Since the onset of the global COVID-19 crisis, people with hearing loss have been experiencing communication difficulties due to the widespread use of face masks and physical distancing. As children return to school, it is paramount to address these communication issues. Many families have expressed concerns that their children with hearing loss will experience greater difficulties in speech understanding when teachers and other students wear masks. In this emergency edition of Tot 10, we outline potential solutions to optimize the communication abilities of children with hearing loss amid the pandemic. We are honored to be accompanied by our colleagues and friends who have been working diligently to support the educational needs of children with hearing loss during this challenging time.

10. Masking from Masks
Several factors contribute to the increased communication difficulties faced by individuals with hearing loss during this pandemic. First, physical distancing often leads to an increased distance between the listener and the talker. Doubling of distance reduces sound pressure levels by approximately 6 dB, resulting in lower speech levels. Physical distancing is not always possible, especially while we are inside, so the use of masks is likely to be the most effective method to reduce the spread of SARS-CoV-2.

Second, masks may low-pass filter speech by an amount influenced by the material of the mask. Figure 1 shows the attenuation to speech caused by different types of masks. As shown, a standard disposable surgical mask offers essentially no attenuation relative to the unmasked condition, whereas an N95 mask and a cloth mask offer approximately 2-3 dB of attenuation from 4,000 to 8,000 Hz. In contrast, a plastic face shield offers 3 to 6 dB of attenuation from 4,000 to 8,000 Hz relative to an unmasked condition (Fig. 2).

To compensate for the masking effect, the audiologist may consider creating a mask-specific program. For example, Signia suggests a manual program increasing gain 3 dB from 2,000-4,000 Hz, and 5 dB above 4,000 Hz in addition to a slight increase (2 dB) in gain for 50 dB inputs to compensate for the increased distances in typical communication.

Association for the Deaf and Hard of Hearing, and works in improving access to hearing technology. Dr. McNiece is an educational audiologist at Summit Educational Service Center in Ohio. She has over 20 years of professional experience and a lifetime experience of living with hearing loss. Dr. Caraway is the CEO of Hearing First, the founding president of the AG Bell Academy for Listening and Spoken Language, a co-founder of Hearts for Hearing, where Dr. Wolfe is an adjunct assistant professor at the University of Oklahoma Health Sciences Center and Salus University and the director of audiology at Oklahoma City’s Hearts for Hearing, where Ms. Smith is a founder and the executive director and Dr. Neumann, a CI/pediatric audiologist, works as the audiology research manager and a deaf education consultant. Dr. Miller is the coordinator of graduate studies in audiology. Dr. Birath is the coordinator of speech-language pathology at The Moog Center for Deaf Education and a professor at Washington University. Dr. Childress is an educational audiologist, adjunct lecturer, mentor, and advocate. As a late-deafened adult with bilateral cochlear implants, her areas of expertise include (hearing) assistive technology, accessibility, and psychosocial adjustment to hearing loss. Ms. McNally is the chair of the board of directors of the Alexander Graham Bell Association for the Deaf and Hard of Hearing, and works in improving access to hearing technology.
Finally, based on our anecdotal experiences in the clinic, many individuals with significant hearing loss converse more effectively with clinicians who use face shields instead of surgical or cloth face masks. Despite the high-frequency attenuation with a face shield, it may result in better communication than face masks because visual cues (i.e., speech reading) are accessible.

9. What about Face Shields?
Face shields may be a desirable relative to face masks because shields allow for speech reading. Of note, at the time of this writing, several infectious disease specialists have expressed concern that the coronavirus may also be transmitted through the eyes. Face shields have an added advantage of protecting the eyes. Scientists at the University of Iowa reported that face shields block a substantial portion of airborne contagions from reaching the face of the wearer.² Moreover, in our experience, many people find face shields to be relatively comfortable to wear.

