evaluation, they are not meant to replace any other component. The eyes and ears of the physician and the clinician cannot be replaced. The most important aspect of the diagnostic voice evaluation is the ability to talk to one's patients—that is, to conduct a patient interview that will yield the necessary diagnostic information. If only one evaluation component were available to me, the patient interview would be my choice.

Another important aspect of the evaluation process is to gain an understanding of the functional impact of the voice disorder on the individual in daily life. Those in clinical practice know that individual patients will perceive similar voice disorders differently. For example, a professional voice user with vocal nodules may be devastated by the effect that nodules have on the voice, whereas a computer programmer may not consider the mild dysphonia to be a problem. One method of gaining this functional measure is through the use of validated tools that measure the patient's self-assessment of the voice disorder.[2,3]

The primary objective of the voice evaluation is to uncover etiologic, physiologic, or behavioral factors specific to the development and persistence of the voice disorder. Speech-language pathologists (SLPs) will use all of their scientific acumen and artistic skill in a systematic evaluation to determine these specific causes. In addition, a detailed analysis of the vocal symptoms, both subjective and objective, will be completed. A systematic management approach will be the result. Secondary objectives of the diagnostic evaluation include education and motivation of the patient and establishment of the credibility and trust in the voice pathologist that is necessary for a successful outcome. Most patients have little knowledge or understanding of the normal voice, to say nothing of their own voice disorders. During the voice evaluation, the SLP may find it useful to explain, in simple terms, normal voicing and how it relates to the patient's current problem. Videostroboscopy, when available, is invaluable as a patient education tool and often encourages patients to become partners in their own care. The better understanding patients have of their voice disorders, the more helpful they can be in answering questions designed to discover the causes of their voice disorders. In addition, the well-informed patient may better understand the therapy process and therefore is ready to adhere to the therapy process and change behavior.

It is essential that the credibility of the SLP be established early during the evaluation. Many probing questions regarding the patient's personal life must be asked in seeking etiologic factors. The patient must trust the voice pathologist's intent to use this information appropriately. The voice pathologist who projects a casual, yet professional demeanor may develop credibility and trust at the initial patient contact. This type of relaxed demeanor will reduce anxieties and establish an atmosphere for easy discussion.

Once the primary etiologic factors have been discovered, the vocal symptoms have been subjectively and objectively described, the impact of the disorder has been determined, the patient has been educated regarding the disorder, and the clinician has established credibility, the management plan can be outlined. When patients understand the causes of the problem and are

presented with a systematic management approach, along with a reasonable estimated time for completion, a positive therapeutic attitude usually is developed.

Management Team

Evaluation and management of patients with voice disorders increasingly have been accomplished through the teamwork of several professionals. The two primary professionals are laryngologists and SLPs. SLPs who specialize in the treatment of voice disorders are sometimes called voice pathologists. You will notice that both terms, "SLP" and "voice pathologist," are used by case study contributors in this text. Other medical specialists who might contribute to the care of patients with voice disorders include allergists, pulmonologists, gastroenterologists, and neurologists, among others. In addition, speech/voice trainers and singing teachers or coaches may be part of the team. The laryngologist is trained to examine the laryngeal mechanism and to determine the need for medical, surgical, or behavioral intervention. The SLP is trained to identify the precipitating and persisting functional causes of the voice problem, evaluate the vocal symptoms, and establish improved vocal function through various therapeutic methods. The speech/voice trainer or singing teacher judges the efficiency and correctness of performance technique and suggests modifications as deemed necessary. This complementary professional relationship has significantly improved the care of the voice-disordered population.

Medical Evaluation

A laryngologic examination involves examination of the entire head and neck region, as well as a detailed medical history. It includes otoscopic examination of the ears; observation of the oral and nasal cavities; palpation of the salivary glands, lymph nodes, and thyroid gland; and a visual examination of the larynx. The visual examination of the larynx may be performed in the office using indirect mirror observation, a fiberoptic nasal endoscope, or a rigid oral endoscope. The fiberoptic or rigid scopes may be attached to a digital camera, permitting the vocal folds to be viewed on a monitor. A laryngeal stroboscope also may be used with the digital video equipment and endoscopes to provide a simulated, slow-motion view of vocal fold vibration.[4]

The vocal folds also may be viewed directly through direct laryngoscopy performed in the operating room. During this surgical procedure, the patient receives general anesthesia, and a magnifying laryngoscope is placed into the oral cavity and pharynx to yield a direct view of the larynx. Biopsies and surgical excisions also may be performed through the laryngoscope. This procedure is generally limited to patients requiring surgical intervention or exploration and is not a routine diagnostic test of vocal health.

