## *Mobile Hearing Screening in a Rural Community School in Ghana*

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### *Abstract*

Hearing screening in public schools is not common practice in developing countries like Ghana. Yet, the World Health Organization (WHO) (2012) reported that 90% of children with hearing problems live in developing countries. This study was conducted in a rural community in the Central Region of Ghana to find out (a) hearing problems among students in rural community schools, (b) accessibility to hearing screening facilities in rural communities, and (c) benefits mobile hearing screening services could bring to people in rural communities in Ghana. Two hundred forty students from a public high school that served about 7 neighboring rural communities were randomly selected for otoscopy examination and pure tone hearing screening tests. One hundred sixty-five of the students passed both otoscopy examinations and pure tone hearing screening tests while 75 of the subjects failed both tests. Recommendations made included regular school-based hearing screening for all students, and increased access to mobile hearing screening in rural communities.

### *Background*

Hearing services are critical to maintaining and improving hearing and communication abilities (Blazer, Domnitz, & Liverman, 2016), but the degree of importance attached to the critical role that hearing-related services play in hearing health care is minimal (National Institute on Deafness and Other Communication Disorders [NIDCD], 2016). Hearing services include assessment of hearing and communication difficulties, diagnosis of medical conditions, evaluation of hearing loss and treatment needs, counseling, and many other services that help to improve a person's hearing and communication abilities. Green, Fryer, Yawn, Lanier, and Dovey (2001) explained that these hearing services are provided by different hearing health care professionals such as audiologists, hearing instrument specialists, otolaryngologists, primary care physicians, and others. Blazer et al. further explained that, in the United States, hearing health care services are expensive and time-consuming, and many individuals are unable to access hearing health care services because of the lack of information about those services.

It is estimated that, about 740,000 children are born annually worldwide with hearing loss or acquire permanent bilateral hearing loss within the first few weeks of life (Olusanya, 2015), and 90% of those children live in developing countries (Swanepoel, 2009). The prevalence of hearing impairment differs according to gender, with overall prevalence estimated to be 10.5 percent for males and 6.8 percent for females (National Center for Education Statistics, 2017). It would therefore be expected that more male students in schools would have hearing impairments.

Olusanya further explained that, unlike living in high-income countries, children living in developing countries typically do not receive hearing screening services at birth, and are not frequently screened for signs of hearing loss when they go to school. Hearing screenings in public schools are used to identify children who might have or could be at risk for having auditory disorders (Absalan, Pirasteh, Khavidaki, Rad, Esfahani, & Nilforoush, 2013; Levar, Loven, & Lucero, 2014). In 2012, the World Health Organization (WHO) estimated that 75 million people had auditory disorders (Boesen & Lykke, 2012; Offei, 2015), of which a sizeable percentage could be in children in school.

Hearing loss among children, for instance, is not rare; and if left undiagnosed, its impact on learning and even life trajectory may be devastating. In industrialized countries, screening for hearing disorders in childhood is a widespread practice (Gell, White, Mackenzie, Smith, Thompson, & Hatcher, 1992; Olusanya & Akinyemi, 2009), and may continue through high school. Unfortunately, it is not so in many developing countries (Offei & Yekple, 2014; Olusanya, 2015) due to several factors. For instance, McPherson (2008) concluded that hearing loss is not the highest priority for individuals in developing countries who have other health issues, such as life threatening illnesses or diseases. Furthermore, hearing impairment requires expensive rehabilitation options, so it is overlooked (Olusanya, 2007). Additionally, hearing healthcare services tend to be concentrated more in urban areas than rural areas of these countries (Swanepoel, Louw, & Hugo, 2007; Offei & Yekple, 2014). Offei (2005, 2015) cited inadequate facilities, inadequate personnel, tools and other equipment as some of the reasons for the limited hearing health care services available to consumers in a developing country like Ghana.

