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Original Article

Eligibility for live, interactive otolaryngology telemedicine: 19-Month experience before and during the COVID-19 pandemic in Taiwan

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ABSTRACT

Background: Unequal access to healthcare is a global medical problem. Telemedicine, recently made possible by technological advances, may mitigate this inequity. However, the usefulness of telemedicine for procedure-driven disciplines, such as otolaryngology, under infectious conditions (e.g., the COVID-19 pandemic) is unknown.
Methods: Telemedicine was made legal in Taiwan by an amendment to the Physician Act in 2018. Kaohsiung Chang Gung Memorial Hospital was the first hospital in Taiwan to provide the telemedicine service by connecting to the Chenggong Branch of Taitung Hospital (CGBTH) in November 2018. This retrospective cohort study included all new and established otolaryngology outpatient consultations between November 2018 and May 2020 at CGBTH. The Current

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Procedural Terminology and International Classification of Disease, 10th Revision codes, patient demographic data, and questionnaire data were obtained.
Results: The study included 123 patients with 218 encounters over 19 months. The majority of complaints were ear-related (52.6%). Overall, 49% of the encounters required a specialized procedure for diagnosis and treatment; of these, cerumen removal was the most common procedure. The patient subjective improvement rate increased over the study period (from 62.0% to 78.9%). The rates of return and case closure were both around 90% in 2018 and 2019. The number of otolaryngology consultations and rate of return declined after the start of the COVID-19 pandemic; however, the subjective improvement and case closure rates remained stable. The telemedicine service saved at least 2 h driving time per visit.
Conclusion: Telemedicine for otolaryngology is a promising approach for remote and underserved regions, as well as during an infectious disease pandemic.

At a glance commentary

Scientific background on the subject

Telemedicine is a promising approach for remote, medically underserved regions. However, the usefulness of telemedicine for procedure-driven disciplines, such as otolaryngology, under infectious conditions (e.g., the COVID-19 pandemic) is unknown.

What this study adds to the field

Telemedicine for otolaryngology is a promising approach for remote and underserved regions, as well as during an infectious disease pandemic. However, procedural eligibility is a major concern for whom are planning to implement a telemedicine program in otolaryngology services.

Telemedicine uses telecommunication technology to deliver healthcare at a distance. Although telemedicine is increasingly used to provide specialty care to remote patient populations [1], few otolaryngology programs have successfully integrated telemedicine into routine clinical practice [2,3]. Telemedicine enables the delivery of healthcare services to underserved regions, nursing homes, and prisons, as well as during infectious disease outbreaks; thus, the use of telemedicine to provide otolaryngology services has become crucial in the coronavirus disease 2019 (COVID-19) era.

Unequal access to healthcare between urban and rural regions is a global problem, and Taiwan is no exception. In 2018, the Taiwanese Medical Association [4] reported that in the 368 towns and counties in Taiwan, on average, one physician served 495 individuals; conversely, in the 48 mountainous regions and offshore islands, which have poor health services, some areas with more than 6000 residents were served by one physician. Notably, only six otolaryngologists serve the 48 mountainous areas and offshore islands, which have the fewest health resources and least access to healthcare services in Taiwan. These findings highlight the inequality of health care accessibility and medical resources across geographic regions in Taiwan.

With the advent of high-resolution cameras with rapid zooming capabilities, enhanced internet speed, and user-friendly interfaces, telemedicine has become an effective, accessible, and feasible delivery mode for healthcare, particularly for medical specialties that are highly dependent on image-based diagnosis [5,6]. In June 2018, the Taiwan Ministry of Health and Welfare amended the Physician Act to allow the establishment of a telemedicine service to cover medically underserved regions [7]. Taitung County, the most medically underserved county in Taiwan, has only six practicing otolaryngologists; all are located in the city of Taitung, the urban center of the county. The Chenggong Branch of Taitung Hospital (CGBTH), a district hospital, is the largest hospital in Taitung County outside Taitung; however, only three physicians (i.e., a general surgeon, a dentist, and a family practice physician) are affiliated with the hospital. The hospital is located between Hualien in the north and Taitung in the south; travel times to the hospital are 1 h from Taitung and 2.5 h from Hualien. The Kaohsiung Chang Gung Memorial Hospital (KCGMH), a medical center located in Kaohsiung City, participated in this innovative program by collaborating with the Taiwan Ministry of Health and Welfare and CGBTH to provide telemedicine services for otolaryngology, ophthalmology, and dermatology in October 2018 [8].

