



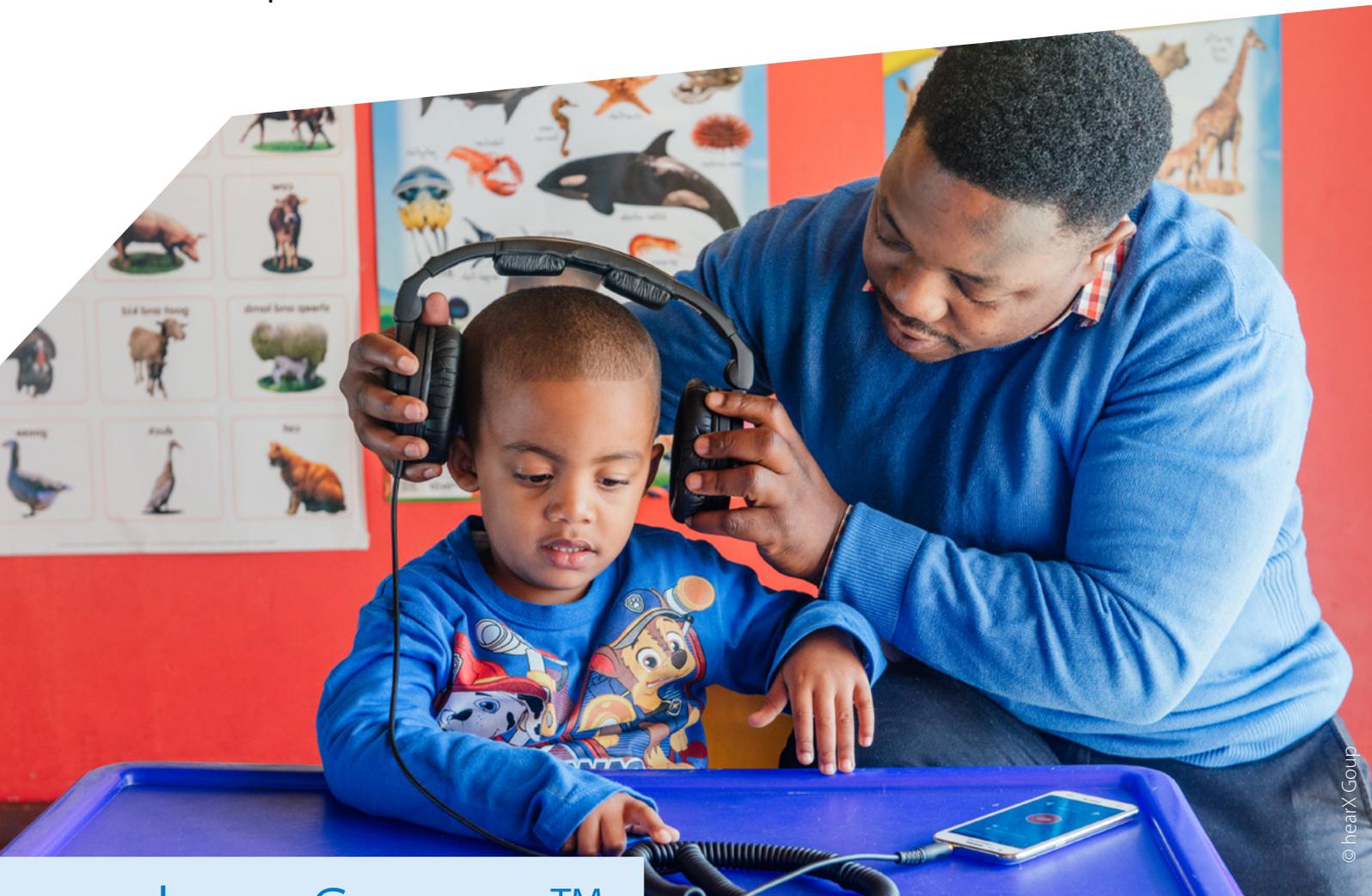
United Nations  
Educational, Scientific and  
Cultural Organization



