Received: 29 June 2020 | Revised: 30 August 2020 | Accepted: 18 September 2020

DOI: 10.1002/lio2.466

EDITORIAL

Laryngoscope Investigative Otolaryngology

Expanded use of teleservices in otology and neurotology in response to the COVID-19 (SARS-Cov-2) pandemic

Beginning in December 2019, Dr Li Wenliang, an ophthalmologist, was silenced by the Chinese government as he tried to alert health authorities about a novel and deadly disease similar to SARS. On December 31, 2019, the first report of an epidemic of a serious respiratory disease caused by a new coronavirus virus originating in Wuhan (Hubei province), China was made to the local World Health Organization office. The virus and disease were termed Severe Acute Respiratory Syndrome (SARS-CoV-2) coronavirus 2. The disease caused by this virus was later named COVID-19.[1]

On January 20, 2020, an otolaryngologist/head and neck surgeon in Wuhan became the first physician to die of COVID-19.[2] On February 6, 2020, Li Wenliang, the ophthalmologist who originally tried to raise the alarm, died of COVID-19.[3,4] The first recorded instance of an entire surgical care team becoming infected by COVD-19 also occurred in Wuhan: All 14 team members participating in an endonasal endoscopic-assisted hypophysectomy and providing preoperative and postoperative care to the patient were infected.[5] The COVID-19 viral load was later determined to be concentrated in the upper airway, causing the high rates of infections and death among otolaryngologists/head and neck surgeons, ophthalmologists, and Chinese endoscopists during the first several months of the epidemic.[6-9] Later, Patel and coworkers reported that many Italian and Iranian otolaryngologists/head and neck surgeons were infected and isolated.[7] The same high risk has been recorded in Europe. This high-risk to otolaryngologists/head and neck surgeons has recently been reviewed.[10]

COVID-19 has changed our medical practices in virtually every dimension, especially since aerosolization of the viral load puts us as otolaryngologists/head and neck surgeons at higher risk. One adjustment to avoid viral spread in the hospital and community has been our specialty's embrace of telehealth. Otology-neurotology is the subspecialty most amenable to telehealth. Other subspecialties such as head and neck surgical oncology are less able to use telehealth, and still others subspecialties fall in-between. For otology-neurotology, the new health constraints have pushed our traditional 20th century office practices to rapidly adopt new technological platforms required to transform practice as we enter the third decade of the 21st century.

Otolaryngologists/head and neck surgeons who serve rural populations have long used telemedicine modalities to accommodate the inherent transportation challenges associated with physically bringing patients and physicians together.[11-14] Likewise, teleaudiology has been used, albeit sporadically, for audiometric evaluations, while hearing aid and cochlear implant remote programming are emerging practices.[15-21] Two major obstacles heretofore to the development of teletechnology have been the inability to bill for teleservices, and the need for all platforms—the physician's and the patient's—to be HIPAA compliant. Previously only face-to-face encounters could be reimbursed. The rapid institution of reimbursement for telehealth services by the Centers for Medicare and Medicaid Services (CMS) and other third-party payors in response to the COVID crisis, has finally made the currently available and needed technology practical and financially feasible. Unfortunately, one of us (D.B.W.) still has state-level telehealth constraints that preclude new office visits across state lines. In addition, the rapid waiver of the previous requirement that all communication platforms to be HIPAA compliant has enabled the patient to use their own devices to communicate with their physicians. It remains to be seen in what form these adjustments will remain in place.

Currently, CMS defines the physical location of the telehealth as the location of the patient rather than the physician practicing medicine. During the COVID-19 pandemic, this restriction was suspended for established patients. The prepandemic CMS rule presents reimbursement and legal challenges for providing telehealth services across state lines or for US insured patients visiting or living in other countries. Resolution of this conflict could be accomplished in at least two ways: (a) reciprocity for medical licenses across all states in the US; or (b) CMS or Congress redefining the location of medical care as that of the physician providing that care. The former is unlikely due to state's rights issues, while the latter should be possible to accomplish—particularly since the medical care provided is being practiced by the state licensed physician in their medical office.