One of the more efficient ways to reach rural communities for hearing screening is through mobile hearing screening (Levar, Loven, & Lucero, 2001; McPherson, Law, & Wong, 2010). Mobile hearing screening is the practice whereby audiological services are delivered “on wheels” in communities rather than in a well set up urban audiological facility (Boesen & Lykke, 2012; Magian, Anderson, McKenzie, and Person (1976). Mobile audiology, significantly, facilitates early detection and intervention of educationally significant auditory problems (Levar et al., 2001). By providing basic ear/hearing services in rural communities, barriers to successful academic progress of several children would be removed and, would indeed, put smiles back on the faces of many children who suffer in silence (Dodd-Murphy, Murphy, & Bess, 1992).

Although, several studies, such as Magian et al. (1976), Gell, White, Newell, Mackenzie, Smith, et al. (1992), Levar et al. (2001), McPherson at al. (2010), and Boesen & Lykke (2012) have reported that mobile hearing screening in deprived communities is not new, it is a recent practice in Ghana (Offei & Yekple, 2014). Offei and Yekple further reported that the few mobile hearing screening facilities in Ghana are concentrated in three southern and mid-central metropolitan areas of the country, thus making those services inaccessible to consumers in the rural areas.

In Ghana, there are three audiology mobile vans, also called the Hearing Assessment and Research Klinik (HARK). One of those audiology mobile vans is located at the Komfo Anokye Teaching Hospital in Kumasi, which serves communities within and around the mid-regions of Ghana, namely, Ashanti and Brong Ahafo Regions. The second audiology mobile van is located

in Accra at the Korle-Bu Hospital Hearing Assessment Centre, and serves the Greater Accra Region and surrounding areas.

The third mobile van, which happens to be the newest, was a joint donation by the Rotary Clubs of Llanelli in Wales, and Labone-Accra to the Centre for Hearing and Speech Services in the Department of Special Education, University of Education, Winneba (UEW). This mobile facility serves communities within the Central and Western Regions of Ghana. The HARK at the Centre for Hearing and Speech Services at UEW has its own power generator, and is particularly useful for community mobile hearing screening, especially, since Ghana has been experiencing serious electric power crisis in recent times. Unfortunately, the Northern, Upper East and Upper West Regions of Ghana, which also have high incidence rates of children with educationally significant auditory disorders, do not have access to any of the HARKs.

Effective identification and appropriate intervention significantly affect the quality of life of children with disabilities and their families (Gell et al., 1992; Levar et al., 2001; Olusanya, Wirz, & Luxon, 2008)). In spite of efforts made so far toward providing hearing screening services for the majority of children in Ghana, the prospect of many children getting their auditory abilities tested and monitored early in life remains extremely limited (Offei, 2005; Offei, 2015). Although the incidence of ear and hearing problems has been documented extensively, school-age identification, early intervention and school-based services needed to overcome hearing problems of students are relatively nonexistent (Offei, 2013; Offei & Acheampong, 2014).

One of the factors that militate early and school-based identification of hearing disorders in Ghana is the lack of appropriate tools for testing and monitoring the auditory development of infants and children (Offei, 2013; Offei & Acheampong, 2014, Offei & Yekple, 2014). For instance, very few centers for screening are available to rural folks since most hearing screening facilities are located in cities and urban centers. Consequently, families that are poor, vulnerable or less privileged, and who tend to live in rural communities, are unable to access services provided at the screening centers. Specifically, families in rural communities often cannot afford the costs involved in travelling to the urban centers to screen their children or attend follow-up appointments. Instead, they resort to the use of untested local herbs and medicines, which then can cause additional problems (Offei 2005).

The issue of cost benefit is often raised when discussing whether or not mobile audiology should be the preferred practice to traditional center-based service delivery systems (Offei, 2015; Offei & Acheampong, 2014). For instance, data from the Centre for Hearing and Speech Services at the University of Education, Winneba, showed that the greatest number of clients screened per day at the facility was 20, but a mobile audiology screening unit potentially serves more individuals within their communities. In addition, the mobile audiology team would be able to interact with clients and their family members within their local settings, which in turn, could increase the chances of the mobile hearing team educating more rural community members about ear care, referral, and treatment options. Mobile audiology services, therefore, could be cheaper and more convenient, as clients and their families would pay little for transportation, registration, consultation, and education.

