LSHSS

Clinical Forum

Quick Screen for Voice and Supplementary Documents for Identifying Pediatric Voice Disorders

Linda Lee
University of Cincinnati, OH
Joseph C. Stemple
Blaine Block Institute for Voice Analysis and Rehabilitation, Dayton, OH
Leslie Glaze
University of Minnesota, Minneapolis
Lisa N. Kelchner
University of Cincinnati, OH

Voice is the product of a combination of physiologic activities, including respiration, phonation, and resonance. 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 (Colton & Casper, 1996; Stemple, Glaze, & Klaben, 2000).

ABSTRACT: Three documents are provided to help the speech-language pathologist (SLP) identify children with voice disorders and educate family members. The first is a quickly administered screening test that covers multiple aspects of voice, respiration, and resonance. It was tested on 3,000 children in kindergarten and first and fifth grades, and on 47 preschoolers. The second document is a checklist of functional indicators of voice disorders that could be given to parents, teachers, or other caregivers to increase their attention to potential causes of voice problems and to provide the SLP with information pertinent to identification. The final document is a brochure with basic information about voice disorders and the need for medical examination. It may be used to help the SLP educate parents, particularly about the need for laryngeal examination for children who have been identified as having a voice problem.

KEY WORDS: voice disorders, screening voice, voice assessment, pediatric voice disorders

The incidence of voice disorders in children is often estimated at between 6% and 9% (Boyle, 2000; Hirschberg et al., 1995). However, other sources identify ranges of 2% to 23% (Deal, McClain, & Sudderth, 1976; Silverman & Zimmer, 1975). In one study, 38% of elementary school-aged children were identified as having chronic hoarseness (Leeper, 1992). Unfortunately, it is estimated that the vast majority of children with voice disorders are never seen by a speech-language pathologist (SLP; Kahane & Mayo, 1989), and children with voice disorders only make up between 2% and 4% of an SLP's caseload (Davis & Harris, 1992).

Few studies have identified the type of laryngeal pathologies that are most common to children. Dobres, Lee, Stemple, Kretschmer, and Kummer (1990) described the occurrence of laryngeal pathologies and their distribution across age, gender, and race in a pediatric sample. Data were collected on 731 patients seeking evaluation or treatment at a children's hospital otolaryngology clinic. The most frequent laryngeal pathologies were subglottic stenosis, vocal nodules, laryngomalacia, functional dysphonia, and vocal fold paralysis. For the total sample, these

0161–1461/04/3504–0308

pathologies were much more common in males than in females, with the youngest patients (less than 6 years old) identified as having the most pathologies. The distribution of pathologies within the races sampled (Caucasian, African American, and Asian) was similar to that found throughout the total sample.

Although it has been argued by some that treating voice disorders in children is unnecessary or even potentially harmful (Batza, 1970; Sander, 1989), others have argued for the opposite opinion (Kahane & Mayo, 1989; Miller & Madison, 1984). Indeed, Andrews (1991) suggested that unlike some other developmental disorders, maturation alone does not significantly affect vocal symptoms. Habitual patterns of poor voice use do not, as some have suggested, disappear at puberty. In other words, children do not outgrow voice disorders.

The identification and management of pediatric voice disorders is important for the child's educational and psychosocial development, as well as physical and emotional health. The underlying cause of any dysphonia must be determined because voice disorders that share the same quality deviations may have vastly different behavioral, medical, or psychosocial etiologies (see review in Stemple et al., 2000).

The majority of children with voice problems are identified by individuals other than the school SLP (Davis & Harris, 1992). Typically, the teacher, nurse, or a family member notices that a child has developed an abnormal voice quality and makes the initial contact with the SLP. These referral sources lack training in making perceptual quality judgments, so they may miss more subtle problems that need professional attention. Depending on the task, teachers may or may not be accurate in identifying children with voice deviations (see review in Davis & Harris, 1992), and many parents may assume that the child will outgrow the disorder. Perceptual voice quality evaluation can be difficult even for the SLP (Kreiman, Gerratt, Kempster, Erman, & Berke, 1993; Kreiman, Gerratt, Precoda, & Berke, 1992), so depending on untrained persons to identify these children is less than ideal.

One common method of identifying childhood communication disorders is through mass screening. Unfortunately, voice has received scant attention in most speech and language screening tools. For example, the Fluharty-2 Preschool Speech and Language Screening Test (Fluharty, 2001) has one line for clinician response to voice quality ("sounded normal; recheck may be necessary"). Similarly, one line for description of the voice is allotted on the Speech-Ease Screening Inventory (Pigott et al., 1985). These conventional one-line summaries fail to address the voice comprehensively; that is, they do not assess the three subsystems of respiration, phonation, and resonance. Voice problems are typically reduced to a generic description of quality deviation and may easily be overlooked because of such minimal opportunity for evaluation.

Identification of children with voice disorders could be facilitated with several documents. A screening tool covering multiple aspects of voice, respiration, and resonance could replace the more general voice evaluation statements that are provided on current screening tools. Additionally, a checklist of functional indicators of voice disorders in children and adolescents that could be given to parents, teachers, or other caregivers may increase their attention to potential causes of voice problems and provide the SLP with information pertinent to identification. Finally, a brochure with basic information about voice disorders and the need for medical examination may help the SLP educate parents. These needs are addressed in the present document.

QUICK SCREEN FOR VOICE

A screening tool entitled Quick Screen for Voice (see Appendix A) was developed by the second author (JS). It provides more thorough delineation of tasks and measures than the more open-ended requests for observation of voice quality that are currently available on speech and language screening tests. The tool may be used for speakers of all ages, from preschool through adult.

Respiration, phonation, resonance, and vocal flexibility are the hallmarks of healthy and acceptable voice production, and all are included in this test. These subsystems of voice production are assessed separately. Lists of perceptual characteristics that are commonly associated with disorders of that subsystem are contained in each section. Definitions of each perceptual characteristic are provided in Appendix B.