Sustainable  
Development  
Goals



Pearson



© hearX Group

# hearScreen™

## Case study by UNESCO-Pearson Initiative for Literacy



**Name**  
hearScreen™



**Location**  
Screenings deployed in 21 countries and currently operating in South Africa, Ethiopia, Philippines, Tanzania, Malawi and Botswana



**Implementing organization**  
hearX Group



**Year launched**  
2015



**Focus of intervention**  
Improve detection of hearing loss among underserved communities



**Reach**  
Over 35,000 users in currently active programmes

## Summary

Globally, 360 million people, or more than 5 per cent of the world's population, suffer from disabling hearing loss, with the greatest prevalence in the Asia Pacific and sub-Saharan Africa regions (WHO, 2013). However, many developing countries have very little awareness of hearing impairment and limited resources to implement screening campaigns. The World Health Organization (WHO) (2017) estimates that unaddressed hearing loss poses a global cost of 750 billion international dollars each year.<sup>1</sup> From a developmental perspective, unidentified hearing problems present a real barrier to effective learning. Hearing impairment among children often leads to delayed language development and other socio-emotional limitations (WHO, 2017). Such factors can have an adverse effect on educational achievement, preventing learners from completing their schooling.

hearScreen™ aims to improve hearing screening and early detection services among children and adults, especially for underserved communities. The solution was developed as an inexpensive alternative to conventional screening methods, with specific applications to school-based administration. hearScreen™ has been shown to cut traditional screening costs by 50–70 per cent, and can be administered by non-specialists and screeners with even basic literacy and low digital skills (Pascarel and Coetzer, 2017).

hearScreen™ was officially launched in 2015 in partnership with the University of Pretoria in South Africa, and has been deployed in over twenty countries. The service operates as an application on a smartphone or tablet device, and had been administered to over 35,000 individuals by June 2017.

<sup>1</sup> An international dollar is a currency unit defined by the World Bank as a value that would buy in a given country goods and services comparable to the amount a US dollar would buy in the United States.

## ABOUT THIS CASE STUDY

Through the UNESCO-Pearson Initiative for Literacy: Improved Livelihoods in a Digital World, this case study is part of a series highlighting how inclusive digital solutions can help people with low skills or low literacy levels use technology in ways that support skills development and, ultimately, improve livelihoods – in contribution to achieving the Sustainable Development Goal on education. For more information go to [en.unesco.org/themes/literacy-all/pearson-initiative](https://en.unesco.org/themes/literacy-all/pearson-initiative).

## Why selected

The hearScreen™ digital solution demonstrates how people with even basic literacy and digital skills can be participants in community health support through the use of inclusive digital solutions. Furthermore, incorporating quality control mechanisms in the solution and the programme administration is key to such participation.

## Key takeaways

- 1 / hearScreen™ offers a practical response to the growing demand to detect and support hearing impairment in underserved communities through technology.
- 2 / Rigorous validation through clinical testing helps improve the credibility of alternative technologies in comparison with conventional methods.
- 3 / HearX Group recognizes the importance of local and global partnerships for service expansion.

## Context and project origins

*In 2015, over 1 billion people were affected by either moderate or greater hearing loss, placing it as the second most prevalent impairment (GBD, 2016).<sup>2</sup>*

*In developing countries, early [hearing] detection services are inaccessible to the vast majority of people because of the prohibitive costs and lack of trained personnel.*

In many developing regions of the world, it is difficult for people to access health professionals and obtain care related to their hearing because such professionals are scarce and/or inaccessible.

A 2009 survey of ear, nose and throat (ENT) services in Africa confirmed the scarcity of health care providers across eighteen countries in sub-Saharan Africa (Fagan and Jacobs, 2009). Many countries across the region have just one audiologist for every million people, while South Africa has 2.4 audiologists for every 100,000 people, on average (ibid.). By contrast, the United Kingdom has 16.4 audiologists per 100,000 people. This study has since been repeated, and almost ten years later little had changed in terms of health professional accessibility (Mulwafu et al., 2017).

