Dysphagia: Interprofessional Management, Impact, and Patient-Centered Care

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Abstract
Dysphagia affects a multitude of people worldwide with tremendous impact on the affected individual, families, and caregivers. Understanding dysphagia, as well as the status of screening, evaluation, and treatment, aids in the knowledge required by an interprofessional team to holistically care for patients with dysphagia and their caregivers. The impact of dysphagia includes potential associated risk and a cascade of effects. Conversations regarding meeting nutrition and fluid needs with consideration for quality of life need to be integrated into the plan of care for individuals with dysphagia. (Nutr Clin Pract. 2018;00:1–16)

Keywords
aspiration; deglutition disorders; dysphagia; interdisciplinary communication; speech-language pathology

Introduction
Providing nutrition through oral intake (OI) and the joy of eating is often taken for granted. It is hard to disagree with the importance of adequate nutrition and fluid intake. When swallowing becomes inefficient, uncomfortable, or is deemed unsafe, additional care and consideration regarding OI and the many factors related to this change must occur. Dysphagia is a swallowing disorder that impacts oral, pharyngeal, and/or esophageal function because of anatomic or physiological insult.1 Repercussions of dysphagia can impact quality of life (QoL), hydration, nutrition, and medication administration, and there may be increased risk for or an association with further medical complications. The realm of dysphagia is vast and impacts a variety of individuals around the globe. The collaboration of an Interprofessional team, including providers, speech language pathologists (SLPs), occupational therapists, registered dietitian nutritionists, nursing staff, respiratory therapists, pharmacists, social services, and a variety of others, is essential for the most sensitive and effective care. Functions of each discipline working with individuals with dysphagia may vary and can overlap from area to area. Communication between the disciplines and a united plan of care is vital.

This discussion will emphasize oropharyngeal dysphagia (OD), as the scope does not allow the thoroughness required to cover other phases of or causes for dysphagia, though many points of discussion also apply to pharyngeal and esophageal dysphagia. It is critical that medical professionals have a working awareness of dysphagia and the impact it can have on individuals, especially regarding nutrition, hydration, and QoL, to more comprehensively serve them.

Causes
There are many causes for dysphagia, and in some cases, etiology may be difficult to ascertain. Neurologic disorders such as stroke can cause dysphagia, which may occur in 37%–55% of stroke patients. Stroke severity as assessed by the National Institutes of Health Stroke Scale; ≥5 is a reliable predictor of dysphagia.1 Severity of dysphagia may vary according to the region affected by the stroke. Brainstem strokes, especially lateral medullary, tend to have the most severe and longest lasting dysphagia. Among the hemispheric strokes, strokes with insular region

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involvement present with more severe dysphagia. Dysphagia may result from traumatic or nontraumatic brain injury, depending on the area and extent of injury. Spinal cord injury can cause dysphagia as well.

Neurodegenerative diseases and neuromuscular diseases, including but not limited to Parkinson’s disease, multiple sclerosis, amyotrophic lateral sclerosis, muscular dystrophies, polymyelitis, myasthenia gravis, and dementias, are other causes of dysphagia. Dysphagia may be the result of structural lesions (eg, thymectomy, cervical hypertosis/osteophytes, etc). Connective tissue disorders (eg, polymyositis, dermatomyositis), iatrogenic causes (eg, endotracheal intubation, anterior cervical disectomy and fusion), and cancer of the oral cavity, pharynx, or esophagus and related treatment (eg, surgical resection and radiation) are other possible etiologies for dysphagia.

Medication use has been associated with dysphagia. Although most studies assessing the relationship between medications and dysphagia have been case reports or small-scale studies, it is important to be aware of these when no other cause can be identified. Medications such as central nervous system depressants (neuroleptics/antipsychotics or anesthetics) may depress brainstem function and control of swallowing. Additionally, antipsychotics have anticholinergic properties that may induce salivary changes and impair esophageal peristalsis. Furthermore, dopamine antagonists can result in dystonia and dyskinesias, and fat-lowering agents may have a side effect of myopathy, according to case and anecdotal reports. Esophageal dysphagia can be related to medications such as nonsteroidal anti-inflammatory agents, potassium salts, bisphosphonates, and medications that relax the lower esophageal sphincter and can lead to injury and acid reflux with damaging effects.

Age and frailty have been associated with dysphagia. Presbyphagia, or frailty in swallowing, may be due to age-related loss of swallowing muscle mass or sarcopenia. Elderly persons with sarcopenia and dysphagia may not only have disease-related dysphagia but also sarcopenic dysphagia identified by reduced calf circumference, grip strength, and trunk muscle mass. Socioeconomic challenges have also been identified as a cause of malnutrition leading to sarcopenia. Physiological changes in oropharyngeal swallowing begin to manifest in individuals over age 60 years of age, and in a study by Robbins, Hummel, Banaszynski, Hind, and Rogus-Pulia, the decreased pressure reserve noted with aging was suggested to put the older population at greater risk for dysphagia. Changes related to aging also include altered cough reflex, lowered immunity, decreased lung elasticity, decreased saliva production leading to changes in microbial flora, decreased muscle tone impacting the chest wall (cough strength, airway clearance), tongue (oral clearance), and intestinal motility (reflux, increased use of proton pump inhibitors), which all can lead to a decrease in the body’s ability to fight infection.

Statistics

Incidence and Prevalence

To appreciate the significance of dysphagia, a brief discussion of the incidence/prevalence is shared. Bhattacharyya analyzed the 2012 National Health Interview Survey and found that annually, 1 in 25 adults was reported to be affected by swallowing problems. According to The National Foundation of Swallowing Disorders, 10 million Americans are evaluated for swallowing difficulties each year, and 22% of those over 50 years of age may have dysphagia. According to estimates, about 8% of the world’s population have difficulty eating and drinking because of dysphagia. Defining the prevalence of dysphagia within the general population has its challenges. Instead, studies have been conducted on the incidence/prevalence within specific populations, including older adults and individuals who have experienced mechanical ventilation, acute stroke, anterior cervical fusions, and more. Ikenstein et al report an incidence of OD >50% within 72 hours of a new stroke. A systematic review by Valenzano et al found small case studies and definitions of dysphagia to be inconsistent for individuals who have experienced traumatic spinal injury, indicating the need for further research with a specific definition of dysphagia, as the broad definition of dysphagia implies impact along various sections or phases of the swallow. Further exploration can lend insight relevant to prevalence or incidences, given various medical conditions or factors. As further studies are conducted regarding the prevalence of dysphagia, the impact dysphagia has on nutrition, hydration, and QoL must not be lost.