Our primary objective was to determine the proportions of encounters and types of diagnoses that were eligible for telemedicine. Our secondary objective was to estimate the feasibility and effectiveness of telemedicine for a general otolaryngology practice that relies on a telemedicine examiner to perform physical examinations in a live interactive encounter. COVID-19 has rapidly infected many individuals worldwide since its identification in December 2019. Otolaryngologists are at particular risk of the disease due to their close contact with the mucous membranes of the upper respiratory tract. Therefore, we also assessed the hospital-based otolaryngology telemedicine service during the COVID-19 pandemic.

Methods

After the amendment to the Physician Act in May 2018, the Taiwan Ministry of Health and Welfare collaborated with KCGMH to establish an innovative telemedicine consultation program. InTouch Lite technology (InTouch Technologies, Inc., Santa Barbara, CA, USA) allows rapid, smooth camera zooming, such that the physician can interact visually and

verbally with the patient in real time. Technical integration of the two hospitals' information systems was performed to enable physicians to write notes, suggest prescriptions, and check laboratory values virtually. Furthermore, high internet speed was needed for rapid imaging and video processing. Physicians at KCGMH were able to use the system to make accurate diagnoses and provide treatment. An otolaryngology clinic was held weekly on Wednesday afternoon.

Telecommunication equipment and data transfer

The InTouch Lite® was provided for medical use and supported by a mobile telemedicine cart issued in Taiwan. A well-structured platform was chosen, which was compliant with the Health Insurance Portability and Accountability Act and certified by the Health Information Trust Alliance for data-secure teleconsultation. Using a patient access device, physicians were able to consult or provide second opinions to patients via Provider Access Software installed on a PC or tablet, at a specified location and time. In addition to two-way audio and video communication, the physician was able to remotely zoom the camera to actively monitor the patient, which facilitated the clinical workflow. The connection was linked via the internet; a minimum bandwidth of 764 kbps was required for good image and connection quality. Using a digital hand-held diagnostic device, including an otoscope and fiberscope, the physician was able to deliver real-time telemedicine services based on system compatibility using approved universal serial bus (USB) peripheral devices and high-definition multimedia interface (HDMI) image input (Fig. 1A and B). Simultaneously, image (JPEG) and video (H.264) files could be captured and saved for further analyses.

Data collection

All "new" and "established" otolaryngology outpatient evaluations and management codes generated between November 2018 and May 2020 at CGBTH were identified. The Current Procedural Terminology codes; International Classification of Disease, 10th revision codes; and patient demographic data were collected. Encounters were deemed eligible or ineligible for a telemedicine consultation based on the need for a specialized procedure. Indeed, a regular diagnostic or treatment procedure performed by a trained specialist was barely accessible for a general practitioner. Therefore, the consultation was determined to be ineligible if there was a procedural code in the outpatient record; otherwise, it was deemed eligible, as mentioned in a previous study [9]. In this telemedicine program, a general surgeon in CGBTH who had

Fig. 1 **Live, interactive telemedicine practice.** (A) The physician is able to remotely zoom the camera to actively monitor the patient, (B) which facilitates the clinical workflow when working with a telemedicine examiner. Using digital hand-held diagnostic tools, including (C) a fiberscope (arrow) and (D) a rigid scope (arrowhead), the physician is able to perform real-time endoscopic examinations of the larynx and nose using the telemedicine system. (E) Treatment procedure, such as cerumen removal, could be performed as well under the supervision of the specialist.