In South Africa, the 2012 Integrated School Health Policy mandated universal screening of hearing for all school children, but implementation has been low because of the lack of equipment and trained staff. The plummeting costs of technology and increasing demand for specialists to diagnose non-fatal conditions such as hearing impairment provide an opportunity to leverage new resources to improve access to, and increase the impact of, hearing care services.

hearScreen™ is one response to this opportunity. The application-based platform features accurate headphone calibration according to industry standards and is administered using low-cost smartphone devices. Built-in control features such as ambient noise monitoring, automated administration protocol and interpretation offer an easy to use solution for screening practices. The integration of a cloud-based data management and surveillance platform provides detailed reporting of programme efficacy and of referrals of patients to service providers. The mHealth Studio Cloud SYNC feature allows devices to operate without an internet connection and then upload stored patient and facility entries once connectivity is restored.<sup>3</sup> Built-in GPS positioning facilitates the identification of nearby professional health providers to provide quick patient referral when follow-up care is needed.

<sup>2</sup> Classified as hearing loss greater than 20 dB (GBD, 2016).

<sup>3</sup> A description of mHealth Studio Cloud can be retrieved from <https://hearxgroup.com/mhealth/>

Recently, hearScreen™ has partnered with Peek Vision to allow joint sensory screening for hearing and vision.<sup>4</sup> This combined sensory screening platform offers a complete e-health solution for detecting hearing impairment and vision loss in communities with a limited prevalence of professionally trained care providers.

As a low-cost solution, hearScreen™ is well suited to improve community-based screening practices using minimally trained health workers (Swanepoel et al., 2014). As of June 2017, more than 35,000 hearing screenings had been administered across twenty-one countries, and there were plans to expand globally. hearScreen™ projects are funded through various sources including direct grants, subgrants and self-funded programmes. The total development cost for the prototype of the digital solution was around US\$100,000 in 2014.

<sup>4</sup> Peek Vision website: [www.peekvision.com](http://www.peekvision.com)



# Designing with the user

hearScreen™ was designed with two main demographic bases in mind. The first concerns its patients, who are intended primarily to be children and adults from underserved communities, with hearing impairments that would otherwise go undetected. The second involves its staff. hearScreen™

targets local community members and health workers to act as screeners and administer the exams. Importantly, hearScreen™ was designed to employ screeners who have no formal training or background in audiological conditions and services.



© hearX Goup

**1 / Patients.** Patients can use the service regardless of their reading proficiency. hearScreen™ operates in communities where English is used as a second or third language and digital literacy is low.

**2 / Screeners.** The profiles of screeners vary in different countries, contexts and projects. Most screeners come from low-income communities in both rural and urban settings. The application interface has some text and text inputs, so screeners must have a basic proficiency in written English. Screeners can easily navigate the application with the automated testing protocols and response prompts built into the software design. This automation process facilitates the use of hearScreen™ among community health workers and expands the reach of the service to communities without trained audiologists. Further, basic patient and facility details can be pre-loaded while the screener selects between easily identified yes/no icon prompts. Adapting the software to the literacy context in the communities where it is administered is one of the major strengths of hearScreen™.

*Screeners require no prior audiological training, knowledge or skills as hearScreen™ incorporates automated testing protocols and interpretation of results.*

The digital solution is implemented in partnership with local governments, non-governmental organizations (NGOs), and schools and organizations that have existing relationships with the communities. The hearX Group supports implementation by assisting with the service design and by coordinating training efforts.

hearScreen™ is accompanied by a full step-by-step user manual. The hearX Group also provides telephone and email support by experienced personnel. The user design requires only a basic level of literacy and digital literacy, so that screeners can switch the phone on and off, select the application, enter user information and enter yes or no responses through visual icons. The initial pilot studies of the hearScreen™ prototype were conducted among student groups at the University of Pretoria, South Africa. Based on the prototype, the project team conducted interviews among the users to understand their experiences and perceptions of the smartphone-based screenings.

Informed by findings from the pilot activities, hearX Group updated the software to automatically select adult or child protocols based on date of birth to avoid any possible errors in administration. Other updates included disabling the option of cancelling a rescreen prompt or exiting the application during a rescreen, and adding pop-up notifications to inform the screener when rescreening is required. After applying the updates, clinical tests confirmed that the hearScreen™ platform performed to the same standard as conventional audiological screening methods (Swanepoel et al., 2014; Mahomed-Asmail et al., 2015).

hearScreen™ screeners are recruited from local communities to help enhance the patient experience. This produces screeners who relate well to the patients, understand their cultural contexts, and communicate in their local language. Partner organizations often assist in the recruitment process by recommending individuals they have worked with or by helping spread the message in the community. Recent studies concluded that the hearScreen™ application effectively enables minimally trained community health providers to provide time-efficient administration of hearing impairment detection (Yousuf Hussein et al., 2015; Louw et al., 2017).