Economic Impact

In addition to morbidity and mortality, there is monetary cost to dysphagia that affects healthcare systems and individuals worldwide. A systemic review of OD on healthcare costs and length of stay by Attrill et al found “the presence of dysphagia added 40.36% to healthcare costs across studies.” A study by Westmark, Melgaard, Rethmeier, and Ehlers looked at costs in and out of the hospital setting and found that in the geriatric dysphagia population, costs were significantly higher for those with a dysphagia diagnosis. As per Bhattacharyya’s analysis of the National Health Interview Survey, it was noted that a minority of the number of persons with self-reported dysphagia sought healthcare, and adults with reported swallowing difficulties indicated 11.6 ± 2.0 missed workdays compared with 3.4 ± 0.1 missed days per year for individuals without reported swallowing difficulty.
Screening and Evaluation

Screening and Clinical Swallow Evaluation (CSE)

Dysphagia is an indicator for morbidity and mortality in the medical setting, and early identification and treatment of dysphagia and aspiration is imperative for lessening potential negative outcomes for patients and medical care facilities. Underlying neuromuscular abnormalities frequently warrant OD screening. The World Gastroenterology Organization (WGO) Guidelines state that “stroke patients should be screened for dysphagia within the first 24 hours after the stroke and before oral intake.” They report that this screening guideline has the potential to significantly reduce the risk for dysphagia-related complications after acute stroke. The WGO also recommends screening for patients with weight loss and repeated chest infections. Other mechanical abnormalities or obstructions may require OD screening, including abscesses, diverticulum, myositis, fibrosis, head/neck malignancies and treatment sequelae, post-cervical surgery, osteophytes, and others. Nurse-performed screening is frequently done in the critical care setting; however, post-extubation screening lacks specific guidelines.

Swallow screening performed by a registered nurse (RN) is a common practice for those with overt symptoms of dysphagia, such as pocketing of food, a wet gurgly voice, or coughing after eating or drinking; however, there is a need for further standardization of swallow screening for those with the less common etiological factors of dysphagia. In addition, silent aspiration, which is aspiration without overt symptoms, is undetectable in screenings and subsequently not referred for an instrumental assessment to identify dysphagia. Cough reflex testing, inducing a cough with citric acid and evaluating the strength of that cough, has been suggested as a means to identify those who might be at risk of silent aspiration. At this time, there is no evidence-based practice for detecting silent aspiration without imaging. The bedside RN plays an important role in identifying overt dysphagia symptoms and referring for further evaluation by an SLP, as access is available.

Screening, evaluation, and treatment for dysphagia is a universal concern. Ickenstein et al assert that although numerous tools exist, the worldwide medical community lacks a universal protocol with both high specificity and sensitivity for predicting aspiration. The bedside practitioner needs effective yet simple tools for initial assessment. Screening tools in the literature include questionnaires, mealtime observations, and/or various administration techniques for swallowing water and/or food boluses. Some studies involved swallowing a single volume of water, whereas others involved subtests with gradually increasing volumes. It is beyond the scope of this article to cover the numerous techniques that have been developed, as many are offered. Systematic reviews provide an overview of related research and publications relative to many techniques. In addition to screenings, the breadth and depth of the CSE, administration of food and/or liquid by an SLP to assess overt signs and symptoms of dysphagia, has been covered by others, including Coyle.

Screening tools and the CSE or bedside swallow evaluation are an important initial step in dysphagia diagnostics; however, screening and bedside evaluation methods alone are insufficient for thorough evaluation of swallowing anatomy and physiology and/or the detection of aspiration. Two recent studies reviewed evidence of the effectiveness of dysphagia screening for reducing associated risks, such as pneumonia. Teusch et al completed an observational study of 993 screened and 401 unscreened patients and found similar rates of stroke-associated pneumonia: 5.0% for the screened group and 5.5% for the unscreened group. Of 216 patients with a nothing-by-mouth status, 13.9% still developed pneumonia. A systematic review concluded that there is insufficient evidence that current dysphagia screening protocols reduce risk for pneumonia, death, or dependency after stroke. Therefore, ideally, bedside screening measures should lead to supplemental evaluation with instrumental assessment for a comprehensive, thorough examination of oropharyngeal anatomy and physiology, as indicated and available.

Instrumental Assessment

Instrumentation is widely regarded as the gold standard in dysphagia diagnostics. This includes videofluoroscopy (VFS)/modified barium swallowing studies (MBSS), fiberoptic endoscopic evaluation of swallowing (FEES), high-resolution manometry (HRM), and upper endoscopy. Instrumentation provides the opportunity for quantitative, reliable evaluation of oropharyngeal anatomy and physiology when using an established clinical protocol. See Table 1 for further information. Protocols for VFS/MBSS are well established and include numerous standardization efforts, including the penetration-aspiration scale. Modified Barium Swallow Impairment Profile, oropharyngeal swallow efficiency, and Dynamic Imaging Grade of Swallowing Toxicity. Advantages of the VFS/MBSS are that it provides more information about the physiology of the pharyngeal phase, and it also allows for visualization of the oral and esophageal phases. FEES provides direct visualization without radiation exposure, is more accessible to patients who are immobile or in critical care because it can be completed at the bedside, and allows for immediate biofeedback training. When compared with VFS, penetration, aspiration, and pharyngeal residues were perceived as more severe with FEES.
endoscopy evaluates structural reasons for dysphagia and visualizes the pooling of secretions and/or food/liquid residuals in the oropharynx; however, endoscopy is not sensitive for evaluating swallowing physiology. HRM directly quantifies pressures of muscle activations involved with swallowing and has promising applications in the future, as the field of dysphagia evolves. Several other applications combine various evaluation techniques to provide a more comprehensive examination and increase knowledge of swallowing mechanics.

In the SLP community, controversy exists regarding the necessity of the CSE because of its inability to evaluate oropharyngeal anatomy and physiology against the gold standard of instrumental assessments. Coyle argues that the CSE is indeed necessary as an initial step prior to instrumental evaluation or when instrumental testing is not feasible. Feasibility is multifactorial, and the most common reasons for its use include accessibility/availability (often a function of clinical setting), necessity (the instrumental study should provide new information that a CSE cannot), and patient refusal. Certainly, the CSE has incredible value for building patient rapport, offering diagnostics, and determining the appropriateness for and preliminary groundwork prior to further instrumental evaluation and therapeutic intervention trials during instrumental assessment. The incorporation of the CSE also initiates the establishment of the therapeutic alliance and the educational foundation needed for patient-centered care and further decision making.