previously trained as a cardiovascular surgeon served as the remote telemedicine examiner. He performed specialized procedures as well under the supervision of an otolaryngologist at KCGMH. A telephone survey was performed to determine the patient subjective improvement rate. The rate of return was also determined based on whether further appointments were deemed necessary. Case closure was defined as significant improvement in signs and symptoms after the previous treatment in the physician's opinion, with no further appointments anticipated to be necessary for the same chief complaints. Google Maps was used to estimate the travel distance and time between the patient's home address and the hospital. Descriptive statistics were calculated.

Results

Patient clinical characteristics

The study cohort included 123 patients (63 male patients and 60 female patients) with 218 encounters at CGBTH and 270 diagnoses. The median age of diagnosis was 65 years (range, 5–93 years). Most of the 270 diagnoses were ear-related (52.6%); the remaining diagnoses included throat-related problems (14.1%) and nose-related complaints (13.3%). Cerumen impaction was the most common diagnosis (9.2%); other common diagnoses included chronic otitis externa (8.1%) and otitis media (8.1%). Most of the patients who attended the Ear Nose and Throat (ENT) Department at KCGMH during the same period were diagnosed with chronic rhinitis, hearing loss, or oral cavity cancer (Table 1).

Telemedicine eligibility

A specialized procedure was not required for diagnosis and treatment of 51% of the encounters; thus, they were considered eligible for telemedicine. Table 2 shows the percentages of the most common ENT complaints eligible for telemedicine. Eligibility varied according to anatomical site. In the remaining 49% of encounters, specialized procedures were performed in the clinic by an examiner under the supervision of an otolaryngologist via the telemonitor (Fig. 1C and D). The most common procedures were cerumen removal (42.5%) (Fig. 1E) and endoscopic examinations of the larynx and nose (27.5%). Other procedures included the removal of foreign bodies, repositioning maneuvers, and topical treatments.

Effectiveness of telemedicine

We performed a telephone survey, during which patients were asked whether they had experienced improvements after the telemedicine service. The patient subjective improvement rate increased over the study period, from 62.0% in the first year (2018) to 74.3% in the second year (2019), and then again to 78.9% in the third year (2020). In addition, the rate of return was around 90% in 2018 and 2019, while the case closure rate was 91.4% during the same period (Fig. 2).

Table 1 Ten most common otolaryngology diagnoses made between November 2018 and May 2020 using the telemedicine service, stratified according to hospital site.

CGBTH			KCGMH		
Diagnosis	Number (%)	Site	Diagnosis	Number	Site
Impacted cerumen	25 (9.2%)	E	Chronic rhinitis	38015	N
Chronic otitis externa	22 (8.1%)	E	Hearing loss	26158	E
Otitis media	22 (8.1%)	E	Oral cavity cancer	23848	T
Tinnitus	20 (7.4%)	E	Chronic rhinosinusitis	15795	N
Vertigo/dizziness	17 (6.3%)	E	Tinnitus	15387	E
Oral mucositis	15 (5.6%)	T	Chronic pharyngitis	14673	T
Chronic rhinitis	14 (5.2%)	N	Oral leukoplakia	09505	T
Hearing loss	12 (4.4%)	E	Deviated nasal septum	07868	N
Oral leukoplakia	12 (4.4%)	T	Sleep apnea	07647	T
Chronic rhinosinusitis	10 (3.7%)	N	Vertigo/dizziness	07640	E
Total	62.4%				

Abbreviations: CGBTH: Chenggong Branch of Taitung Hospital; E: ear; KCGMH: Kaohsiung Chang Gung Memorial Hospital; N: nose; T: throat.

Table 2 Percentages of the most common ear, nose, and throat complaints deemed eligible for telemedicine. Patients who did not require a specialized diagnosis procedure were considered eligible for telemedicine.

