

# Challenges and Successes of an Audio-Technician Training Program in Guatemala

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## ABSTRACT

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Hearing healthcare outreach in developing countries is ill defined and inundated with sustainability challenges. One method to facilitate sustainable efforts is by training local personnel on certain aspects of hearing healthcare. The purpose of this descriptive study was to identify the challenges and successes of an audio-technician training program conducted in various regions throughout Guatemala. A collaboration was created between Healing the Children, Centro de Audicion, the University of Washington, and Gallaudet University to create a learning environment for Guatemalan audio-technicians and audiology graduate students. Administration of the audio-technician training component of this program began in 2008 and continues today. Challenges and successes were identified around five themes: (1) audio-technician recruitment and skills upon entering training program; (2) practical and logistical components of clinical training; (3) collaboration and resources for ongoing care; (4) funding for travel, time, and accommodation for personnel involved in training sessions; and (5) cultural differences surrounding our approach to hearing healthcare and training. Approaches to overcome the barriers identified and future directions are discussed.

**KEYWORDS:** Guatemala, audio-technician, global hearing healthcare

The incidence of hearing loss globally has reached alarmingly high levels, and has enormous economic and personal consequences, particularly in low- and middle-income countries.<sup>1</sup> Over 5% of the world's population has

disabling hearing loss, affecting 328 million adults and 34 million children.<sup>2</sup> Estimates suggest that permanent congenital or early-onset hearing loss is nearly double in developing countries compared with developed countries,

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and that 90% of individuals with hearing loss live in low- or middle-income countries.<sup>3,4</sup> Children in developing countries with untreated hearing loss suffer from impaired speech and language abilities leading to social isolation and limited schooling options. In addition, adults with hearing loss have higher rates of unemployment and have lower paying jobs compared with those without hearing loss. Therefore, the consequences of untreated hearing loss are far-reaching, particularly in developing countries.

Guatemala is considered an upper middle-income country (i.e., developing), where the gross national income per capita is between \$3,996 and \$12,375.<sup>5</sup> Accurate prevalence data of hearing loss in this region are sparse due to lack of population-based studies; however, in Latin America, various sources have estimated 6 to 27% of the population have hearing loss.<sup>3,4</sup> The lack of country-specific prevalence data fosters limited public and government awareness of hearing loss and subsequent consequences.<sup>6</sup> In many developing countries, resources for healthcare are limited and stagnant, despite rapidly increasing population sizes. Treatment for hearing loss competes against life-threatening illnesses such as heart disease and HIV/AIDS; therefore, treatment and prevention of hearing loss are not often a priority. Delays in diagnosis and treatment are prevalent, and have been attributed to social attitudes, local customs, and cultural bias.<sup>7</sup>

The primary intervention recommended by the World Health Organization (WHO) is the prevention of hearing loss and has been found to be highly effective. The intervention described in this program focuses on the secondary and tertiary interventions: to detect hearing loss at an early stage and treat it promptly; and to reduce the impact of an established hearing loss and improve communication function.<sup>1</sup> The focus of the program is on training for Guatemalan service providers and treatment for Guatemalan children identified with hearing loss. These priorities are consistent with recommendations by researchers for hearing healthcare outreach in middle-income countries<sup>3</sup> and with the most valued outreach service provision by 360 U.S. audiologists.<sup>8</sup> The goal of the program was to improve hearing healthcare accessibility by training local audio-technicians. Furthermore, the type of training program described attempts to overcome the so-

called brain-drain problem, where trained professionals migrate to higher income countries.

## PROGRAM HISTORY

For many years, Healing the Children provided various services in Guatemala (e.g., ophthalmology, neurology), in collaboration with a local pediatric foundation called "Guatemala Pediatric Foundation" (Fundacion Pediatrica Guatemala). Starting in 2001, the fourth author, an audiologist, accompanied an otolaryngology team, and provided diagnostic and fitting services for several years. During this time, a Rotarian group in Guatemala City requested audiological services in Petén, a northern part of the country. With funding from the Guatemala City Rotary Club, a team led by the fourth author took 100 hearing aids to Petén in 2005 for 4 days of clinic. The need for services was obvious, with 100 kids in line to be seen on the first day of the clinic. Two individuals from Petén (a male security guard and a female kindergarten teacher) volunteered to assist during this trip. The audiology team trained the volunteers to troubleshoot hearing aids and distribute batteries to the children (provided by the audiology team) when needed. The fourth author enquired whether the volunteers had a desire to learn more about hearing healthcare. After agreeing to this, the audio-technician training program began.

