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In late December 2019, the China CDC reported several cases of pneumonia of unknown aetiology in Wuhan, Hubei. (1) Subsequently, in January 2020, the causative agent was found to be a strain of coronavirus named SARS-COV-2. The pneumonia and associated pathologies caused by this virus were named COVID-19. (1) COVID-19 is a highly transmissible disease, and it did not take long for the virus to reach the shore of the British Isles. On March 26, 2020, the United Kingdom entered its first lockdown to reduce the transmission of COVID-19 and we started our long fight against this pandemic up to the present day. (2)

Though initially known to only cause pulmonary symptoms, SARS-COV-2 was soon found to cause a wide array of symptoms involving multiple organ systems, including neurological, cardiovascular, dermatological and otorhinolaryngologic abnormalities. (3) A majority of patients might experience no symptoms or recover from the acute symptoms within the first 2 weeks, but a significant proportion of patients experience lingering effects of COVID-19 long after they first become infected. (3) According to the REACT-2 study, an estimate of over 2 million people in Britain might have experienced one or more COVID-19 symptoms beyond 12 weeks of initial infection. (4)

In order to provide treatment to such a large group of patients, the National Health Service (NHS) opened more than 60 clinics across England in December 2020. (5) In addition, the National Institute of Clinical Excellence (NICE) provided a guideline on managing the long-term effects of COVID-19. (6) The guideline includes a formal definition of long COVID, which encompasses both 'ongoing symptomatic COVID-19' and 'post-COVID-19 syndrome'. (see Figure 1)

- 'Ongoing symptomatic COVID-19' is defined as 'signs and symptoms of COVID-19 from 4 to 12 weeks'
- 'Post-COVID-19 syndrome' is defined as 'signs and symptoms that develop during or after an infection consistent with COVID-19, continue for more than 12 weeks and are not explained by an alternative diagnosis'. (6)

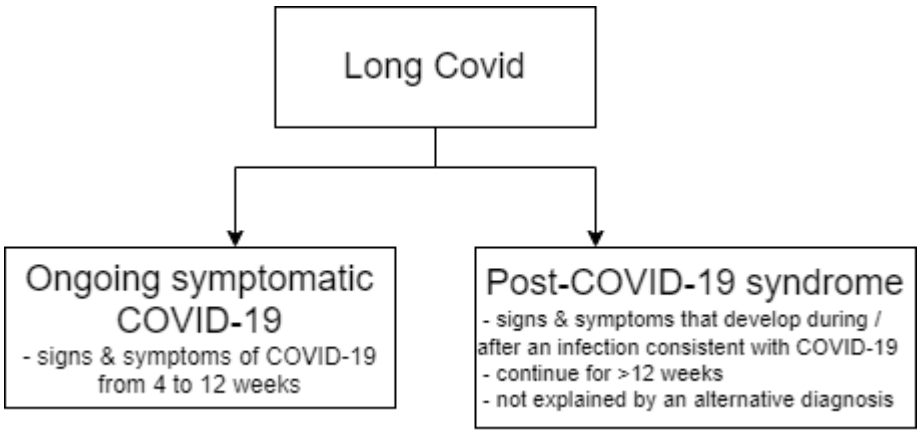

Figure 1: Definitions of Long COVID, Ongoing symptomatic COVID-19 and Post-COVID-19 syndrome (6)

Long COVID can be a debilitating syndrome that severely lowers the quality of life for the patients and prevents them from leading a productive life. There are over 200 symptoms that patients with long COVID could potentially experience. (3) This essay will focus on the long COVID symptoms specifically pertinent to the ENT profession and describes services needed

to support patients suffering from these symptoms. The symptoms to be discussed are split into three categories: (see Table 1)

1. parosmia in rhinology (7-9)
2. tinnitus, hearing loss and vertigo in otology (10, 11) and
3. dysphagia & dysphonia in laryngology(12)

Although the symptoms might be very different, all the services described in this essay need to be provided with a patient-centred approach and require multidisciplinary collaboration.