The protocol is designed to be administered in 5 to 10 min. Administration time is reduced when the child's voice is judged to be normal. When abnormal signs are found in any subsection, the test form provides appropriate language for vocal behaviors that the SLP may not observe or identify without it. These identifiers can then be used when reporting findings and generating individualized educational plan (IEP) goals, if a management program is necessary.

Directions and Scoring

The Quick Screen for Voice should be administered in a quiet area that is free of distractions. The tester should be seated close to the individual.

Perceptual characteristics of the voice are judged by listening to the individual speak. Therefore, the examiner should engage the individual in topics, such as family or friends, hobbies or other interests, favorite holidays or vacations, favorite classes in school, and so on. To assist elicitation of spontaneous speech, the individual may be asked to tell a story about pictures that are sufficiently detailed to allow a 2–3 min description or elicited sample. Recited passages, counting, or other natural samples of continuous speech may also be used.

The examiner responds to a checklist of observations that are made during the spontaneous speech and other voicing tasks. The speaker fails the screening test if one or more disorders in production are found in any section. In such cases, the individual would be scheduled to be screened again, have a more comprehensive voice evaluation, or be referred to a physician with a request that the child be examined by an otolaryngologist or other specialist.

Field Tests and Subsequent Revisions

The screening tool was used during two formal mass speech and language screenings with preschool and school-age children, and more informally with adult graduate students taking a voice disorders class. The primary purpose of using the tool in these situations was to determine its ease and clarity of use, whether or not it contained complete lists of observations under each category, and confirmation of the criterion for passing or failing.

Screening of kindergarten and first and fifth grade students. The Quick Screen for Voice was used as part of a comprehensive speech, language, and hearing screening of 3,000 elementary school children in 53 school districts throughout Ohio. Half of the children were in regular kindergarten and first grade; half were in fifth grade. The school districts were chosen because they represented a wide variety of urban, rural, and suburban locations; average family income; percentage of minority population; and district expenditure per pupil. Students receiving part-time special education services were included. Students receiving full-time special education in segregated classes or separate buildings were omitted from the sample. Seven university departments participated. The screening tests were administered by trained graduate students under the supervision of licensed and certified SLPs. The students practiced administering the tests before conducting the screening.

The percentage of students failing the total screening test and each subcategory is contained in Table 1. Some individuals who fail screening tests will be found by more intensive diagnostic tests not to have a communication disorder (i.e., a false positive). Conversely, some students with a communication disorder may pass a screening, although the incidence of these false negatives is expected to be low if examiners are trained and tests are properly administered. The actual number of false positives and false negatives resulting from the mass screening is not known. Therefore, the percentage of students failing the screening was adjusted by factors that would correct for both false positives and false negatives by using the Delphi technique (Linstone & Turoff, 1975; Rothwell & Kazanas, 1997; Woudenberg, 1991). This procedure involves a series of steps to elicit and refine the perspectives of a group of people who are experts in the field. The first step was selection of the panel (in this case, a group of individuals in academic and clinical settings with extensive knowledge about similar tests and their outcomes). The second step was to survey the panel members to obtain their predictions of test outcome based on their knowledge about the current literature. The estimates were analyzed using descriptive statistics such as mean and median. If the estimates were close to each other, the values were used. If the estimates were not close, the results were cycled back to the panel members, who were asked to reconsider their answers. Respondents who were relatively far off from the average figures were asked to explain why they kept their original response, if they decided to do so.

False positives were calculated as a ratio of the number of students without a voice disorder who were incorrectly classified as having failed the test, over the total number of students failing the test. False negatives were calculated as a ratio of the number of students with a voice disorder who were incorrectly classified as having passed the test, over the total number of students passing the test. Because the actual number of false positives and false negatives was not known, the numbers used in the ratios were based on expert panel predictions. The panel first adjusted the observed scores for false positives, and then made an additional adjustment for both false positives and false negatives, combined. These percentages are contained in Table 1.

Table 1. Results of administration of the Quick Screen for Voice to 3,000 students, half in kindergarten and first grade and half in fifth grade. The total percentage failed, percentage by subcategories of the test, and percentage after Delphi adjustment are presented. Individual percentages do not add up to the total percentage because it is possible that a child could have more than one item checked in each area.

	Percentage failing	*After Delphi adjustment for false positives*	*After Delphi adjustment for false positives and false negatives*
Grades K and 1			
Total	34.5	23.3	19.7
Respiration	17.4	11.3	9.6
Phonation	10.2	8.0	7.1
Resonance	3.3	3.9	2.0
Range/flexibility	29.1	17.0	15.3
Grade 5			
Total	20.9	18.1	14.1
Respiration	6.6	5.9	4.0
Phonation	7.5	6.5	5.6
Resonance	1.8	2.1	1.1
Range/flexibility	13.8	11.3	9.4

The percentage of actual failures (34.5% for kindergarten and first grade; 20.9% for fifth grade) was higher than most previous reports in the literature (Boyle, 2000; Deal et al., 1976; Hirschberg et al., 1995; Silverman & Zimmer, 1975). The percentage of children failing the present voice screening was consistent with the results of the concurrent speech and language screenings, which were also considered high (16.9%, 3.2%, and 1.2% of kindergarten and first graders, and 13.5%, 2.6%, and 1.1% of fifth graders failed language, articulation, and fluency, respectively). Overall, 39.2% of kindergarten and first graders and 29.5% of fifth graders failed all language, articulation, fluency, voice, and hearing screening, even after Delphi adjustment for false positives.