Ear		Nose		Throat	
Diagnosis	Percentage	Diagnosis	Percentage	Diagnosis	Percentage
Vertigo/dizziness	10.6%	Chronic rhinitis	4.9%	Oral mucositis	9.9%
Tinnitus	09.9%	Chronic rhinosinusitis	4.9%	Acute pharyngitis	4.9%
Chronic otitis externa	07.0%			Oral leukoplakia	4.9%
Hearing loss	05.6%				
Total	33.1%	Total	9.8%	Total	19.7%

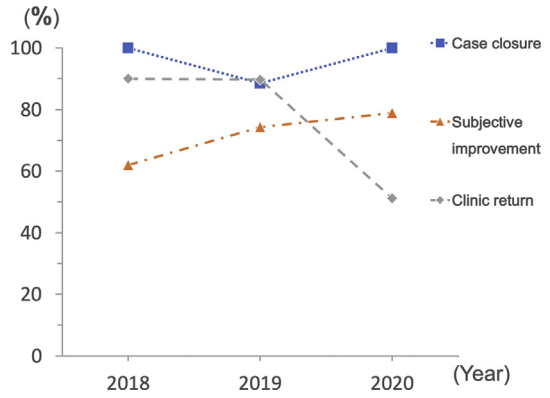

Fig. 2 **Patient satisfaction rate, case closure rate, and rate of return in 2018 (introduction of the telemedicine service), 2019, and 2020 (the COVID-19 pandemic).** The patient subjective improvement rate increased over the study period, from 62.0% in the first year (2018) to 78.9% in the third year (2020). The rate of return and the case closure rate were around 90% in 2018 and 2019. However, the rate of return decreased to 57.1% in 2020 during the COVID-19 pandemic, while the patient subjective improvement rate and the case closure rate remained high.

Time savings

Travel data were available for 119 (96.7%) patients. Of those, 105 (88.2%) lived near the Cheng Kung town center; their median round-trip travel distance was approximately 2 km to reach the CGBTH. The remaining 14 patients lived in other towns in Taitung County; their round-trip travel distances ranged from 38 to 118 km. Before telemedicine was available, patients had to travel to Hualien in the north or to Taitung in the south for an otolaryngology consultation, which involved round-trip distances ranging from 106 to 176 km; thus, the telemedicine service saved at least 2 h of driving time.

Telemedicine during the COVID-19 pandemic

We identified and assessed encounters that occurred during the COVID-19 pandemic (February to May 2020). The number of otolaryngology consultations decreased by 37.8% (from 37 to 23) compared with the same period in the previous year. Ear-related complaints were present in the majority of patients (52%): tinnitus (16.0%) and vocal cord disorders (12.0%) were the most common diagnoses (Table 3). In total, 61% of the patients required a procedure performed in the office setting. Endoscopic examination of the larynx and nose was performed during 26% of the telemedicine visits. Although the rate of return decreased to 57.1% during this period, the patient subjective improvement rate and the case closure rate remained high (Fig. 2).

Discussion

Here we report our experience with the first otolaryngology telemedicine service in Taiwan. In this descriptive study, we found that the remote face-to-face, real-time otolaryngology consultation service was an efficient, time-saving, and satisfactory healthcare delivery mode. Due to the heavy reliance on specialized procedures in otolaryngology consultations, telemedicine eligibility is a crucial concern for otolaryngology consultation services. Our service allowed otolaryngology specialists to deliver optimal healthcare to people living in medically underserved regions and under conditions of an infectious pandemic.

The COVID-19 pandemic has rapidly and radically altered the delivery of care in the otolaryngology outpatient setting. Continuity of care for established patients and the development of a professional relationship with new patients has been challenging during this public health emergency [10]. Moreover, cross-district transport services have been prohibited in several geographic areas to avoid the risk of COVID-19 transmission. The current pandemic, which further complicates the unequal access to healthcare, has compelled physicians to embrace telemedicine and other virtual modalities. Telemedicine allows patients to consult qualified otolaryngology specialists without risking the spread of disease due to personal contact. The hospital-based service reported here, which has operated smoothly for 19 months, could be replicated in any location worldwide.