However, face shields may not be as effective as face masks in controlling the spread of airborne infection because they have openings near the sides and bottom of the face. In its guidance³ for school officials, the U.S. Centers for Disease Control and Prevention (CDC) does not support the use of face shields in educational settings, stating:
- Clear face coverings may be considered for teachers or staff who interact with students who are deaf and hard of hearing.
- Face shields are not considered clear face coverings.
- It is not known if face shields provide any benefit as source control to protect others from the spray of respiratory particles. The CDC does not recommend the use of face shields for normal everyday activities or as a substitute for cloth face coverings. Some people may choose to use a face shield when sustained close contact with other people is expected.

8. Modified Face Shields
Some industrious designers have cleverly altered face shields to reduce or eliminate the potential spread of droplets and aerosol from the sides and bottom of the shield while also preserving the visual cues made available by a face shield. Figure 3 shows a sample face shield (i.e., the Humanity Shield) that has an apron around the sides and bottom of the face shield giving it the appearance of a beekeeper’s headgear. Figure 4 shows another modification (i.e., Badger Shield+) with a drape surrounding the bottom and sides of the shield and a drawstring that allows the wearer to secure the drape to the sides and bottom of the face. Tightening the drawstring should substantially reduce the likelihood of droplets and aerosols exiting the face shield. Although it may be difficult for clinicians and teachers to obtain these products in the next few weeks, an ambitious and crafty individual may be able to modify a face shield to reduce the spread of transmission from the sides and bottom of the face (for additional guidance, check out https://bit.ly/3iiv6PT4 and https://bit.ly/33CPmb59).

7. Clear Face Masks
Given the importance of visual cues to people with hearing loss and the CDC’s recommendation for the use of face masks rather than face shields, many audiologists have gravitated toward the use of face masks with a clear “window.” A quick internet search or a stroll through Etsy identifies several entrepreneurs who are selling face masks with clear fronts. A quick internet search will also turn up multiple tutorials describing the steps for creating a do-it-yourself face mask with a clear front. Additional information on the pros and cons of various types of face masks and shields is available on this site developed by https://connect-hear.com.⁶

If face shields are used without a mask, they should wrap around the sides of the wearer’s face and extend to below the chin.

Figure 1. Frequency response measured in the Live Speech mode of Audioscan Verifit with probe microphone fixed in free field. The audio signal (white noise) was presented from a loudspeaker located one meter from the probe microphone. The output (dB SPL) was measured in four conditions: (1) no mask: loudspeaker was not covered, (2) surgical mask: loudspeaker diaphragm was covered with a standard disposable surgical mask, (3) N95 mask: loudspeaker diaphragm was covered with an N95 mask, and (4) cloth mask: loudspeaker diaphragm was covered with a homemade cloth mask.

Figure 2. Frequency response measured in “Live Speech” mode of Audioscan Verifit with probe microphone fixed in free field. The audio signal (white noise) was presented from a loudspeaker located one meter from the probe microphone. The output (dB SPL) was measured in three conditions: (1) no mask: the loudspeaker was not covered, (2) surgical mask: the loudspeaker diaphragm was covered with a standard disposable surgical mask, and (3) face shield: a face shield was placed in front of the loudspeaker’s diaphragm.
6. Addressing Face Mask Fogs
If you wear eyeglasses and have donned a face mask, you already know your breath will exit the face mask and fog up your glasses like a hot shower fogs up a bathroom mirror in the middle of winter. The use of a face mask may also fog up the clear window of a face mask, a face shield, or the lenses of a loupe used during cerumen management. Fogging can be prevented with these ingenious solutions.

First, try rubbing a drop or two of dish soap on your lenses or shield and then wipe it away with a dry cloth. Second, rub shaving cream across the lens or shield and then wipe it away. Third, go online to search for anti-fogging sprays (Fog Gone works well) that may be used on lenses, face shields, and mask windows. Others suggest rubbing a soap bar or toothpaste across lenses or shields, but many experts warn against these strategies to avoid scratching and damaging the lenses or shields.

