měl doporučit osobu k otolaryngologovi, foniatrovi, psychoterapeutovi, psychologovi, fyzioterapeutovi atp. v případech, kde je to nutné. V odborné kompetenci otolaryngologa je výběr vhodné metody laryngoskopického vyšetření.

Diagnostické hodnocení hlasu pacienta obeznámí a edukuje v oblasti jeho poruchy. V tomto světle se na hodnoticí nástroj můžeme právem dívat jako na nástroj primární terapie (Stemple, Roy & Klaben 2014).

Závěrem prvního zhodnocení hlasu je třeba splnit všechny cíle. Logoped i klient mají mít informace o odchylce v kvalitě hlasu, závažnosti dané poruchy i o etiologických faktorech souvisejících s poruchou. Na hodnocení lze navázat následně, pokud zbyly nějaké nezodpovězené otázky. Stejný postup hodnocení lze uplatnit i u sledování výstupů terapie.

2.3b
The Practical Implementation of the Voice Evaluation Protocol

Baiba Trinite

The evaluation of voice function and the consequent diagnosis is very important part of the work of speech and language therapists (SLT). The first assessment of voice function has following aims: (1) determine the presence of the deviant voice quality considered as disorder; (2) determine the etiological factors related to the disorder; (3) determine the disorder severity. During the assessment SLT have to identify main symptoms of voice disorder and should try to understand the origin of them. G. P. Moore (1971) said that, diagnosis is the process of discovering the causes of certain symptoms. Diagnosis of voice disorders ordinarily encompasses the recognition and description of individual vocal deviations and a systematic search for the factors that cause these deviations. The information obtained during the first evaluation determines the strategy of voice therapy and contributes the choice of specific techniques. In addition, type and severity of the disorder allow predict the duration of therapy and expected outcome.

The voice assessment is based on understanding about physiology of voice production and complex nature of voice disorders. The comprehension of the basic concepts about the voice and its disorders is essentially necessary for planning an assessment process and taking a final decision regarding to voice quality.

Phonation *– the physical act of sound production by means of vocal folds interaction with the exhaled airstream. Voice – audible sound produced by phonation (Aronson 1990).*
Vocal parameters *(the elements of voice) – pitch, loudness, quality, flexibility.*
Pitch *– the perceptual correlate of the fundamental frequency of voice.*
Loudness *– the perceptual term that relates to vocal intensity (Stemple, Roy & Klaben 2014).* ***Quality*** *– a composite of sound source (vocal folds) and sound resonance (supraglottal structures of the vocal tract) (Case 1991).*
Flexibility *– the perceptual correlate of frequency, intensity, and complexity variations.*
A voice disorders *exist when quality, pitch, loudness or flexibility differs from the voices of others of similar age, sex, and cultural groups. No fixed standards of abnormal voice exists, just as no absolute criterion for normal voice can be established. Vocal standards are culturally based and environmentally determined (Moore 1971).*

They are different explanations of voice disorders which reflect the multifaceted nature of voice. The social aspect of the voice disorders is highlighted in the definition provided by Aronson and Bless (2009): abnormal voice is any voice that calls attention to itself, does not meet the occupational and social needs of the speaker. Also Colton and Casper (1990), emphasize the restrictions of everyday life due to voice: a voice disorder is present when a person's quality, pitch, and loudness differ from those of a person's of similar age, gender, cultural background, and geographic location, or when an individual indicates that his or her voice is not sufficient to meet daily needs, even if it is not perceived as deviant by others.

Besides abnormal pitch, loudness and vocal quality that are mentioned as main symptoms of voice disorders, Mattiske, Oates and Greenwood (1998) indicate that voice disorders are manifested by vocal fatigue, hoarseness, aphonia, weakness, strained harshness, poor pitch and loudness modulation, and abnormal throat sensations during speech. Voice disorders can reduce speech intelligibility and be aesthetically unacceptable, resulting in severe personal, social, vocational, and economic penalties. Voice disorders range from a mild hoarseness to complete voice loss.