Taiwan was less affected initially by the worldwide the COVID-19 pandemic in the beginning of 2020 [11]. Nevertheless, the number of all outpatient visits decreased by

Table 3 Comparisons of most common diagnoses before and during the COVID-19 pandemic.

Pre-COVID-19			During COVID-19		
Diagnosis	Number (%)	Site	Diagnosis	Number (%)	Site
Impacted cerumen	23 (9.4%)	E	Tinnitus	4 (16.0%)	E
Otitis media	22 (9.0%)	E	Vertigo/dizziness	3 (12.0%)	E
Chronic otitis externa	20 (8.2%)	E	Vocal cord disorders	3 (12.0%)	T
Tinnitus	16 (6.5%)	E	Impacted cerumen	2 (08.0%)	E
Oral mucositis	15 (6.1%)	T	Chronic otitis externa	2 (08.0%)	E
Vertigo/dizziness	14 (5.7%)	E	Otalgia	2 (08.0%)	E
Chronic rhinitis	12 (4.9%)	N	Chronic rhinitis	2 (08.0%)	N
Hearing loss	11 (4.5%)	E	Chronic pharyngitis	2 (08.0%)	T
Oral leukoplakia	11 (4.5%)	T	–	–	–
Chronic rhinosinusitis	10 (4.1%)	N	–	–	–
Total	62.9%		Total	80.0%	

Abbreviations: E: ear; N: nose; T: throat.

approximately 15% during the outbreak period. Otolaryngologists are at particular risk due to their close contact with the mucous membranes of the upper respiratory tract; thus, outpatient visits to ENT specialists decreased by 20%–25%. We found that ENT telemedicine consultations decreased by 37% after onset of the COVID-19 pandemic, compared with the same period in 2019. In addition, the rate of return decreased from 90% to 57.1%. The reduction in telemedicine consultations is presumably because these consultations comprise a hospital-based service; notably, hospital attendance has been affected by warnings against unnecessary hospital visits. Similarly, the dermatology telemedicine consultations were decreased (by 20%). However, the patient subjective improvement rate increased in 2020 (Fig. 2), indicating that patients were still satisfied with the telemedicine service during the COVID-19 pandemic. The types of encounters during the COVID-19 pandemic did not markedly differ from those before the pandemic: ear-related complaints constituted most of the encounters, and endoscopic examinations of the larynx and nose were performed in 26% of the patients. Although these findings are contrary to the notion that endoscopic examinations were deferred during the COVID-19 pandemic [12], two reasons may explain this disparity. First, there were no confirmed cases of COVID-19 in eastern Taiwan where the CGBTH is located; thus, no marked changes occurred in the hospital-based telemedicine service. Second, because most otolaryngology examinations required specialized procedures, the rates of telemedicine eligibility were already relatively low.

Telemedicine eligibility is a greater concern for otolaryngology services than for other medical disciplines. In our cohort, slightly more than half (51%) of the encounters did not require a specialized procedure and were deemed eligible for telemedicine. Most of the specialized examination procedures to correctly diagnose inner ear complaints (vertigo and tinnitus) are eligible via telemedicine. Conversely, problems affecting the larynx and external ear were frequently ineligible for telemedicine because they required endoscopic examination or cerumen removal, respectively; these results are consistent with the findings of a previous study [9]. The major barrier to telemedicine for surgical subspecialties is the procedural component of the physical examination; this was considered when we expanded our otolaryngology telemedicine service. Innovative devices that aid in the remote detection and capture of otologic pathology, such as a smartphone-enabled otoscope, have also been investigated as a means to facilitate virtual evaluations [13]. In addition, imaging modalities such as plain films or even CT scans may be preferred over endoscopic examination, particularly in positive or unknown cases, to decrease the risk of transmission. Although other methods can be substituted for procedural examinations, the necessity of local treatment has yet to be eliminated. Recently, KCGMH sought to broaden the telemedicine service area by collaborating with hospitals in mountainous regions and offshore islands. Telemedicine eligibility was thus taken into consideration for the preliminary training program. KCGMH has developed education and training programs for remote telemedicine examiners, including a 1-day face-to-face course with a 2-week observation period in the clinic, to familiarize them with the procedures performed in ENT clinics without a steep learning curve. After completing the education and training program, there is a post-training appraisal of the trainees (Supplement 1). In brief, telemedicine has promise in the ENT field only if the telemedicine examiners can be well trained and enabled to offer more procedures during office visits [9].