Rhinology (Nose)	**Otology (Ear)**	**Laryngology (Throat)**
Parosmia	Tinnitus Hearing loss Vertigo	Dysphagia Dysphonia

Table 1: Long COVID symptoms relevant to ENT

Rhinologic symptoms of Long COVID - Parosmia

A loss or change to your sense of smell or taste is recognised as one of three main symptoms of acute COVID. (13) Most patients recover within 2 weeks, but around 10% of patients cannot regain their sense of smell in that timeframe. (8) Their lives could be adversely impacted in unexpected and significant ways. They might lose their appetite because previously delicious food might no longer be palatable. They might put their lives in danger because they lose the ability to detect burning smell or rotten food. They might even find difficulty maintaining intimacy because their partners might carry repugnant smells. (8)

For patients with prolonged symptoms of parosmia, the following services are needed:

- Parosmia lasting < 3 months: **virtual consultation with general practitioners** in the community. (9)
- Parosmia lasting ≥ 3 months**: referral to ENT specialists for initial virtual consultations**; if additional nasal symptoms or red-flag symptoms are reported, patients might be invited for face-to-face consultations in the hospital. (9)

<u>Parosmia lasting < 3 months</u>:

General practitioners (GPs) can confirm patients' COVID status via testing and take a comprehensive history of the severity and progression of the symptom in the community. GPs can also offer anosmia advice, scent training and signposting to support groups, such as AbScent and Fifth sense. (14)

<u>Parosmia lasting ≥ 3 months</u>

Patients should be referred to 'smell clinics' led by rhinologists in the hospitals. The initial consultations can be conducted virtually to triage patients based on their subjective reports of symptoms. In addition to taking a comprehensive history of parosmia and any concomitant nasal symptoms, rhinologists can also take advantage of this opportunities to initiate smell training, make referral to patient support groups and offer self-care tips.(14) Subsequent face-to-face consultations allow clinicians to conduct nasal endoscopy to rule out any anatomical pathology causing the parosmia and perform psychophysical assessments, such as Sniffin' sticks, to objectively assess the odour threshold, discrimination, and identification. (14)

Regardless of the location or mode of service provision, whether it is in a virtual call from GP office or a face-to-face consultation in smell clinic, patients should have access to sound advice regarding safety, proper instructions of olfactory training and reassurances from peer support groups. (9, 15)

Safety advice needs to include:

- maintaining functional smoke detectors to warn patients of possible fire because the body's natural detector of burning scent is impaired by long COVID(15).
- monitoring food expiration dates to prevent intake of rotten food (15).
- making diet adjustment to maintain sufficient nutrient intake, even though change of smell and taste can reduce appetite. (14, 15)

Olfactory training is a self-management technique that expedites a patient's recovery of their sense of smell. The training needs to include instructions on: (15, 16)

- assembly of training kits of different aromatic oils, such as rose, lemon, clove and eucalyptus;
- flushing of the noses with saline water daily
- deliberate sniffing of aromatic oils for 20-30 seconds, twice daily
- keeping of dairies of perceived strength of each smell sensation and comments on whether the patients can recognise the scent as stated on the label.

Peer support groups, such as AbScent and Fifth Sense, allow patients to feel less anxious and depressed and offer a wealth of self-help information on olfactory training. (16)

Otologic symptoms of Long COVID – tinnitus, hearing loss and vertigo

A systematic review reveals that about 14.8%, 7.6% and 7.2% of patients with COVID-19 experience symptoms of tinnitus, hearing loss and vertigo, respectively. (11) In another cross-sectional study, 40% of patients with COVID-19 symptoms reported worsened tinnitus symptom after being infected with SARS-COV-2. (10) Though the reported prevalence varies, otologic symptoms are consistently reported by patients with long COVID. (3)

To help these patients, the UK need **general practitioners and ear clinics led by a multidisciplinary team of ENT surgeons, audiologists, psychologists, and physiotherapists**.(17-19)

