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Audiologists' perceptions of hearing healthcare resources and services in South Africa's public healthcare system

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Abstract

Background: Hearing loss prevalence is exceptionally high across developing world regions, including Africa, which has the greatest burden of hearing loss compared to other continents. Despite the availability of cost-efficient preventative and intervention measures for hearing loss, these hearing healthcare resources and services remain inaccessible in many developing countries. The purpose of this study was to describe audiologists' perceptions regarding hearing healthcare resources and services within South Africa's (SA) public healthcare system.

Methods: A national telephonic survey study was conducted with audiologists in public healthcare system hospitals across SA, and the final sample comprised 100 audiologists.

Results: Most audiologists perceived that their hospitals did not have adequate hearing healthcare resources to render efficient audiology services to patients. Furthermore, binaural amplification devices (invasive and non-invasive) for adults with bilateral hearing loss who adhered to the criteria for these devices were perceived to be unavailable in most hospitals. Audiologists also perceived that universal newborn hearing screening services, adult aural rehabilitation services, and follow-up care of all hearing devices post-warranty expiration were limited.

Conclusion: A greater understanding of the status of hearing healthcare in SA's public healthcare system hospitals is critical in gaining support for hearing loss from SA's legislative sector and advocating for the integration of disability and quality of life concerns related to hearing loss on the national healthcare agenda.

Background

Approximately 1.5 billion people worldwide currently live with a hearing loss, of whom 430 million require rehabilitation services to address their disabling hearing loss [1]. According to 2021 WHO estimates, the prevalence of hearing loss will likely escalate to 2.5 billion by 2050, with at least 700 million requiring rehabilitation services [1]. Despite the high prevalence of hearing loss, it has often been overlooked as a global health priority [2]. The negative impact associated with disabling hearing loss is well documented. Regardless of the age of onset, it has a catastrophic effect on an individual's quality of life, social-communicative competence, psychosocial health, and economic independence [3, 4]. Additionally, disabling hearing loss also harms a country's social and economic development [5, 6]. Moreover, unaddressed hearing loss is the third most common cause of years lived with disability worldwide, where failure to address hearing loss appropriately has resulted in an annual global loss of approximately US$ 1 trillion [1]. Hearing loss can therefore be considered an extensive global health concern [7, 8].

Despite the significant implications and burden of hearing loss, it can be prevented in many instances, and in other cases, it can be treated effectively, thereby reducing its burden [1]. Given that most of the estimated costs of unaddressed hearing loss are associated with its impact on quality of life and productivity, these costs can be lessened by implementing timeous and cost-efficient measures [1, 9–11]. Cost-efficient, preventative, and treatment interventions that can reduce the burden of hearing loss include childhood hearing screening initiatives, earplugs for noise protection, noise-reducing technology, hearing devices such as hearing aids and cochlear implants (CIs), and the early and prompt treatment of infections and diseases such as otitis media and meningitis [12]. Even though these cost-efficient interventions for hearing loss exist, they often remain unaffordable and therefore inaccessible in low-income and middle-income countries, where hearing loss is most common compared to high-income countries [12].

Access to substantial and sustainable hearing healthcare resources is a prerequisite for the efficient delivery of hearing healthcare services to address the burden of hearing loss and improve quality of life. However, in most countries, there is a lack of integration of ear and hearing care services into health systems, with health systems lacking the capacity to deliver these services where they are needed most [1, 13]. The sparse availability of human resources greatly signifies the incapacity of hearing health systems [14, 15]. Furthermore, there exists a substantial difference between the number of trained hearing healthcare professionals between high-income, upper-middle income, lower-middle income, and low income countries [1, 14, 15]. More than half (56%) of the countries within the African region reportedly have less than one ear, nose, and throat (ENT) specialist per million population, and 78% have less than one audiologist per million population [14]. In contrast, more than 70% of countries within the European region have more than 50 ENTs per million, and 52% have more than ten audiologists per million [14]. Hence it is evident that trained human resources in hearing healthcare are limited within Africa, where there are significant gaps in the availability of ENTs and audiologists compared to higher-income countries [1, 14, 15]. Consequently, there are a minimal number of trained professionals able to provide specialized care in addressing ear disease or in diagnosing and managing hearing loss using hearing technology [1].