The medical examination also may include special radiographs of the head and neck, as well as blood analysis and swallow studies. The final result of the medical examination is a diagnosis of the problem and recommendations for treatment, including medical, surgical, voice evaluation, and voice therapy, or any combination thereof.

Voice Pathology Evaluation

The evaluation format presented here may be classified as semi structured. The basic questions remain the same from patient to patient, but the answers given by individual patients dictate the direction in which the questioning will proceed and the order in which each diagnostic section is reviewed. This format favors the more experienced voice clinician. The beginning clinician may feel the need for a more structured format. As experience is gained, the structured formats may prove limiting, and the semi structured method is often the method of choice. Some SLPs also feel most comfortable audio or video recording the entire diagnostic session for later review. This may help in determining the exact vocal components produced during the evaluation and serves as a record of the baseline voice quality. Even if the entire diagnostic session is not recorded, recording of a standard speech sample is necessary for later comparison. It is not unusual for the SLP and the patient to forget the actual severity of the baseline quality. Audio recordings serve as an objective reminder and should be liberally used.

When referral is made for a diagnostic voice evaluation, the four major objectives of the SLP are to do the following:

1. Uncover etiologic, physiologic, or behavioral factors specific to the development and persistence of the voice disorder.
2. Describe the aberrant respiratory, phonatory, resonatory, and articulatory components in the voice.
3. Determine prognosis for treatment through diagnostic probing and trial therapy.
4. Develop an individualized treatment plan.

Various methods have been used to identify the precipitating and persisting behavioral causes of the voice disorder and those that might impact optimal surgical outcomes. These methods include the formal interview with the patient or a predeveloped case history form to be completed either by the patient or by the patient and clinician together. This author finds prepared forms to be restrictive and prefers to use the patient interview format. Beginning clinicians may find prepared questionnaires useful, however. The following interview procedure (reprinted from Stemple, Roy, and Klaben[5]) describes specific goals for each component of the patient interview, as well as pertinent areas of investigation.

Referral

The primary referral source will be the otolaryngologist, but referrals may also come from other physician specialties like pulmonology, gastroenterology, allergy, and neurology. SLPs, singing teachers, and vocal coaches are referral sources, as are the patient's relatives and friends, or the patient may be self-referred.

Reason for the Referral

The goals are to:

- establish the exact reasons for patient referral
- establish patient understanding of the referral
- develop the patient's knowledge of the voice disorder

- establish the credibility of the examiner

It is important to have adequate information regarding the exact reason the patient was referred. When a physician refers a patient, the specific medical diagnosis should be reported along with the physician's expectations. There are many reasons for patient referrals. These may include preoperative objective measures of voice, evaluation without management, baseline description of present voice, preoperative trial therapy, postoperative follow-up therapy, or a complete diagnostic voice evaluation with appropriate vocal management. Understanding the physician's expectations will avoid confusion and help maintain the necessary working relationships.

Voice therapy suffers from poor patient adherence, and several studies have documented a high dropout rate from therapy.[6] The literature documents that there is an improved likelihood that the patient may follow through with the recommendation for voice therapy if these three key elements occur: (1) communication between the physician, SLP, and patient is open and optimized; (2) the expected outcome from therapy is discussed prior to the initiation of therapy; and (3) the patient's readiness for change is determined and addressed early in the therapy process. Chapter 1 presented detailed descriptions of cases whereby adherence was a problem, and solutions suggested result in improved adherence to the treatment plan.

There are differing opinions regarding explanation of diagnosis and treatment processes. Since one editor (ERH) has the opportunity to work in the office side by side with the physician when first evaluating a patient, she is able to complete both the laryngeal imaging examination and voice evaluation at the time of the first physician/SLP visit. Together with the physician she is able to discuss the diagnosis, prognosis, and process of therapy, including length of sessions, likely focus of sessions, goals, and commitment to therapy. Therefore, she does little further explanation of the therapy process during the valuable therapy time but rather spends time on direct voice therapy and increased self-awareness avoiding explanations of the process unless requested or deemed needed by the patient.

