Purpose of review
Dysphagia and dysphonia are common presentations of both acute and long coronavirus disease 2019 (COVID-19). The majority of peer-reviewed publications in 2020 and early 2021 were expert guidance and consensus statements to support dysphagia management in multidisciplinary teams while protecting clinicians and patients from the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus. This review discusses dysphagia and dysphonia primary data published in 2021–2022, focusing on patient presentations, pathophysiology, and evidence for interventions.

Recent findings
Clinicians and researchers amassed knowledge of the cross-system presentation of dysphagia and dysphonia in patients with COVID-19, from severe disease requiring ICU stays to those with mild-to-moderate disease presenting to outpatient clinics. Pre-COVID-19 health status, hospitalization experience, presence of neurological symptoms, and impact of the virus to the upper aerodigestive and respiratory system need consideration in patient management. Long-term dysphagia and dysphonia manifested from COVID-19 require otolaryngologist and speech-language pathologist input.

Summary
Changes in immunity through population vaccination and variations in COVID-19 from SARS-CoV-2 mutations mean prevalence data are challenging to interpret. However, there is no doubt of the presence of long-term dysphagia and dysphonia in our clinics. Long-term dysphagia and dysphonia are complex and a multidisciplinary team with a tailored approach for each patient is required.

Keywords
coronavirus disease 2019, deglutition disorders, dysphagia, dysphonia, severe acute respiratory syndrome coronavirus 2

INTRODUCTION
Never before have dysphagia and dysphonia healthcare providers been in a position to act so defensively for clinician and patient safety than since March 11, 2020 with the World Health Organization’s declaration of coronavirus disease 2019 (COVID-19) as a pandemic. For more than two generations, the focus has been on assessment, treatment, and quality of life for patients. Researchers and clinicians, like everyone else across the globe, were unprepared for the consequences of COVID-19. Much of the early publications culled then current knowledge about transmission, contagion, and safety as they related to dysphagia and dysphonia practices. The majority of 2020 and early 2021 publications were consensus statements [1] and researcher- or international association-led expert guidance to support dysphagia multidisciplinary teams to manage patients while protecting against the virus. Nearly every publication described the impact of COVID-19 and resulting limitations on dysphagia and dysphonia practices [2–7,8,9,10,11]. Although dysphagia and dysphonia can occur in isolation, their shared anatomy and upper
aerodigestive tract physiology has led to co-occurrence in both acute and long COVID-19, leading to great research interest and many published papers. In early 2022, Miles et al. [8] published an invited narrative review of dysphagia and dysphonia after COVID-19 in *Dysphagia*. This manuscript provided a critical appraisal of 15 published studies with a combined 1112 patients and preliminary insights from emerging, unpublished primary data from another 9 international sites (698 patients). This comprehensive review of data published in mid-2021 primarily focused on prevalence, observational clinical presentations and risk factors for poor outcomes. Whereas early papers presented strong evidence of dysphagia and dysphonia in patients with severe disease and prolonged intubations, later papers often reflect the presentation of abnormal breathing patterns, dysphonia and dysphagia in outpatient clinics.

As we write this current opinion in mid-2022, we are conscious that much of these data are pre-vaccination, pre-COVID-19 antiviral regimes, and pre-Omicron variants (Fig. 1). This suggests that prevalence data are challenging to interpret in the current climate with Omicron as the primary severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) variant across the globe. In this review, we focus less on prevalence and review primary data from 2021 to early 2022, exploring the pathophysiology of dysphagia and dysphonia after COVID-19 across disease severity and the current evidence for interventions.

**KEY POINTS**

- Dysphagia and dysphonia after coronavirus disease 2019 (COVID-19) is frequent, complex, multifactorial and wide ranging in pathophysiology across patients.
- Dysphagia and dysphonia often co-occur with a wide spectrum of severity in patients after COVID-19.
- Dysphagia and malnutrition often co-occur during and after a COVID-19 diagnosis.
- A multidisciplinary team and tailored approach for each patient is necessary.
- Telehealth approaches are viable options for screening and clinical evaluations in appropriate patient populations.