One of us (M.I.R.) has been using real-time video interviews with physical examinations for distant patients since 2011. Another of us (P.A.W.) has been using the Skype platform to provide uncompensated screening in initial otology-neurotology evaluations for out-of-state and international patients over the last decade, and is an ardent adopter of telemedicine in response to the 2020 pandemic. The range of patients have been people of all ages with the entire

spectrum of acute and chronic problems such as sudden hearing loss, third window syndrome, skull base tumors, chronic ear disease and cochlear implant candidates. The teleinterviews use HIPAA compliant platforms, such as WebEx, or Zoom for Healthcare, and require the patient to have access to a smart phone, laptop, or desktop computer with a microphone and camera.

For years, before the advent of COVID restrictions, the emerging live-motion technology had been embraced by Deaf and hearing-impaired people.[22,23] For our cochlear implant candidates since 2013, the teleinterview had been very well accepted. Family members could more easily find the time to join the appointment. For those patients who could speech-read, having the physician's face closer to the webcam greatly augmented the patient's comprehension. The physician could also share the screen to type questions, which the patient would then answer orally. The combination of the patient hearing, seeing, and reading was found to be superior to a face-to-face interaction; and the patients could read everything written in real-time. Indeed, on the day of first physical interaction—the day of surgery—the surgeon, patients, and family frequently remarked, "*I feel like I've already met you face-to-face—that we've been in the same room together*."

In the COVID era restrictions, teleinterview provide even more advantages beyond the elimination of travel and the reduced risk of contagion. We are finding that the teleinterview also provides very useful insight into a patient's work and home environments. Current restrictions in our hospitals and academic medical centers prohibit family members' presence in the examination rooms and limit just one parent for a child; telehealth allows the entire family to attend the interview. Engaging more of the interested parties facilitates understanding of the health issues. Finally, in the teleinterview, the physician can remove their mask, and sit closer to the webcam, which is tremendously helpful for our hearing-impaired patients.

For the best use of the otologic-neurotologic interview and examination, some parameters have become apparent over the years and refined during this pandemic:

1. All accompanying information—the audiometric studies, radiological images, previous operations must be forwarded to the otologist-neurotologist in advance.
2. Examination of the ear canal and eardrum is clear and satisfying, if every single anatomic feature is favorable. Many platforms, including smart phone compatible apps are available for the ear exam.[24-26] However, in the presence of absolutely any obstacle—hair, a tortuous canal, wax, pus, granulation polyp—a clear view of the tympanic membrane is impossible. Pre-COVID-19 we found that even irrigation by an advanced practice provider in the local physician's office usually did not help visualization. And, as every academic otologist has experienced with our medical students and interns—it is very difficult to articulate, without demonstration, how to angle the speculum or straighten the external auditory canal effectively.
3. For patients with hearing loss, the physician can position their face closer to the webcam so that patient use speech-reading to assist in understanding.
4. If needed, the otologist-neurotologist can easily split the screen to type questions which the patient can read and then can answer orally. If the interview format is standard—as we do for our distant cochlear implant patients, the interview text can be typed, stored, and retrieved for each interview—and the patient's answers can be typed in and added as an addendum to their medical record.
5. For the majority of otology-neurotology patients, telehealth can be used for the initial encounter and then the patient can be seen after imaging and audiology testing has been completed. This saves patient travel time, parking expenses, waiting times and is much more convenient for the patient, physician, and family. In addition, the efficiency of having all relevant diagnostic studies at the time of initial physical examination allows for an immediate diagnosis and treatment plan to be made.
6. For many types of return visits, telehealth can be equally or more effective than face-to-face encounters. Examples would include: discussing medication management in vestibular migraine patients; reviewing postoperative or expectant management MRI studies in vestibular schwannoma patients; and discussion of management options with patients being followed with serial audiograms who have progressive hearing loss.
7. A pleasant surprise has been how much more focused the telehealth visits are than in traditional physician-patient interactions. Both the physician and patient spend more time thinking about the visit, organizing diagnostic studies, and thinking about their symptoms that results in more efficient interaction. It is also the case when patients fly from other states or countries to be seen they expect far more time with the physician when seen face-to-face.
8. While intuitively it would be expected that practice costs would be reduced, the workflow is actually more time intensive in coordinating and gathering all of the diagnostic records, confirming telehealth appointments, helping patients and families navigate the unfamiliar technology, managing validated survey instruments, and capturing and entering patient questionnaires into the electronic medical record.