This author (JCS) believes it is also desirable during the evaluation to establish the patient's understanding of the referral for "speech therapy." A typical dialogue between a patient (PT) and voice pathologist (VP) might be as follows:

> VP: "Do you understand why the doctor referred you here?"
>
> PT: "Not really. The doctor just said I needed speech therapy, but I really don't understand what it is all about. My speech is OK; I'm just hoarse."

This is an excellent opportunity for the SLP to explain in some detail the goals he or she intends to accomplish during the evaluation. The more patients understand the procedures, the more reliable they will be in communicating pertinent information to the clinician throughout the evaluation.

It also is helpful to establish and develop the patient's knowledge of the voice disorder before proceeding. This may be accomplished by explaining briefly how the normal laryngeal mechanism works and how it is affected by the disorder. With this information, patients will better understand where

certain questions are leading and may be able to give more reliable information. Some patients even volunteer pertinent information following this discussion and before other questions are asked. For example:

VP: "Do you understand what vocal nodules are?"

PT: "They're some kind of growths on my vocal cords, aren't they?"

VP: "Something like that. Do you know what your vocal folds look like?"

PT: "No, not really."

VP: "Well, when the doctor looked down your throat at your vocal folds, she or he was essentially looking at two solid shelves of muscle tissue covered by a soft pliable skin, one on each side. [Draw a diagram, show pictures, or use a video.] Those shelves are the vocal folds, or cords, and we're looking down on top of them. The point here where they meet is your Adam's apple. Can you feel yours? [Give patient spatial orientation.] Now, the space between the vocal folds is the airway where air travels to the lungs as we breathe.

"Attached to the back of each vocal fold we have two cartilages: one here, and one here. The reason we have these cartilages is so that other muscles that work the vocal folds may have a place on which to attach. Some muscles separate the folds, whereas other muscles draw them together. This is certainly a simplified explanation, but I think it will give you the basic idea of how the system works.

"To move the vocal folds together, we have muscles attached to each cartilage pulling in opposite directions. These pull the vocal folds to the middle where they vibrate, giving us our voices.

"If these muscles pull too hard, such as when we shout, talk loudly for a long time, or clear our throats, this excessive pull will cause the vocal folds to rub and bang together. [Demonstrate with clapping hands.] If this rubbing and banging occur too frequently, they eventually will cause some swelling of the tissues that usually causes temporary hoarseness. The hoarseness may go away after a day or so, but if whatever caused the swelling persists, the folds will remain swollen and eventually attempt to protect themselves from further damage. In your case, they've done this by developing, layer by layer, small, callous like structures, which are called vocal nodules.

"As you've experienced, the nodules cause a change in your voice. Because of the swelling and the nodules, your voice is deeper in pitch; because the nodules are holding your folds apart when you try to vibrate them, your voice is breathy. You've also probably noticed that when you do a lot of talking your voice fatigues, and it becomes quite an effort just to talk. Sometimes by the end of the day, you may be worn out from the effort, and you simply don't feel like talking anymore.

"One final point. Vocal nodules are not cancer, are not related to cancer, and do not lead to cancer. Many people do not

understand this, and I think it's important to mention. So, do you now understand basically what the vocal folds are like and what vocal nodules are?"

PT: "Yes, now I do. I'm glad you mentioned cancer. I was worried about that. But what do you think caused the nodules? I don't raise my voice very much."

VP: "That's what we're here today to find out. I'm going to ask you many questions. I need to get to know who you are and how you use your voice. From that information, we will try to determine what specifically has caused your nodules. Any questions?"

It also should be noted that this type of discussion goes far in developing your credibility as an "expert" in this area. You usually will have managed to develop a high level of trust before you begin questions regarding the history of the problem.

History of the Problem

The goals are as follows:

- Establish the chronologic history of the problem.
- Seek etiologic factors associated with the history.
- Determine patient motivation.