Voice disorders may be due to habits of vocal misuse and hyperfunction (e.g., improper use of the larynx, such as excessive throat clearing, yelling, prolonged talking over loud background noise, muscular imbalances) commonly producing physical changes in the vocal folds, other medical/physical conditions (e.g., trauma, neurological disorders, allergies) or psychological factors (e.g., stress, conversion reactions, personality disorders). It is not uncommon for a voice disorder to reflect a combination of these factors (Ramig, Verdolini 1998).

Roy et al. (2004) used a broad definition for the estimating the lifetime prevalence of voice disorders in teachers and in the general population. They used the statement that a voice disorder is any time your voice does not work, perform, or sound as you feel it normally should, so that is interferes with communication.

The vocal function is a multidimensional function. It is something like physical strength. Physical strength cannot be determined with any single scale. There is no single measure either with which one can evaluate the entire aspects of the vocal function. Any vocal function test can evaluate only part of the vocal function (Hirano 1989).

In 2001 the basic protocol for functional assessment of voice pathology was elaborated by the Committee on Phoniatrics of the European Laryngological Society (Dejonckere et al. 2001). The aim of the project was to reach better agreement and uniformity concerning the basic methodology for functional assessment of voices. The protocol was based on the principle that voice is multidimensional phenomenon and following components were included in the assessment of dysphonia: perceptual and acoustic assessment of voice, videostroboscopy, aerodynamic measurements, and subjective rating of voice by patient.

Professionally trained speech therapists can provide all types of assessment except endoscopic exam of the vocal folds. The instrumental assessment of vocal folds and upper airways and medical diagnosis of vocal fold pathology is carried out by otolaryngologists or phoniatricians. It is highly recommended to work together speech therapists and physicians with involving neurologists, psychologists, and singing teachers.

The assessment methods used in the protocol allow obtain separate quantitative data of ***maximal phonation time*** **(MPT)** and acoustic

parameters (fundamental frequency (F0), jitter (Jitt), shimmer, frequency and intensity range). Although there is an opinion that optimal evaluation and understanding of the treatment effect requires the intrinsic comparison of the scores of the different components (Dejonckere et al. 2001) we consider that use of one single score which integrate all obtained values is more effective in clinical practice. The first appointment includes communication with the client and complete understanding of the voice problems by them stimulates the active participation into the therapy. The voice disorder's score presented to the client clearly demonstrate the current severity of the vocal problems.

The group of Belgian voice scientists developed multiparametric measure *Dysphonia Severity Index* (DSI) that reflects the overall vocal quality based on an integration of voice range profile, aerodynamic, and acoustic measurements (Wuyts et al. 2000). The DSI consists of a specific weighted combination of the highest F0, the lowest intensity, the MPT, and the Jitt.

$$DSI = 0.13MPT\,(s) + 0.0053F0_{max}\,(Hz) - 0.26I_{min}\,(dB) - 1.18Jitt\,(\%) + 12.4.$$

The range of DSI is from -5 to +5. The more negative is DSI value the more dysphonic is voice and *vice versa* the highest it is, the better is voice quality. Mathematically this scale is modified into percentage scale (DSI %) where 0% corresponds to the average DSI for severely dysphonic voices, and 100% to the average DSI for normal voices. The cutting point between abnormal and normal voices is 66% (DSI %) or 1.6 (DSI) (Raes, Wuyts, De Bodt & Clement 2002; De Bodt, Wuyts 2010).

The structured, time effective, and maximal information providing voice assessment is essential in the clinical practice. The time allowed for the consultation in medical institutions is restricted. Speech therapists have to manage the first voice evaluation in the time of 40–60 min. Efficient use of time while collecting the most eligible information to differentially diagnose a voice disorder is the main goal of a voice evaluation (Sapienza & Hoffman Ruddy, 2013).