Another accelerant in adopting teleservices in the COVD-19-era is the increased use of conferencing platforms for meetings and lectures. More recently, this has been extended to interviews with resident, faculty, advanced practice provider applicants. One of us (M.I.R.) has been using telecommunications for resident lectures, mock oral examinations, and national presentations since 2016. At Rutgers in 2020, we transitioned our entire Grand Rounds Program over to the WebEx digital platform. The major advantage of teleconferencing presentations is the tremendous conservation of travel, time, wait-time, time away from practice, and expense. The meeting, lecture, or oral examination is easier for everyone to attend. The speaker's face can be in close-up instead of a small portion of the entire visual field. Any object needed for the lecture—a drilled temporal bone perhaps—can

be shown in close-up and special features can be pointed out. Sharing the screen allows the speaker or any of the participants in a split classroom to present their lecture or homework assignment.

Facility with teleinterviews, teleexaminations, and teleeducation have also enabled us to provide education abroad in our global otology efforts. The experience gained has been crucial for global surgery education and support—conferencing, lecturing, and supervising operations.[27-30] Once again there are parameters for successful long-distance teaching and telementoring. The relationships must already have been established with the overseas learner or surgeon. The United States and the overseas partners have to know, respect and trust each other. The overseas internet bandwidth and availability must be adequate. Timing of lectures and operations is extremely difficult, and finding a free operating room and surgical team which is during waking hours in the United States and determining the hour can be problematic, especially when there is technical support specialist in a third time zone. Greenwich Mean Time (GMT) is the most easily understood time standard when attempting to consider time differences, even though it is difficult initially to gain acceptance. This is particularly useful when multiple times zones are being used across learners or educators. With these arrangements, lectures can proceed and operations can be mentored and proctored. The overseas trainees frequently comment, "*I wasn't scared at all during the surgery. It felt like you were just exactly in the room with me.*"

As the new academic school year starts, with restrictions on patient contact and travel for sub-interns, two of us (M.I.R. and P.A.W.) have modified the telementoring platform Proximie (Proximie, Boston, Massachusetts) for use in otology-neurotology operations.[27] The students who are currently restricted from attending operations or travel can view our operations in real time. Equipment required are a cable connecting the digital camera's video-out to the AV.io 4K (Epiphan Video, Palo Alto, California) digital capture card, and a cable from the AVIO capture card to a laptop's USB port. United States internet speeds can support the video transmission, although a consultation with the hospital IT department may be needed to address firewalls. TeamViewer (TeamViewer AG, Goeppingen, Germany) is essential for the transmitting laptop for real time trouble-shooting.

In summary, the COVID-19 pandemic has accelerated the implementation of available technology and the modification of billing protocols so that telemedicine is now being practiced in metropolitan centers. The advantages are tremendous and the major obstacle remains the inferior quality of the otologic and neurotologic otologic examination. It is likely that this acceleration and adoption of the use of telehealth is the single positive outcome from the medical response to the COVID-19 pandemic; however, this practice transformation will benefit innumerable patients in the future.

KEYWORDS

COVID-19, teleaudiology, telehealth, telemedicine, telementoring, teleservices

CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

Miriam I. Redleaf MD, FACS[1]
D. Bradley Welling MD, PhD, FACS[2]
P. Ashley Wackym MD, FACS, FAAP[3]

[1]*Professor of Otology/Neurotology, Ethiopian Otology Fellowship Director, Division of OHNS, Department of Surgery, University of New Mexico, Rio Rancho NM, University of New Mexico, Albuquerque NM*
[2]*Harvard Department of Otolaryngology Head & Neck Surgery, Harvard Medical School, Boston, Massachusetts*
[3]*Department of Otolaryngology—Head and Neck Surgery, Rutgers Robert Wood Johnson Medical School, Rutgers University, New Brunswick, New Jersey*