This section of the evaluation is designed to yield a chronological history of the voice disorder from the onset of vocal difficulties, through the development of the problem over time, and ending with the patient's present vocal experiences. All questions are designed to yield information regarding the causes of vocal difficulties. Finally, the patient's motivation for seeking vocal improvement is determined. A list of appropriate questions may include the following:

- When did you first notice you were having some difficulties with your voice?
- Was this the first time you ever experienced vocal difficulties?
- How did the problem progress from there?
- What finally made you decide to see your doctor about it?
- How did the doctor treat the problem?
- Did your family doctor refer you to the otolaryngologist?
- Has anyone else in your family ever had voice problems?
- Is your voice better in the morning than in the evening or vice versa?
- Have you ever totally lost your voice?
- Do you have any occasion at all to raise your voice, to shout, or to talk loudly over noise?
- Do you talk often to anyone who is hard of hearing?
- Not knowing you prior to your vocal difficulties, I don't know what your normal voice is like. I have a scale of 0 to 5. How hoarse are you right now if 0 is normal and 5 is very hoarse?
- The effort to talk is sometimes a real problem for people. On a scale of 0 to 7 with 0 being no effort and 7 being extreme effort to talk, how much effort does it take you to make your voice work throughout the day?
- How much does this problem actually bother you?
- Are you interested in doing something about it?

Medical History

The goals are as follows:

- Seek medically related etiologic factors.
- Help establish awareness of the patient's basic personality.

Taking the medical history is the process of seeking out any medically related etiologic factors regarding the presenting disorder. Questions are asked regarding past surgeries and hospitalizations. Chronic disorders are probed, along with the use of medications. Smoking history and alcohol and drug use are explored. The patient's hydration habits also are discussed. The medical history also helps to establish in the clinician's mind how patients "feel" about their physical and emotional well-being. Asking patients whether, on a day-to-day basis, they feel "excellent, good, fair, or poor" may accomplish this task. The response to this question will provide the SLP with insight into how patients feel about themselves. Some patients report lengthy medical histories with many chronic disorders, but they indicate that they feel "good" on a day-to-day basis. Other patients with unremarkable medical histories may report feeling "fair" or "poor." This information is helpful in learning patients' basic personalities.

Social History

The goals are as follows:

- Know the patient's work, home, and recreational environments.
- Discover emotional, social, and family difficulties.
- Seek more etiologic factors for the disorder.

The social history finalizes in the clinician's mind a perception of the patient. It yields information regarding work, home, recreational, and social lifestyles and whether these lifestyles contributed to the development of laryngeal disorders. All questions probe for answers to possible etiologic factors. For example:

- Are you married, single, divorced, or widowed?
- How long have you been (married, divorced, widowed)?
- Do you have children?
- What are their ages?
- How many are still at home?
- Does anyone else live in your home? Parents? Others?
- Do you work? Where? How long?
- Specifically, what do you do in your work?
- How much talking is required?
- What is the work environment?
- Does your husband or wife work? Where? How long? What shift?
- When you're not working, what do you enjoy doing? (Include clubs, groups, hobbies, organizations, and so forth.)

As you begin the social history questions, it often is helpful to explain to patients that you need to get to know who they are and what they do to find the causes for their vocal difficulties. You want patients to "excuse" you if some of the questions seem personal. This questioning is necessary to discover all possible causes. Do not be surprised when patients open up to you with many personal, family, social, marital, or work problems. If you have developed your credibility and gained their trust, you often will be entrusted with this important information.

Oral-Peripheral Examination

The goals are as follows:

- Determine the physical condition of oral mechanisms.
- Observe areas of the upper body for tension during breathing, speaking, and at rest.
- Check for swallowing difficulties.
- Check for laryngeal sensations.

A routine oral-peripheral examination also should be conducted to determine the condition of the oral mechanism in its relation to the patient's speech and voice production. Also included is observation of the patient's laryngeal area tension utilizing visual observation of posture and neck muscle tension, as well as digital manipulation of the thyroid cartilage. The patient should be asked whether any swallowing difficulties are present to determine whether this function has been affected by or is affecting vocal production. Finally, the patient should be asked whether any laryngeal sensations are present. The laryngeal sensations most often associated with voice disorders include aching, dryness, tickling, burning, and a feeling of a "lump in the throat."

Voice Evaluation

The goals are as follows:

- Describe the present vocal components.
- Examine inappropriate use of the vocal components.