Observing that in-country follow-up care was a critical component of hearing outreach programs, the fourth author sought out the only audiologist in the country, Dr. Patricia Castellanos, AuD, owner of Centro de Audicion in Guatemala City. The goal was to discuss culturally appropriate approaches to continue serving the rural population of Guatemala, including enlisting others to train as audio-technicians. Over the subsequent years, audiology teams returned to Guatemala annually to provide additional training and clinical services, traveling to various locations for onsite training, and recruiting more audio-technicians (see Table 1). Dr. Castellanos stored the team's equipment at her office and supplied office staff to travel with the teams. These individuals assisted with earmold impressions, audiometry, and hearing aid fittings.

Another critical group associated with the success of this program comprised university

**Table 1 Descriptive Data on Outreach Trips Taken to Guatemala over the Length of the Program**

Year	Service & Training Teams	Audio-technicians	Evaluations	Children fitted with aids <sup>a</sup>	Locations
2003	1	0	230	43	Guatemala City
2004	2	0	300	90	Guatemala City
2005	2	0	297	183	Guatemala City, Santa Elena, San Andres
2006	2	3	478	210	Guatemala City, Santa Elena, Zacapa
2007	2	4	378	129	Guatemala City, Morales, Puerto Barrios, Poptun, Santa Elena, Zacapa, Quezaltenango
2008	2	6	685	145	Morales, Pt. Barrios, Poptun, Santa Elena, Zacapa, Quezaltenango, Coban
2009	2	6	448	162	Coban, Morales, Pt. Barrios, Poptun, Santa Elena, Quezaltenango, Zacapa
2010	2	8	751 <sup>b</sup>	140	Morales, Santa Elena, Quezaltenango, Zacapa, San Lucas Toliman, San Marcos
2011	2	8	475	154	Morales, Santa Elena, Zacapa, Puerto Barrios, Monterico, Quezaltenango, San Marcos
2012	2	10	786	149	Morales, Santa Elena, Puerto Barrios, Quezaltenango, San Marcos, Quiche
2013	1	14	125	84	Morales, Santa Elena, Puerto Barrios, Poptun
2014	1	14	216	77	Quezaltenango, San Marcos, Retalhuleu, Salcája
2015	2	14	666	99	Huehuetenango, Quezaltenango, Retalhuleu, San Marcos, Salcája
2016	2	14	1075	249	Huehuetenango, Quezaltenango, San Marcos, Tumbador, Retalhuleu, Morales, El Estor
2017	1	16	250	64	Panjachel, Solola, Santiago, San Lucas Toliman, San Juan La Luguna
2018	2	17	849	94	Panjachel, Santiago, San Lucas Toliman, Puerto Barrios, Morales
Total	28	20 <sup>c</sup>	7258	2072	

<sup>a</sup>Includes binaural and monaural hearing aid fittings.

<sup>b</sup>300 school screenings.

<sup>c</sup>20 individuals.

graduate (AuD) students. The first U.S. student joined the team in 2010, attending a surgical trip as an undergraduate student. Her passion for the work motivated her to return to Guatemala several years later to provide additional training and to complete a research project on aspects of hearing aid orientation in rural Guatemala. In 2014, other students and faculty members from the University of Washington (UW) were recruited.

Thus, the first U.S. student team traveled to Guatemala to serve the community, which developed into an annual trip primarily focused on training. Various UW audiology faculty and community audiologists have served as supervisors, including the first and second authors. During this same period, the third author took a leave of absence from her job at a children's hospital to travel to Guatemala to improve her

Spanish skills. Dr. Castellanos connected the third author to our team and she has been returning regularly for both training and surgical trips, and has included students from the AuD program at Gallaudet.