The experience of the Speech and Voice Research Laboratory of Liepaja University (Latvia) of the practical implementation of the voice evaluation protocol will be discussed further. The voice evaluation process

provided by speech therapist includes following parts: (1) collecting of anamnesis; (2) aerodynamic assessment; (3) auditory-perceptual assessment; (4) acoustic assessment; (5) self-evaluation of voice function by client; (6) diagnosis and recommendations.

Anamnesis

Voice is something more that physical function created by the coordinated movements of muscles of the larynx. Voice reflects person's inner psychological state, anxiety, personality, and physical health. The long lasting stress, tiredness, bad working environment, neglecting of basic vocal hygiene, and health problems could results as voice problems. Therefore for better understanding the client's voice problems the interview have to be trust and cooperation encouraging. The following points have to be discussed during the first appointment:

- Client's complaints about the voice. The information obtained there is very important, because eliminating the symptoms mentioned by client have to be a priority of the therapy. The client have to see that SLT is working with the problems that makes him suffer.
- The initiation of the voice problems. The data about the onset of vocal changes gives guidelines for the future differential diagnosis. Did voice problems start gradually or suddenly? Did some additional changes observe in the speech (unintelligible articulation, hypernasality) or swallowing? Did some significant factors be present in the history (emotional stress, illness of upper respiratory tract, surgery)?
- Characteristics of the symptoms. Do voice changes are permanent, periodically or unpredictable? Does voice change during the day (the symptoms are more manifested in the morning or in the afternoon)? Do voice changes are related to the vocal load? It is important to know that physical tiredness and emotional stress increase all vocal symptoms regardless of its etiology. The presence of tiredness, tension, coughing and throat clearing, feeling of

irritation and dryness in the larynx, heartburning can indicate about the presence of other diseases.

- Information about the overall health. Voice changes can present in cases of laryngeal pathologies, chronic diseases of airways (chronic obstructive pulmonary disease, asthma), gastroesophageal reflux disease, neurological diseases (stroke, traumatic brain injury, pseudobulbar paresis, dystonia, Parkinson disease, amyotrophic lateral sclerosis, multiple sclerosis), allergies, endocrine disorders (hypo- and hyperthyroidism, hormonal disorders), psychiatric disorders (depression, schizophrenia, acute or chronic anxiety), hearing disorders, oncological diseases.
- Factors of voice ergonomics and vocal hygiene for representatives of voice professions (teachers, singers, actors, judges, and so forth). Voice ergonomics is awareness of work-related risk factors for voice disorders, knowledge about how to improve voice production and speech intelligibility in different work environments to prevent occupational voice disorders. The environmental risk factors of voice disorders include noise and sound conditions, acoustics, indoor air quality, working postures, working practice, lack of aids needed (Sala et al. 2009).

Aerodynamic assessment

Maximal phonation time is objective measure of phonatory ability that provides information about the control of respiratory function, glottal efficiency, and laryngeal control (Colton & Casper 1990).

The MPT is measured with stopwatch. A client have to phonate sustained vowel /a/ at a modal or habitual pitch level for as long as possible after deep inspiration. The measurement is repeated three times and the best score (greatest value) is recorded in the protocol.

Significant differences in MPT exist between sexes, but that difference does not begin to appear until puberty (Hirano 1981). The mean MPT for adult males is 25.89 s (SD 7.41), for adult females 21.34 s (SD 5.66) (Colton & Casper 1990). The MPT is often negatively affected by

laryngeal pathology caused by inefficient vocal fold vibration. Therefore, pretest and posttest MPT measures may be used as a tool to demonstrate voice improvement (Stemple, Roy, Klaben 2014).

Another respiration test used in the voice assessment is s/z ratio. Eckel and Boone (1981) proposed the use of s/z ratio as an indicator of laryngeal inefficiency. The authors state that individuals without laryngeal pathology should be able to sustain vocalization of /z/ for a period equal to that of sustained vocalization of /s/.