**Treatment**

By identifying persons with dysphagia and subsequently providing thorough diagnostics for underlying impairments involving oropharyngeal anatomy and physiology, SLPs are equipped to develop specific, individualized care plans tailored toward patients’ specific goals. Clinical management of dysphagia is a relatively new field; however, the field of speech language pathology has made significant progress since the early 1980s, when pioneering clinical researchers made strides developing clinical dysphagia practice patterns. Nonetheless, the literature consistently acknowledges that the field of dysphagia has a paucity of evidence and needs much more research.

The American Speech Language Hearing Association (ASHA) defines treatment goals to optimize safety and efficiency and target feeding methods and techniques. Consideration for minimizing pulmonary risk and reducing the burden of care while optimizing the patient’s QoL must also be considered. Dysphagia treatment must strive to provide support for adequate nutrition and hydration in order to allow for the return to safe and efficient OI as soon as possible while incorporating patients’ preferences. From an SLP perspective, treatment is generally divided into 2 categories: compensations and restorative/rehabilitative approaches.

**Compensations**

Swallowing compensations alter and/or improve the swallow but do not facilitate a lasting functional change in the physiological swallow when the technique is not used. The most commonly implemented techniques are alterations of diet and liquid consistency, postural changes (eg, chin tuck, head turns, etc), timing/coordination techniques (eg, oral preparatory set), laryngeal maneuvers (eg, supraglottic swallow), environmental changes (eg, bolus presentation methods, reducing distractions, etc) sensory modifications (eg, thermo-tactile stimulation, carbonation, dissolvable flavored films, etc), and others. Throughout the years, there have been a variety of clinical practice patterns in use for compensations. Some compensations are contraindicated in specific cases. For example, a chin tuck position may contribute to airway entry in some people, so following the treating clinician’s recommendations is vital.
Food and Liquid Modification

Diet modification by changing the texture or consistency of foods and/or liquids is a common practice in medical settings for compensation of dysphagia. Diet modifications are assistive in improving an individual’s efficiency of OI and potentially reducing the risk of aspiration. ASHA recognizes diet modification as compensatory, since it is used as a tool to improve swallowing but does not create a lasting functional change to the swallow physiology itself. For liquid and food texture modification, various diet levels are established to facilitate safer, more efficient swallowing. Thickened liquid boluses have increased viscosity, which in turn slows food bolus movement through the oropharynx, as compared with a thinner bolus, which moves more quickly. The speed of the thinner bolus may place the patient at higher risk for timing and coordination issues leading to potential aspiration. It is important to consider the impact of thickened liquids on patients with oropharyngeal weakness, as this can lead to increased retention and aspiration after the swallow. Additionally, lack of willingness for patients to take thickened liquids is a common problem when managing dysphagia. Although modified diets compensate for some types of dysphagia immediately, patients have reported a dislike of altered textures and thickened liquids, which can lead to reduced fluid OI and dehydration. Global efforts have been made to standardize food and liquid modifications.

Dysphagia Diet Standardization

Healthcare facilities have been using the National Dysphagia Diet: Standardization for Optimal Care (NDD) since its inception in 2002. At the time of its introduction, many care facilities had their own set of diets with varying degrees of texture modification that were used for patients with swallowing difficulty. The NDD was designed to help mitigate some of the discrepancies when transferring from one facility to another. However, challenges remained globally with varying levels, descriptions of food and liquid, and labels that led to further safety risks for patients.

In pursuit of global standardized international terminology for dysphagia foods and liquids, a multidisciplinary task force from around the world met in June of 2012; from their meeting, The International Dysphagia Diet Standardization Initiative (IDDSI) was formed. Primary reasons for the establishment of the international initiative included improving patient safety by increasing consistent communication and standards and striving for better treatment outcomes as the field of dysphagia continues to evolve using evidence-based practice.

Components of the IDDSI were released in steps between September and November 2015. The IDDSI framework consists of 8 levels with 2 inverted pyramids. Visit the IDDSI website to see the model in color and with explanations. Each level has a distinct color and number label. Transitional foods are shown on the outside of the food pyramid. Transitional foods are foods that change texture with the addition of moisture or temperature. The IDDSI Syringe Flow Test and Pressure Fork Test are methods that were developed to allow professionals, caregivers, and patients to assess the appropriate consistency of liquids and foods. Specific guidelines on how to perform the Pressure Fork Test and the Syringe Flow Test can be found on the IDDSI website at http://www.iddsi.org/framework.

The IDDSI website provides useful resources that are free and readily available. The IDDSI model and its outcomes will be formally reviewed in 2020 by the international committee that developed the framework.

Restorative and Rehabilitative

Restorative and rehabilitative techniques are aimed at improving physiologic swallow function. These techniques include skill and/or strength training. Skill training focuses on coordination and timing of swallowing. This is a relatively recent area of clinical practice, and future directions with biofeedback (eg, surface electromyography) are promising. Strength training utilizes exercise physiology for striated muscle building to combat muscle weakness due to sarcopenia or other neuromuscular causes. Some evidence supports the effectiveness of exercise-based therapy compared with the use of behavioral compensations. Rehabilitative approaches include maneuvers such as Mendelsohn and effortful swallow and strengthening exercises targeting lingual muscles, suprapharyngeal muscles, pharyngeal constrictors, etc. Some other specific examples include expiratory muscle strength training, the McNeill Dysphagia Therapy Program, and neuromuscular electrical stimulation. Another emerging concept in rehabilitation is preventative swallowing therapy, particularly for patients with head and neck cancer who are undergoing radiotherapy. Again, many of these philosophies and techniques have at least some support in the literature; however, much more research is needed.

Individualization

SLPs lack a uniform concept of “usual care practices,” according to Carnaby and Harenberg. They surveyed Special Interest Group 13 (Swallowing and Swallowing Disorders), which includes ASHA members, with the majority of members having at least 15 years of experience from a variety of work settings. When given a single hypothetical patient case, responses generated 47 different treatment techniques. Most concerning, only 6 of the 47 (13%) techniques proposed were exercise-based, which literature supports for making a functional change to the underlying
physiologic impairments. Additionally, respondents commonly reported use of techniques that did not directly correspond to the specific symptoms of physiological abnormalities. Ciucci et al also discuss this “one-size-fits-all” approach as the status quo but also suggest that SLPs are moving in a positive direction toward more individualized therapy approaches. SLPs need an increased awareness of evidence to support treatment while maintaining holistic, patient-centered, and individualized therapy.