## PROGRAM OVERVIEW

A total of 20 audio-technicians have been trained to various degrees across Guatemala in 10 service locations. As a result, over 7,000 children have had their hearing evaluated, and over 2,000 children have been fitted with hearing aids (see Tables 1 and 2 for details). Over the years, 23 audiologists and 25 students have volunteered their time and expertise to the program. In its current form, the program typically consists of two teams traveling and serving in Guatemala each year. Being mindful of holiday and school dates, the first team typically serves in August with a primary focus on training audio-technicians. Secondary purposes include treating permanent, mild to severe hearing loss with amplification, education/counseling, and identifying potential patients eligible for surgery. The training trips are 1 to 2 weeks in length with approximately 8 weeks of prior preparation for the graduate students. The preparation curriculum consists of readings on global hearing healthcare and information on Guatemalan culture (e.g., a guest lecture from Guatemala). Specific details on the background and audiology skills of the audio-technicians they will be training are provided (e.g., level of audio-technician when skills were last assessed). Safety and precautions (e.g., immunizations, communication, emergency procedures); logistics of clinic and training days (e.g., locations, training focus, and methods); and creating laboratories and curriculum for teaching audio-technicians are also discussed. Additionally, significant effort is devoted to fundraising (e.g., silent auctions, online donations, special events) for audio-technicians' travel and accommodations.

During a typical training trip, a combination of methods is used including didactic lectures with laboratory-based instruction (~30% of the 1–2-week trip), and clinic-based instruction while serving the community (~70%). Often the first half of the day would be spent serving children and in clinical training, and the latter part of the day would be spent in laboratory- or lecture-based training. Graduate students would

be matched with local audio-technicians and conduct training sessions, while audiologists would supervise. The focus of the training was specific to the skill level of the audio-technician, yet was designed to be flexible and based on an array of topics. Hearing aid troubleshooting was broad; however, fittings focused on the Resound Match (Ballerup, Denmark) behind-the-ear product, a digital trim-pot device available in three strengths, which were purchased through the International Hearing Aid Purchasing Program (Oklahoma City, Oklahoma). This product was combined with SureFire (Fountain Valley, CA) earmolds for fitting children, and referrals to the nearest clinic for impressions and permanent earmolds were provided. Hearing aid orientation and counseling was conducted with interpreters, sometimes in a group format, and always accompanied by written material with pictures and straightforward language. Names and contact information for all children seen were given to local audio-technicians for follow-up.

The second team typically serves in November with a focus on surgical treatments for those patients identified by the training team. Students from the United States mainly participate on the training team, although some have also participated on the surgical team. Students prepare for surgical trips by planning laboratory activities and reviewing lectures so that they are prepared to provide training for the technicians as time allows. Technicians have a unique opportunity to better understand ear disease not only during lectures, but also by observing surgery when possible. While the surgical visits are an important part of serving the Guatemalan community, the focus of the remaining portions of this article is on the successes and challenges of the audio-technician training component of the program.

The purpose of this descriptive study was to document and reflect on the training model used in the program, and to identify areas of consideration for future programs. Five themes emerged upon our reflection of the program: (1) audio-technician recruitment and skills upon entering training program; (2) practical and logistical components of clinical training in these environments; (3) collaboration and resources for ongoing care and training; (4) funding for travel, time, and accommodation for personnel