## The digital solution

hearScreen™ operates on Android-based smartphones or tablet devices, and delivers the screening via calibrated headphones. The application interface includes input controls, date and search fields, checkboxes and toggles that allow the screener to accurately record the patient and facility data. Once the screener has started the application, icons and tooltips are presented to

assist them in navigating contextualized information based on the test component results. The screeners indicate the patients' responses by selecting from the yes/no response options provided. Throughout the application, graphics and images supplement the text to assist screeners who have a low level of literacy (Figure 1).

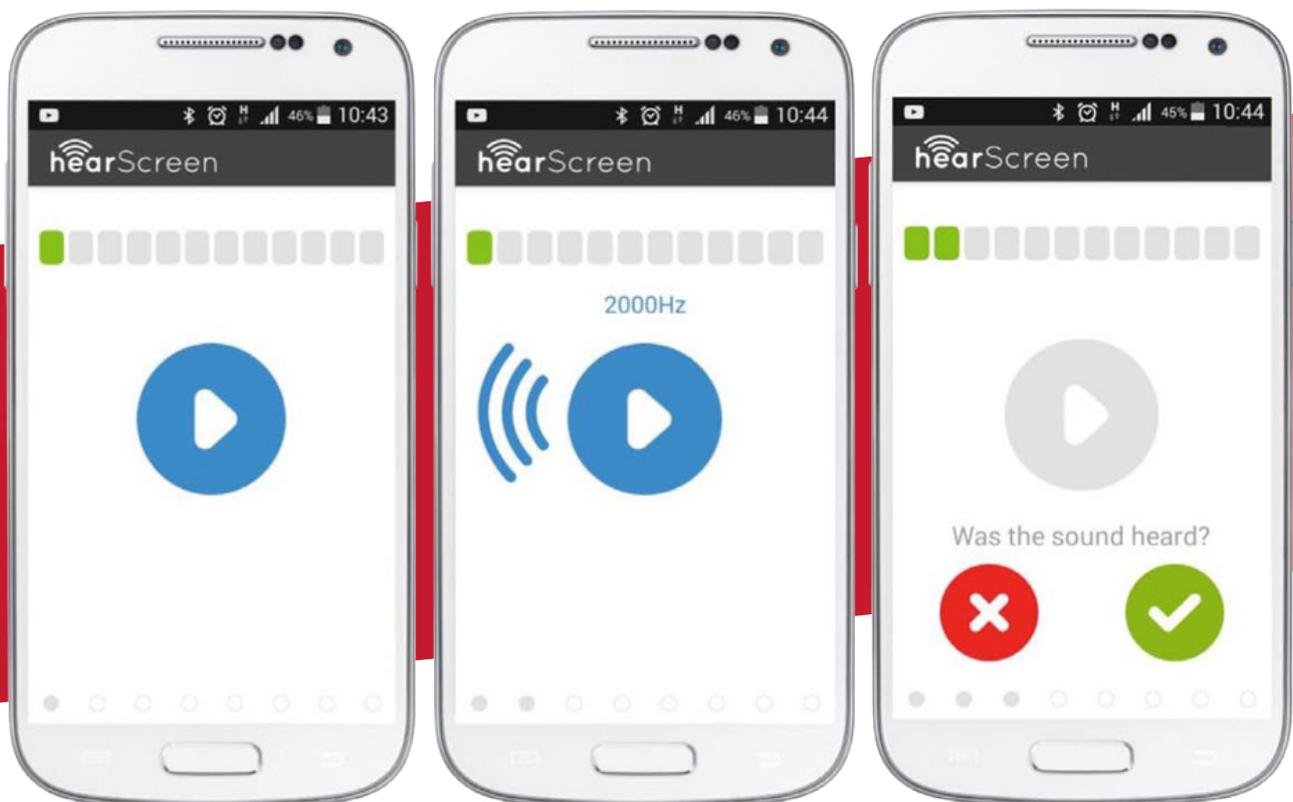


Figure 1. hearScreen™ screener interface

Test administrators undergo basic audiology training prior to using the digital solution, to ensure they understand the concepts specific to hearing screening. The training covers test procedures, delivering instructions to the patient, conditioning the patient to respond when they hear a sound, noise monitoring, and communicating the results to the patient.