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**FIGURE 1.** Timeline of peer-reviewed publications addressing COVID-19-related dysphagia and dysphonia. The figure identifies: (1) the online availability date for each of the COVID-19-related peer-reviewed publications cited in this article, (2) the five SARS-CoV-2 variants of concern with their respective dates of designation, and (3) the COVID-19 cases across seven World Health Organization (WHO) regions. These include 1 editorial, 6 guidelines, 1 consensus statement, 35 primary data, and 4 review or systematic review articles published since the beginning on the COVID-19 pandemic. As of June 1, 2022, there have been 527 603 107 confirmed cases of COVID-19. Graph credits: World Health Organization. COVID-19 explorer. Available from: https://worldhealth.org.shinyapps.io/covid/ [Accessed: June 1, 2022]. World Health Organization. Tracking SARS-CoV-2 variants. Available from: https://www.who.int/activities/tracking-SARS-CoV-2-variants [Accessed: June 1, 2022].
PREVALENCE ESTIMATES

Prevalence data are complex to estimate. Different rates of dysphonia and dysphagia occur in different clinical areas and different facilities – even within the same city – and across different waves of the pandemic. One early report of prospectively recruited patients with severe COVID-19 requiring admission to the ICU with intubation from the UK resulted in as many as 68% of patients with dysphonia postextubation, 57% of those with continued dysphagia at hospital discharge [12]. Another early report found dysphonia was prevalent in 188/702 (27%) patients with mild-to-moderate COVID-19 in 19 hospitals across 16 European cities, considering a multiplicity of recruitment types (i.e., referral, database identification, advertisement, healthcare workers) – the largest study to date [13]. Coughing occurred with dysphonia in 63% of these patients, a significant association. Variable but similar trends in dysphonia rates appear globally: 79% of patients with mild-to-moderate COVID-19 [14], 79% in hospitalized patients [15], and 54% in patients after tracheostomy [16]. Three months after hospital discharge, 25% of ICU patients and 10% of ward patients experience chronic dysphonia [17]. In line with these latter data, a systematic review of dysphonia among 1410 patients (seven studies) with COVID-19 found a prevalence of 31% (95% confidence interval [CI]: 13, 48), with women more often affected [18]. Collectively, the results from these studies are in line with at least seven other common respiratory pathogens (i.e., rhinovirus, influenza, adenovirus, coronavirus, Mycoplasma pneumoniae, Chlamydia pneumoniae, Human metapneumovirus) known to be associated with laryngitis in similar ratios [19]. Therefore, it appears the effects of SARS-CoV-2 on the larynx are similar to times before the COVID-19 pandemic.

Similar themes in dysphagia prevalence are seen in the literature. Current evidence suggests that approximately one-third of patients hospitalized with COVID-19 will require dysphagia services [8**,9,10,11*,12–22,23*,24–32]. Risk factors for dysphagia and/or for poor dysphagia prognosis include age, chronic neurological and respiratory conditions (preexisting or new), intubation, tracheostomy and ventilation, prolonged illness with deconditioning, prolonged cognitive impairments, and fatigue [8**]. Data for dysphagia in nonhospitalized patients with mild-to-moderate disease is starting to emerge and large community survey data assist in understanding community prevalence. One report surveyed 3762 patients who had symptoms that persisted beyond 28 days across 56 countries, with >30% reporting symptoms of globus/difficulties swallowing and ~30% reporting changes in voice [33]. Another report summarized the published literature on SLP outpatient clinic data in patients who were or were not hospitalized and common presentations included chronic cough, disordered breathing patterns, globus, muscle tension dysphonia, vocal cord paresis and dysphagia [8**].

PATHOPHYSIOLOGY

As the pandemic endures, expert opinions continue to be published on the potential pathophysiology of dysphagia and dysphonia in relation to COVID-19.

Pre-coronavirus disease 2019 health status and hospital deconditioning

Hospital-acquired sarcopenia and malnutrition after COVID-19 may be a causal factor in the development of swallowing difficulties with prolonged hospitalization [34]. Moreover, dysphagia severity and malnutrition after COVID-19 may also be associated with age, comorbidities and preexisting dysphagia [34], all unmodifiable risk factors.

Tissue injury

Medical interventions

COVID-19-related dysphagia is associated with endotracheal intubation [6,35,36] and frequently results in impaired vocal fold movement [32]. Dysphonia from intubation is also frequent postextubation [37], even independent of COVID-19. Interestingly, both over-hydration and lower bio-electrical impedance analysis (BIA) phase angle appear to be predictors of postextubation dysphagia, suggesting nutrition and hydration monitoring is critical in ICU for better dysphagia outcomes [38]. Laryngeal injury rates are high in published reports of patients with COVID-19, particularly in those with long durations of intubation, most commonly resulting in vocal cord movement impairments, laryngeal edema, granulomas, ulceration and stenosis [8**,16,23*,32]. These all contribute to airway protection impairments and voice disorders. Boggiano et al. [23*] provide a good overview of laryngeal manifestations in patients with COVID-19 from their experiences of mass ICU admissions in 2020 in the UK. Miles et al. [8**] also provide endoscopy examples of cases where laryngeal manifestations impact on swallowing and voice function, offering insight into pathology and patient outcomes.