**Table 2 Demographics of the Guatemalan Audio-Technicians Recruited to the Training Program**

Number	Year Joined	Age	Gender	Location	Education Level	Background
1	2006	48	F	San Benito	High School	Kindergarten Teacher
2	2006	unknown	M	San Benito	unknown	Security Guard
3	2007	47	F	Morales	University	Speech-Language Pathologist Technician/Aid
4	2008	50	F	Xela	University	Linguistics
5	2008	44	F	Puerto Barrios	University	Deaf Educator
6	2009	35	M	Morales	University	Teacher
7	2012	25	F	San Marcos	University	Deaf Educator
8	2012	unknown	M	San Marcos	unknown	Deaf Educator
9	2014	56	F	Xela	University	Unknown
10	2014	40	F	Xela	University	Physical Therapist
11	2014	unknown	F	Retalhuleu	unknown	Deaf Educator
12	2015	unknown	F	Huehuetenango	University	Physical Therapist
13	2015	30	F	San Marcos	University	Deaf Educator
14	2017	unknown	M	San Lucas Toliman	unknown	Audiometric Technician
15	2017	26	F	Solola	University	Audiometric Technician
16	2017	40	F	Nebaj	University	Teacher
17	2017	43	M	Nebaj	High School	Teacher
18	2018	unknown	M	Mazatenango	unknown	Hearing Aid Dispenser
19	2018	33	F	Mazatenango	University	Hearing Aid Dispenser
20	2018	unknown	F	Antigua	unknown	Speech-Language Pathologist Technician/Aid

involved in training sessions; and (5) cultural differences surrounding our approach to hearing healthcare and training. The subsequent sections discuss these themes in detail, followed by identifying areas of further development for future international service programs.

## REFLECTIONS ON THE AUDIO-TECHNICIAN TRAINING PROGRAM

### Audio-Technician Recruitment and Skills

Finding willing-to-train audio-technicians in Guatemala has not been difficult (see Table 2 for demographics). Many audio-technicians come from allied health professions (e.g., physical therapy) or with teaching backgrounds and are strongly motivated to gain additional skills. Commitment to training is high, with most technicians returning annually for additional

training with little persuasion (note that fundraising covers the costs associated with travel to/from training sites, accommodation, and meals for audio-technicians). Most audio-technicians possess high levels of interpersonal and verbal skills. Therefore, communicating with patients, families, and trainers is a skill most audio-technicians have already mastered.

While audiology students in developed countries enter graduate programs with strong foundational knowledge, on which the depth and breadth of audiologic training continues, this foundation may not be the case in training programs designed for individuals in developing countries. One challenge to the program has been consistently recruiting audio-technicians with advanced analytic/quantitative skills. This challenge becomes evident when masking is introduced, and later when hearing aid gain and output rules are discussed. Currently, recruitment is conducted by word-of-mouth

and screening of interested candidates is not performed; however, a screening test could be implemented with similar programs in the future. Alternatively, the training program could be adapted to suit the skills and motivation of the audio-technician.

### **Practical and Logistical Components of Clinical Training**

The nature of clinic days on service trips is different from typical clinic days in the United States: all patients show up at the same time (first thing in the morning), and equipment is distributed into stations to facilitate easier flow of patients and clinical training of technicians (e.g., case history, otoscopy/cerumen management, immittance, audiogram, hearing aid fitting, orientation/counseling). Furthermore, instructors have only 1 to 2 weeks to teach content and due to these differences, approaches to supervision and clinical training have varied over the years in an effort to find effective teaching methods. One advantage of pairing training with clinical service days was there was no shortage of available patients. In addition, having equipment set up in different rooms was conducive to laboratory-based learning conducted in the afternoons, without spending time hauling equipment by hand (and sometimes by boat) to locations of adequate size to accommodate a large group for training.

One challenge was whether to aim for broader versus deeper learning given the limited time. Some sessions would keep audio-technicians at one station all day (or a half day), which facilitated deeper learning on that particular skill. Other times, audio-technicians were assigned to one patient at a time and completed all stations to practice integration skills. Benefit was noted for both types of teaching; however, the limited amount of time to see all of the patients in a day (and over 100 patients waiting on some days) with extra time needed for translation meant that most often audio-technicians followed up one patient at a time, conducting all testing. In other words, sometimes efficiency outranked effectiveness in these situations. U.S. students remained at one station each day, providing training and support to audio-technicians as they rotated through. An audiologist would review the case

with the audio-technician at the completion of the stations, asking questions to assess skills and treatment decisions. Providing structure and content to facilitate integration of patient test results was then incorporated. This component proved effective in determining an audio-technician's level of understanding and skills, which provided a basis for future training.