During the exam, the screener explains the procedure to the patient in their mother tongue, selects the icons to begin the automated protocol, and records the patient's responses. The application analyses the responses and reports either a pass (with no further action required) or a fail, with referral options (Figure 2). When a referral is recommended, hearScreen™ can provide information on the nearest clinic. Screeners who are learning the screening process typically work in pairs so they can assist each other. Each group of screeners also has a team leader who supports them and monitors their screening quality index, which gives an objective measure of their screening performance.

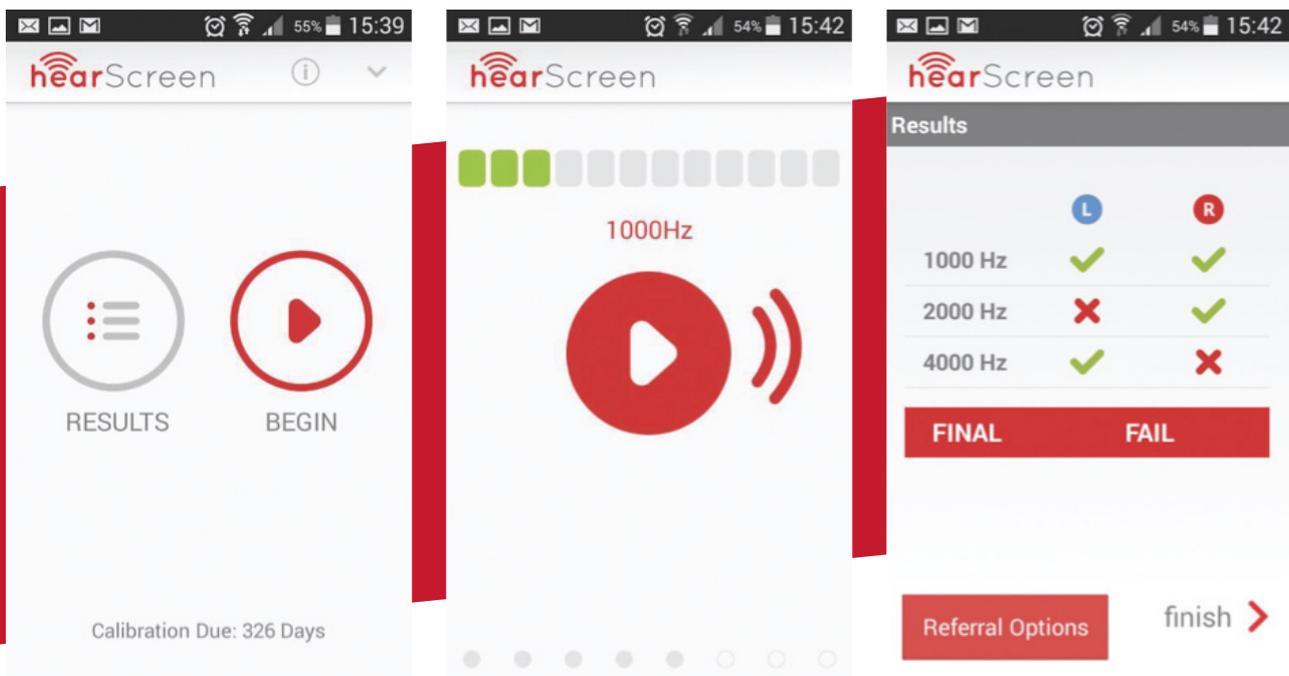


Figure 2. Sample hearScreen™ operation screenshots: (from left to right) home screen, signal presentation and results page

*'By learning this skill,  
I can make a difference  
in my community  
in a meaningful way.'*

— Screener testimony

Prior to each implementation, the hearX Group conducts a needs assessment and screener training. During implementation, the Group offers ongoing technical support by phone and email. hearScreen™ can be customized to fit the application features to the specific needs of the partnering organization.

