



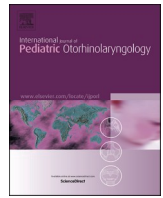
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# Dysphonia and dysphagia consequences of paediatric inflammatory multisystem syndrome temporally associated with SARS-CoV-2 (PIMS-TS)

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## ARTICLE INFO

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## ABSTRACT

**Importance:** Paediatric inflammatory multisystem syndrome, temporally associated with SARS-CoV-2 (PIMS-TS) is a novel disease first identified in 2020. Recent cohort studies have described the complex presentation and symptomatology. This paper provides detailed description of the dysphagia and dysphonia symptoms, management, and outcome.

**Objective:** To describe dysphagia and dysphonia in PIMS-TS.

**Design:** Retrospective cohort study.

**Setting:** Single tertiary and quaternary children's hospital.

**Participants:** All 50 children treated for paediatric multisystem inflammatory disease between April and June 2020 were included in this study.

**Main Outcome(s) and Measure(s):** Dysphonia: GRBAS Perceptual Severity Scores, Vocal Handicap Index scores and the Vocal Tract Discomfort Scale. Dysphagia: Functional Oral Intake Scale.

**Results:** Fifty children met the diagnostic criteria for PIMS-TS. 33 (66%) were male. Median age was 10 years (range: 1–17). 36 (72%) were of Black, Asian or minority ethnic background. Nine (18%) required specialist assessment and management of dysphagia and/or dysphonia. Five (55%) were male with a median age of 9 years 7 months (range: 1–15 years). Symptoms typically resolved within three months. Two children presented with persisting dysphonia three months post-presentation. Neurological, inflammatory, and iatrogenic causes of dysphagia and dysphonia were identified.

**Conclusions and Relevance:** Dysphonia and dysphagia are present in children with PIMS-TS. Further data is required to understand pathophysiology, estimate incidence, and determine prognostic factors. This preliminary data highlights the need for dysphagia and dysphonia screening and timely referral for specialist, multidisciplinary assessment and treatment to ensure short-term aspiration risk is managed and long-term, functional outcomes are optimised.

## 1. Introduction

COVID-19 is a novel disease caused by the coronavirus SARS-CoV-2, first identified in Wuhan, China at the end of 2019. Evidence from the first wave of the pandemic in the UK suggested children generally presented with milder disease [1], rarely requiring hospital treatment and case-rate mortality was <0.5% [2]. In April 2020 however, it was

recognised that increasing numbers of children were presenting with a severe inflammatory response requiring specialist inpatient care across the UK. This triggered a rapid review by the Royal College of Paediatrics and Child Health (RCPCH) and a new condition, now known as Paediatric Inflammatory Multisystem Response Syndrome temporally associated with SARS-Cov-2 (PIMS-TS) was defined. This syndrome has similar but distinct features to other inflammatory conditions such as

**Abbreviations:** ENT, Ear nose and throat; FEES, Fibreoptic endoscopic evaluation of swallowing; MDT, Multidisciplinary; NIHR, National institute of health research; PIMS-TS, Paediatric Inflammatory Multisystem Response Syndrome associated with Covid-19; PROMS, Patient reported outcome measures; SLT, Speech and language therapist/therapy; TPN, Total parenteral nutrition; UCL, University College London; UK, United Kingdom; VFSS, Videofluoroscopic swallow study.

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**Table 1**  
Recorded reason for initial referral and voice outcome measures at initial voice outpatient clinic.

Patient	Reason for referral	Days from SLT/ENT screen to initial voice outpatient clinic appointment	GRBAS*	VHI**	VTDS Measures***	Intervention Type
1	“Breathy, asthenic voice quality ranging from mild dysphonia to some periods of complete aphonia”	45	G2 R1-2 B1-2 A2 S1	20/120	Mild consistent dryness, mild occasional tightness and aching	Medication Voice therapy
2	“Moderate-severe dysphonia”	66	G1 R0-1 B1 A1 S0	67/120	Occasional dryness	Injection medialisation Voice therapy Voice therapy
3	“Hoarse voice”	17	G1-2 R1-2 B1-2 A1 S1-2	∅ Incomplete as difficulties being heard via remote clinic	Previous Soreness.	Voice therapy
4	“Dysphonia”	10	G1-2 R0 B1 A1-2 S0	55/120	Frequent tickling and irritability in the larynx.	Voice therapy
5	“Altered voice that has persisted”	17	NAD	7/20 WNL	NAD	Prednisolone treatment in acute phase Voice care advice and discharge Voice care advice
6	“++quiet. Hoarse, harsh quality”	37	G0-1 R0-1 B0-1 A0 S0-1	∅ Not completed as via remote clinic	∅ Not completed as via remote clinic	Voice care advice Voice care advice
7	“Aphonia”	72	G0-1 R0-1 B0-1 A0-1 S0	7/20 WNL	Frequent mild tickling	Voice care advice and discharge
8	“Severe dysphonia”	31	G0 R0 B0 A1 S0	48/120 <i>Results impacted by co-existing features of social communication disorder.</i>	Tightness, aching, soreness, a lump in the throat and dryness	Discharge no follow up