The client is asking to take a deep breath and produce sustained /s/ as long as possible in comfortable pitch and loudness without strain. The stopwatch is used for the time measuring. Three trials are provided and the best (greatest) score is written in the protocol. The same procedure is repeated with the sustained phonation of voiced consonant /z/.

The s/z ratio is calculating by dividing the time of the longest /s/ by the time of the longest /z/. Ratio greater than 1.4 is consider abnormal. The s/z ratio may be formally tested in cases where vocal nodules are known to be present on the vocal folds. The presence of laryngeal mass lesions will yield a longer voiceless /s/ than voiced /z/ because of the inability of the folds to adequate approximate (Stemple, Roy, Klaben 2014).

Auditory perceptual assessment

Auditory perceptual analysis refers to the use of the human auditory perceptual system, often in combination with an external rating system, to make judgments of the nature and appropriateness of an individual's voice pitch, loudness, and quality (Welham 2009). Through the client interview and sustained vowels phonation, the SLT has had a subjective impression about the client's voice quality.

There is a need to organize these observations in the structured system. The voice pitch can be evaluated as too high, too low or normal. The voice loudness, respectively, as too loud, too silent (weak) or normal. The deviant voice quality (or timbre) usually is characterized with the term of *hoarseness*. One of the tools that allow structured perceptual measure an overall voice quality is the GRBAS scale. The GRBAS scale

proposed by the Japan Society of Logopaedics and Phoniatrics (Hirano 1981) is internationally accepted and widely used tool for the perceptual evaluation of voice.

GRBAS scale evaluates five parameters of voice:

1. Overall grade of hoarseness (G) – severity of hoarseness, overall voice quality integrating all deviant components.
2. Roughness (R) – irregularity in the vibration of the vocal folds, indicating the sense of roughness on the issue. The description of each parameter here and hereafter is given by Behlau (as cited in Franco 2014).
3. Breathiness (B) – audible turbulence such as a hiss, air leak at the glottis, a feeling of air in the voice.
4. Astheny (A) – vocal weakness, loss of power, reduced vocal energy, poorly defined harmonics.
5. Strain (S) – impression of hyperfunctional state, acute frequency, noise in the high frequencies of the spectrum and marked treble harmonics.

These parameters are ranked in an ordinal scale of severity, with values that can vary from 0 to 3: 0 = *normal voice* or *absence of disorder*; 1 = *mild disorder* or in case of doubt the existence of alterations; 2 = *moderate disorder*; 3 = *severe disorder* (Hirano 1981). Grades refer to the degree of hoarseness or voice abnormality and characterize the severity of dysphonia.

The prior training and experience of evaluation of voice samples are necessary for the using the GRBAS scale in clinical practice. The DSI has good correlation with the GRBAS scale and if clinicians are able to use the DSI, then perceptual evaluation of voice with this scale could be omitted. However, it should be noted, that speech therapist, which is trained to use the GRBAS scale once will classify and rate separate voice components automatically always. In addition, speech therapist who is working with voice patients can describe audible voice peculiarities even he or she do not know any standardized scale.

Acoustic assessment

Acoustic measures can provide objective and non-invasive analyses of vocal function. The acoustic analysis of voice allows obtain information about vocal fold physiology. The origin of voice disorders is change in vocal fold structure or vibratory characteristics and acoustic analysis helps identify and quantify these changes. Acoustically perceived deviations of voice can be identify and proven by objective measurements (Sapienza & Hoffman Ruddy 2013).

The most frequently analysed voice parameters are frequency, intensity, short-term perturbations (jitter, shimmer), relative noise levels and spectral features. The measurements of jitter, highest frequency and lowest intensity should be obtained during acoustic analysis for calculating the DSI.