Studies about hearing screening in Ghana have mainly addressed screening during infants and childhood, but we suspected that there could be adolescents and young adults who had never been screened for hearing disorders, and who would not have the opportunity of getting screened for hearing problems. The present study was therefore conducted to find out (a) the types of hearing problems found in students in a rural community high school, (b) the prevalence rate of hearing impairments by gender, and (c) benefits of mobile hearing screening on a rural community schools.

## *Method*

### Participants

The participants were 240 final-year students (103 males and 137 females) from a community high school that served about 7 neighboring rural communities in the Central Region of Ghana. The mean age of the subjects was 18.9 years with a standard deviation of 1.1. The school, which is one of Ghana's public co-educational senior high schools, has a population of over 700 students and offers coursework in general science, general arts, home economics, visual arts, and business.

Final-year students were selected for the screening exercise for two main reasons. First, they were preparing to write their exit examinations, and that would most likely be the last opportunity for them to get their hearing screened before exiting high school. Second, the exit examination included Oral English, a test which involved listening to a voice recording on a CD and responding to questions. Students, who had hearing loss of either a conductive or sensorineural nature, even when mild, as well as those with unilateral one-sided hearing loss, could typically find it difficult to listen in noise. Unfortunately, many classrooms in Ghana are not suitable for oral tests such as "oral English" because they are generally noisy and are not properly acoustically treated. Preliminary analysis of the participants' responses to a pre-screening survey indicated that none of the participants had ever had their hearing screened.

### Setting

The mobile screening van (the HARK) was used for pure tone testing. The van is built in such a way that it is partly sound-proof, averaging 23dBA of ambient sound level. A relatively quiet room on the compound with an average ambient sound level of 20-25dBA was selected for the hearing test. A sound level meter was used to measure the sound level in the room every 15 minutes during to validate our recordings.

### *Questionnaire*

The participants completed a 10-item questionnaire on the students' and their families' hearing medical history, accessibility of hearing screening in their communities, and their average scores in Oral English, Mathematics, Economics, Biology, Science and English Literature.

Table 1. *Distribution of participants from the seven communities*

| | Students | | |
|---|---|---|---|
| Community | Males | Females | Total |
| Community 1 | 15 | 18 | 33 |
| Community 2 | 18 | 22 | 40 |
| Community 3 | 12 | 23 | 35 |
| Community 4 | 13 | 20 | 33 |
| Community 5 | 16 | 15 | 31 |
| Community 6 | 15 | 19 | 34 |
| Community 7 | 14 | 20 | 34 |
| Total | 103 | 137 | 240 |

**Procedure**

The first author was a Carnegie fellowship scholar in Ghana when the study was conducted. The screening included otoscopic examination, pure tone audiometric testing, and cerumen management procedures. The Siemens HearCheck screener with disposable ear cups and a portable hand-held screening audiometer were used for pure tone screening, while the Heine Otoscope was used for the outer ear examination (otoscopy). Otoscopic examinations were the first test to be done after which the students completed the HearCheck screen. Otoscopic examination was conducted outside a quiet office. Students who passed the otoscopic test (ear canals clear, no sign of infection, tympanic membrane visible and healthy looking) went for the HearCheck screen. Students who subsequently passed the HearCheck Screen were discharged. Students who failed the HearCheck screen were referred to the UEW Centre for Hearing Science for pure tone audiometric testing and further management. Students who failed the otoscopic examination were referred for an appropriate management - ear wash or treatment for ear infection.

Figure 1 shows the procedure for hearing testing.