Correspondence
Miriam I. Redleaf, MD, FACS, Professor of Otology/Neurotology, Ethiopian Otology Fellowship Director, Division of OHNS, Department of Surgery, University of New Mexico, Rio Rancho NM, University of New Mexico, Albuquerque NM.
Email: mredleaf@salud.unm.edu

ORCID

D. Bradley Welling https://orcid.org/0000-0002-9963-469X
P. Ashley Wackym https://orcid.org/0000-0002-2904-5072

REFERENCES

1. World Health Organization. WHO Director-General's opening remarks at the Mission briefing on COVID-19 12. https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-mission-briefing-on-covid-19—12-march-2020. Accessed August 5, 2020.
2. Chan JYK, Wong EWY, Lam W. Practical aspects of otolaryngologic clinical services during the 2019 novel coronavirus epidemic: an experience in Hong Kong. *JAMA Otolaryngol Head Neck Surg*. 2020;146:519-520. https://doi.org/10.1001/jamaoto.2020.0488.
3. BBC News. Li Wenliang: Coronavirus death of Wuhan doctor sparks anger. https://www.bbc.com/news/world-asia-china-51409801. Accessed September 1, 2020.
4. New York Post. China exonerates doctor who warned of impending coronavirus outbreak. https://nypost.com/2020/03/20/china-exonerates-doctor-who-warned-of-impending-coronavirus-outbreak/. Accessed September 1, 2020.
5. China Newsweek. Super Spreader: He was in 4 hospital wards and infected 14 medical staff (Chinese). https://view.inews.qq.com/a/20200125A07TT200?uid=&devid=BDFE70CD-5BF1-4702-91B7-329F20A6E839&qimei=bdfe70cd-5bf1-4702-91b7-329f20a6e839. Accessed September 1, 2020.
6. Bloomberg News. Europe's doctors repeat errors made in Wuhan, China medics say. https://www.bloomberg.com/news/articles/2020-03-17/europe-s-doctors-getting-sick-like-in-wuhan-chinese-doctors-say. Accessed September 1, 2020.
7. Patel ZM, Hwang PH, Nayak JV, et al. Otolaryngologists may contract COVID-19 during surgery. https://www.enttoday.org/article/otolaryngologists-may-contract-covid-19-during-surgery/. Accessed September 1, 2020.