Comparison of the reasons for otolaryngology visits between CGBTH and KCGMH revealed that the disease pattern differed between the district hospital and the medical center (Table 1). For example, critical illnesses, such as head and neck cancer, were predominant among the otolaryngology visits in KCGMH. Furthermore, the epidemiology of a local region can be precisely determined using telemedicine. Our findings showed that most complaints were related to otology both before and after the onset of the COVID-19 pandemic (Table 3); additionally, more otology patients were eligible for telemedicine (Table 2). However, because the visits to the district hospital and the medical center were affected by multiple factors, the findings should be loosely interpreted.

In this study, the patient subjective improvement rate was lower than the case closure rate over the entire study period (Fig. 2). The case closure rate depends on significant improvement of symptoms and signs based on the physician's opinion. On the other hand, the patient improvement rate is based on the patients' subjective perception. Thus, the discrepancy between the patient subjective improvement and case closure rates may have resulted from differences in opinion between physicians and patient. Interestingly, we found that the patient subjective improvement rate increased over the study period. One possible explanation for this is that both remote physicians and telemedicine examiners became increasingly familiar with the telemedicine service over time, thus indirectly improving patients' confidence in the virtual visits. In order to further understand the predictive factors for satisfaction and subjective improvement rate from telemedicine consultations, Fieux M et al. carried out a prospective questionnaire study in 100 patients [14]. He found that patients with prior experience with telemedicine consultation and sufficient sound quality and smooth video quality during their consultation tended to be more satisfied. Additionally, patients already using video calls in everyday life were more likely to use teleconsultation [15], which probably supported the finding of higher overall satisfaction in patients with prior experience with teleconsultation. In contrast, patients bothered by the lack of a physical examination tended to have a poorer satisfaction rate [14]. In our study, the patient subjective improvement was recorded via a random anonymous telephone survey, and a more detailed analysis of patient subjective improvement was not feasible. A more comprehensive study of satisfaction and subjective improvement rate should be conducted in the future (Supplement 2).

Although the trend for telemedicine services in otolaryngology is increasing, the program has some limitations. First, virtual visits cannot completely replace a face-to-face visit with an otolaryngologist [14]. For example, physical palpation, which is important for the physician to characterize the consistency of the neck masses, cannot be

performed using current telemedicine technology. Second, our service currently remains a hospital-based service. Other telemedicine disciplines, including teledermatology, employ more user-friendly delivery methods such as a flexible platform that links a portable electronic device (e.g., mobile phones) to the patient site; this increases the accessibility and flexibility of the virtual health service. With regard to patient eligibility, however, otolaryngology telemedicine requires considerable progress prior to reaching this level of service.

Conclusions

In summary, we report our experience with the first otolaryngology telemedicine service in Taiwan. Telemedicine eligibility should be considered in education and training courses for telemedicine examiners in the ENT field. With this convenient, precise, and time-saving service, the qualified and optimal health care provided by otolaryngology specialists in medical centers can be delivered to underserved regions, as well as during an infectious disease pandemic.

Conflicts of interest

The authors have no conflicts of interest relevant to this article.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.bj.2021.07.012.

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