Abbreviations: \* Grade, Roughness, Breathiness, Astenicity, Strain [12]; \*\* The Voice Handicap Index (VHI) [13]; \*\*\*Vocal Tract Discomfort Scale [14].

hemophagocytic lymphohistiocytosis (HLH), Kawasaki disease, toxic shock syndrome and macrophage activation syndrome [3]. It has since been defined by the RCPCH as involving a persistent fever, inflammatory response and single or multi-organ dysfunction not explained by other microbial causes [4]. Whilst the majority of these cases present with a negative SARS-CoV-2 PCR, the children often present with antibodies consistent with previous SARS-CoV-2 with or without a known epidemiologic link [3]. The delayed post-viral onset and clinical manifestations of PIMS-TS are distinct to that of primary respiratory phenotypes of SARS-CoV [5]. Although children may present with respiratory features such as cough, this is not a prominent feature of the disease.

Increasing numbers of cohort studies have highlighted the complex and multi-system nature of the condition [6,7] and defined the need for multi-specialist management including cardiology, critical care, infectious diseases, and rheumatology [8].

A recent paediatric cohort study outlined the otolaryngologic manifestations of a cohort of children with PIMS-TS [9] and identified dysphonia and dysphagia as the primary reason for in-person follow up by an otolaryngologist following hospital admission for PIMS-TS. However, to date there have been no studies detailing the specific dysphagia and dysphonia presentations and outcomes of these children.

The aim of this paper is to present a detailed description of the dysphagia and dysphonia symptoms, management and outcome in the cohort of children first described by Cheong et al. [9]. We suggest key time points and a care pathway for dysphonia and dysphagia assessment and intervention in children with PIMS-TS.

## 2. Methods

### 2.1. Patients

Patients meeting the RCPCH criteria for PIMS-TS [4] presenting to a tertiary children’s hospital between April and June 2020 were included in this cohort study. Patient demographics, SARS-CoV-2 serology and

nasopharyngeal PCR, date of presentation to hospital and intubation history were collated via retrospective review of electronic patient records. Ethnicity was classified and reported in accordance with UK Government standard groups [10]. This study was registered as a service evaluation project at Great Ormond Street Hospital (registration number 3051).

### 2.2. Data collection

The functional oral intake scale (FOIS) [11] was used as the primary outcome measure for dysphagia. Outcomes were recorded at initial assessment and at three months post-presentation. Clinical data regarding swallow function, including instrumental assessment results, were gathered from medical records by a specialist speech and language therapist (SLT).

Clinical voice measures included the GRBAS Perceptual Severity Scores, Vocal Handicap Index (VHI) scores and the Vocal Tract Discomfort Scale (VTDS) [12–14]. Measures were recorded by a specialist SLT in paediatric voice at initial and three month follow-up voice clinic appointments.

Due to the small cohort numbers, descriptive statistics are reported.

## 3. Results

50 patients with a confirmed diagnosis of PIMS-TS were admitted between April–June 2020. The median age was 10 years (range: 1–17). 33/50 were male and 36/50 were of Black, Asian or minority ethnic background. 12/50 of these cases had positive PCR test results detecting SARS-CoV-2 and 42/50 of these cases presented with positive IgG antibodies against SARS-CoV-2. 38/50 children required paediatric intensive care (PICU) admission and 18/50 required intubation and mechanical ventilation. No children received a tracheostomy.