It should be noted that the highest percentages of failures on the Quick Screen for Voice were in the category of vocal range and flexibility. On the version of the tool used in the mass screening, habitual pitch, pitch inflection, loudness effectiveness, and loudness variability were based on clinician judgment of these parameters during conversational speech. The authors suspected that the failure rate on this subtest may have been inflated because of difficulty with judging these particular parameters during conversation,

especially because the parameters were not defined. Therefore, specific tasks to demonstrate pitch and loudness were substituted for the more subjective judgments. Habitual pitch and loudness are determined by having the child count from 1 to 10, repeat, but stop at "three" and hold out the /i:/. A maximum phonation time (MPT) task was also added to this section. The changes in the tool may lower the percentage of failures on this subtest.

Screening of preschool children. The second revision of the Quick Screen for Voice followed screening of 47 children (25 boys; 22 girls; ages 3–6 years) in a Head Start program at Arlitt preschool in Cincinnati, Ohio. None of the children who participated in this screening had been previously diagnosed with a voice disorder. Four trained graduate students completed the testing.

Results revealed that 19% (9 out of 47) of the participants failed the initial screening. Six were boys; three were girls. Subjects failed because of abnormalities in the areas of respiration (n = 1), phonation (n = 4), and resonance (n = 4). No abnormalities were found in the category of nonverbal vocal range and flexibility. The 4 subjects who failed the initial screening because of resonance disturbance passed the second screening. The examiners had noted signs of a cough and nasal congestion upon initial examination, and these problems apparently resolved before the second test. The remaining 5 subjects retained the characteristics found on the initial screening and failed the second screening.

In order to determine intrajudge reliability, one examiner gave the test a second time to 5 subjects who passed the screening test and the 4 subjects who failed the phonation section. The second test was administered a week following the first, and the results of the initial test were not available to her. Interjudge agreement was measured by having two of the graduate students independently test 5 subjects who failed any portion of the screening test and 6 subjects who passed it. Both intrajudge reliability and interjudge agreement were excellent (100% for each measure). Finally, all subjects who failed the initial screening were tested again 5 months later. No intervention was provided between screening tests. The 5 subjects who failed the second screening also failed the third.

Final version of the tool. Clinicians participating in both the preschool and school-age screenings provided feedback to the authors about their experiences with the screening tool. Suggestions for improving directions, ease of use, and lists of observations under each category were incorporated into subsequent revisions, all of which were considered minor. The clinicians agreed with the pass/fail criterion provided a second screening was considered for any child who demonstrated signs of illness, such as congestion resulting from an upper respiratory infection.

FUNCTIONAL INDICATORS OF VOICE DISORDERS IN CHILDREN AND ADOLESCENTS

The identification of children with voice disorders in the schools does not rely on annual screening of every child. Although policies differ across districts, the usual practice is to screen only certain grades each year. Some evidence exists that teachers can be a reliable referral source if they are asked to make a gross dichotomous judgment (refer/do not refer) and if they are encouraged to overrefer if in doubt (Davis & Harris, 1992).

The Functional Indicators Checklist (Appendix C) is an informal probe that is designed to detect evidence of consistent voice differences that can represent a potential voice disorder resulting from underlying medical, voice use, or emotional factors. The checklist uses symptoms or situational-based judgments that are identifiable to parents, teachers, and other caregivers of children and adolescents. The specific probe items are nonstandardized, and there is no critical number of positive signs that suggest a need for further referral. Rather, the "yes/no" format is intended to summarize an inventory of impressions about the speaker's ability to use effective voice in the "real world."

The checklist items were derived from the authors' experience with common case history questions that are useful in signaling a potential *threat* to voice quality. The probes are intended to "operationalize" specific judgments of voice production and quality. For example, rather than querying abstract constructs related to voice loudness or endurance, a representative functional indicator was selected and was related directly to academic interference, which is a key qualification standard for service in the schools (e.g., "Can't be heard easily in the classroom when there is background noise"). Because information is sought about vocal competence, as well as overall speaker confidence in the functional communicative environment, probe items were included to assess the emotional impact of voice differences (e.g., "Doesn't like the sound of his/her own voice" or "Is teased for the sound of his/her voice").

The Functional Indicator Checklist is a quick and easy supplement that may cross-validate the other Quick Screen judgments made for voice production. For example, the item "Voice sounds worse after shouting, singing, or playing outside" will provide the screener with information about variability and potential voice use factors that may support audio-perceptual judgments of vocal instability. Although the checklist is meant to be a supportive adjunct to the Quick Screen, it may also be used as a follow-up survey.

Finally, the Functional Indicators Checklist can lend support to any future treatment plans if the real world ties to communication needs are sufficiently meaningful to children and adults. A child may certainly not care about the pitch, loudness, or quality of his or her vocal signal, but may respond more willingly to goals that are designed to create a voice that is loud enough to call a play on the baseball field, or answer a question from the back of the class, or doesn't hurt or sound "scratchy" at the end of the day. These and other functional voice connections can inform the treatment process and provide direct applications to generalization and treatment outcome measures.

YOUR CHILD'S VOICE

"Your Child's Voice" (see Appendix D) is a document that was developed to help SLPs educate the parent of a

child who has been identified with a voice disorder. It was developed in response to comments to the authors by a number of otolaryngologists that parents had only a vague sense of why they were instructed to bring their child for evaluation. SLPs have limited time to provide information to parents, and parents tend to retain more of the information if it is supplemented in writing. Lack of parental follow-up on the SLP's request for laryngeal examination by a physician is a primary concern of school-based clinicians (Leeper, 1992). The American Speech-Language-Hearing Association Preferred Practice Patterns for the Profession of Speech-Language Pathology (1997) states:

> All patients/clients with voice disorders must be examined by a physician, preferably in a discipline appropriate to the presenting complaint. The physician's examination may occur before or after the voice evaluation by the speech-language pathologist. (Section 12.7)

"Your Child's Voice" provides some basic information about how voice is produced; how a voice disorder might affect a child's education; and common causes of voice disorders, including voice misuse, medical problems, and personality-related issues. This is followed by an explanation of purpose and procedures of the voice evaluations conducted by the otolaryngologist and SLP. The importance of medical examination is emphasized, and some suggestions are provided for circumstances where the otolaryngology examination is not covered by insurance. A section about various types of management is provided, along with resources for more information. It is suggested that the SLP conclude the document with some information specific to the voice problem of the child in question.