**Dysphagia, Aspiration, and Pneumonia**

**Definitions**
The definitions of dysphagia and aspiration are established; pneumonia and/or pneumonitis due to aspiration is less clearly defined. Son et al completed a literature review covering the most recent evidence on aspiration, aspiration pneumonitis, and aspiration pneumonia. To clarify terminology, dysphagia is a swallowing disorder characterized by underlying impairment, impacting normal swallowing anatomy and/or physiology; aspiration is the entry of material from the oropharynx or gastrointestinal tract through the larynx into the trachea. Aspiration pneumonitis results from aspiration of noxious contents, usually sterile refluxed gastric contents with a pH of 2.4 or lower. Aspiration pneumonia results from aspiration of oropharyngeal or gastric contents because of colonized bacterial load introduced from the large volume aspirated. According to Son et al, this material is usually not acidic enough (>2.5 pH) to lead to pneumonitis. It is difficult to differentiate pneumonitis and pneumonia; however, these conditions are distinct diseases with differing pathophysiology.

**Complex Relationship**
The relationship between dysphagia, aspiration, and aspiration pneumonia is not fully understood or defined. Although it may seem obvious, dysphagia and aspiration are not the same, nor do they always lead to the development of aspiration pneumonia or pneumonitis. The consequences of aspiration can range from normal physiology to serious medical complications, including mortality. In a 2010 normative study evaluating healthy, ambulatory adults aged 61–90 years, laryngeal penetration occurred in 83%, and aspiration occurred in 28% of these adults. In a 2017 study that included normal, healthy adults aged 20–90 years, laryngeal penetration occurred in 50% and aspiration occurred in 18% at some point. Out of the adults that aspirated, 75% aspirated silently or without a sensorimotor response. These studies, therefore, indicate that aspiration, even silent aspiration, can happen occasionally in normal, healthy adults. However, Butler et al acknowledge that differentiation between normal and pathological aspiration in healthy adults remains unclear in view of a paucity of evidence in this area; therefore, the healthcare team must incorporate critical thinking and synthesize relevant information while being cognizant of the holistic aspects involving the patient as well as utilizing instrumentation for a comprehensive evaluation. Son et al describe the potential manifestations of aspiration and 3 important characteristics to consider: infectious inoculum, volume of inoculum, and acuity of onset. Aspiration pneumonia is thought to result from infectious inoculum, macro-aspiration, and acute onset.

Literature does not currently support an absolute causal relationship between aspiration and pneumonia. In a study of 152 patients post video swallow evaluation followed for 3 years, Feinberg found a lack of support between prandial liquid aspiration and pneumonia. They suggest that the relationship between aspiration, including volume and frequency of aspiration, as well as gastroesophageal reflux and pneumonia is unclear. It is well known that food and liquid aspirated can cause pneumonia, but several factors were unclear: volume of aspiration, frequency of aspiration, and oropharyngeal versus gastric reflux aspiration. Interestingly, the study found that individuals with “artificial feeding” (or more sensitively termed non-OI [NOI] or enteral nutrition [EN]) had the highest frequency of pneumonia; therefore, nothing by mouth with an alternate means of providing nutrition is not necessarily successful for preventing pneumonia.

**Clinical Considerations**
The complexity of these relationships poses a challenge to the healthcare team to integrate input from the SLP in terms of providing the most appropriate level of management for patients. As Butler et al point out, appropriate management is a challenge because the lack of normative data on “what constitutes normal swallowing?” Overmanagement of dysphagia is a reality. Because of liability concerns, healthcare providers often operate under a conservative “risk” mentality with the assumption that aspiration always leads to pneumonia. To be clear, aspiration certainly must occur for aspiration pneumonia to develop. However, the relationship is multifactorial, complex, and remains largely unknown. Therefore, recommendations often strive to prevent aspiration related to OI and reduce risk; however, aspiration of saliva and reflux is unavoidable, and research and experience have shown that some aspiration can possibly be a normal variant. Unfortunately, this overmanagement approach can contribute to unintentional negative health outcomes, such as decreased hydration, nutrition, and potential for subtherapeutic medication levels. QoL is another factor impacted by overmanagement. Smith’s findings showed that a significant amount of both SLP’s and nurses’ knowledge of clinical practices regarding dysphagia and aspiration is inconsistent with current
medical literature and may have the potential to cause unintended harm. Alternatively, if swinging too far on the other end of the spectrum, patients can be under managed and at a higher risk for developing serious respiratory illnesses. Clinical judgment integrating observation, comorbidities, ambulatory status, oral cares, and ability to handle oral secretions, as well as other factors, is essential to appropriate management of patients. SLPs, providers, and other members of the healthcare team must consider these multiple factors in conjunction with patient views, wishes, and goals when making safe, appropriate, patient-centered recommendations based on patient-centered discussion. Elements of patient-centered care include that it is holistic, collaborative, and includes responsive care. Ethical principles, including nonmaleficence (do no harm), should provide a framework in guiding discussion. Palliative care input can be helpful in identifying and discussing short-term and long-term goals, needs, and wishes with the patient and their family and should be included as important decisions are made, as indicated.

Risk Factors

Poor oral hygiene has been linked to pneumonia with chronic and/or large-volume aspiration of colonized bacteria from oropharyngeal or gastric sources providing an infectious source for aspiration-induced lung injury. The oral risk is due to microflora in patients with intact teeth as well as those who are edentulous, with the related organisms differing, though with similar risk for pneumonia. According to Son, Shin, and Ryu, risk factors for pneumonia include altered mental status, gastrointestinal disorders, intervention factors (enteral tube feeding, endotracheal tube), dysphagia, and esophageal motility disorders. Langmore et al investigated predictors of aspiration pneumonia in elderly patients from outpatient, inpatient acute care, and nursing home settings and found that dysphagia alone is insufficient to cause pneumonia, unless other risk factors are also present. The most significant predictors of pneumonia included being dependent for oral care, being dependent on tube feeding before pneumonia, being dependent on others for feeding, taking a number of medications, currently smoking, and having multiple medical diagnoses and a number of decayed teeth. Langmore et al conducted a subsequent study on predictors of aspiration pneumonia for nursing home residents with results supportive of their prior findings. Completing thorough oral hygiene, maintaining oral moisture, and ensuring oropharyngeal clearance after OI are crucial to reducing the risk for aspiration pneumonia, and the importance of this simple hygiene task cannot be overstated. Certainly, more research is needed in this area, as the significance of findings can inform recommendations for clinical practice.