As previously published, 18/50 (36%) presented with parent reported dysphonia and 18/50 (38%) with parent reported dysphagia

**Table 2**  
Dysphagia presentation and outcome.

Patient	FOIS at initial assessment (appendix 1)	FOIS 3 months post assessment	Instrumental assessment	Key findings from instrumental ax	Hypothesised cause of dysphagia
1	1	6	Videofluoroscopy swallow study	Reduced soft palate elevation leading to escape of contrast to the nasal cavity. Partial epiglottic inversion. Diminished pharyngeal stripping wave and reduced base of tongue retraction. Reduced duration of pharyngoesophageal opening leading to partial obstruction of the bolus through the PES. Collection of residue within the pharyngeal structures. Aspiration of pharyngeal residue.	Cranial neuropathy
2	1	6	Fibreoptic endoscopic evaluation of swallowing	Base of tongue candida and diffuse inflammation throughout the pharynx. Swallow initiation prompt with good vestibular closure and epiglottic inversion. Images indicate mild left sided weakness. Vallecular residue was observed with assessment duration.	Myopathy
3	2	7	No	N/A	Myopathy (myopathic changes on EMG)
4	5	7	Videofluoroscopy swallow study	Swallow initiation at the level of the pyriform sinus.  Partial approximation of arytenoids to epiglottic petiole. Incomplete laryngeal vestibule closure. Persistent Laryngeal penetration.	Iatrogenic laryngeal nerve injury

during their acute admission [9]. Of those 50 patients, nine were identified as requiring specialist assessment for dysphonia and/or dysphagia; one dysphagia only, three dysphagia and dysphonia and five isolated dysphonia. The median age of these patients was 9 years 7 months (range: 1–15 years). 5/9 (55%) were male. The mean time to referral for those identified with a dysphagia ± dysphonia was 13.5 days and for those with an isolated dysphonia was 71.6 days post presentation.

### 3.1. Dysphonia

Eight children (16%) required follow-up SLT assessment for persisting dysphonia post-discharge from hospital. The median age of the children was 10 years 8 months (range: 8–15 years). 5/8 children were intubated for a median number of 4 days (range: 1–12 days). One child had a history suggestive of a pre-existing dysphonia exacerbated by PIMS-TS symptomology. For the children presenting with co-existing dysphagia, the dysphonia was often documented in the clinical notes during admission but referral for in-depth assessment of the dysphonia was not made at the time.

### 3.2. Assessment and management of dysphonia

The overall voice quality severity score in the eight children with persisting clinical dysphonia ranged from mild to severe with the most prominent features being asthenia and breathiness. In 2/8 cases additional adaptive strain/muscle tension was identified. Challenges with pitch control were noted in two patients and subsequently confirmed to be associated with unilateral neurological weakness. Multidisciplinary team (MDT) assessment including laryngoscopy with stroboscopy was carried out on all 8 cases (with the MDT Paediatric Voice Clinic re-established in early June). Findings included generalised neurological pharyngeal and laryngeal weakness (3/8), unilateral vocal fold weakness (2/8), generalised inflammatory pharyngeal and laryngeal response (2/8) and one patient showed no organic changes. One case had a co-occurring candida infection associated with prolonged steroid management. 4/8 children reported symptoms of vocal tract discomfort, consistent with laryngeal findings, including soreness, tightness, and dryness. Self-reported psychosocial impact as evaluated using the VHI varied between minimal and severe impact and was not related to the level of perceptual voice severity. Table 1 outlines dysphonia

presentation at initial outpatient appointment and associated dysphonia management.

Management was specific to the child's own psychosocial report of voice problems, their communication environment, vocal requirements and the confirmed aetiology. Management included voice care and conservation advice and physiological voice exercises. One child had a vocal fold medialisation injection and post-operative direct voice therapy. 6/8 cases were discharged with resolution of symptoms by six months but in 2/8 cases the dysphonia persisted.

### 3.3. Dysphagia

Four children (8%) required specialist SLT assessment and intervention for dysphagia. The median age of these children on admission was 10 years 5 months (range: 1–15 years). All required intubation and one patient required ECMO. The median number of days intubated was 6.5 days (range: 3–13 days). None of the children had any pre-existing dysphagia.

### 3.4. Assessment and management of dysphagia

All four children received total parenteral nutrition (TPN) or nasogastric tube feeds whilst intubated. 3/4 of the children were referred directly to SLT following observed concerns of aspiration by the nursing staff. Of these children, two were initially able to tolerate a modified texture diet alongside nasogastric tube feeds and one child was placed nil oral. The median time to resolution of symptoms was 45.5 days (range: 28–127 days).

Beside clinical assessment of swallowing was completed for all four children. Two of the children received a videofluoroscopic swallow study (VFSS) and one child a fiberoptic endoscopic evaluation of swallowing assessment (FEES) to characterise swallow physiology and guide management of aspiration risk. Table 2 outlines feeding outcomes, hypothesised causes of the dysphagia and management for children assessed.