Finally, try inserting a folded facial tissue between the face and top edge of the mask. This may also absorb moisture and prevent fogging of glasses or shields (go online to look for a quick tutorial for this handy tip). Additionally, placing double-sided tape on the bridge of the nose and the cheekbones where the mask sits may keep the mask adhered to the face and stop the wearer’s warm, moist breath from exiting the mask and traveling to the lenses. Another solution is using a self-adhesive aluminum nose strip that may be stuck to a cloth mask so it adheres to the face. This option prevents the wearer from having to put tape on her or his skin. These strips are available online. Also, you can purchase lenses, shields, or mask windows that contain a polycarbonate or polyester film with anti-fog and scratch-resistant properties. Also, some online entrepreneurs have designed clear plastic masks with vents to disperse the fog.

5. Basic Communication Strategies
This pandemic highlights the importance of facilitating good communication strategies in the classroom. Now more than ever, teachers need to use clear speech including enunciate clear enunciation (without over-enunciating), avoid speaking rapidly, avoid chewing gum or sucking on candy while talking, minimize background noise as much as possible, and face the class while speaking (i.e., avoid facing the board while speaking; more tips from this white paper†). Teachers should also remember to repeat the questions and answers provided by other students in the classroom to provide a better opportunity for every child to hear peer comments.

Teachers must provide strategic seating for children with hearing loss. In traditional classroom settings, students with hearing loss should be seated near the teacher in an area with good lighting and minimal background noise. Small groups must be seated away from noise sources, such as heating and AC blowers, busy hallways, and outdoor windows, and individuals must maintain appropriate distance.

Frequent communication between teachers and parents of younger students will confirm the sufficiency of existing accommodations or the need for additional classroom services. Older students are encouraged to advocate for their school-based communication needs when additional support or modifications are required. To avoid singling out students with hearing loss, teachers can develop a silent communication system with the student to signal comprehension or misunderstanding. For example, some of the authors of this article have used a red and green card system wherein the student places a red card on his on her desk to indicate the need for assistance; the green card indicates comprehension. Through modeling and role play, parents and educators can help students use effective coping strategies to reduce anxiety and seek help during difficult or stressful situations.

This pandemic provides an opportunity to promote self-advocacy and determination training among students with hearing loss. Educators and hearing health care providers should ask children with hearing loss about the areas in which they are having difficulty. The Listening Inventory for Education (LIFE-R) or other checklists may be used to facilitate questions about students’ difficulties related to masks, physical distancing, remote learning, etc. Finally, to address increases in listening fatigue that may occur because of the pandemic, it may be helpful to schedule planned listening breaks throughout the day for both students and teachers.

4. Note Taking Considerations
New barriers created by masks, online learning, and physical distancing may require the reconsideration of the need for note-taking services. Having a note taker allows older students to focus on the lecture; a written script of the lecture is later
The Individuals with Disabilities Education Act (IDEA) is the primary federal program that requires public schools to address the needs of children with disabilities in educational settings. IDEA requires that the educational needs of children with hearing loss are listed in an Individualized Education Plan (IEP), which serves as a legal contract between the child, the child’s family, and the school to ensure the child’s access to services, technologies, and support required to meet her/his educational needs and goals.

If the necessary support is identified in the IEP, then the school is legally bound to provide that support for the child. Families should ensure that any COVID-related modifications are listed in their child’s IEP. It may be necessary to ask for a meeting to be scheduled to review the child’s goals and determine what additional supports (e.g., correct use of a remote microphone system, captioning, note taker, etc.) should be provided to ensure the goals are met despite the challenges created by the pandemic. The IEP meeting is also a good opportunity for the family to reiterate any special communication needs of the child. Of note, some children with hearing loss do not have IEPs because their school system claims the children do not have an educationally significant hearing loss that qualifies as a disability. In these cases, Section 504 of the Rehabilitation Act states that all agencies receiving federal funding must provide supports that ensure all individuals with disabilities have access to their programs. Section 504 may be used to ensure that students with hearing loss have access to accommodations such as captioning, note takers, interpreters, and hearing assistive technology.

If your patients do not have access to educational audiologists in their school settings, this is a great time to advocate for one. Educational audiologists work with teachers, administrators, students, and other school staff to help ensure that students’ equipment is working and providing access in the classroom (either in person or virtually) and to help identify and implement accommodations on IEPs and 504 plans.