Nutrition, Hydration, and Medication

Nutrition

Sarcopenia (loss of muscle tissue because of the aging process) has been linked to impaired nutrition status and increased malnutrition risk, which may contribute to weakness in swallowing and further impair existing OD. Sarcopenic dysphagia or difficulty swallowing due to sarcopenia of skeletal and swallowing muscles can be differentiated from presbyphagia, which refers to age-related swallowing changes associated with frailty. In looking at hospitalized patients with restricted OI without dysphagia who exhibited sarcopenia, 26% developed dysphagia with evidence for sarcopenic dysphagia. In a study monitoring nutrition intake, those with a caloric intake <22 kcal/kg/d exhibited significantly poorer recovery from dysphagia than those with an intake >22 kcal/kg/d, suggesting the importance of nutrition status maintenance relative to effective swallowing. Optimal nutrition must be part of the rebuilding or therapeutic process for regaining strength and safety in swallowing; it is indispensable for sarcopenic rehabilitation.

Feeding Tube Use for Providing Nutrition, Hydration, and Medication

The need for feeding tube use is usually indicated when one is unable to consume adequate nutrition by mouth and/or consuming nutrition and/or fluid orally is deemed unsafe and the use of a feeding tube is consistent with a person’s goals of care. Prevalence of feeding tube use related to dysphagia may be increasing as screening for and detection of dysphagia increases. Discussion of research related to tube use and related outcomes is difficult to generalize because of multiple factors in reported studies, including tube size, type, and delivery site feeding regime, including feeding and fluid provision plan and multiple patient-specific factors. The nutritionDay Project, a 1-day prevalence study of 191 nursing homes from 14 countries in Europe and the United States between 2007 and 2012 reflected that tube feeding was reported in 14.6% of residents with dysphagia. In this study, the mortality of residents with dysphagia receiving tube feeding was not statistically different from those who were not receiving tube feeding (21.4% vs 25.3%, \( P = 0.244 \)). A descriptive, cross-sectional population-based study of 4920 nursing home residents between 1994 and 1998 with severe and irreversible cognitive impairment reflected feeding tube use in 10.1% of White subjects and 38.9% for Black subjects \( (P < 0.001) \). Tube use was strongly associated with swallowing difficulties, and the role of ethnicity in end-of-life decisions was suggested for further study.

Nasogastric feeding tubes are often used to deliver nutrition support when length of need is unknown or
anticipated to be of short duration, though definition of short duration is subjective, as small-bore tubes have been used successfully for months. Estimated duration of need is helpful in determining the best tube choice. Additionally, estimated duration of need is often an important factor in criteria for reimbursement when providers such as Medicare are involved, as length of need of >3 months and serving as primary source of nutrition must be documented. The smallest diameter and softest tubes possible are obvious choices for nasogastric tubes for patient comfort, safety, and, when secured as discreetly as possible, for patient dignity. Tube flushing after use and before and after each appropriate form of medication is administered can help prevent clogging of small-bore tubes to enhance their use. As alluded in the section on medication administration, research and education are called for in this area.

Percutaneous abdominally placed tube choice should also be patient specific. Aspiration risk due to gastric reflux (vs OD) may prompt discussion of need for jejunal access, but gastric tube use, whenever possible, provides more patient feeding options. Gastric feeding tubes (G tubes) may be placed in methods other than endoscopically (percutaneous endoscopic gastrostomy tubes), including direct surgical placement and placement using fluoroscopy, which is often done without general anesthesia. Increasing this as an option for some who are not candidates for general anesthesia.

Gastric feeding regimens can be helpful for the patient with dysphagia who will socialize where food is involved by suggesting administering a feeding prior to a food-related event to dampen hunger, which may help some socialize more easily, though this does not necessarily reduce the desire for food. On the other hand, postmeal gastric feeding can be used to promote OI where this is safe to allow best appetite for the oral meal. The feeding can be adjusted according to how well the meal was eaten (eg, half of a good meal, with 1 carton of feeding needed instead of 2, all, or none) on a meal-by-meal basis to help transition back to OI and reduce dependency on feeding via tube, when it is deemed safe. Nocturnal feeding may require professional guidance in adjusting feeding to promote appetite during the daytime as OI becomes safe.

Fluid provision is a critical component of enteral tube feeding to ensure adequate hydration, even when oral fluid intake is possible, until there is consistent adequate oral fluid intake. Comparison to usual terms, such as recommending 4 or 6 cups of water per day, is often more helpful than suggesting milliliters of fluid. Normalizing feeding regimens are not only helpful for comprehension of the suggested regimen but also for comparison to usual meal-like routines, which can assist with the now significantly altered QoL aspects. When EN is used, it is the responsibility of the healthcare team to promote an administration and care regimen that best meets patient needs, considering efficacy, simplicity, comfort, safety, and cost effectiveness, in conjunction with patient goals and wishes. Research regarding means to help meet patients’ nutrition and fluid needs using enteral feeding tubes while preserving QoL, as possible, is a suggested area of need.

Removal of G tubes was associated with a variety of factors, as found in a literature review by Wilmskoetter with the strongest predictor being the absence of aspiration on modified barium swallow. This reflects the importance of ongoing monitoring for improvement in the safety of swallowing so that OI can resume as quickly as it is deemed safe and efficient. Wojner and Alexandrov looked for clinical indicators to help predict tube feeding dependency in stroke patients with dysphagia to help enhance the timing of medical interventions, such as tube feeding initiation, and optimize outcomes while reducing risk in a poorly reimbursed diagnostic group. In addition to being older with higher stroke severity scores, 4 independent risk factors were identified, including wet voice after swallowing water, hypoglossal nerve dysfunction, NIHSS score, and incomplete oral labial closure.