The Functional Indicators Checklist and "Your Child's Voice" documents have not been tested formally. However, they have been used by many SLPs who attended previous presentations by the authors. Informal feedback has been very positive.

ADDITIONAL CONSIDERATIONS: ETIOLOGIES WITH LOWER INCIDENCE

Etiologies with lower incidence than those due to vocal misuse or abuse may also be identified through the use of the Quick Screen for Voice and the Functional Indicators Checklist. There are increasing numbers of children in special and regular education who have extensive medical problems that may result in voice disorders or laryngeal pathologies. With advancements in the field of neonatology, the numbers of medically fragile babies now surviving and being served by the public school system are increasing. For example, the number of premature babies born in the United States has increased significantly over the past 20 years according to recent reports. Currently, close to 12% (460,000) of babies born annually are premature (defined as < 37 weeks gestation) (Barrett, 2002). These children may be at higher risk for developmental, learning, and academic special needs; however, they are also more likely to have required multiple medical procedures in infancy that can result in injury to the larynx. Such procedures can include multiple and/or traumatic intubations, routine deep suctioning, and/or tracheotomy. Furthermore, coexisting conditions of severe gastroesophageal reflux, pulmonary compromise, multiple medications, and/or chronic dysphagia may result in altered laryngeal and subsequent phonatory function.

Laryngeal/phonatory sequelae may coexist with multiple and/or chronic medical conditions, or in some instances, laryngeal injury may be the only remnant of a previously medically fragile child's history (for more information, see Woodnorth, 2004). Whenever vocal symptoms are present (e.g., voice sounds weak or strained, uses a lot of effort to talk, complains of vocal fatigue) in students with a complicated medical history, the SLP should consider requesting a further laryngeal/voice evaluation. Occasionally, the vocal symptoms indicate a previously undetected laryngeal pathology, such as vocal fold paralysis or laryngeal joint fixation. Etiologies underlying vocal fold paralysis are neurological and may result from disorders of the central nervous system or cranial nerve ten (vagus). Laryngeal joint fixation occurs when the regular position of a cricoarytenoid joint is dislocated secondary to some type of trauma. In either case, if the immobile vocal fold remains in a close to midline position, voice symptoms may be minimal. However, an immobile vocal fold may migrate from its original resting position, resulting in a change to voice quality. These vocal symptoms may worsen through elementary and teenage years as the larynx grows.

Increasingly, the relationship between medically fragile infant conditions and later success in primary and secondary education is being studied. Most investigations focus on the correlation between early health difficulties and later speech, language, intellectual, and academic performance. There are those that specifically examine early pulmonary compromise with later pulmonary function, which in turn can influence phonatory function (Doyle et al., 2001; Gross, Iannuzzi, Kveslis, & Anbar, 1998; Lewis et al., 2002). However, few studies have investigated chronic laryngeal impairment and associated voice disorders in the medically fragile child.

CONCLUSION

The literature suggests that the vast majority of children with voice disorders are never evaluated by an SLP (Kahane & Mayo, 1989). To rectify this situation, SLPs must be prepared to use their knowledge, listening training, and interpersonal skills to intervene. Educating the classroom teacher and families about indicators that put children at risk for laryngeal pathologies may make those with the closest child contact more reliable referral sources. If screening is warranted, the SLP may find the Quick Screen for Voice preferable to the more typical one-line response to voice quality deviation, because it encompasses all aspects of voice production (respiration, phonation, resonance, and vocal range and flexibility). The descriptors for vocal behaviors used in the test may also be helpful when reporting findings or writing IEP goals. Finally, the

obstacle of receiving medical clearance for therapy typically requires educating the parent and, occasionally, the primary care physician. "Your Child's Voice" can be used as a supplement to the parent conference.

Although voice disorders have a lower incidence than many other types of communication disorders, all SLPs recognize their responsibility to use their knowledge, listening training, and interpersonal skills to identify and manage these children. The authors hope that the documents provided here will improve clinician intervention while reducing the time demands inherent in an increasingly complex profession.

ACKNOWLEDGMENTS

The authors would like to thank Chase Striby, MA, for coordinating administration of the Quick Screen for Voice for the preschool children and Ann Glaser, MS, for her input from the statewide elementary school screening.

REFERENCES

American Speech-Language-Hearing Association. (1997). *Preferred practice patterns for the profession of speech-language pathology*. Rockville, MD: Author.

Andrews, M. (1991). *Voice therapy for children.* San Diego, CA: Singular.

Barrett, J. (2002). Environmental links to early deliveries. *Environmental Health Perspectives, 110*, 78–79.

Batza, E. (1970). Vocal cord nodules in children: Pathogenesis, clinical manifestations, therapy. *Clinical Pediatrics, 9,* 14–16.

Boyle, B. (2000). Voice disorders in school children. *Support for Learning*, *15*, 71–75.

Colton, R., & Casper, J. K. (1996). *Understanding voice problems* (2nd ed). Baltimore: Williams & Wilkins.

Davis, C. N., & Harris, T. B. (1992). Teacher's ability to accurately identify disordered voices. *Language, Speech, and Hearing Services in Schools, 23*, 136–140.

Deal, R., McClain, B., & Sudderth, J. (1976). Identification, evaluation, therapy, and follow-up for children with vocal nodules in a public school setting. *Journal of Speech and Hearing Disorders*, *41*, 390–397.

Dobres, R., Lee, L., Stemple, J., Kretschmer, L., & Kummer, A. (1990). Description of laryngeal pathologies in children evaluated by otolaryngologists. *Journal of Speech and Hearing Disorders, 55,* 526–532.