## INSIGHT

# Adapting the platform design to fit client needs

In one hearScreen™ project, the implementation partner requested that the application's output be expanded to include further detail for prioritizing the screening results among the patients. Through another implementation partnership, hearScreen™ offered the ability to map out the facilities where the screenings were taking place through a device-based geo-positioning function. The current partnership with Peek Vision was also established through an implementing partner request. As the digital solution expands regionally, hearX Group is working to adapt the application to fit patient data fields according to client database and system requirements.

Feedback from another implementation partner sparked the need for bulk uploading of patient data onto the server and subsequent syncing of the full patient database of the account to the device. As a result, the programme implemented a 'Data Sync' function to sync both patient and facility data to the device for selection in an offline status. This lowers the burden on the screeners. Instead of typing in the patient and facility details, they can just make the appropriate selection from the menu.

## Monitoring and evaluation strategy

Ongoing monitoring and evaluation is a key component in the deployment of hearScreen™. The platform operates with an integrated mobile and cloud-based data management server called the mHealth Studio Cloud. Daily screening activities are logged and stored directly on the devices. Once the device is connected to a cellular or WiFi connection, the results are uploaded to the cloud-based server. The mHealth Studio automatically generates weekly reports on the number of patients registered, tests conducted and the screener quality index. Programme managers monitor targets in three domains: the screening environment, screeners or test administrators, and patient behaviour.

**1 / Screening environment.** To monitor the quality of the screening environment, hearScreen™ devices collect data on certain facility characteristics. Physical location and ambient noise levels during each hearing test provide useful information for determining acceptable screening environments.

**2 / Screeners or test administrators.** Each screener's daily activities are logged and stored on the devices, and uploaded to the mHealth Studio Cloud data management platform. The data covers the number of tests administered, results from those tests, referral pathways and follow-up return rates. With this data, managers can identify when tolerance levels for specific indicators are not being met, and invite the screeners to retrain.

**3 / Patients.** Patient data is monitored to assess the successful screening rate within a target community (number successfully screened of the population), referral frequency and patient follow-up behaviours.

### INSIGHT

## Develop a screener quality index

The screener is given a prompt each time a sound is played to the patient, and is required to indicate 'yes' (the patient has indicated they have heard the sound) or 'no' (no indication from the patient). During each screening administration, the program randomly presents one double blind, false audio prompt (similar to that shown in Figure 2). While the screener sees the false audio prompt, the patient does not hear any audio. The purpose is to determine whether the screener accurately records the response as 'no' or just records all responses at will without regard to the actual patient response. After the screener has completed a few hearScreen™ exams, an index is calculated on this randomized prompt to measure their individual screener reliability. This index serves as an objective measure of the quality of the screener's work, and allows programme managers to intervene and retrain where necessary.

## Results to date

hearScreen™ solutions have now been used in twenty-one countries around the world. To date, over 35,000 screenings have been conducted for hearing loss. Of these, 88 per cent were of children, and almost one in five detected a need for further professional investigation. It is clear that many more problems are being detected than had been identified previously, and that as a result many fewer people will struggle with undetected and untreated hearing problems.

An independent evaluation assessed hearScreen™ outcomes on nearly 7,000 children in early childhood development centres (ECDs) in South Africa (Pascarel and Coetzer, 2017). In addition to hearing loss screenings, 3,300 children were tested for vision impairment.



© hearX Group

### RESULT

## Healthy Hearing Healthy Learning Project

One hearScreen™ project was implemented in Mamelodi, Gauteng (South Africa) in partnership with Innovation Edge and the NEA foundation. In this project:

- 6,818 children were successfully screened across 324 ECD facilities or schools and linked to the necessary health care services if needed;
- 26 per cent of those screened were identified to have some hearing impairment and referred to local clinics;
- Three community-based clinics partnered with the initiative;
- Four screeners were trained in administering children's hearing and vision exams.