## 4. Discussion

This paper describes the dysphonia and dysphagia outcomes of a cohort of children admitted to a tertiary level hospital with a diagnosis

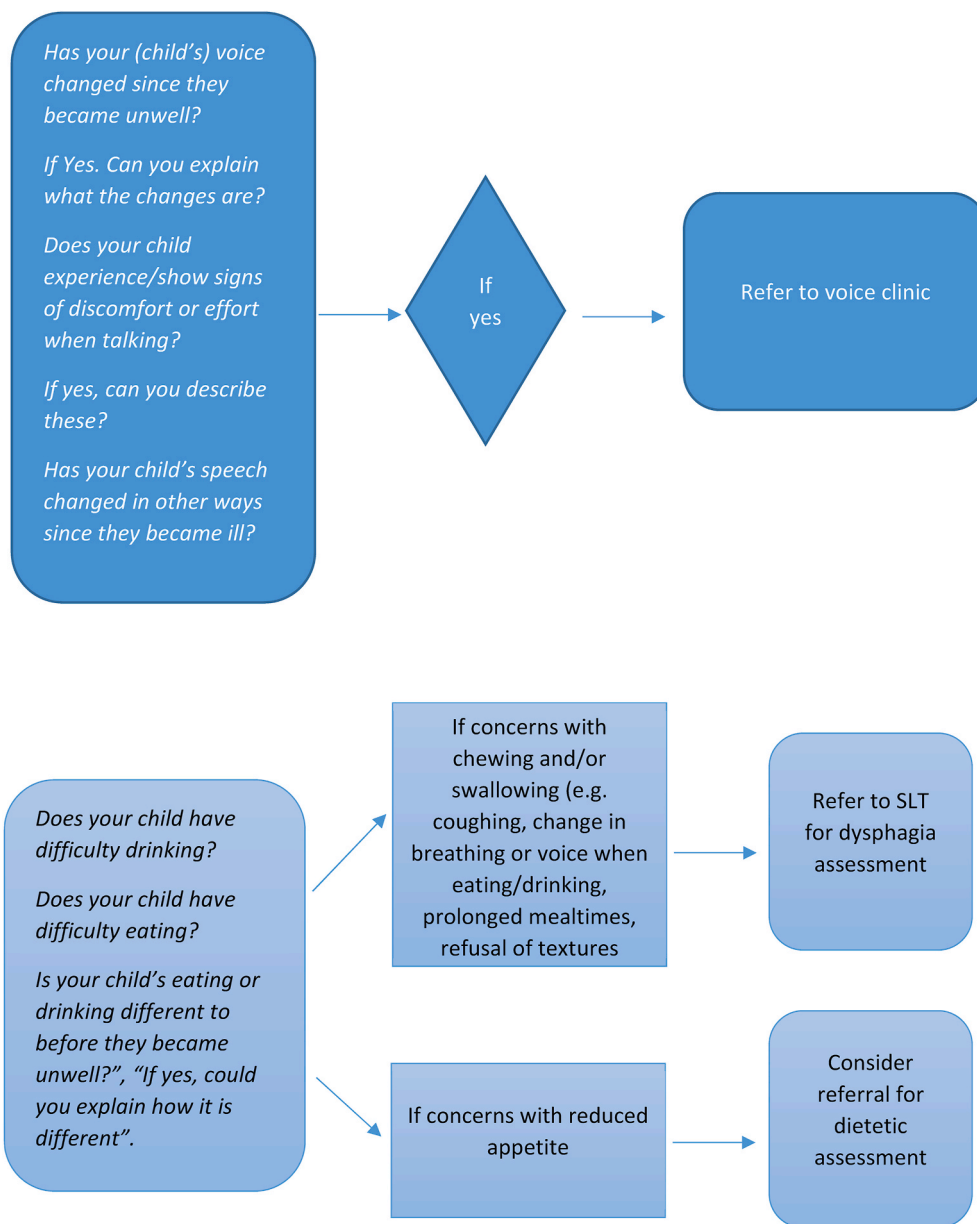


Fig. 1. Recommended dysphonia/dysphagia screening questions during acute ward admission (parent proxy).

of PIMS-TS. In our experience, children with dysphagia require early management of aspiration risk but have good potential for spontaneous recovery within three months, regardless of severity at initial presentation. Children may present with persisting dysphonia post hospital discharge, but this also typically resolves with targeted intervention, within six months.

Causes of dysphonia and dysphagia in our cohort were varied. All of the children intubated in this cohort (36%) presented with moderate-severe impairment in physical functioning post extubation, as determined by a physiotherapist. Whilst this impairment in physical functioning may have resulted from critical illness myopathy or as an outcome of the inflammatory process in PIMS-TS, it is reasonable to assume a proportion of children presenting with dysphonia or dysphagia did so as a result of their intubation and critical illness. Post extubation dysphagia is well documented in the literature [15–17].