Doyle, L. W., Cheung, M. M., Ford, G. W., Olinsky, A., Davis, N. M., & Callanan, C. (2001). Birth weight <1501 g and respiratory health at age 14. *Archives of Disease in Childhood*, *84*, 40–44.

Fluharty, N. B. (2001). *Fluharty-2 Preschool Speech and Language Screening Test*. Austin, TX: Pro-Ed.

Gross, S. J., Iannuzzi, D. M., Kveslis, D. A., & Anbar, A. D. (1998). Effect of pre-term birth on pulmonary function at school age: A prospective controlled study. *Journal of Pediatrics, 133*(2), 188–192.

Hirschberg, J., Dejonckere, P., Hirano, M., Mori, K., Schultz-Coulon, H., & Vrticka, K. (1995). Symposium: Voice disorders in children. *International Journal of Pediatric Otorhinolaryngology*, *32*(Suppl.), 109–125.

Kahane, J., & Mayo, R. (1989). The need for aggressive pursuit of healthy childhood voices. *Language, Speech, and Hearing Services in Schools*, 20, 102–107.

Kent, R. D., Kent, J. F., & Rosenbek, J. C. (1987). Maximum performance tests of speech production. *Journal of Speech and Hearing Disorders, 52*, 367–387.

Kreiman, J., Gerratt, B. R., Kempster, G. B., Erman, A., & Berke, G. S. (1993). Perceptual evaluation of voice quality: Review, tutorial, and a framework for future research. *Journal of Speech and Hearing Research*, *36*, 21–40.

Kreiman, J., Gerratt, B. R., Precoda, K., & Berke, G. S. (1992). Individual differences in voice quality perception. *Journal of Speech and Hearing Research, 35*, 512–520.

Leeper, L. H. (1992). Diagnostic examination of children with voice disorders: A low cost solution. *Language, Speech, and Hearing Services in Schools, 23*, 353–360.

Lewis, B. A., Singer, L. T., Fulton, S., Salvatore, A., Short, E. J., Klein, N., et al. (2002). Speech and language outcomes of children with bronchopulmonary dysplasia. *Journal of Communication Disorders*, *35*, 393–406.

Linstone, H., & Turoff, M. (1975). *The Delphi method: Techniques and applications*. Reading, MA: Addison-Wesley.

Miller, S., & Madison, C. (1984). Public school voice clinics, part II: Diagnosis and recommendations—A 10-year review. *Language, Speech, and Hearing Services in Schools, 15,* 58–64.

Pigott, T., Barry, J., Hughes, B., Eastin, D., Titus, P., Stensel, H., et al. (1985). *Speech-Ease Screening Inventory (K–1)*. Austin, TX: Pro-Ed.

Rothwell, W. J., & Kazanas, H. C. (1997). *Mastering the instructional design process: A systematic approach*. San Francisco: Jossey-Bass.

Sander, E. (1989). Arguments against the pursuit of aggressive voice therapy for children. *Language, Speech, and Hearing Services in Schools, 20,* 94–101.

Silverman, E., & Zimmer, C. (1975). Incidence of chronic hoarseness among school-age children. *Journal of Speech and Hearing Disorders*, *40*, 211–215.

Stemple, J. C., Glaze, L. E., & Klaben, B. G. (2000). *Clinical voice pathology: Theory and management*. San Diego, CA: Singular.

Woodnorth, G. H. (2004). Assessing and managing medically fragile children: Tracheostomy and ventilatory support. *Language, Speech, and Hearing Services in Schools, 35,* 363–372.

Woudenberg, G. (1991). An evaluation of Delphi. *Technological Forecasting and Social Change*, *40*, 131–150.

Received August 16, 2003
Accepted September 15, 2003
DOI: 10.1044/0161-1461(2004/030)

Contact author: Linda Lee, PhD, Professor and Graduate Program Director, University of Cincinnati, Department of Communication Sciences and Disorders, 202 Goodman Avenue, French East Building G-65, Cincinnati, OH 45267-0394. E-mail: linda.lee@uc.edu

APPENDIX A. QUICK SCREEN FOR VOICE

Name: _____

Birth Date: _____ Screening Date: _____ Age: _____

Speech-Language Screening Date: _____ Passed Failed

If failed, describe communication status:_____

Hearing Screening Date: _____ Passed Failed

If failed, describe hearing status:_____

Pertinent medical and social history: _____

_____

Directions: The Quick Screen for Voice should be conducted in a quiet area. Elicit verbal activities, such as spontaneous conversation, picture description, imitated sentences, recited passages, counting, and other natural samples of voice and speech, or perform the tasks requested. The screening test is failed if one or more disorders in production are found in any area, indicating that a more thorough evaluation is needed.

Mark all observations that apply, as the individual produces connected speech:

Respiration

_____ Inhalatory stridor or expiratory wheeze
_____ Infrequent breaths; talking too long on one breath
_____ Limited breath support for speech
_____ Reduced loudness or vocal weakness

_____ Normal respiration for speech

Phonation

_____ Rough or hoarse quality
_____ Vocal strain and effort
_____ Persistent glottal fry
_____ Conversational pitch is too high or too low
_____ Conversational voice is limited in pitch or loudness variability
_____ Breathy quality
_____ Aphonia
_____ Hard glottal attacks
_____ Conversational voice is too loud or too soft

_____ Normal voice quality

Resonance

_____ Hyponasality (observed during humming, nasal consonant contexts: Mommy makes me muffins; Man on the moon; Many men make money, etc.).
_____ Consistent mouth breathing
_____ Hypernasality (observed during vowel and oral consonants)
_____ Nasal turbulence or audible nasal emission (observed during pressure consonant contexts: Counting from 60 to 69; Popeye plays baseball; Give Kate the cake; Buy Bobby a puppy, Take a ticket to Daddy, etc.).
_____ Juvenile resonance characteristics

_____ Normal resonance

Nonverbal Vocal Range and Flexibility

Model the series of nonverbal tasks that are described on the test form. Multiple trials are allowed. Visual cues such as hand gestures, moving a toy car across the table (for maximum phonation time) or up and down a hill (for pitch range), etc. may be used to supplement the auditory model.