There are specific prerequisites for the acoustic measurements. The equipment for sound recording and analysis should be carefully chosen. A typical voice recording and analysis setup includes a microphone, digital signal processing, acoustic analysis system for recording, storing, and analysing the speech signal.

The microphone should be positioned off centre from the mouth to avoid excessive aspirate noise, at constant mouth-to-microphone distance of 15 cm (the distance could be shorter and longer, depends on calibrating) and angled at 45 degree. A common frequency response is 20 to 20 000 kHz and can apply to microphones, recording devices, sound cards, and speakers. If the frequency range is too small to accommodate the entire speech signal, then the signal will be distorted (Stemple, Roy, Klaben 2014).

The digital signal processing converts analog signals (sound waves, composed of a series of air molecules) into a digital format for computer recording and speech processing (analog-to-digital, A/D). The sampling rate for the digital signal processing should be no less than 20 kHz and acoustic signals have at least 16-bit resolution for recording voices for acoustic analysis.

The recordings should be made in quiet room with ambient noise less than 50 dB (Dejonckere et al., 2001). A special sound treated room dedicated for voice recordings is ideal but is not essential for quality voice recordings (Sapienza & Hoffman Ruddy 2013).

The *Multi-Dimensional Voice Programme* (MDVP) developed by the Computerized Speech Lab (Kay Elemetrics Corporation, Lincoln Park, NJ, USA) is currently the most commonly used acoustic analysis software. The MDVP provides measures of 33 voice parameters. The jitter is one of them that is necessary for the calculating of the DSI. A jitter is a short-term (cycle-to-cycle) variation in the fundamental frequency of a signal (Titze, 1994).

The client is instructed to produce a sustained vowel /a/ at habitual, comfortable pitch, and constant loudness. The task is demonstrated by the examiner before making the recording. The vowel producing task should include multiple trials (usually three or more times) to consider individual variability to establish stable baseline performance. The voice sample which is more relevant to the habitual client's voice is using for the analysis. Occasionally it is not the first attempt, because some clients afraid of the standing in front of microphone and their first /a/ is silent and unsure, some clients, especially with the singing background, try to produce /a/ in singing manner. The 3-second midvowel portion is extracted from the chosen voice sample and all necessary acoustic parameters are obtained (Jitt % is needed for the DSI). Perturbation measures become unreliable if the voice signal contains intermittency, strong subharmonics or modulations. Perturbation measures less than about 5% have been found to reliable (Dejonckere et al. 2001).

There is a recommendation to record and store a short phonetically balanced standard passage. The combining of single vowel sample and continuous speech sample into one concatenated sample enables to use another hoarseness severity quantification method – *Acoustic Voice Quality Index* (AVQI). The AVQI is a six-factor acoustic model based on linear regression analysis used to measure overall voice quality in concatenated continuous speech and sustained phonation segments. It is one of the first objective acoustic models to judge continuous speech.

Dysphonia symptoms usually emerge in conversational voice production instead of sustained vowels, and they are most often signaled by the patients themselves in continuous speech. AVQI facilitates higher ecological validity in the evaluation of voice quality (Maryn, De Bodt, Roy 2010).

The highest frequency and the softest intensity are the last acoustic parameters that necessary to obtain for completing the DSI equation.

The *Voice Range Profile* (VRP) or phonetogram is a software program that assess both fundamental frequency and intensity at an individual's absolute minimum and maximum capabilities.

The client is instructed to phonate a sustained vowel /a/ in different frequencies and intensities. The isolate vowel at the particular position (soft, low, high, loud) and the low-high-low glide are produced during the assessment. The VRP is produced simultaneously to phonation, and the client receives instant feedback of his or her voice production. In order to motivate clients to perform to their maximum capacity, the SLT provided verbal support and auditory examples if necessary.