It is also plausible that the dysphonia and dysphagia were caused by the disease itself. A small number of studies report dysphagia as a complication of inflammatory conditions, including Kawasaki disease [18–20] and HLH [21]. Dysphonia in our cohort was not limited to those

who became critically ill or required intubation, suggesting the inflammatory process itself played a causal role. In the context of dysphagia, one child presented with multiple cranial neuropathies including velopharyngeal dysfunction as an early symptom of PIMS-TS. This was characterised by food and fluids coming out of his nose when eating and drinking. Neurological impairment in PIMS-TS has been associated with higher systemic inflammatory markers [22].

In some children presentations were also associated with a secondary response to treatment methods, for example diffuse laryngeal candida secondary to the use of high dose steroidal treatments or laryngeal nerve injury as an iatrogenic consequence of treatment.

There is limited evidence of dysphonia occurring secondary to pulmonary complications such as reduced breath support or cough as was predicted given the differences in disease mechanism between respiratory phenotype of SARS-CoV-2 and the delayed inflammatory response of PIMS-TS [5]. Efforts should be made to identify the underlying physiology and aetiology of the dysphagia and/or dysphonia in order to develop targeted interventions.

To do this, instrumental assessment is required, involving



radiological examination (VFSS) or endoscopic evaluation (laryngoscopy, stroboscopy or FEES). These were identified as aerosol generating procedures (AGPs) early in the COVID-19 pandemic and were not recommended due to the high risk of disease transmission [23]. Specific guidance on AGPs and disease transmission in children was not available and remains limited. At our centre, we utilised comprehensive risk assessment with appropriate personal protective equipment (PPE) [24] to carry out VFSS throughout this period and endoscopic assessments from June 2020. Given the limited data available for this novel disease and varied dysphonia and dysphagia presentations described in our cohort, instrumental assessment is vital to identify appropriate management.

Higher numbers of dysphonia and dysphagia were identified using parent reported outcome measures (previously reported) [9]. This may be due to the transient nature of presenting dysphonia or dysphagia. Alternatively the PROM tool used identified those with changes to their eating and drinking which were not a true dysphagia, such as requiring non-oral feeding while intubated. Discrepancy between PROMs and clinician reported outcomes have also been reported previously [25] however, there is a possibility that a number of children who required SLT assessment were not referred. Therefore, screening of all patients is recommended.

Children with dysphagia were referred to SLT on average 58 days sooner than children presenting with dysphonia alone. Dysphagia is often associated with increased length of hospital admission due to potential complications such as aspiration pneumonia and dehydration [26]. Therefore, timely identification and management of dysphagia is required in order to minimise complications [27], aid return to oral feeding where possible, and support decisions surrounding the need for supplementary feeding methods such as nasogastric tube feeds. We recommend dysphagia is considered in children with PIMS-TS requiring intubation and ventilation. Where intubation has not been necessary, screening questions for dysphagia are outlined (Fig. 1).

Dysphonia assessment and management occurred following hospital discharge. Only one child was seen on intensive care to support their dysphonia. Intervention involved supporting functional communication in an open-plan ward environment where mask and visor use additionally impacted. Comprehensive dysphonia assessment during hyperacute and acute stage treatment was not a priority for patients and their families. Often, dysphonia was only recognised as a priority by children and their parents when the child returned home or to school. We therefore recommend that screening for dysphonia occurs as part of multidisciplinary PIMS-TS follow up clinics with access to ENT/SLT voice clinic assessment where necessary.

#### 4.1. Limitations

A limitation of this study is that it includes data from a single centre. Where outcome measures allowed, data was collected from retrospective review of the notes rather than prospective assessment. This means that there are some omissions of outcome measures or variability in the time-frame in which initial outcome measures were collected. Restrictions on outpatient appointments at time of data collection, including the use of virtual web-based clinics, also prevented some outcome measures being collected.

#### 4.2. Further study

This paper outlines the possible dysphonia and dysphagia consequences of PIMS-TS. To date there has been no reported outcomes of the dysphagia and dysphonia consequences of adolescents presenting with COVID-19 respiratory presentations, despite the high incidence of both seen in adult populations [28,29]. This is a possible area of further study.

## 5. Conclusions

Children with PIMS-TS may present with dysphonia and/or dysphonia arising from a range of different causes. Specialist ENT and SLT assessment of voice and swallowing is required at different time points along the patient journey. Prompt SLT swallow assessment supports safe progression with oral intake within the acute and initial community step-down phases. Joint ENT and SLT outpatient clinics are necessary for the longer term management of dysphonia.

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## Declaration of competing interest

There are no conflicts of interest to declare.

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