The initial consultations should be conducted virtually by general practitioners (GPs) to assess the severity and duration of otologic symptoms. GPs might also perform face-to-face physical examinations of the patients' ears with otoscopes. If the symptoms are severe or red-flag symptoms are detected, patients can be referred to the ear clinics for face-to-face consultations by ENT surgeons, tests of balance, hearing assessments, and possibly radiological examinations. (20, 21) Treatment plans are then created for implementation in the community with virtual follow-ups, consisting of the following components:

- Provide training for sound enrichment therapy, which allows the patients to use gentle low-amplitude background music to become habituated to their tinnitus. The music generators can be self-made by patients or provided by audiologists. Once initiated, the patients can self-manage their therapies in the community; (21)
- Offer cognitive behavioural therapy (CBT) and mindfulness meditation by clinical psychologists; The effectiveness of psychological therapies is demonstrated in clinical evidence and can allow patients to reduce stress caused by tinnitus symptoms and obtain better sleep during the night(21)
- Install appropriate hearing aids by audiologists to assist with patients' hearing; if hearing aids are not suitable, referral can be made to see ENT surgeons to explore the possibility of implantable hearing device(18)

- Prescribe short-term vestibular sedatives by ENT surgeons or GPs, such as cinnarizine or prochlorperazine, to suppress the overactivity of the vestibular apparatus while waiting for the body to readjust after vertigo symptom;(20)
- Educate patients on targeted exercises, such as Cawthorne Cooksey exercises or Epley's manoeuvres, to expedite the body's readjustment after inner ear damage by SARS-COV-2 virus. These exercise trainings can be provided by ENT surgeons or physiotherapists after initial investigations have ruled out other serious pathology. (20)

Laryngological symptoms of Long COVID – Dysphagia & Dysphonia
Though lesser reported in the media, SARS-COV-2 infection can cause laryngeal damages, either directly via weakening of respiratory muscles or indirectly due to the physical trauma caused by intubation. The laryngeal damages can result in dysphagia and/or dysphonia. (12, 22-24)

Dysphagia and rehabilitation service needed:
In a study of 736 hospitalised patients in Birmingham, 28.9 percent of them were referred for swallow assessment. (24) And in another cohort study observing 100 patients who were intubated in the hospital, 27% of patients still experience difficulty swallowing at discharge. (23) Even for those who only experienced mild to moderate COVID-19, 15% of patients reported dysphagia. (12) To help these patients, we need **swallow clinics led by a multidisciplinary team of ENT surgeons, speech and language therapists (SLTs) and dieticians**.

The initial consultations should be conducted virtually to assess the patients' ability to swallow by SLTs. If deemed clinically necessary, patients can be invited to the hospital for face-to-face instrumental assessments, such as videofluoroscopic swallowing study (VFSS) and fiberoptic endoscopic evaluation of swallowing (FEES). (25) Treatment plans are then created for implementation in the community with virtual follow-ups, consisting of the following components: (26, 27)

- Dietary modification: SLTs and dieticians make modification to food texture on an ongoing basis to match the patients' ability to swallow. Specific thickeners and ingredients are delivered to create the appropriate adhesiveness, cohesiveness and firmness for the patients' diets. (26, 27)
- Compensatory strategies: Patients are guided by SLTs, physiotherapists and occupational therapists to make postural changes, such as chin tuck or reclining sitting positions. These changes modify the speed and direction of bolus flow to keep food and fluids away from the laryngeal valve. Other behavioural changes, such as minimizing distractions during eating and eating in small bite sizes, are implemented to minimize the risk of choking. In addition, patients with long COVID are often affected by chronic fatigue so appropriate adjustments need to be made to incorporate breaks and conserve physical energy. (26, 27)
- Swallowing exercises: Patients are guided by SLTs to perform specific exercises, such as effortful swallowing and Mendelsohn manoeuvre, to increase the strengths of oropharyngeal muscles and prolong duration of upper oesophageal sphincter opening while swallowing. (26, 27)
- Oral hygiene & weight management: Patients with dysphagia can also experience xerostomia that can worsen oral hygiene and dysgeusia that can reduce oral intake. Dieticians are well-positioned to ensure appropriate diets so that patients find their

food palatable and do not hold food in the mouth for an extended period of time, in order to reduce the risk of aspiration. (26, 27)