1. Habitual pitch and loudness task: "Count from 1 to 10. Repeat, but stop at 'three' and hold out the /i:/."

   _____ Abnormal pitch and/or loudness

   _____ Normal pitch and loudness

2. Maximum phonation time (MPT) task: "Take your biggest breath and hold out an /a:/ as long as possible." Record time with a secondhand.

_____ Number of seconds /a/ was sustained.

_____ MPT less than:

Age (years)	Normal Mean in Seconds (Range)*
3	7 (3–11)
4	9 (5–15)
5	10 (5–16)
6–7	13 (5–20)
8–9	16 (5–29)
10–12	20 (9–39) Males
	16 (5–28) Females
13–17	23 (9–43) Males
	20 (9–34) Females
18+	28 (9–-62) Males
	22 (6–61) Females

Note. MPT values are related to age and height; multiple attempts also influence results.
*Data summarized from Kent, Kent, & Rosenbek (1987)

_____ MPT within normal limits

3. Pitch range task: "Make your voice go from low to high like this (demonstrate upward pitch glide on the word 'whoop'). Now go down from your highest to low (demonstrate rapid downward pitch glide like a bomb falling)." Or, model and elicit a fire siren sound.

_____ Little pitch variation
_____ Voice breaks in pitch glides up or down

_____ Acceptable pitch range and flexibility

Other Comments or Observations

_____

_____

_____

_____

APPENDIX B. DEFINITIONS OF THE VARIABLES USED IN THE QUICK SCREEN FOR VOICE

Respiration

Inhalatory stridor or expiratory wheeze: Sound heard on inhalation or exhalation, indicating an obstruction at some point in the airway that creates airflow turbulence

Limited breath support for speech: Failure to create a sufficient amount of air to support connected utterances; frequent need to replenish the breath supply; typically, failure to inspire beyond the tidal breathing range

Infrequent breaths; talking too long on one breath: Failure to replenish breath often, or failing to take sufficient breaths so that utterances extend beyond end-tidal breathing into the expiratory reserve

Reduced loudness or vocal weakness: Soft voice, or one that sounds fatigued, possibly due to diminished respiratory support

Phonation

Rough or hoarse quality: Quality deviation of the voice reflecting aperiodic vibration of the vocal folds during phonation

Breathy quality: Quality deviation of the voice reflecting a larger than normal glottal opening, allowing excessive airflow through the vocal folds during phonation

Vocal strain and effort: Tension, strain, and/or effort needed to speak; this may include difficulty initiating or maintaining phonation, and may also include supporting evidence of visible neck or jaw tension

Aphonia: Absence of voicing, which may be intermittent or constant; may occur as voice "cutting out" or whisper, and can be accompanied by apparent strain, tension, or effort

Persistent glottal fry: Rough, low-pitched, tense voice quality that often occurs at the end of sentences, reflecting tightly approximated vocal folds with flaccid edges vibrating at a low fundamental frequency

Hard glottal attacks: A manner of initiating voicing characterized by rapid and complete adduction of the vocal folds prior to the initiation of phonation

Conversational pitch is too high or too low: Relative to the speaker's age and sex, the voice is maintained at an inappropriate average fundamental frequency

Conversational voice is too loud or too soft: Relative to the speaker's age and sex, the voice is maintained at an inappropriate average intensity

Conversational voice is limited in pitch or loudness variability: The voice lacks normal variations in fundamental frequency or intensity, leading to reduction in pitch or loudness variations; monopitch or monoloudness may be considered the extremes

Resonance

Hyponasality: Reduction in nasal resonance during the production of nasal consonants /m, n, N/, reflecting blockage in the nasopharynx or the entrance to the nasal cavity

Consistent mouth breathing: Open-mouth posture; the need to breathe through the mouth because of possible nasal airway obstruction

Nasal turbulence or audible nasal emission: Also called nasal rustle, nasal turbulence is frication heard as air pressure is forced through a partially opened velopharyngeal valve; audible nasal emission, also called nasal air escape, is inappropriate airflow through the nose during speech, typically occurring on high pressure consonants because of velopharyngeal dysfunction; either characteristic may be a consonant-specific learned behavior

Hypernasality: Sound entering the nasal cavity during production of vowels or liquid consonants due to velopharyngeal dysfunction, resulting in excessive acoustic nasal resonance

Juvenile resonance characteristics: Child-like quality to the voice; often accompanied by high pitch and abnormal tongue posture, giving the voice an immature sound, usually seen in teenage girls and women

Nonverbal Vocal Range and Flexibility

Habitual pitch and loudness task: Relative to the speaker's age and sex, the appropriateness of pitch or loudness during a sustained vowel is noted

Maximum phonation time task: The length of maximum phonation time is noted; norms are provided by age category to help the examiner decide whether or not MPT is within normal limits

Pitch range task: Ability to vary the pitch of the voice, and the presence of voice breaks during the gliding activity, are noted; the pitch range increases with age from approximately one-half octave for preschool children to over two octaves for adults

APPENDIX C. FUNCTIONAL INDICATORS OF VOICE DISORDERS IN CHILDREN AND ADOLESCENTS

Please check all that apply to this child:

