personal PERSPECTIVE BARBARA C. SONIES As a teenager I wanted to be an actress or a TV personality, but I realized that I just was not suited to be a starving artist. When I was a senior in high school and had to write a paper for my psychology class, I chose cerebral palsy. I began to visit school programs in the community for children with cerebral palsy. In addition, I visited the local university clinic that trained speech therapists and was introduced to the therapist. Her work was quite fascinating to me, so I made more on-site visits. This field, although not the theater, required good communication skills and seemed to be challenging. After some reflection and more talks with therapists and university students, I was sold on the field as being a match for my aptitude and interests. When I entered college at the University of Minnesota, I knew I was going to enroll in the speech pathology program. It was one of the premier programs in our field, and I was so lucky to have a group of renowned scientists/teachers (Arnold Aronson, Bryng Bryngelson, Gerald Seigel, Frederick Darley, Hildred Schuell, Clark Starr, Jon Eisenson, Willard Zemlin) who were role models for the career that has been mine for 40 years. After working in the schools and hospitals with both children and adults, I went back and earned my Ph.D., knowing that dysphagia was going to be my main focus. My two-decades-long presence in dysphagia grew from working with a patient who could not swallow and from my work with children with cerebral palsy with oral motor and swallowing disorders. I found that we did not fully understand swallowing physiology and that I could use a variety of instrumental techniques to image the oropharynx during the swallow. I learned about a new technology, ultrasound imaging, and developed it as a way to view the oropharynx. I have enjoyed being able to create new methods and models of swallowing behavior.

Dysphagia is exciting for me because we can help patients in relatively few sessions. Personal satisfaction, service to others, and intellectual stimulation are what keeps me in this field. Engaging in social situations remains one of the most pleasant interactions of fam- ily, religious, and community life.Swallowing difficulty presents in a wide spectrum of clinical settings from acute inpa- tient hospitals to outpatient rehabilitation departments, long-term care facilities, skilled nursing residences, and schools.The incidence of dysphagia in nursing homes ranges from 50 to 70 percent and is more common among the elderly who require hos- pitalization and those with neurological conditions (Langmore, Skarupski, Park, & Fries, 2002; Marik & Kaplan, 2003).To understand and treat persons who have dyspha- gia, knowledge of normal and abnormal swallowing is essential, as are cultural issues, effects of aging, instrumental assessments, clinical evaluations, and treatment options.The incidence of dysphagia has been estimated at 15 million per year, and it is estimated that one-third of the 650,000 to 700,000 new stroke patients will have swallowing difficulty (Teasell, Foley, Fisher, & Finestone, 2002).The care for persons who are unable to eat normal diets and thus require supplemental tube feedings is expensive, making swallowing rehabilitation a medical priority.Teams may include a radiologist, gastroenterologist, nurse, nutritionist, dentist, neurologist, respiratory therapist, occupational therapist, phar- macist, nurse, or physical therapist.C1ultural Competence and Swallowing To adequately assess those with a complaint of swallowing difficulty, we must under- stand cultural backgrounds.Dysphagia (difficulty swallowing) is common to a variety of conditions and is seen across the life span from infancy to old age.Most of these pleasurable activities revolve around the interactions that occur during eating. to the hyoid bone.Because swallowing patterns change due to bolus variations,

swallowing is not consid- ered a truly reflexive behavior; rather, it is termed a patterned or programmed response. Although the glottis and the trachea form the top of the airway, as shown in Figure 16.1, these structures are not involved in the swallow; rather, they need to be protected from material entering into the airway by closure of the vocal folds and lowering of the epiglottis. However, it is important to remember that rather than each phase being tem- porally discrete, swallowing is an interdependent, overlapping, and dynamic process where activity may exist simultaneously from the mouth through the pharynx. Physiology of the Swallow Phases of the Swallow The normal swallow consists of four phases or stages: the oral preparatory phase, the oral phase, the pharyngeal phase, and the esophageal phase. Although the swallow pattern is highly repeatable, there are varia- tions in how we swallow depending on the texture, volume, and viscosity of a bolus. This phase is variable in duration and is stimulated