Following the patient interview, the perceptual and instrumental voice evaluations are conducted. Several formal voice rating scales have been developed and utilized for perceptually judging voice quality.[7,8] In an attempt to improve the perceptual evaluation of voice, a committee of the American Speech-Language-Hearing Association Special Interest Group 3, Voice and Voice Disorders, developed the Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V).[9] The CAPE-V uses a 100-mm visual analog scale to assess voice quality at the vowel, sentence, and conversational speech levels. The parameters of voice assessed include overall severity, roughness, breathiness, strain, pitch, and loudness. Areas for describing additional features such as diplophonia, fry, falsetto, asthenia, aphonia, pitch instability, tremor, wet/gurgly, or other relevant terms are provided.

The perceptual voice evaluation is conducted to describe the current condition of voice production and to determine whether any vocal components —such as pitch, loudness, breathiness, and so on—are inappropriate to the degree of contributing to the development or maintenance of the disorder. Beyond the formal scales described above, each vocal component may be examined separately as follows.

Respiration

This includes a description of:

- Conversational breathing patterns, including supportive or nonsupportive.
- Locus of respiration such as clavicular, thoracic, or abdominal-diaphragmatic breathing.
- Breath holding or shallow breathing.
- Coordination of respiration and phonation.

Phonation

Subjective observations regarding vocal function are made through critical listening and are well documented on validated flexible tools like the CAPE-V. The presence of hard glottal attacks, glottal fry, diplophonia, tremor, spasm, and so forth, can be added to the validated form and judged on a 100-mm visual analog scale providing a rating metric. These vocal characteristics should be observed in prolonged vowels, phonemically loaded sentences, standard reading passages, and conversational speech. In addition, the SLP is guided to listen throughout the evaluation for changes in quality when the patient is not responding to formal testing requests.

Resonance

The term "resonance" refers to the location of amplified sound transmission in the upper aerodigestive tract. Terms like "hypernasal" and "assimilative nasality" are used when describing the quality of sound as a result of the extent of sound transmission in the nasal cavity and are most often used in reference to persons with velopharyngeal incompetence or insufficiency. Cul–de-sac resonance may occur when the tongue is held in a posterior fashion and the sound is primarily focused in the oral pharyngeal port. This type of resonance is most often associated with hearing loss and velopharyngeal incompetence, and has been noted in patients with significant compensatory posterior tongue carriage in the absence of a pathological cause. Hyponasality is the sound associated with an upper respiratory infection and stuffy nose. Often called denasal, the patient with hyponasality should be referred to the otolaryngologist for follow-up of the presence of nasal obstruction. Finally, the term "resonance" in voice often means the place in the hypopharynx for primary sound transmission, or what people refer to as focus of the voice. There remains no standardized method to identify tone focus/resonance of voice transmission. The evaluation of resonance is auditory perceptual. Many voice pathologists believe that resonance is sensed as the place where the voice emanates or where the patient senses vibration of sound.

Pitch

Pitch range is tested by having the patient sing up a scale from the lowest note to the highest note and from highest to lowest note while matching the extremes to a pitch pipe or a keyboard. Many patients are embarrassed to produce pitch range. Another method to assess range of phonation is the use of a functional phonatory task one might do when riding a rollercoaster or a sled, the "whee" sound from lowest to highest pitch. One additional method that, while time consuming, is an excellent method to assess the pitch and loudness capabilities of the vocal mechanism is the use of a Voice Range Profile (also known as a phonetogram).[10] The Voice Range Profile is a graphic picture of the limits of the vocal system. The patient is asked to produce the lowest pitch and the highest pitch at softest and loudest phonation that are graphed on a chart with pitch on the horizontal axis and loudness on the vertical axis. Finally, a thorough assessment of pitch should include examining the use of inflection and pitch variability in a conversational context.

Loudness

The appropriateness of the patient's speaking loudness level during the evaluation is described. It is also important to test the patient's ability to increase subglottic air pressure. This may be accomplished by asking the patient to shout "hey." The ability to produce a more solid phonation during a shout is a good indicator of the severity of the problem. If the patient is able to override the dysphonia with increased loudness (which is determined by the ability of the folds to approximate tightly to increase subglottic air pressure), the disorder is perhaps not as severe as when a patient cannot easily increase loudness. If there is a vocal fold tissue pliability issue, the patient may complain that there are places in the vocal range that require greater loudness/effort to produce the sound. One simple task is to ask the patient to sing up the scale while maintaining a steady-state loudness. If the patient reverts to a louder sound at the higher notes, ask the patient to produce the same notes while being cued with "softer, softer, softer." If the patient is unable to produce sound softly, there is likelihood that an adynamic area is present on the vocal folds (an area that does not vibrate), requiring greater subglottal pressures to initiate and maintain vocal fold vibration.