_____ Coughs, clears throat, or chokes frequently
_____ Has difficulty breathing or swallowing
_____ Complains of a sore throat often
_____ Voice sounds rough, hoarse, breathy, weak or strained
_____ Loses his/her voice every time s/he has a cold
_____ Always sounds "stuffed up," like during a cold; or sounds like s/he is talking "through the nose"
_____ Voice sounds worse at different times of the day (morning, after school, evening)
_____ Sounds different from his/her friends of the same age and sex
_____ Voice sounds worse after shouting, singing, playing outside, or talking for a long time
_____ Uses a lot of effort to talk; or complains of vocal fatigue
_____ Yells, screams, or cries frequently
_____ Likes to sing and perform often; participates in acting and/or singing groups
_____ Participates in sports activities or cheerleading activities that require yelling and calling
_____ Has difficulty being understood by unfamiliar listeners
_____ Can't be heard easily in the classroom or when there is background noise
_____ Talks more loudly than others in the family or classroom
_____ Voice problem is interfering with his/her performance at school
_____ Doesn't like the sound of his/her voice; or is teased for the sound of his/her voice
_____ Attends many loud social events (parties, concerts, sports games)
_____ Seems tired or unhappy a lot of the time
_____ Is facing difficult changes, such as death, divorce, financial problems
_____ Does not express his/her feelings to anyone
_____ Lives with a family that uses loud voices frequently
_____ Smokes, or is exposed to smoke at home or at a job
_____ Uses alcohol
_____ Eats "junk food" frequently; or complains of heartburn or sour taste in the mouth
_____ Drinks beverages that contain caffeine; or drinks little water
_____ Has allergies, respiratory disease, or frequent upper respiratory infections
_____ Has hearing loss or frequent ear infections
_____ Takes prescription medications (please list)
_____ Has a history of injuries to the head, neck, or throat (please describe)
_____ Has had surgeries (please describe)
_____ Was intubated at birth or later (please describe)
_____ Has a chronic illness or disease (please describe)

My primary concern about this child's voice is (please describe):

APPENDIX D. YOUR CHILD'S VOICE

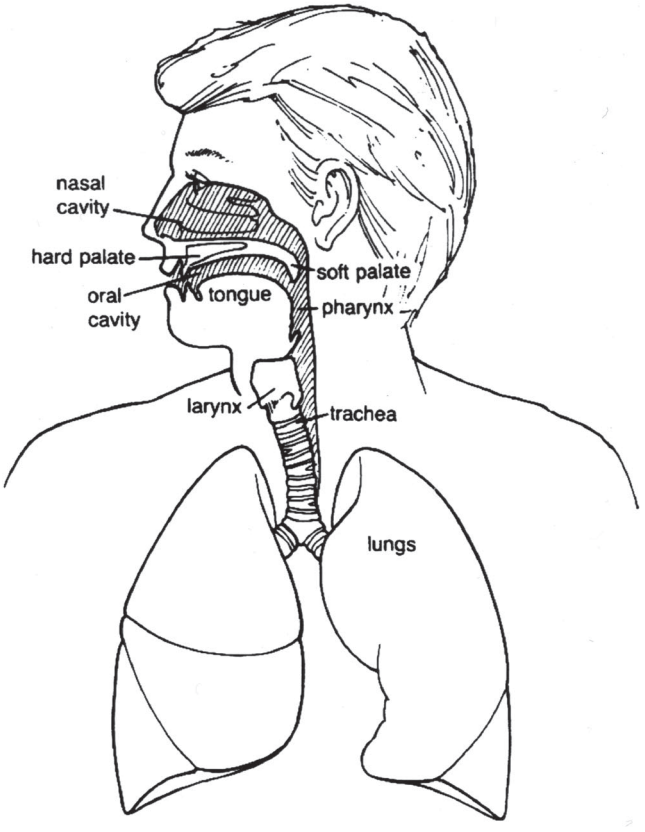
Your child has been identified as having a **voice disorder**, meaning that his/her voice sounds different from that of other children of the same age and sex. The purpose of this pamphlet is to provide you with information about the cause, diagnosis, and management of voice disorders.

How Is Voice Produced?

Figure 1 contains the primary structures in the vocal tract. The larynx is a system of cartilages, muscles, and ligaments in the neck (pharynx). It sits on top of trachea, the passageway to the lungs. The passageway to the stomach is behind the larynx and trachea. The larynx is covered when we swallow, so food does not enter the trachea.

The larynx contains thin membranes, called vocal folds. The vocal folds sit in an open position during breathing. When a person wants to speak, muscles close the folds, and air from the lungs causes them to vibrate. The sound the vocal folds make then resonates through the mouth (or nose, for some sounds) and speech is created. The combination of breathing, vibrating the vocal folds, and shaping or resonating the vibration creates the distinct sound you recognize as your child's voice. A problem with any part of the voicing process may lead to a voice disorder.

Figure 1. The vocal tract.



How Might a Voice Disorder Affect a Child's Education?

The effects of a voice disorder may decrease the child's ability to interact effectively in the classroom setting. Speech may be difficult to hear or understand, and the child may be less likely to participate in daily educational activities, such as volunteering answers or reading aloud. A childhood voice disorder may also decrease the potential for developing a normal adult voice.

What Are Common Causes of a Voice Disorder?

Laryngeal pathologies are changes in the larynx and vocal folds that are associated with voice disorders. Many factors contribute to the development of laryngeal pathologies, including **voice misuse, medical problems,** and **personality-related issues.** Each of these is described below.

Voice Misuse
The majority of laryngeal pathologies are due to the way a child misuses the voice. Children often engage in loud talking, screaming, or shouting, such as at sports events. They may enjoy making vocal noises during play, imitating motorcycles, action figures or monsters. Habits such as these may harm young voices. Excessive coughing or throat clearing may also damage the vocal folds.

Sometimes children learn to speak in an incorrect manner, such as using a very low pitch level. Or, the child may be so eager to communicate that he/she does not pause for enough breaths to support the voice.