- Training of caregivers: Swallowing assessments and exercises can potentially cause choking while the health care providers can no longer perform life-saving measures, such as abdominal thrusts, in a remote setting. Hence, caregivers need to be trained by the healthcare teams on provision of first aids. (27, 28)

Dysphonia and rehabilitation services needed:
In a cohort study observing patients who were intubated in the hospital, 37% of patients still experiences dysphonia at discharge. (23) And for those who only experienced mild to moderate COVID-19 and were not hospitalized, 26% of patients reported dysphonia. (12) Some patients describe hypersensitivity and irritation in their throat, similar to the disease pattern of 'muscle tension dysphonia'. (29) To support these patients, the UK need **voice clinics led by a multidisciplinary team of ENT surgeons, SLTs, clinical psychologists, respiratory physiotherapists and wellbeing coaches**. (29, 30)

The initial consultations should be conducted virtually to assess the nature of dysphonia by physicians and SLTs. They could then decide if the voice disorder is a result of cognitive defects, such as brain fog or difficulty with attention, or mechanical defects in laryngeal muscles. If deemed clinically necessary, patients can be invited to the hospitals for face-to-face instrumental assessments, such as videostroboscopy, by ENT surgeons. (31) Treatment plans are then created for implementation. Some cases may involve surgical interventions by ENT specialists in the hospitals, but the majority is likely to occur via virtual consultations in the community by SLTs. The SLTs may perform the following tasks:

- Educate patients on vocal hygiene, such as avoidance of excessive coughing or throat clearing;(32)
- Educate patients on making postural changes to facilitate voice projection; (32)
- Demonstrate vocal exercises that reallocate the working load to appropriate laryngeal muscles; (32)
- Show techniques of laryngeal massage that can decrease the stress and tension in the vocal muscles (32)
- Collaborate with respiratory therapists to change patients' breathing pattern so that breathlessness and anxiety do not interfere with voice making; (32)
- Work with clinical psychologists to help patients develop relaxation techniques to reduce the stress around speaking; (32)
- Make referral to peer support groups, such as English National Opera (ENO) Breathe programme, so that patients can receive social supports and information on self-managed exercises. (33)

Conclusion:
To summarise, patients with long COVID need to be supported by multidisciplinary teams of caring experts in otorhinolaryngology. These experts are required to use a patient-centred approach to tackle ENT symptoms that are debilitating to the patients and negatively affect their quality of life.

- Healthcare providers should signpost patients to useful online resources and peer support groups, whenever possible, to provide social and emotional supports.
- Patients with parosmia need to be supported by GPs in the community and ENT surgeons in the hospitals. They can receive smell training and peer support in the community.

- Patients with otologic symptoms, including tinnitus, hearing loss and vertigo, need to be supported by GPs in the community, ENT surgeons in the hospital, audiologists and psychologists in virtual clinics to cope with their symptoms. They can receive training for sound enrichment therapy, fitting for hearing aids and psychological therapies for anxiety reduction.
- Patients with laryngeal symptoms, including dysphagia and dysphonia, need to be supported by ENT surgeons in the hospitals, speech and language therapists and dieticians in virtual clinics to rehabilitate their throat and respiratory muscles. They can receive training for vocal exercises, education for vocal hygiene, demonstration of swallowing exercises and modification of their diets.

As more patients are diagnosed with COVID-19, the number of patients with long COVID can increase in the future. This essay only aims to provide a summary of current literature and a proposed framework to support these patients. COVID-19 has only been with us for the last 18 months and the scientific community still have much to learn about the long-term effects of this disease. As our understanding of the underlying pathophysiology evolves, we must continue to learn from our patients, listen to their concerns and provide the reassurance and therapies they need to improve their quality of life.

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