Other major challenges associated with time include the following: limited time spent with audio-technicians (i.e., 1–2 weeks a year); limited volunteer time to develop robust audio-technician training curriculum and evaluation; and time needed to translate between languages. The frequency of training leads to limited progress in skill level year to year in the program. Slow progress between levels occurred even when providing audio-technicians access to online curriculum for foundational framework. Even if the learning goals are very specific for a given audio-technician, sometimes 1 to 2 weeks was not enough time for skill mastery. Pairing an advanced audio-technician with a beginner technician was helpful in eliminating time to translate information. Some audio-technicians have received additional training by Dr. Castellanos at the Centro de Audicion, which has been valuable in reducing training time by our team and in overcoming cultural differences, and thereby establishing in-country networks for support.

A gold standard does not exist for training audio-technicians in developing countries. Therefore, our team often questioned the breadth of skills that should be taught and mastered. Also questioned were the order of skills that should be introduced at a given time. While one may consider training of an audio-technician to be similar to that of an audiology assistant in the United States, there is only one audiologist in the country, located in Guatemala City, who is inaccessible to many individuals in the training program. To that end, the breadth of skills taught in our program has been more comprehensive than those of an audiology assistant. Where to draw the line regarding skills taught has been a topic of much discussion; in particular, whether an audio-technician should be fitting hearing aids. For example, hearing aid test boxes and verification techniques are taught as part of this program, once other skills have been mastered. However, real ear techniques have not been part

of the curriculum and instead verification is performed in a coupler using simulated real ear with age-corrected real ear-to-coupler differences. The reasons for this decision include weighing the risk of error (in performing the technique and in hearing threshold values) to the risk of benefit in outcomes, as well as the high cost of probe tubes.

Regardless of where the line is drawn, the order of milestones in achieving each skill needs to differ from those in the United States. For example, a U.S. student may learn masking in a one-semester class and practice mastering those skills over 1 to 2 years while learning other skills at the same time. In other words, a U.S. student may be at different levels for several skills at any given time, which is accepted and is expected that the student will master these skills by the end of their 3- to 4-year training program. For Guatemalan audio-technicians, a better approach may be mastering one skill at a time (e.g., learn otoscopy only in first year, then learn air-conduction testing the following year). It was noted that those who used the skills in their daily profession were much more likely to advance through levels over the years than those who did not use the skills as often in their daily professional lives.

Finally, formal evaluation of clinical skills has been difficult to assess. Without an approved clinical exam for audio-technician training, the authors attempted to adapt U.S. clinical evaluations from two academic programs (UW and Gallaudet). Individuals often remained in the beginning stages of the evaluation for years, as mentioned previously. Evaluation of skills was made more complex due to language barriers, including the impossible use of "eavesdropping" to appraise skills without a full-time interpreter per audiologist. Over time our program found that case-based questioning with an interpreter following the completion of all stations was an effective and efficient means of evaluation. In addition, one-on-one interviews were conducted with each audio-technician at the end of the training trip to reflect on what was learned and to set the stage for future learning. This, however, was time consuming and deemed not practical for each training trip. In contrast, the opportunity to provide feedback may allow audio-technicians to feel greater ownership over their own learning and should be considered.

Over the years, training has shifted from traditional lectures to more individualized training to maximize the efficiency of the training program. While U.S. audiology students also vary in skill levels over their programs, time is not a luxury for audio-technician training. Therefore, we have proceeded with meeting the needs of each individual audio-technician and advancing them further each year. Based on informal feedback gathered from the technicians, a variety of learning styles and preferences for how material is presented was noted. For some technicians, more case studies were provided; others noted interest in one-on-one tutoring, while others requested more written material.