## Sustainability and future plans

Low-cost mobile technologies and offline access for early detection of hearing problems offer an initial step in improving the lives of those suffering from disabling hearing loss. The vision of hearX Group is that the hearScreen™ solution will be accessible to all communities in under-resourced settings. The design, user interface and experience are central to the success and scaling of the platform.

To improve implementation effectiveness and expansion efforts, hearX Group plans the following updates to try to make the solution more inclusive for users:

- / Enlarge the font size of the application for users with limited vision;
- / Provide a video demonstration of how hearScreen™ operates for users with limited literacy skills;
- / Provide an option to play audio instructions to patients in various languages;
- / Enhance navigation by helping users to identify which icon to select next;
- / Provide concise language in the main navigation menu for easy accessibility;
- / Conduct a review of icons used to ensure they are relevant for international users;
- / Review the grammar and vocabulary used to ensure it is appropriate for basic English speakers and readers;
- / Translate hearScreen™ to various national and regional languages;
- / Provide a voice-based option for the SMS messages that is sent to parents/ caregivers post screening to assist those who cannot read or write.

## Lessons learned and recommendations

*The various field trials to date have produced several ideas for improving the future administration of the hearScreen™ model.*

### Improve the fidelity of implementation.

Implementation fidelity is enhanced when project staff follows a phased approach during development and implementation. The quality of the training and support will determine the quality of the screening.

**Increase the level of parental consent.** Before any The impact of child screening campaigns is lessened when a sizeable proportion of parents and guardians fail to complete the consent forms. To improve reach and impact, ensure buy-in from principals and centre directors, and provide staff with an easy and systematic process to maximize return of parental consent forms.

### Streamline the referral system.

The referral system and the availability of follow-up services needs to be considered from the outset. The system should be as simple as possible to enhance follow-through. A higher proportion of those who fail are likely to go for further screening if they are offered a choice of consultation dates, and when re-screenings are conducted at ECD centres rather than the local clinic.

**Anticipate and plan for logistical issues.** Operational and logistical aspects such as time and place to charge the smartphones and availability of occasional connectivity to sync the data should be planned prior to beginning the administration campaign. Consider insuring the screening equipment against theft and damage. Plan for device calibrations, including arranging back-up devices to ensure service continuity.



## Contact information

The hearX group is a private-sector organization that aims to create sustainable, appropriate solutions for improved hearing health. A key strategy of the hearX Group is recognizing the value of partnerships in the local and global context.



[www.hearxgroup.com](http://www.hearxgroup.com)



[web.facebook.com/hearxgroup/](https://web.facebook.com/hearxgroup/)



[www.twitter.com/hearX\\_Group](https://www.twitter.com/hearX_Group)



[nic@hearxgroup.com](mailto:nic@hearxgroup.com)



[www.linkedin.com/organization/18002825/admin/updates](https://www.linkedin.com/organization/18002825/admin/updates)

## References

Fagan, J. J. and Jacobs, M. 2009. Survey of ENT services in Africa: need for a comprehensive intervention. *Global Health Action*, No. 2, pp. 1932–9.

GBD 2015 Disease and Injury Incidence and Prevalence Collaborators. 2016. Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. *The Lancet*, No. 388, pp. 1545–602.

Louw, C., Swanepoel, D. W., Eikelboom, R. H. and Myburgh, H. C. 2017. Smartphone-based hearing screening at primary health care clinics. *Ear and Hearing*, Vol. 38, No. 2), pp. e93–e100. doi: 10.1097/AUD.0000000000000378.

Mahomed-Asmail, F., Swanepoel, D. W., Eikelboom, R. H., Myburgh, H. C. and Hall, J. III. 2015. Clinical validity of hearScreen™ smartphone hearing screening for school children. *Ear and Hearing*, Vol. 37, No. 1, pp. e11–e17. doi: 10.1097/AUD.0000000000000223.

Mulwafu, W., Ensink, R., Kuper, H. and Fagan, J. 2017. Survey of ENT services in sub-Saharan Africa: little progress between 2009 and 2015. *Global Health Action*, Vol. 10, No. 1, pp. 1–7. <http://dx.doi.org/10.1080/16549716.2017.1289736> (Accessed 9 August 2017.)