The VRP for a person with a healthy voice typically shows an elliptical shape, with the smallest range of intensity produced toward the lowest and highest fundamental frequencies. Patients with voice disorders may have an overall reduction in the range of fundamental frequency and intensity, or both that they can produce (Sapienza & Hoffman Ruddy 2013).

Self-evaluation of voice function by client

The objective assessment methods provide data about the voice quality, structural and functional conditions of larynx, but do not give information about the functional impact of the voice disorder on the individual in daily life. It is the patient who has to live with his/her voice (Dejonckere et al. 2001). Different clients will perceive similar voice problems differently.

Jacobson et al. (1997) developed a psychometrically validated tool – *Voice Handicap Index* (VHI-30) for measuring the psycho-social handicapping effects of voice disorders. The VHI-30 has three subscales with ten items in each: physical, functional, and emotional. A 5-point Likert scale is used to rate each statement as it reflects the client's experience with the voice disorder.

The VHI completed before and after treatment by the patient, permits an understanding of the handicapping nature of the voice disorder as perceived by patient. The authors indicated that a VHI test score difference of 18 points or more indicates a significant shift in psychosocial function of the voice.

In our practice the client completes the VHI at the end of consultation. It is important to note, that VHI should be provided in the language that is well known to the client, client has to have ability to read and understand the test items.

Diagnosis and recommendations

Analysis of voice problems involves the examination of many individual components. These components include the statement of the problem, the symptoms, the anamnesis, and all data obtained during the specific measurements. SLT have to assess how the voice disorder affects an individual in everyday situations.

The final stage of the first consultation includes summarizing of data, determination of prognosis for change, making the decision regarding to voice diagnosis, and recommendations for intervention and support.

Although instrumental evaluation of larynx was not included in the assessment protocol provided in the speech therapist's office, the physical examination is essentially needed to every patient with voice problems. SLT should recommend referral to the otolaryngologist, phoniatrician, psychotherapist, psychologist, physiotherapist and so forth where it is necessary. It is a professional competence of otolaryngologist to choose appropriate methods of larygoscopic assessment.

The diagnostic voice evaluation teaches and educates the patient about the disorder. In this manner, the evaluation tool may be viewed in its own right as a primary therapy tool (Stemple, Roy, Klaben 2014).

At the end of the first voice assessment all aims targeted must be achieved. The speech therapist and client have information about the presence of deviant voice quality, the severity of disorder, and etiological factors related to the disorder. The assessment can be continued next time if some questions regarding to voice function are still unanswered. The same assessment procedure is applicable during the therapy for monitoring the therapy outcomes.

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2.4a
AAK u dospělých osob v zařízeních pro osoby s komunikačním a kombinovaným handicapem

Lenka Neubauerová, Adéla Černá, Karel Neubauer

Užití AAK pro osoby se zdravotním postižením

Alternativní a augmentativní komunikace (AAK) je frekventovaně vnímána jako oblast pomoci osobám, které nemohou využívat efektivně řečovou komunikaci z důvodu zdravotního postižení. Alternativní komunikační systémy se používají jako náhrada mluvené řeči (Laudová 2007, Reichle & Brady 2012). Augmentativní komunikace podporuje již existující komunikaci, která však nemusí být pro okolí zcela srozumitelná. Podpora je v tomto případě myšlena jako usnadnění vyjadřování a zvyšování kvality porozumění řeči. Z hlediska objemu slovní zásoby mluvenou řeč AAK nikdy nenahradí (Janovcová 2003). Hlavním cílem AAK je zapojit jedince se závažnou poruchou komunikace do společnosti a umožnit mu aktivně se podílet na komunikaci. AAK k tomu využívá všech možných schopností daného jedince (Laudová 2007, Neubauerová 2013).

Mezi výhody AAK patří:

- možnost vyjádřit své přání, touhy, pocity, atd.;
- být stávajícím aktivním účastníkem komunikace, která mi byla dříve odepřena;
- možnost prostřednictvím AAK dále se rozvíjet a vzdělávat;