by the sensory inputs of the cranial nerves (V, VII, IX) that control taste, smell, and temperature. Peristaltic activity is initiated throughout the esophagus to move the swallowed mater- ial to the stomach for further digestion. Swallowing behavior is predictable and follows a replicable pattern that is both reflexive and voli- tional. Once the reflexive swallow (pharyngeal and esophageal phases) occurs, it is difficult to impede the flow of a bolus. In the volitional phases (oral preparatory and oral phases), the swallow can be terminated at will if the taste or smell is unpleasant or if food is spoiled. To initiate a swallow, the tongue tip and blade ele- vate behind the incisors, placing the bolus in position to begin to swallow. The esophagus is a closed structure composed of striated muscle in the upper third and smooth muscles in the lower two-thirds. In the oral preparatory phase of the swallow, the lips remove food from a spoon, fork, straw, or cup to form a tight seal that will prohibit any leakage of food out of the mouth. In the oral preparatory phase, food is manipulated and chewed. These sequential phases are overlapping. Oral Preparatory Phase. N1eurology of the Swallow Cortical and Subcortical Innervation Daniels (2004) stated that "evidence from anatomical and functional imaging indi- cate[s] involvement of a widely distributed neural network for swallowing." Swallowing was once regarded as a function controlled by the swallowing center in the medulla and pons, part of the brain stem; however, recent studies using functional imaging of brain activity have revealed numerous areas of cortical regulation of the swallow (Daniels & Foundas, 1997, 1999; Daniels, Foundas, Iglesia, & Sullivan, 1996; Dziewas et al., 2003; R. E. Martin & Sessle, 1993; Suzuki, et al., 2003). A schematic of these structures is found in Figure 16.2. According to Bass (1997), the volitional com- ponents of the oral and pharyngeal swallow are modulated by "the supramedullary structures, such as pons, mesencephalon, and limbic and cerebral cortex" (p. 23). Studies examining brain activation during the normal swallow using functional mag- netic resonance imaging (fMRI) and positron emission tomography (PET) have found strong evidence for cortical activation of the following cortical structures: sensorimo- tor cortex, insula, cerebellum, putamen, globus pallidus, thalamus, anterior cingulate gyrus, and supplemental motor area, with evidence for localized involvement of the basal ganglia, pons, and medulla (Daniels & Foundas 1997; Daniels et al., 1996; Dziewas et al., 2003; Hamdy et al., 1999; R.E. Martin & Sessle, 1993; Suzuki et al., 2003). Trigeminal, Cranial Nerve V This nerve supplies the main sensory (afferent) input during the oral and oral preparatory phases of the swallow by providing oral sensation to the anterior two-thirds of the tongue, soft palate, cheeks, floor of the mouth, teeth and gums, temporomandibular joint, lips, nasopharnx, soft

palate, hard palate, and tonsils and visceral sensation to the salivary glands.There are five cranial nerves that are responsi- ble for the swallow: trigeminal V, facial VII, glossopharyngeal IX, vagus X, and hypoglossal XII (Perlman, 1991).It also innervates the floor muscles of the mouth--the mylohyoid, geniohyoid, and digastric--to assist in elevation of the hyoid bone. Facial, Cranial Nerve VII The facial nerve conveys taste sensation to the anterior two-thirds of the tongue and sensation to the soft palate and salivary glands.Hypoglossal, Cranial Nerve XII The hypoglossal nerve provides the major motor input to all of the lingual muscles during the oral preparatory, oral, and pharyngeal phases of the swallow.It is important in that it innervates the tongue to seal the oral cavity, prepare the bolus, and remove food particles from the buccal sulcus, palate, and teeth in the oral preparatory phase of the swallow.Vagus, Cranial Nerve X This cranial nerve is often termed the major, or primary, cranial nerve for swallowing, as it has both sensory and motor fibers and provides innervation to the entire upper and lower digestive system, including the pharynx, larynx, esophagus, and stomach, as well as to the gastrointestinal system from the stomach to the colon.There are, however, numerous changes that can impact the ability to swallow. decreased tongue pressure and strength due to general muscle wasting or sarcopenia (Evans, 1995; Nicosia et al., 2000; Robbins, Hamilton, Lof, & Kempster, 1992; Robbins, Levine, Wood, Roecker, & Luschei, 1995; Sonies, 1991b; Sonies et al., 1988).This is attributed to thinning of the vertebral column and degeneration of the vertebral vertebrae resulting in the ossification and inward sinking of the thorax and reducing vital capacity (Sonies, Stone, & Shawker, 1984).In addition, it has been found that normal elderly persons have a pattern where there is bolus retention in the pharynx and the swallow is delayed, but the bolus