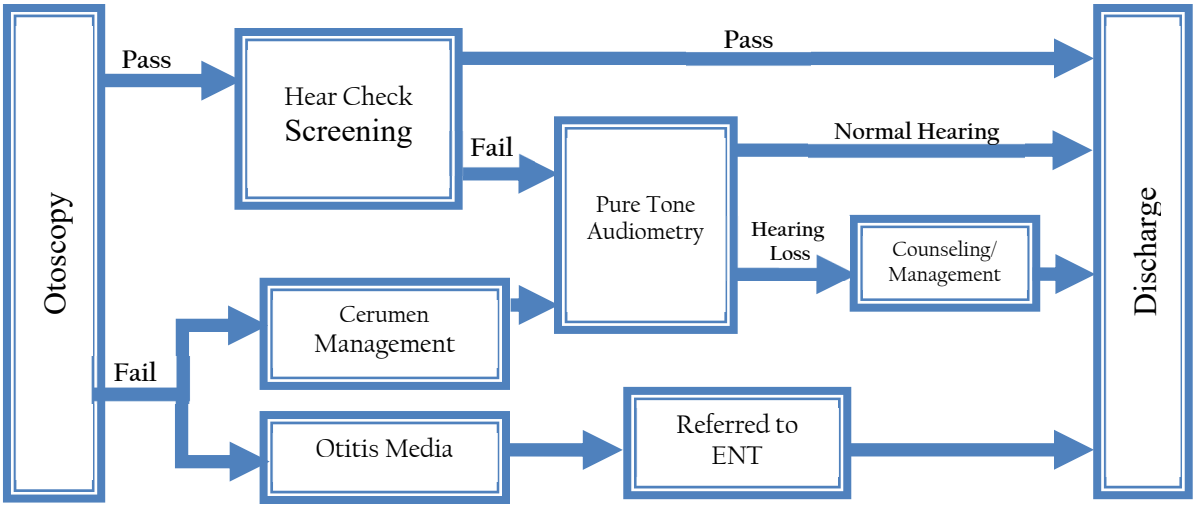


Figure 1: *Hearing test procedures*

## ***Results***

Analyses of the screening data showed that out of the 240 students screened, 165 (68.75%) students, comprising 57 males (23.75%) and 108 females (45%), passed both the otoscopy examination and pure tone hearing screening, and therefore needed no further interventions. However, 75 (31.25%) of the students failed both tests. Specifically, 55 (22.91%) of the students had impacted cerumen/wax in either one or both ears, 16 (6.6%) of the students failed the pure tone hearing test and 4 (1.74%) of the students had middle ear infection. The results are presented graphically in Figure 2. Overall, the percentage of male students who failed the screening tests was higher than their female counterparts. Specifically, 26 (25%) of the male students and 29 (21%) of the female students, respectively, had hearing difficulties resulting from impacted wax conditions, while 9 (8.7%) of the male students and 7 (5.1%) of the female students, respectively, failed the pure tone screening test, and 2 (1.9%) of the male students and 2 (1.4%) of the female students, respectively, had ear infections.

Students with cases of impacted cerumen had the wax removed and those with middle ear infection were referred to ENT specialist for further attention.

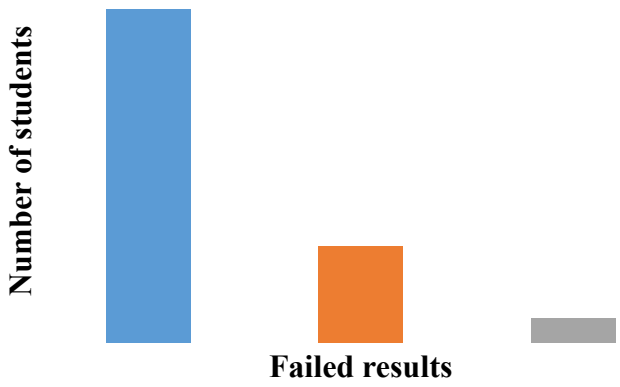


Figure 2:
*Details of failed results*

Additionaly, analysis of the data of the students who undertook the pure tone audiometry after failing the HearCheck screening indicated that 4 had unilateral hearing loss in either the left ear or right ear, and 16 had bilateral hearing loss of varying degrees. Of this number, 16 had mild sensorineural hearing loss, 9 had moderate hearing loss and 4 had profound sensorineural hearing loss. Figure 3 is the graphical representation of this distribution.