### Resources for Ongoing Care

While a network of skilled individuals exists in Guatemala, both through our audio-technician training program and the Centro de Audición and satellite locations, proximity to rural patients remains an unsolved problem. Furthermore, it can be difficult to contact individuals in rural regions who may not have access to phones and email, making follow-up care and outcome measures difficult to conduct. Given the proximity of Guatemala to the United States, it is a country that has been served by several other organizations providing hearing healthcare; therefore, follow-up and troubleshooting could be coordinated and take place at these visits. An improved network for communication among various teams traveling to similar regions would be valuable for many reasons (as recommended by the WHO), including providing additional training to audio-technicians and maintaining better continuity of care for patients. In addition, due to the volunteer aspect of the team, documentation practices could be enhanced by improving systematic communication between each team.

One success for our program was the transition of pediatric skills learned by audio-technicians to providing services to adults. Five of the audio-technicians (covering three sites) have transitioned into making hearing healthcare their full-time career by providing diagnostics and hearing aid services to private paying adult clients, thus creating earning opportunities. In addition, three individuals work part time as audio-technicians

through their primary employer. All eight of these technicians are provided with new hearing aids to fit on children, with the expectation that families will be charged a small fee for batteries and services. For adults, technicians purchase new aids to sell. These established sites are evidence of the sustainability of the training program (albeit, not 100% self-sustaining), and have increased the networks required to meet the needs of Guatemalans with hearing loss.

### Funding

As is true for most outreach programs, funding continues to be a challenge, despite the annual success. The needs for funding a training and service program such as this one include finding sources for hearing aids, earmolds, related supplies and materials, ongoing care; equipment and maintenance, audiologist's time preparing students; and travel/accommodation/meals. It is possible that individuals are also losing salary/vacation if taking time out from another job to serve.

Despite the high need for funding, this program has been well supported by Rotary for equipment and supplies through district and international grants. All audio-technician locations have received equipment supported by Rotary donations, including audiometers, video otoscopes, tympanometers, and hearing aid test boxes. U.S. students also undertake a significant amount of fundraising (\$6–8,000), which first goes toward supplies and audio-technician training, followed by supporting their own travel.

### Cultural Differences

Cultural differences have played a role in the logistical and practical aspects of training. Language barriers are an obvious challenge, with interpretation adding time and unintended semantic effects to training. Finding interpreters with a high level of proficiency in both languages is difficult, and clarifying the intended message uses valuable training time. In rural settings, interpretation would occur across three languages (e.g., English, Spanish, and an indigenous language). In addition, accepting criticism or feedback from a person who is from

a different culture could be met with resistance and meaning could be misinterpreted.

It is also possible that the logistics of the training trips conflict with cultural norms for either traditional work days and or holidays. Typically, the training and service days involve long hours and hard work, followed by lengthy team dinners with evening training, often resulting in 12- to 14-hour workdays. Mental and physical fatigue has become a concern as technicians are often traveling to attend a clinical training week and subsequent weekend courses, then returning to their families and home life responsibilities with little downtime. While not directly communicated, at times it appeared that the audio-technicians, students, and faculty needed more of a break during the day, due to the stress of having many children waiting for care while learning (audio-technician/students) and instructing (students/faculty). Trainings are typically organized by the audio-technician in the region where the training takes place, resulting in the local technicians being pulled away from training time to address logistical questions or other work responsibilities. Along these lines, the educators have assumed the best method of training without considering cultural differences that may exist in the nature of training programs in general.

Pairing audio-technicians between advanced and beginner trainee was immensely valuable for many reasons. First, cultural nuances of training and interpretation time could be reduced. Second, it fostered a local network of trusted resources for audio-technicians which resulted in training between parties during other parts of the year. Third, the pairing approach facilitated confidence in the advanced technician's abilities. It was found that cultural differences surrounding the training program would potentially be identified and reconciled faster within this trusted network.

### CONSIDERATIONS FOR FUTURE INTERNATIONAL SERVICE PROGRAMS

Although the need for audiology services in developing countries is well documented,<sup>1–4,9</sup> developing best practices and the logistics of implementing such projects is more challenging given the uniqueness of each program and

country. The hearing healthcare outreach program in Guatemala has been defined by key elements the team considered crucial in establishing the structure of the program. These elements can serve as a framework for any group considering similar international service projects, and fall under the broader categories of local engagement, program goals, and sustainability.