The vocal folds are covered by a thin layer of mucous membrane, somewhat similar to the lining of the cheek. If a child drinks caffeinated soft drinks and little water, this membrane can become dry. Other sources of dryness may be exposure to smoke, dust, or dehumidified air.

The examples presented are habits that may cause irritation to the vocal folds. Constant irritation may lead to vocal fold changes, such as swelling (edema), redness, or callous-like growths called vocal nodules.

Medical Causes
Some children develop voice disorders because of a medical problem. An infant may be born with structural defects of the larynx. Neurologic problems, such as vocal fold paralysis, can occur. Chronic upper respiratory or other viral infections, allergies, and gastrointestinal disorders are other examples of medical problems that may lead to laryngeal pathologies. The larynx may be damaged during an accident or surgery. Finally, some medications have side effects that may contribute to changes in vocal fold vibration.

A resonance problem is a special category of voice disorders related to how the sound travels through the oral and nasal cavities after it leaves the larynx. The hard palate separates the two cavities, and the soft palate acts like a valve to open or close the nasal area. The sound should resonate in the oral cavity for all vowels and consonants except *m, n,* or *ng,* which resonate in the nasal cavity. A resonance imbalance occurs when the sound takes the wrong path, or when the sound is distorted due to a problem encountered as it travels through the cavity. For example, if a child sounds like he/she has a cold (hyponasality), it may be due to a blockage somewhere between the nose and mouth. Enlarged adenoids are one common cause of hyponasality. If sound is heard coming through the nose when it should not be present

(hypernasality or nasal turbulence), there may be an incomplete closure of the soft palate. Children born with a cleft palate are among those who may develop resonance problems.

Personality-Related Causes
The larynx is very sensitive to emotions. Therefore, a child's voice disorder may be due to the way he or she feels, physically and emotionally. For example, a child experiencing overall tension because of anxiety encountered in school or at home may also tense the muscles that control the voice, and this can lead to a voice disorder. Occasionally, difficulties in the child's life may become so severe that he/she may unconsciously develop a voice disorder in an attempt to avoid the stressful situation. Other types of voice disorders are related to personality development or hormonal changes during puberty.

How Will I Know the Cause of *My* Child's Voice Disorder?

It is important to note that no one can tell the cause of a voice disorder by the way a child sounds. A child with a vocal nodule caused by yelling and screaming can have the same voice characteristics as the child with a laryngeal pathology due to a medical problem. In order to determine the cause of your child's voice problem, the vocal folds must be examined.

Who Will Examine My Child, and How Will It Be Done?

Although some primary-care physicians will examine the vocal folds, most refer the child to an Ear, Nose and Throat specialist (ENT). Another name for an ENT is an **otolaryngologist**. The otolaryngologist will determine the presence and cause of any **laryngeal pathology.**

The otolaryngologist may view the vocal folds by one of several methods. Some physicians place a small mirror in the child's mouth to visualize the folds. Others use a small flexible scope inserted into the child's nose. This procedure is called nasendoscopy, and it can also be used to examine a child with a resonance problem. A third method, called videostroboscopy, involves placing a small video-scope in the child's mouth. When attached to a special instrument called a stroboscope, the vocal folds can be viewed during their vibration. Both nasendoscopy and videostroboscopy provide a view of the vocal folds or other structures on a television monitor.

None of the procedures used to examine the child with a voice disorder is harmful, and children tolerate them well. Sprays may be used to temporarily numb the nose or back of the throat to eliminate any mild discomfort.

Some otolaryngologists work in collaboration with **speech-language pathologists** who specialize in voice disorders. The speech-language pathologist (SLP) will determine the effect of the laryngeal pathology on **voice production.** The SLP in your child's school may have already conducted a voice evaluation.

What if the Otolaryngologist's Exam Is Not Covered by My Insurance, or I Cannot Afford It?

Most private insurance, managed care plans, and Medicaid cover the costs of diagnostic procedures. To determine coverage of your specific insurance, you are encouraged to discuss this issue with the provider-relations representative. Should your insurance be one of the few that does not cover this examination, you may negotiate a reasonable payment plan with most otolaryngology offices. The speech-language pathologist at your child's school may also provide information about funding sources.

How Will My Child's Voice Disorder Be Corrected?

Methods of correcting your child's voice disorder depend entirely upon the cause. Treatment may be managed through voice therapy provided by a speech-language pathologist, medical management provided by an otolaryngologist, or a combination of the two.

Because the cause of a voice disorder cannot be determined by the characteristics of the voice, the speech-language pathologist in your child's school cannot conduct voice therapy until a physician provides a medical diagnosis. Parents know their child's vocal habits and are sometimes convinced the problem is due to misuse. As an example, they may feel the voice disorder will simply go away if the child stops screaming. Unfortunately, the most vocally-abusive child may have a coexisting medical condition requiring medical management. **For the child's protection, the American Speech-Language-Hearing Association's Preferred Practice Patterns (1997) require medical examination prior to voice therapy.**

Most **voice problems due to misuse or abuse** can be eliminated through voice therapy. The child learns to eliminate the causes of the voice problem and ways to change the manner of speaking. Vocal exercises or other activities may be combined with learning healthy vocal habits to eliminate the problem and prevent future recurrence.

Medically-caused voice problems are typically managed through medication or surgery. Sometimes voice therapy is needed after medical intervention.

The speech-language pathologist, working closely with you and other individuals in the child's life, often manages **personality-related voice problems**. Sometimes a psychologist or classroom teacher is included in the therapy process.

Where Can I Find More Information About Voice Disorders?

Many resources exist to provide information about voice disorders. The speech-language pathologist at your child's school and the otolaryngologist will have suggestions specific to your child's voice disorder. Textbooks about voice disorders are available through university or medical libraries.

The American Speech and Hearing Association is a national organization serving all individuals with communication disorders. For information, call 1-800-498-2071, or use the address http://www.asha.org on the Internet.

The Following Information Is Specific to My Child