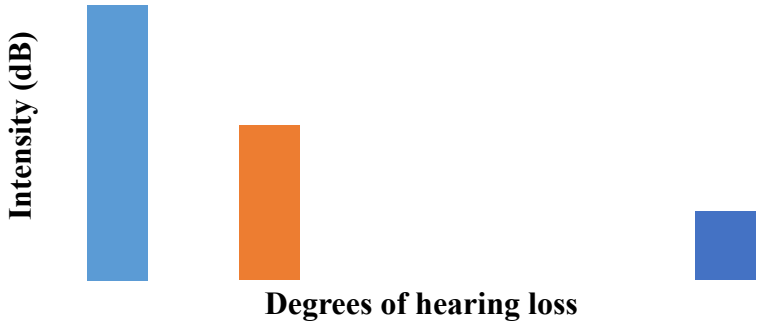


Figure 3: *Degrees of hearing*

Table 2. *Failed results by community*

| Community | Impacted wax | | Pure tone | | Infection | |
|---|---|---|---|---|---|---|
| | Males | Females | Males | Females | Males | Females |
| Community 1 | 4 | 5 | 2 | 0 | 0 | 1 |
| Community 2 | 2 | 5 | 1 | 2 | 1 | 0 |
| Community 3 | 6 | 4 | 0 | 1 | 0 | 1 |
| Community 4 | 5 | 3 | 2 | 1 | 0 | 0 |
| Community 5 | 2 | 2 | 1 | 0 | 0 | 0 |
| Community 6 | 4 | 6 | 2 | 2 | 0 | 0 |
| Community 7 | 3 | 4 | 1 | 1 | 1 | 0 |
| Total | 26 | 29 | 9 | 7 | 2 | 2 |

**Analysis of the Questionnaire**

The analysis of participants' responses to the 10-item questionnaire indicated that, to the best of their knowledge, none of them or any member of their family (including parents and siblings) had had a hearing screening test prior to the time of the study. It was found that 6 of the students who failed the pure tone test had problems with English Language, 7 students had problems with Mathematics, 3 students had problems with Economics, Biology, and Science, respectively, and one student had problems with English Literature. It appeared, however, that some of the students had problems with comprehension and not necessarily hearing. This could be due to other teacher/student/environmental factors. For instance, it could be that some of the students in this category showed a hearing loss (per Pure Tone Average –PTA) resulting from uncontrolled classroom environment, and this might have significantly affected the test results. Another reason could be that they were borderline cases (mild) and those with unilateral hearing loss (one-sided). One of the challenges of one-sided hearing loss is the difficulty to locate the source of sound (problem when the sound source is in the direction of the deaf ear) or difficulty listening in noise (noisy classrooms as found in Ghana). It would be difficult to predict with certainty whether or not students would be able to perform well on oral English exam, which would require them to respond to unfamiliar recorded voices.

One student with a significant bilateral hearing loss could not hear well and this was evident across all coursework. The student struggled in the class, but it appeared that teachers and non-teaching staff were not aware of the student's problems. The student indicated that he relied on friends for support who sometimes did not explain things well, or might have been impatient with the student. In this student's situation, the mobile hearing team thought that a hearing aid would be most useful. For those with unilateral cases, the team recommended to teachers to consider more appropriate seating arrangements. For instance, in one case the team observed a student who was asked to sit very close to the window in class with his better ear toward the window and the deaf ear toward the class. An immediate change of his seating was recommended to enable the student to benefit from instruction in the classroom.

## *Conclusions*

A mobile hearing screening conducted in one community high school provided a team from a university-based center for hearing science an opportunity to screen 240 students from seven communities in about six hours, something that was impossible to do at a center-based clinic. As a result of what was achieved from the free school-based mobile screening at the rural community high school, we recommended to educational administrators in the region to ensure that school-based hearing screening be made available to all students, at least once every school year. Secondly, the team decided to conduct follow-up screenings and other educational activities for students identified as having a hearing disorder and/or hearing loss. Thirdly, we recommended that community awareness on ear-care, signs of hearing problems, and referral to qualified health care personnel be vigorously organized for rural communities in the Central Region of Ghana. Fourth, community leaders and the screening team decided to involve not-for-profit organizations and the Ghana Education Service to provide assistive devices to students with hearing impairments. Finally, considering the evidence supporting the positive impact of the HARK on the lives of families living in communities that have had access to services delivered through it, efforts should be made to extend mobile hearing screening services to the Northern, Upper East and Upper West Regions of Ghana, as well.

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