8. Ran L, Chen X, Wang Y, Wu W, Zhang L, Tan X. Risk factors of healthcare workers with corona virus disease 2019: a retrospective cohort study in a designated hospital of Wuhan in China. *Clin Infect Dis*. 2020;ciaa287. https://doi.org/10.1093/cid/ciaa287.
9. Lai THT, Tang EWH, Chau SKY, Fung KSC, Li KKW. Stepping up infection control measures in ophthalmology during the novel coronavirus outbreak: an experience from Hong Kong. *Graefes Arch Clin Exp Ophthalmol*. 2020;258(5):1049-1055. https://doi.org/10.1007/s00417-020-04641-8.
10. Kulcsar MA, Montenegro FL, Arap SS, Tavares MR, Kowalski LP. High risk of COVID-19 infection for head and neck surgeons. *Int Arch Otorhinolaryngol*. 2020;24(2):e129-e130. https://doi.org/10.1055/s-0040-1709725.
11. Puskin DS. Opportunities and challenges to telemedicine in rural America. *J Med Syst*. 1995;19(1):59-67. https://doi.org/10.1007/BF02257191.
12. Franken EA Jr, Harkens KL, Berbaum KS. Teleradiology consultation for a rural hospital: patterns of use. *Acad Radiol*. 1997;4(7):492-496. https://doi.org/10.1016/s1076-6332(97)80235-8.
13. Alverson DC, Shannon S, Sullivan E, et al. Telehealth in the trenches: reporting back from the frontlines in rural America. *Telemed J E Health*. 2004;10(Suppl 2):S-95-109.
14. Drake C, Zhang Y, Chaiyachati KH, Polsky D. The limitations of poor broadband internet access for telemedicine use in rural America: an observational study. *Ann Intern Med*. 2019;171(5):382-384. https://doi.org/10.7326/M19-0283.
15. Yimtae K, Israsena P, Thanawirattananit P, et al. A tablet-based mobile hearing screening system for preschoolers: design and validation study. *JMIR Mhealth Uhealth*. 2018;6(10):e186. https://doi.org/10.2196/mhealth.9560.
16. Hatton JL, Rowlandson J, Beers A, Small S. Telehealth-enabled auditory brainstem response testing for infants living in rural communities: the British Columbia early hearing program experience. *Int J Audiol*. 2019;58(7):381-392. https://doi.org/10.1080/14992027.2019.1584681.
17. Campos PD, Ferrari DV. Teleaudiology: evaluation of teleconsultation efficacy for hearing aid fitting. *J Soc Bras Fonoaudiol*. 2012;24(4):301-308. https://doi.org/10.1590/s2179-64912012000400003.
18. Angley GP, Schnittker JA, Tharpe AM. Remote hearing aid support: the next frontier. *J Am Acad Audiol*. 2017;28(10):893-900. https://doi.org/10.3766/jaaa.16093.
19. Hughes ML, Sevier JD, Choi S. Techniques for remotely programming children with cochlear implants using pediatric audiological methods via telepractice. *Am J Audiol*. 2018;27(3S):385-390. https://doi.org/10.1044/2018_AJA-IMIA3-18-0002.
20. Cullington H, Kitterick P, Weal M, Margol-Gromada M. Feasibility of personalised remote long-term follow-up of people with cochlear implants: a randomised controlled trial. *BMJ Open*. 2018;8(4):e019640. https://doi.org/10.1136/bmjopen-2017-019640.
21. Schepers K, Steinhoff HJ, Ebenhoch H, et al. Remote programming of cochlear implants in users of all ages. *Acta Otolaryngol*. 2019;139(3):251-257. https://doi.org/10.1080/00016489.2018.1554264.
22. Puig de la Bellacasa R. Telecommunications, computers and other complementary communication means on behalf of the disabled. *Int J Rehabil Res*. 1980;3(2):191-204. https://doi.org/10.1097/00004356-198006000-00005.
23. Pearson DE. Transmitting deaf sign language over the telecommunications network. *Br J Audiol*. 1986;20(4):299-305. https://doi.org/10.3109/03005368609079028.
24. Shah MU, Sohal M, Valdez TA, Grindle CR. iPhone otoscopes: currently available, but reliable for tele-otoscopy in the hands of parents? *Int J Pediatr Otorhinolaryngol*. 2018;106:59-63. https://doi.org/10.1016/j.ijporl.2018.01.003.
25. Demant MN, Jensen RG, Bhutta MF, Laier GH, Lous J, Homøe P. Smartphone otoscopy by non-specialist health workers in rural Greenland: a cross-sectional study. *Int J Pediatr Otorhinolaryngol*. 2019;126:109628. https://doi.org/10.1016/j.ijporl.2019.109628.
26. Clark MPA, Nakku D, Westerberg BD. An endoscopic ear trainer for the low-resource setting. *J Laryngol Otol*. 2019;133(7):571-574. https://doi.org/10.1017/S0022215119001257.
27. Kerolus J, Korra B, Ahmad TA, Moukhtafi A, Redleaf M. Real-time interactive telementoring between Ethiopia and the United States. *Online J Otolaryngol Rhinol*. 2020. https://doi.org/10.33552/OJOR.2020.02.000546.
28. Snyderman CH, Gardner PA, Lanisnik B, Ravnik J. Surgical telementoring: a new model for surgical training. *Laryngoscope*. 2016;126(6):1334-1338. https://doi.org/10.1002/lary.25753.
29. Khor WS, Baker B, Amin K, Chan A, Patel K, Wong J. Augmented and virtual reality in surgery-the digital surgical environment: applications, limitation and legal pitfalls. *Ann Transl Med*. 2016;4(23):454. https://doi.org/10.21037/atm.2016.12.23.
30. Greenfield MJ, Luck J, Billingsley ML, et al. Demonstration of the effectiveness of augmented reality telesurgery in complex hand reconstruction in Gaza. *Plast Reconstr Surg Glob Open*. 2018;6(3):e1708. https://doi.org/10.1097/GOX.0000000000001708.