Rate

The rate of the patient's speech may contribute to the development of the vocal disorders. This is especially true for the individual who speaks with an exceptionally fast rate. During the diagnostic workup, the rate of conversational speech is described as normal, fast, or slow.

Instrumental Voice Assessment

Instrumental measures of vocal function, sometimes called laryngeal function studies or phonatory function tests, may be conducted if the appropriate instrumentation is available. Acoustic, aerodynamic, and laryngeal imaging analyses are used to objectively describe vocal function. Common *acoustic measures* include:

- fundamental frequency
- frequency range
- frequency perturbations (jitter)
- habitual intensity
- intensity range (maximum/minimum)
- intensity perturbations (shimmer)
- signal-to-noise ratio
- spectral analyses
- cepstral peak

Useful *aerodynamic* measures include:

- airflow volume
- airflow rate
- maximum phonation time
- subglottic air pressure
- glottal efficiency
- phonation threshold pressure
- laryngeal airway resistance

Laryngeal *videostroboscopy* demonstrates a simulated, slow-motion view of the vocal fold vibration. This view provides much additional diagnostic information, including:

- configuration of glottic closure
- degree of supraglottic activity
- vertical level approximation of the vocal folds
- condition of the vocal fold edge
- amplitude of vibration
- integrity of the mucosal wave

- nonvibrating areas of the vocal folds
- phase and symmetry of the vibratory pattern of the vocal folds

Hearing Screening

The American Speech-Language-Hearing Association mandates that patients who undergo speech, voice, and language evaluations must have a current hearing screening. Audiometric evaluation is important for the patient with a voice disorder. The inability to monitor one's voice may result in the use of inappropriate vocal components. Severe voice disorders are often observed in hard-of-hearing and deaf populations.

Impressions

The goal is to summarize the etiologic factors associated with the development and maintenance of the individual's voice disorder. This section of the diagnostic procedure is used as a summary for the causes of the voice disorder discovered throughout the evaluation. These causes are listed in order of perceived importance, relating first to the initiation of the problem and second to the maintenance of the problem. Remember that the precipitating factor may not be the maintenance factor.

Prognosis

The goal is to analyze the probability of improvement through voice therapy. The prognosis for improving many voice disorders through voice therapy is generally good. Nonetheless, many factors influence prognosis (see Chapter 1), including the motivation, interest, and time of the patient; ability of the patient to follow instructions; the physical and emotional conditions of the patient; and the general condition of the vocal folds. The prognosis section permits the SLP to give a subjective opinion regarding the chances for successful remediation based on the diagnostic information. A reasonable time frame for expected completion of the management program also should be stated.

Recommendations

The management plan should be outlined based on the etiologic, physiologic, and behavioral factors that precipitated the voice disorder and that cause it to persist, which were discovered during the evaluation. The plan includes the therapy approaches to be used, results of voice probing and trial therapy, prognosis, and additional referrals suggested.

Chapter Summary

Successful voice therapy is totally dependent on an in-depth and accurate diagnostic evaluation. This author views the voice evaluation as a primary therapy tool. The evaluation determines the causes for the disorder, teaches the patient about the disorder, and describes the vocal function that must be modified for voice improvement to occur. This information lays the foundation for voice therapy.

The remainder of this text is devoted to management techniques for voice disorders. You will realize in studying the many case presentations that selecting the appropriate treatments depends

on the multidisciplinary cooperation and management by the voice team members. The chapters are organized to describe management strategies for disorders of primary and secondary muscle tension dysphonia (MTD), glottal incompetence, irritable larynx/cough/paradoxical vocal fold dysfunction, neurogenic voice disorders, and professional voice. Chapter 8 offers a discussion of nontraditional vocal challenges and nontraditional service delivery models. Many crossovers in management approaches are evident and useful for the various disorders. All successful voice therapy, however, begins with accurate diagnosis and planning through the medical examination and voice evaluation.

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