even- tually clears (Dejaeger, Pelemans, Ponette, & Joosten, 1977; Perlman, Schultz, & VanDaele, 1993). Larynx The larynx comprises one bone and several cartilages (Boone & McFarlane, 2000).Saliva Saliva is an essential bodily secretion that serves to maintain oral moisture, prevent tooth decay, lubricate the oropharynx and esophagus for digestion, mineralize the teeth, assist in digestion, and neutralize stomach acid (Logemann, 1998a; Stuchell & Mandel, 1988).Without sufficient saliva in the oral cavity during chewing, there is poor bolus preparation and impaired bolus transportation over the tongue, and food sticks to the palate, teeth, tongue, or wall of the throat (Baum, 1986, 1989; Bertram, 1967; Caruso, Sonies, Fox, & Atkinson 1989; J. Scott, Flower, & Burns, 1987).There are several quali- ties of taste that are perceived by the taste buds: salty (NaCl), sweet (sucrose), bitter (quinine hydrochloride), sour (citric acid), and Umani (Japanese Savory).Environmental effects from years of smoking, chewing, wearing poorly fitted or poorly maintained dentures, and taking medications cause change in the oral mucosa (Sonies, 1991b).Rapid decrease in salivary secretion may be an indication of a pathological condition or result from pharmacological interventions and medical interactions (Sonies, 1991b). Mistretta, 1984; Weiffenbach, 1984) that the threshold for detection of taste increases with age and that foods taste bland.GERD: Gastroesophageal Reflux Disease Chronic gastroesophageal reflux dis- ease (GERD) is a common complaint with advanced age and is often associated with a hiatal hernia. A1bnormal Swallowing Dysphagia, difficulty swallowing, is derived from the Greek dys + phagein “to eat” and is defined as difficulty moving food from the mouth to the stomach (Dorland’s, 1988). Dysphagia is commonly associated with a variety of neurologic, neuromotor, systemic, immunologic, developmental,

and iatrogenic conditions as well as infectious processes, surgical changes, and trauma. Dysphagia can occur in infants, children, adults, and the elderly. Conditions such as stroke, head and neck cancer, and Parkinson's disease are among the most common causes of dysphagia.Aspiration and PenetrationOne of the major symptoms of abnormal swallowing physiology, aspiration, can be determined from instrumental studies. Aspiration occurs when the individual directs the bolus into the respiratory system (trachea and lungs) instead of into the digestive system. When food or liquids enter the airway above the level of the vocal folds, it is called penetration, and when the material enters the airway below the vocal folds, it is termed aspiration. In normal persons, when swallowed material enters the airway, a protective cough is elicited to clear the material out of the laryngeal vestibule, just above the airway, and back into the pharynx, where it is then either swallowed or expelled orally. In persons with various conditions causing dysphagia, the reduced strength and coordination of the swallowing muscles, inadequacy of cranial nerve innervation, reduced oropharyngeal sensation, and structural abnormalities that accompany the conditions often promote aspiration. In some conditions such as Parkinson's disease, silent aspiration is found, where the individual is unaware of aspi- rated material and, therefore, does not clear the airway volitionally. Material can be aspirated from the mouth during or before a swallow, or it can back up from the esophagus and enter the airway after a swallow (reflux) (Koufman, 1991). In either case, once material enters the airway and passes into the trachea, it will enter the lungs, potentially causing infection and aspiration pneumonia or pneumonitis, which are serious medical complications and need aggressive medical treatment To adequately assess whether the person is safe for oral feeding or at risk of mater- ial entering the airway, results of instrumental studies must be carefully examined on a frame-by-frame, or moment-to-moment, basis.Brain stem strokes usually cause dysphagia if the corticobulbar tracts, nucleus tract solitarius, trigeminal nuclear complexes, nucleus ambigus, hypoglossal nuclei, or medullary swallowing centers are involved (Groher, 1997).The two procedures that best examine whether the material is actually entering the airway or is cleared from the airway by coughing, clearing, or a subsequent swallow are the videofluoroscopy (VFS) and fiberoptic endoscopic evaluation of swallowing (FEES).Neurological Conditions Affecting SwallowingThe causes of neurogenic dysphagia can be vascular, infectious, traumatic, autoimmune, metabolic, neoplastic, or degenerative in etiology.Left- and right-hemisphere strokes can occur from plaque buildup in the internal or middle carotid artery or from altered blood supply caused by an embolism, thrombosis, aneurysm, or hemorrhage.The severity of dysphagia is dependent on the size, depth, and exact location .of the infarct