Hydration

Dehydration or insufficient fluid may be viewed as a form of malnutrition. Adequate fluid is critical for numerous essential functions, including homeostasis, waste elimination, maintaining perfusion, and thermoregulation, for healing and for general well-being. Dehydration in healthy young adults has been linked to fatigue, anxiety, and headaches, as well as effects on concentration and memory; effects in the elderly can be more severe. With increased age and fragility, dehydration may increase thromboembolic complications and can be predisposing to recurrent stroke in addition to kidney dysfunction and delirium.

Crary looked at hydration status of acute ischemic stroke patients with dysphagia in a retrospective review of 67 patients, according to serum urea nitrogen/creatinine (BUN/Cr) ratio as a hydration marker. Modification of solid diets or thickened liquids resulted in significantly elevated BUN/Cr values at discharge, and liquid or diet modifications were felt to impair hydration status. In a prior report, they indicated that acute stroke patients with dysphagia demonstrated significantly higher BUN/Cr levels than those without dysphagia. In a study by Murray of 69 participants post stroke in acute care (65% of participants) and rehab setting, the mean thickened liquid consumption was 781 mL, or only half the intended consumption for hospital inpatients and well below general recommendations of 2100 mL for women and 2600 mL for men per the Australian National Health and Medical Research Council. Of note, according to The Institute for Medicine, 2011, recommendations are 3700 mL for men and 2700 mL for
women over the age of 19, including >70 years of age, with only 19% of this fluid coming from food. In the study by Murray et al, fluid intake was higher in the rehab vs acute setting and in younger vs older participants. The authors, who reinforce the importance of adequate hydration, suggest that free water protocols may be a way of increasing total fluid intake for individuals with dysphagia in rehab settings.

The Frazier Free Water Protocol is an option for optimizing hydration for those who are at risk for aspirating or are aspirating thin liquids. The protocol allows regular, thin water 30 minutes following meals after aggressive oral care for patients who are carefully selected. Appropriate candidates include those who can maintain alertness, are relatively mobile, have reasonably intact cognition, and are independent with feeding or have adequate supervision. Candidates not appropriate for the protocol are those who have degenerative neurological conditions, are impulsive, or have an excessive cough reflex to thin liquids. In a systematic review involving 8 studies with 215 rehab and or have an excessive cough reflex to thin liquids. In a systematic review involving 8 studies with 215 rehab settings.

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It is imperative that aggressive oral cares are completed prior to drinking thin water. When other liquids, foods, or bacteria from the oral cavity are aspirated, the patient may be at risk for developing aspiration pneumonia. When the oral cavity is adequately cleaned and pure water is potentially aspirated, the risk of developing aspiration pneumonia is less because pure water may be considered benign to nonacute or chronically ill lungs. Adequate oral cares include brushing teeth/dentures, brushing the tongue, and using mouthwash as appropriate in order to reduce the oral cavity of remaining bacteria. Patient perception of swallow-related QoL appeared to improve with the use of the Frazier Free Water Protocol.

Medication Administration

In addition to altering the texture of fluid and food intake for OI, medication administration must also be considered when the need for adjustment to OI is considered necessary, as well as when alterations to pills, capsules, and other meds must be made for administration via feeding tube. Those who have difficulty swallowing or need to administer medications via tube may need to crush or suspend them or open capsules and liquefy them. Improper modification could have unintended or adverse effects. Some medications cannot be crushed because of their extended-release formulation, enteric coating, or carcinoid properties. Patients may refuse to take certain medications crushed because of the taste. Certain medications do not dissolve into fine particles when crushed, increasing the risk of clogging a feeding tube. Some medications come in liquid formulations; however, the cost of liquid formulations is often much higher, which is not always feasible.

The intended dose of a medication is impacted by many factors when a patient requires thickened liquids or when administered via enteral feeding tube. Viscosity, ionic charge, particle size, thickener formulation, and enteral feeding formulation all can impact the bioavailability of medications. Some studies have shown that thickened liquids can impact gastric emptying rate and therefore the absorption rate.

Precautions need to be taken when thickening some medications for oral ingestion. Xanthan gum will have a different impact than starch-based thickeners on some medications. When combining starch-thickened products with polyethylene glycol (eg, Miralax), the mixture immediately thins out, but it can remain thick when mixed with xanthan-based thickeners. A review of a popular nursing drug handbook does not describe the interaction that can occur, and the prescriber, administrator, or recipient of the medication may not be aware that this mixture may no longer follow the recommended dietary consistency for OI.

Consistencies administered during MBSS are also considered a form of medication because of the barium content. Mixing barium sulfate powder with thickening agents may change consistency within the oral cavity, whereas there are other products that are developed that are prethickened and fall within the current IDDSI framework. Of note, aspiration of barium sulfate powder versus iohexol during MBSS was explored by Sun and Li, with a higher occurrence of pneumonia in the group administered consistencies with barium sulfate powder products; however, there was no statistical significance with the incidence rate of pneumonia between the 2 groups.

Lohmann et al assessed the knowledge and training needs of 373 nurses and 75 physicians regarding unsuitable drugs for patients with dysphagia or feeding tubes and found knowledge gaps, which could possibly result in erroneous medication administration. In a systematic review of medication administration for those with dysphagia by nurses in aged care facilities, Forough et al found a scarcity of information, suggesting the need for more information in this area. The need for enhanced knowledge in this area also emphasizes the importance of interprofessional collaboration, including between acute and community care pharmacists, nurses, providers, dietitians, SLPs, radiology staff, and others. The American Society for Parenteral and Enteral Nutrition has offered a useful resource in this area: a guidebook on enteral medication administration that covers a variety of issues related to medication delivery via feeding tube.
**QoL**

Dysphagia has physical, psychological, social, and financial impact\(^{124}\) and can profoundly affect QoL. According to the World Health Association, QoL is defined as an individual’s perception of his or her position in life in the context of the culture and value systems in which he or she lives and in relation to his or her goals, expectations, standards, and concerns\(^{125}\).

Dysphagia is an example of a chronic condition with significant impact because of its effect on OI, in addition to the fact that it is often considered a symptom of another disease, such as cancer or a neurological or neuromuscular condition.\(^{126}\) Dysphagia can not only lead to dehydration, malnutrition, weakness, and aspiration pneumonia but also feelings of suffocation, anxiety\(^{127}\), and the potential to choke. It can cause embarrassment as well as a loss of meal time pleasure, leading to changes in socialization, including refusing to eat around others or be around others who eat when one can no longer partake.