Patient manifestations

Given the nature of SARS-CoV-2, areas throughout the respiratory tract are vulnerable, including the
Larynx. People who have experienced the ‘common cold’ have likely also dealt with voice changes resulting from the infection – inflammation from the virus, inflammation from persistent coughing, or both. In similar light, it is difficult to distinguish dysphonia caused by COVID-19 from dysphonia caused by prolonged endotracheal intubation.

Neurological injury
The neurological deficits seen in patients with COVID-19 most certainly caused alarm early in the pandemic. Clinical researchers describe multiple cranial nerve damage directly related to the acute neurotrophic/neuroinvasive nature of the SARS-CoV2 virus [39] with Neeval et al. [15] reporting laryngeal nerve impairments in those without hospitalization or intubation and Ozcelik et al. [40–41] reporting a wide range of symptoms with dysphonia and dysphagia as well as taste and smell deficits. Angiotensin-converting enzyme 2 (ACE2), found in lung alveoli but also glial cells and neurons, is thought to be the mostly likely cause of these neurological deficits acting as a functional receptor for SARS-CoV-2 entering the body through the olfactory nerve [39].

Encephalopathy, acute cerebrovascular disease, and acute polyradiculopathy or neuropathies have been repeatedly reported in case studies/series after severe COVID-19 impacting swallowing function [42]. More recently, patterns of neurological defects in those with long COVID-19 have also emerged including movement disturbances as well as cranial nerve neuropathies [43–44]. A recent systematic review of long COVID-19 identified five papers that addressed chronic dysphagia [43]. The authors reported fatigue, altered taste and smell, and cognitive and neuropsychiatric symptoms that may impact mealtime safety, efficiency and enjoyment [40].

INTERVENTIONS FOR DYSPHAGIA AND DYSPHONIA
Whereas observational studies, prevalence studies and opinion articles have been plentiful throughout the pandemic, experimental studies and efficacy studies of assessment protocols and rehabilitation programs have been lacking. At the beginning of 2021, a consensus approach for the management and rehabilitation of communication and swallowing function in the ICU during COVID-19 was published [17]. Endorsed by 15 international societies, a modified Delphi methodology brought together 35 speech pathologists across 12 countries to identify a set of core practices for working in the ICU in the COVID-19 pandemic covering workforce preparation, resourcing, training, interventions for communication and for swallowing. Swallowing practices focused heavily on reducing risk from aerosol-generating procedures included tracheostomy management, use of endoscopy, training of ICU staff to monitor swallowing function and enabling patients to commence swallowing therapies independently where possible. A UK/Greece team recently reported on the adaptation of the Leeds Postextubation Dysphagia Screen to an online learning environment for implementation with patients after COVID-19 (L-PEDS-COVID). The study also described the impact of online clinical training with a small group of ICU staff. ICU staff were positive and knowledge and confidence improved posttraining, but effectiveness of the program is limited during its continued development and implementation [45].

Nutritional interventions
Early in the pandemic, Brugliera et al. [46] reported extremely high rates of dysphagia (>90%) and malnutrition risk (>70%) in their hospitalized patients with COVID-19 in Italy. They discussed malnutrition risk as a predictor of poor prognosis from COVID-19 and an effect of severe COVID-19. They attributed malnutrition to prehospital health status, sarcopenia caused by prolonged immobilization as well as to reduced oral intake due to nausea, diarrhea, and loss of appetite. They presented a novel COVID-19 nutritional rehabilitation protocol with positive effects on discharge BMI. Their protocol included nutritional assessment and malnutrition screening, nutritional rehabilitation (including energy, protein, carbohydrate, lipid and water requirements) and continuous monitoring.

Azzolino et al. [47] wrote a letter to the editor warning of the use of BMI as a measure of nutritional status in older age and simplifying nutritional problems to age and pathologies instead of describing a more multifactorial effect of pathology, age-related physiological changes in metabolism, sensory function, swallowing and mastication, sarcopenia and psychosocial factors on nutrition after COVID-19. They discussed the increase in pro-inflammatory cytokines in older age and how SARS-CoV-2 is thought to trigger rapid activation of innate immune cells with a marked elevation in pro-inflammatory cytokines and chemokines, placing older people at greater vulnerability to inflammatory reaction with resulting nutritional impact. They proposed that COVID-19 nutritional rehabilitation protocols should include nutritional screening, sarcopenia assessment, dysphagia screening and masticatory function and provided a simple list...
of their recommended screening tools. A three-step nutritional intervention, including counseling, diet modification, supplementation and enteral feeding as required, was proposed as follow-up [47]. Both of these nutritional rehabilitation protocols offer useful clinical information to clinicians working with people after COVID-19. It remains evident that all dysphagia teams should have dietitian support to maximize nutritional status in patients through recovery.

