinely use to perform acoustic analysis with voice disordered clients. Select all that apply:

- A. Multispeech (PENTAX Medical)
- B. CSL - Computerized Speech Lab (PENTAX Medical)
- C. MDVP - Multidimensional Voice Program (PENTAX Medical)
- D. VisiPitch (PENTAX Medical)
- E. Praat
- F. WaveSurfer
- G. Speech Analyzer (SIL Language Technology)
- H. SFS Speech Filing System (University College London)
- I. None
- Other (Please specify)

40. Please rate your perceived importance of what acts as barriers to the use of acoustic techniques in the assessment of voice.

	Very unimportant	Unimportant	Neutral	Important	Very important
Not having access to appropriate equipment					
Limited knowledge in the use of acoustic assessment					
Limited knowledge in the interpretation of electroglottography evaluations					
Shortage of CPD educational events					
Lack of time					
Low priority of voice disorder assessment in a larger caseload					

41. Please state any other reasons which may act as barriers in the implementation of acoustic assessment.

#### 10. AERODYNAMIC ASSESSMENT

42. Please indicate which types of aerodynamic assessment you routinely use in your clinical experience in the assessment of voice disordered clients. Please choose all that apply:

- A. Maximum Phonation Time
- B. Glottal Flow Rate
- C. Mean Subglottal Pressure
- D. Laryngeal Resistance
- E. s/z ratio
- F. None
- Other (Please specify)

43. In your clinical experience, how important have you found aerodynamic measures in the assessment of voice disorders?

Very unimportant	Unimportant	Neutral	Important	Very important
------------------	-------------	---------	-----------	----------------



44. Please rate your perceived importance of what acts as barriers to the use of aerodynamic measures in the assessment of voice:

	Very unimportant	Unimportant	Neutral	Important	Very important
Not having access to appropriate equipment					
Limited knowledge in the use of aerodynamic assessment					
Limited knowledge in the interpretation of electroglottography evaluations					
Shortage of CPD educational events					
Lack of time					
Low priority of voice disorder assessment in a larger caseload					

45. Please state any other reasons which may act as barriers in the implementation of aerodynamic assessment:

## 11. FUTURE PRACTICE

46. How interested would you be in attending a CPD event regarding the use of instrumental techniques in the assessment of voice disorders?

Not at all interested	Slightly interested	Neutral	Interested	Very interested
-----------------------	---------------------	---------	------------	-----------------

47. If you are interested in such a CPD event, please rank-order the types of instrumental methods of assessment in terms of importance for you personally (1 = most important, 4 = least important):

Stroboscopy and videostroboscopy  
 Electroglottography  
 Aerodynamics measures  
 Acoustic analysis

48. If you have any further comments on the use of instrumental techniques in voice assessment, please provide them in the space below:

Table 1. Frequency of use of client self-perception scales by participating SLTs.

Client self-perception rating scale	Frequency of use n (%)
VHI	26/33 (78.8%)
VHI-10	18/33 (54.5%)
Reflux Symptom Index	13/33 (39.4%)
VRQOL	10/33 (30.3)
Paediatric VHI	9/33 (27.3%)
Vocal Tract Discomfort Scale	9/33 (27.3%)
Voice Symptom Scale	7/33 (21.2%)
Paediatric VRQOL	4/33 (12.1%)
Paediatric Voice Outcome Survey	2/33 (6.1%)
Vocal Performance Questionnaire	2/33 (6.1%)
Voice Outcome Survey	0(0%)

Table 2. Acoustic measures used by participant SLTs in voice assessment (n = 15).

Acoustic measures	Frequency of use n (%)
Mean speaking intensity	10/15 (66.6%)
Mean speaking $f_0$	9/15 (60%)
Habitual $f_0$ range	8/15 (53.3%)
Physiological $f_0$ range	6/15 (40%)
Habitual intensity range	6/15 (40%)
Jitter	6/15 (40%)
Shimmer	5/15 (33.3%)
Physiological intensity range	4/15 (26.6%)
Harmonics-to-noise ratio	3/15 (20%)
Cepstral peak prominence	0/15 (0%)

**LIST OF FIGURE CAPTIONS**

Figure 1. Clinical practice setting of participant SLTs.

Figure 2. Frequency of use of voice assessment methods by participant SLTs.

Figure 3. Barriers to the use of instrumentation indicated as important or very important by the participants.