An examination of the perceived effects of dysphagia on patients, their families, and caregivers is helpful for those caring for them to try to understand what this experience may be like for them. Various tools exist to guide this exploration, as evidenced by a systematic review to assess the most effective tools.\(^{126}\) Specific tools are available to assess QoL, including the swallowing QoL questionnaire, or SWAL-QOL, for assessing QoL in stroke patients with dysphagia,\(^{128}\) validated through studies in multiple countries.\(^{129,130}\)

A systematic review of studies of patients with OD\(^{131}\) highlighted the feelings of depression as well as anxiety (eg, will this get better and if so, when?) associated with the diagnosis of dysphagia. In a systematic review reduced to 8 studies that met criteria, food bolus modification (cutting, pureeing, or mashing food, thickening fluid) was more frequently associated with worse QoL for those with OD.\(^{107}\) In assessing the impact of OI vs NOI for 79 patients diagnosed with stroke and dysphagia, a significant association was noted between swallowing function (those with OI) and QoL. This suggested that as swallowing function improves, so does QoL, as this is satisfying a basic human need on Maslow’s hierarchy of needs.\(^{129}\)

Dysphagia affects not only patients or those who experience it but also those who care for and about them. Nund et al\(^{132}\) explored the effects on caregivers of persons with dysphagia who were not dependent on gastrostomy tubes. They reported disruptions in daily life and the need to adapt as well as a disconnection between expectations and reality and experiences with services and support. They reported feeling ill prepared. In exploring survivors’ experiences, these same authors also noted the theme of entering the unknown and uncertainty about life after treatment for patients with head and neck cancer. In 2016, they explored the impact of the effects of dysphagia on caregivers of head and neck cancer patients using a semistructured interview linking this with the International Classification of Functioning.\(^{133}\) They posit that the associated levels of distress and reduced QoL can be understood as a third-party disability.

In the assessment of care assistant perceptions of helping those with dysphagia, the realm of helping could be labeled in 3 categories: recognizing dysphagia, making adjustments, and facing the dilemma of dysphagia management. Sixteen care assistants interviewed about their work in this area\(^{134}\) included comments noting that patients had decreased social interaction and depression related to dysphagia. Feeding them was time-consuming and exhausting. They noted the benefit of sitting at the same height (level) as the patient to better interact and watch him or her. They also suggested the need for training in this area.

In a qualitative study by Brockbank\(^{135}\) of 24 head and neck cancer patients, patients reported wanting information about the impact and prognosis for their swallowing ability, preferably in verbal format by someone knowledgeable about dysphagia with individual preference for the manner and pace in which this information is presented. LaDonna et al\(^{136}\) suggest that “healthcare providers need to balance issues of clinical concern with those of importance to individuals and their families,” and they recommend an assessment of their knowledge and burden at each clinic visit.

Of 14 caregivers interviewed regarding their perception of dysphagia in a palliative care setting,\(^{137}\) themes that emerged included caregiver knowledge and meaning of dysphagia, the symbolic role of food, emotional responses, and tension leading to discordance. Caregivers had little knowledge of dysphagia and correlation with the dying process as well as lack of awareness of means to assist. Perceptions about dysphagia and struggles with OI may impact the patient-caregiver relationship. They suggest using a risk management, conservative approach to dietary alteration in the palliative care setting, offering information as well as support to deal with conflicting emotions in this difficult time.

Caregivers may project their own food-related beliefs, attitudes, and values in situations involving others.\(^{137}\) An example of this is exhibited in the following case study. A young adult nonverbal female with a history of cerebral palsy was admitted to acute care for a second occurrence of aspiration pneumonia. A dysphagia workup, including a video swallow, revealed a strong tendency for her to aspirate all textures, and a percutaneous gastric feeding tube was recommended. In discussing this life change with the nutrition support nurse, her mother shared her reluctance to take away OI, one of her few remaining pleasures in life. In discussing the experience of eating, her mother shared that meals often took about 1–2 hours and required coaching. Her daughter reflected signs of anxiety with OI, which
her mother began to see as possibly fear of choking and that though OI is pleasurable for most, it may not be any longer for her daughter. She reluctantly agreed to have a gastrostomy tube placed but said she would then focus on providing other forms of stimulation and pleasure for her daughter, such as backrubs and reading to her more to replace what she viewed as loss of pleasure related to eating. A follow-up phone call to her care facility several weeks later revealed the excitement that she demonstrated when staff would assemble the equipment for her meal-like feeding via the G tube, as she seemed to equate feeding via her tube as satisfying hunger and therefore pleasurable without the fear of choking that she may have previously experienced.

Transition (the process of moving from one life phase to another) or the process of moving to textured food or nothing by mouth status may be perceived as abrupt, characterized by lack of communication and awareness of the need for change, according to Ullrich and Crichton. They suggest that the approach should be person-centered, respecting not only the fundamental physiologic need for food and water but also for belonging, esteem, self-actualization, and trust. Instead of using a punitive or risk averse approach (promoting fear of choking, pneumonia, and possible death), they suggest a focus on connection between food and QoL, easing the transition with a person-centered approach. Kenny discussed the professional obligation to minimize harm balanced with upholding autonomy; “a complex relationship exists between food and emotional wellbeing.” She explores the ethical implications of restricting patient autonomy in exercising food preferences. In the discussion of ethical concerns, food culture, and patient preferences, she suggests the use of a shared decision-making model (SDM) in helping prepare those who are encouraged to modify their usual eating patterns to guide critical decision-making. This model includes thorough patient/family education, open communication, and clear documentation of plans and decisions.

Ultimately, at the forefront of dysphagia management is the individual. From an ethical standpoint, medical professionals, especially SLPs, face challenging situations when making treatment recommendations. Dysphagia not only impacts hydration and nutrition but also poses psychosocial and QoL challenges. Morley suggests that competent patients with dysphagia in nursing homes should be given the choice regarding modified diets after thorough education of risks and benefits. Ullrich and Crichton highlight the need for care facilities to revise protocol and language to promote a person-centered approach to dysphagia management with clearer communication that fosters improved understanding, readiness, and willingness to transition to modified diets. A systematic review in 2018 looking at patient adherence to treatment recommendations revealed an average range of 21.9% (“fully adherent”) to 51.9% (“average adherence”), though further research would enlighten this topic as well. Patient preferences, ethical considerations, and adherence are all factors when considering individualized patient care based on the SDM model.