Pascarel, N. and Coetzer, P. 2017. *Evaluating the implementation of the mHealth Joint Sensory Screening Initiative and proposing potential business models for scale*. Cape Town, South Africa: Reciprocity.

Swanepoel, D. W. 2016. mHealth improves access to community-based hearing care. *Hearing Journal*, Vol. 69, No. 8, pp. 30–2. doi: 10.1097/01.HJ.0000491120.97166.e3.

Swanepoel, D. W., Myburgh, H. C., Howe, D. M., Mahomed, F. and Eikelboom, R. H. 2014. Smartphone hearing screening with integrated quality control and data management. *International Journal of Audiology*, Vol. 53, No. 12, pp. 841–9. doi: 10.3109/14992027.2014.920965.

WHO (World Health Organization). 2013. *Multi-Country Assessment of National Capacity to Provide Hearing Care*. Geneva: Switzerland: WHO. [www.who.int/pbd/publications/WHOReportHearingCare\\_Englishweb.pdf](http://www.who.int/pbd/publications/WHOReportHearingCare_Englishweb.pdf) (Accessed 9 August 2017.)

WHO. 2017. *Deafness and hearing loss fact sheet*. [www.who.int/mediacentre/factsheets/fs300/en/](http://www.who.int/mediacentre/factsheets/fs300/en/) (Accessed 9 August 2017.)

Yousuf Hussein, S., Swanepoel, D. W., Biagio de Jager, L., Myburgh, H. C., Eikelboom, R. H. and Hugo, J. 2016. Smartphone hearing screening in mHealth assisted community-based primary care. *Journal of Telemedicine and Telecare*, Vol. 22, No. 7, pp. 405–12. doi: 10.1177/1357633X15610721.

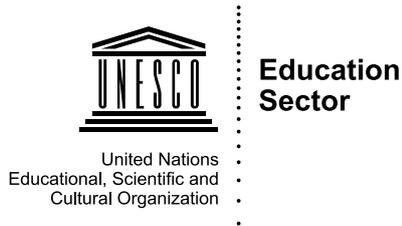
This case study was commissioned by UNESCO and Pearson as part of the UNESCO-Pearson Initiative for Literacy: Improved Livelihoods in a Digital World. The views and opinions expressed in this case study are those of the authors; they are not necessarily those of UNESCO and do not commit the Organization.

Authors: Nathan M. Castillo, Education Consultant, and Steven Vosloo, Section of Youth, Literacy and Skills Development, Education Sector, UNESCO.

UNESCO is grateful to the hearX Group their support in developing this case study.

## UNESCO Education Sector

Education is UNESCO's top priority because it is a basic human right and the foundation on which to build peace and drive sustainable development. UNESCO is the United Nations' specialized agency for education and the Education Sector provides global and regional leadership in education, strengthens national education systems and responds to contemporary global challenges through education with a special focus on gender equality and Africa.



## The Global Education 2030 Agenda

UNESCO, as the United Nations' specialized agency for education, is entrusted to lead and coordinate the Education 2030 Agenda, which is part of a global movement to eradicate poverty through 17 Sustainable Development Goals by 2030. Education, essential to achieve all of these goals, has its own dedicated Goal 4, which aims to *"ensure inclusive and equitable quality education and promote lifelong learning opportunities for all."* The Education 2030 Framework for Action provides guidance for the implementation of this ambitious goal and commitments.



## About Pearson

Pearson is a digital education company, with expertise in educational courseware and assessment, and a range of teaching and learning services powered by technology. Our mission is to help people make progress through access to better learning. We believe that learning opens up opportunities, creating fulfilling careers and better lives.



## About Project Literacy

Project Literacy is a global campaign founded and convened by Pearson to make significant and sustainable advances in the fight against illiteracy so that all people - regardless of geography, language, race, class, or gender - have the opportunity to fulfill their potential through the power of words.



ED/PLS/YLS/2017/09

# Stay in touch

 [en.unesco.org/themes/literacy-all/pearson-initiative](http://en.unesco.org/themes/literacy-all/pearson-initiative)

 [ICTliteracy@unesco.org](mailto:ICTliteracy@unesco.org)

 [www.projectliteracy.com](http://www.projectliteracy.com)