Physical rehabilitation

More than two years later, dysphonia and dysphagia have received little attention for physical rehabilitation. Swallowing difficulties after COVID-19 are multifactorial with severity depending on pre-morbid status, severity of illness and the invasiveness of the respiratory interventions required. During the most recent 6 months, publications are emerging that explore COVID-19 rehabilitation after ICU discharge. Bertolucci et al. [48] in Italy reported on the outcomes of 39 patients who received rehabilitation following severe respiratory failure requiring ventilation after COVID-19 infection in mid-2020. They categorized rehabilitation into respiratory, motor and swallowing therapeutic interventions. However, the swallowing therapies listed are primarily compensatory rather than rehabilitative: sensory-motor stimulation, postural compensation, change in food consistency, progressive introduction of foods of different consistency and oral hygiene. On admission to rehabilitation, 11 patients had a tracheostomy, 7 were enterally tube fed and 31 still required oxygen therapy. By discharge (mean length of stay = 25.5 ± 16.3 days), eight required oxygen therapy, one required a tracheostomy for secretion management and all patients had returned to oral intake. Confusion and antipsychotic drugs were common during their rehabilitation stay. These data provide some insights into the respiratory, cognitive and physical challenges and considerations for rehabilitation but does not offer much in terms of specific rehabilitation interventions and their efficacy.

Regan et al. [28] extended their observational study across 11 acute hospital sites in the Republic of Ireland. In their 100 patients with COVID-19 who were intubated and referred to SLP in 2020, 90% required oral diet alterations and one-third received dysphagia interventions postextubation, including oro-motor exercises, pharyngeal strengthening exercises, and expiratory muscle strength training (EMST). At hospital discharge, 27% of patients with dysphagia and 37% of patients with dysphonia required outpatient services.

Most recently, a Portuguese research team described an intensive, multimodal, inpatient rehabilitation program studying 42 patients following an ICU admission for COVID-19 in 2020 through early 2021 [49]. Their program was tailored for each patient but involved multidisciplinary therapies twice daily totaling 4–5 h, 5 days per week. Swallowing difficulties were present in >70% of patients on admission, dropping to 26% on discharge. Dysphagia interventions included muscle strengthening, sensory stimulation and respiratory-swallowing coordination training. Delirium, preexisting cognitive deficits, and new onset depression and anxiety were common. These issues clearly impact rehabilitation programs, ultimately influencing the potential recovery of cognitive and mood disorders and higher disability at discharge. Dysphagia teams need to find ways to engage and work with patients to reach optimal outcomes despite these barriers.

Telehealth

Telehealth has received a lot of attention as a means to access healthcare without risk of contracting COVID-19. Malandraki et al. [50] provided a rapid systematized review of the recent literature on the use of telehealth by dysphagia clinicians during the COVID-19 pandemic, providing a roadmap for establishing telehealth services in dysphagia and discuss privacy, legality, reimbursement, internet connectivity, technology, patient and clinician factors. They summarized the increasing prepandemic evidence-base (clinical assessment, videofluoroscopy and rehabilitation) and offer reflections on the pandemic and the challenges of rapid uptake in telehealth services to avoid loss of access to dysphagia care. Moreover, this is a valuable resource for providers looking to create a telehealth service. Aggarwal et al. [51] describe similar challenges in their surveyed clinicians in India who moved to telehealth in response to the pandemic. Their clinicians had positive attitudes towards telehealth but described issues with technology, child cooperation and clinician skill. Despite potential pitfalls, Borders et al. [52], provided data to support the feasibility and reliability of a clinical swallowing evaluations using telehealth.

CONCLUSIONS

As we continue to work with a high prevalence of COVID-19 in our communities, there is no doubt that clinics will continue to encounter patients with dysphagia, dysphonia, and likely, middle airway disorders such as chronic cough/hyper-sensitive larynx syndromes. With COVID-19 prevalence still
soaring, referrals are likely to increase, particularly in those with mild disease and long COVID-19. Outpatient clinics need to be staffed well. There is now no doubt that dysphagia and dysphonia after COVID-19 is complex, multifactorial and wide ranging in pathophysiology. This makes the search for effective interventions challenging. Dysphonia and dysphagia remain the symptoms of a wide range of diseases and disorders. Identifying the likely contributors to voice and swallowing changes in our patients remains critical to appropriate management. A multidisciplinary team and tailored approach for each patient continues to consider as the best practice available.

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Conflicts of interest

There are no conflicts of interest.

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