Although diet recommendations are ultimately implemented based on provider order, SLPs often initiate recommendations to providers and the care staff based on an underlying sense of responsibility for determining the safest, most efficient, least restrictive diet that optimizes hydration, nutrition, and QoL. This decision is rarely simple; it is multifactorial in nature with many potential consequences. An SLP’s role is to evaluate the individual situation from an oropharyngeal perspective and make recommendations based on multiple factors, synthesizing these factors with multidisciplinary input regarding nutrition status, mental health, medical comorbidities, etc. Smith acknowledges the uncomfortable position of an SLP to make recommendations for patients with dysphagia, especially individuals known to aspirate. Often, this clinical decision making is confounded by insufficient familiarity with limited evidence, an unrealistic pressure to eliminate or prevent aspiration pneumonia, patient-family dynamics, and liability concerns. It is important to recognize that, at times, waivers of liability have been attempted to be used if patients decline certain recommendations; however, these waivers have been unenforceable within the courts. The interprofessional team in general is challenged by the need to provide safe, effective recommendations for OI as well to provide for nutrition, fluid, and medication delivery balanced with the goals and wishes of the patient, especially if they differ.

Providing Care Currently With a View Toward the Future

In large epidemiologic studies, Leder et al reported marked increases for swallow evaluation with a 63% increase for 60–90+ year old geriatric hospitalized participants, despite only a 23% increase in hospital discharges for the year 2007 vs 2014. They suggest that “more dysphagia specialists are needed through 2060 and beyond because of projections of continued population ageing resulting in ever increasing referral rates for swallow assessments.” Dysphagia experts are underrepresented, and there is need for additional resources, administrative support, training, and interprofessional communication as the synergy of collaboration can enhance the science in conjunction with quality research. This requires funding and other resources as well as engagement with industry, including the pharmaceutical industry. Dysphagia is a universal topic, as evidenced by research and discussion on this topic from around the globe, as well as the call to unite in this area.

Access to highly qualified healthcare personnel to detect, assess, and treat persons with symptoms of dysphagia may
be limited in many settings, including rural and long-term care facilities.\textsuperscript{59,124} Periodic monitoring throughout the continuum of care for changes in patient status has the potential for improvement, including having adequate healthcare resources and increasing awareness of dysphagia impact both personally and economically. Suggestions to help meet residents’ needs include virtual consultation and collaboration with experts via telehealth,\textsuperscript{59} training care staff in early detection and prevention of aspiration and mobile instrumentation evaluation. Integral to this consultation and collaboration is the need to base dialogue within an ethical framework based on principles of patient-centered care. Virtual consultation may involve increased challenges in the establishment of the therapeutic relationship. Research related to outcomes and means to overcome barriers, such as through patient reporting outcome research, may be very informative for future models of consultation, collaboration, and care in this area. Ongoing research is needed to provide evidence to guide practice. Park et al\textsuperscript{10} describe the benefit of an evidence-based nursing care algorithm for dysphagia management in Korean settings with likely application to other settings. Much can be learned from colleagues across the globe.

Future research challenges include a lack of standardized definitions of dysphagia and malnutrition, as systematic review could not clearly determine prevalence of both conditions individually or their co-occurrence.\textsuperscript{106} Cause-and-effect relationships between the incidence of dysphagia and ill effects or the lack thereof could lend insight to guide recommendations for potentially life-altering therapies. A recurrent theme also includes the need for improved standardization of screening and evaluation across healthcare settings. There may be exploration and potential for use of bioinformatics for predictive modeling.\textsuperscript{145} Potential new treatments may include items such as transcranial direct current stimulation, transcranial magnetic stimulation, and acupunture.\textsuperscript{146,147} There is a lack of consensus for support of items such as these, and further research is needed.

Research in the area of medication related to the development or exacerbation of dysphagia, as alluded to previously, as well as for possible beneficial effects in the treatment of dysphagia, could be helpful. Morley suggests the need for randomized trials of angiotensin-converting enzyme inhibitors and dopamine agonists, which may increase the cough reflex, comparing benefit vs potential harm and looking at dose effects. He also discussed the reported use of amantadine, a dopamine agonist, for dysphagia related to stroke\textsuperscript{24,148,149} and rotigotine transdermal patches to improve swallowing for patients with Parkinson’s disease.\textsuperscript{150} Huang concluded that fluoxetine (Prozac) may be useful in improving swallowing function in a retrospective review of 159 stroke patients, though they suggest the need for a placebo controlled, randomized clinical trial to confirm their finding.\textsuperscript{151} Further research regarding medication use may impact the treatment of dysphagia, especially in specific conditions.

In discussing what is on the horizon and further out, Ciucci et al\textsuperscript{59} point out that therapy has been reactive. The focus will increase in the area of preventative therapy, such as during irradiation, and extend to other areas; rapidly advancing technology and science will enhance research, and focus will be on further individualizing treatment. Enhanced use of telehealth can help in underserved areas; wearable technology will be increasingly useful, but barriers to this practice must be reduced, including in reimbursement and state licensure.\textsuperscript{59,124} Another opportunity for improving the field of dysphagia would be to increase advocacy and field entry knowledge of practicing clinicians.\textsuperscript{87,124} Ciucci et al also suggest continuation of investigation into the neurophysiological basis for dysphagia with a potential for noninvasive brain stimulation. They recommend an appreciation of a more holistic approach, including the consideration of complementary medicine. Reinforcing the benefit of interdisciplinary, united academic, medical, and advocacy efforts is also stressed. Bedside clinicians play a role in enhancing the science while serving as important patient advocates in the area of dysphagia that affects millions worldwide.\textsuperscript{59}

**Conclusion**

Dysphagia awareness has increased and is likely to continue,\textsuperscript{130} placing emphasis on the need for efficient and accurate screening in various settings with potential for referral to experts who will further evaluate and offer suggestions to guide best practice. Knowledge of the relationship between dysphagia, aspiration risk, and pneumonia or other ill effects must be balanced with awareness of the impact of dietary modification or feeding via tube as well as QoL. Healthcare professionals must balance safety and efficiency with patient goals and wishes, which can create moral and ethical challenges. They also have a responsibility to remain abreast of and contribute to research as it evolves. A patient-centered approach based on nonjudgmental, caring dialogue with patients and families can help promote the best, mutually agreeable outcomes. Practical approaches and tips have been integrated in this dialogue for enhancement of current practice and questions raised for future practice in this issue, which impacts healthcare around the globe.

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