### Local Engagement

For any program to be successful, engagement and commitment by local providers is key. This project reflects local engagement across a broad spectrum of individuals as well as regions of Guatemala. The audio-technician training program began with individuals in rural areas expressing interest and motivation in learning more about audiologic care. Local technicians and Dr. Castellanos have continued to work to expand and enhance audiologic services throughout the country. Other training programs have been successful in large part due to local engagement.<sup>10</sup> Local individuals involved in the program help the international team navigate local cultural and political realities. For example, although Guatemala is a Spanish-speaking country, the primary language for many in the rural areas is not Spanish and many individuals may not be able to read. Consideration of how to best communicate with families is a crucial element. An international service project needs local commitment for the continuity and for the foundation of any lasting training program.

### Program Goal

Maintaining a clear definition of the program goal is essential to determine the scope of didactic and practical training. The Guatemala audio-technician training program has been defined by its primary purpose of training local individuals with basic audiological and amplification skills, with a secondary purpose of serving Guatemalan children. Audiologists often made decisions on how to spend time during a busy clinic day based on the training goal of the trip, and not necessarily the community service component. For example, if the U.S. student or audiologist performed the evaluation, more

children could have been served, yet would have detracted from the audio-technician's training. Therefore, keeping the purpose of the training program in the forefront is essential as the team identifies approaches and content to be taught. Many factors such as time and budget constraints can ultimately dictate the curriculum and program structure.

### Sustainability

Another key element to consider for all international programs is the topic of sustainability. It is widely recognized that providing services—whether diagnostic or treatment—without in-country resources for follow-up is problematic. Many humanitarian projects operate in areas for which there is no recognized audiologic profession. The Guatemalan training program was designed with the goal of sustainability as a key element. The identification of local individuals interested in providing follow-up care to children receiving hearing aids was foundational in creating a sustainable program. As indicated earlier, the most recent training sessions have focused on helping experienced technicians become mentors to less experienced individuals (i.e., a type of train-the-trainer program).

Additional aspects of sustainability are funding and staffing. With the partnership between two university programs, the Guatemala training program has been able to sustain consistent staffing with faculty and students for several years. Students have benefitted from learning about international service programs and increased cultural awareness while providing significant time and energy toward fundraising. Nonetheless, even this model will bear some stress, as it is difficult for individuals to commit the time for extensive trip preparation and travel on an annual basis. Furthermore, while this program has been well supported financially, the sources are not guaranteed, nor is the program financially self-sustaining. A plan should be built into any international service program for continuity both in-country and from the program developers.

### AREAS FOR FUTURE STUDY

While feedback from the technicians has been positive, many technicians have expressed a desire

for ongoing training, and our program has not been evaluated for efficacy. Areas for future research could include partnering with a public health professional to evaluate what is working well and what changes could be made to better meet the needs of the technicians and patients in Guatemala. Furthermore, as suggested by others,<sup>1</sup> a program for the prevention of hearing loss could significantly reduce the burden experienced in Guatemala. Another fundamental area is identifying children with hearing loss earlier, so as to maximize the critical period of speech and language learning. With this in mind, the fourth author in collaboration with Dr. Castellanos obtained the Rotary International Grant to start a newborn screening program in 2018. This grant provided equipment, tracking, training, and supplies for newborn hearing screenings in three centers. So far, more than 2,000 infants have been screened, with 10 diagnosed with hearing loss, fitted with hearing aids, and referred to a center for early intervention. An additional Rotary grant application is being prepared to expand screening and identification throughout the country.

## CONCLUSIONS

The audio-technician training program in Guatemala has experienced many successes in regard to clinical training, sustainability, and children served. We found the greatest success with involving audiology graduate students, making valuable connections with local resources (e.g., local audiologist and Rotary Clubs), pairing audio-technicians between advanced and beginner learners, and using a highly individualized training approach. Key factors that could improve success would be greater local input on cultural and language barriers of the training program itself, sustainable funding, creative ways to implement follow-up services, and resources to conduct epidemiological studies to evaluate the outcomes of the program.

## CONFLICT OF INTEREST

None declared.

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