1. Remote Microphone (RM) and Hearing Assistive Technology

It is well established that RMs are critical for children with hearing loss in education settings. This technology is even more important in this age of face masks and physical distancing and face masks, which reduce speech recognition by disrupting speech acoustics and visual cues. RM technology can improve speech recognition by as much as 60 percentage points or more in typical classroom listening situations. The considerable improvement in speech recognition provided by RM systems can help children with hearing loss overcome communication difficulties posed by face masks and physical distancing.

Rudge, et al., found that the use of a cloth face mask alone resulted in significantly poorer speech recognition than when not using a face mask. But when an RM system was used along with a cloth face mask, the listeners’ speech recognition improved to levels that were statistically similar to those when listening without a mask. RM systems continue to reign as the king of technological support for children with hearing loss in the classroom, especially during a global pandemic.

However, it should also be noted that Rudge and colleagues did find that the use of certain face masks, such as plastic masks that surround the face, reduced or eliminated the benefit

given to the student to review. For younger children, the script may be reviewed by caregivers or tutors at home. If needed, a note taker may also provide real-time captioning of the lecture.

3. Speech-to-Text Apps

The digital age has transformed the process of transcribing lectures and other types of audio communications in the classroom. Several apps provide real-time captioning of speech in live face-to-face and online situations (e.g., Google Live Transcribe for Android users, Otter for iOS users, Ava for Android and iOS users, etc.). Many of these apps may be operated on consumer tablets, computers, and mobile phones, making these services readily accessible to students in brick and mortar classrooms, online distance learning programs, small groups, and social situations. For example, multiple mobile phones or tablets (or a mobile phone and a tablet) may be digitally connected, and the speech received by one device may be wirelessly delivered to the other devices in the network (see Fig. 5). This network setup may be used in traditional lecture settings (i.e., teacher speaking directly to students) and in group settings (i.e., each talker speaks into a smart device equipped with a speech-to-text app that delivers the text message to one or every student in the group). Additionally, a wireless Bluetooth lapel or boom microphone may be paired with a mobile phone or tablet, and the signal captured by the microphone may be delivered to the tablet. If a remote microphone is not available, a unidirectional external microphone plugged into a portable device can also help enhance the speech input at a distance due to its more concentrated beam-forming capabilities compared with those of an internal device microphone. Moreover, many of these apps may be used to provide real-time captioning and transcription of speech signals via a computer or tablet during online classes (i.e., some platforms have integrated captioning or partner with companies to deliver this service). Finally, some apps allow students to save the transcript at the end of the session so they have a written record of the learning session.

2. Great IDEA

The Individuals with Disabilities Education Act (IDEA) is the

Figure 5. Speech captured via a Bluetooth microphone and delivered to a mobile device.
of RM use. This is likely attributed to the degradation of the speech signal by a non-porous plastic material that is not acoustically transparent. The researchers recommend the use of a face shield with a drape (similar to those mentioned in item eight of this article) to enable the use of visual cues and maximize RM benefits (learn more: https://bit.ly/33CPmb5). Of note, modern RM systems are small, lightweight, and comfortable when used with a Bluetooth microphone for digital speech-to-text as described in item three of this article. Moreover, RM systems and hearing assistive technologies can be used to wirelessly stream audio from computers or tablets directly to a child’s hearing aids, cochlear implants, or bone conduction hearing device when the child is participating in online distance learning. Most hearing aids and cochlear implants can be equipped with a program that allows the child to disable or reduce the sensitivity of the device microphone and focus his or her attention on the signal streaming from the computer or tablet. RM systems can be sanitized using a UV-C box and a disinfectant approved by the device manufacturer, and teachers can use their lanyard to reduce the spread of COVID-19. Information on sanitizing hearing devices is available online.11-13

As we strive to support children with hearing loss and their communication needs in educational settings, hearing health care professionals need to work together in utilizing all technologies and services at our disposal and sharing ideas and strategies that promote our patients’ successful listening and learning in the classroom and beyond during this pandemic.  
Editor’s note: Send feedback and ideas to hj@wolterskluwer.com or via Twitter (@HearingJournal and @audiosooner).

References for this article can be found at http://bit.ly/HJcurrent.