In addition to human resources, financial resources are required to provide hearing healthcare resources and services [1]. Health facilities require these financial resources to employ hearing healthcare personnel, establish and improve hearing healthcare infrastructures and procure and maintain essential ear and hearing-related equipment and hearing devices [1]. Due to the invisible, non-life-threatening nature of hearing loss when compared to more serious infectious, life-threatening conditions, it has often been overlooked as a global health priority [2]. As a result, financial resources dedicated to hearing healthcare are minimal because of contending health priorities such as life-threatening or infectious healthcare problems [16, 17]. Consequently, the burden of deafness is exacerbated because of this lack of prioritization. However, the World Health Organization does not restrict the definition of health as the absence of disease but as the complete physical, mental, and social well-being of an individual, thus past survival [18]. Therefore, it can be argued that resource distribution between the diverse healthcare conditions should be equitable and also favorable to neglected and non-life-threatening conditions such as hearing loss [19].

Africa accounts for the greatest burden of hearing loss compared to other world regions [12]. It has also been predicted that by 2050, the most significant hearing loss escalation will be within the African region [12]. Considering this region encompasses South Africa (SA), the global burden of disabling hearing loss must be addressed at a South African National level [20]. SA's healthcare system is, however, dichotomized [21]. Most of its population (84%) rely on public healthcare sector services compared to the 16% of the population who belong to SA's self-funded private healthcare sector [22]. Consequently, most of the South African population with hearing loss are unable to afford audiology services within private healthcare sector services at large and are solely reliant upon public healthcare sector services [23]. Therefore, the status of hearing healthcare resources and services within this public healthcare sector must be recognized.

To date, no large-scale studies on the status of hearing healthcare resources and services in SA have been conducted [23, 24]. Moreover, to the authors' knowledge, national data on the status of hearing healthcare within SA's public healthcare sector are non-existent. Such data is essential in gaining support for hearing loss from SA's legislative sector and advocating for the integration of disability and quality of life concerns related to hearing loss on the national healthcare agenda [23]. Hence, increased insight into hearing healthcare in SA's public healthcare sector is necessary. Therefore, the aim of the current study was to describe audiologists' perceptions of hearing healthcare resources and services within SA's public healthcare system.

Methods

Research and ethical approval for this study were obtained from the Research Ethics Committee of the Faculty of Humanities, University of Pretoria (HUM005/1019) before any participants were recruited for this study.

Study setting and participants

A descriptive, telephonic survey design was employed. Proportional, stratified random sampling was implemented, followed by simple random sampling to select the final set of public healthcare system hospitals to be telephonically contacted. In 2020, 182 public healthcare system hospitals across SA's public healthcare sector had audiology departments (Table 1). Qualified audiologists employed at these hospitals were recruited as participants for this study. Only one audiologist per hospital was required to complete the telephonic survey to avoid the possibility of obtaining conflicting perceptions from different audiologists within the same hospital setting. The final sample comprised 100 audiologists employed at 100 hospitals (Table 1). Proportionate stratified sampling was used, ensuring the sample size of each stratum was equal to the stratum's proportion in the population as a whole (Table 1). The sample was, therefore, representative of audiologists in public healthcare system hospitals.

Table 1
Layout of proportionate stratified sampling procedure

	Population statistics		Sample statistics	
Hospital	Population size	% of the total population	Sample size	% of the total sample
District	99	54.4	54	54.0
Regional	38	20.9	21	21.0
Provincial tertiary	17	9.3	9	9.0
Central	10	5.5	6	6.0
Specialized	18	9.9	10	10.0
Total	182	100	100	100

Materials for data collection

Data were collected through a telephonic survey that was developed specifically for the purpose of this study. First, a pilot study involving five audiologists employed within South African public healthcare system hospitals was conducted to establish the validity of the survey. An item content validity index (I-CVI) was computed in order to give the proportion of experts agreeing on an item [25]. An acceptable I-CVI value is 1 when the expert panel consists of three to five experts [26]. The expert panel made some minor recommendations that were incorporated into the survey. Content validity was established since the I-CVI equaled 1 for each item in the modified survey.

The survey was used to obtain demographic information and information concerning audiologists' perceptions of hearing healthcare resources and services within the hospitals in SA's public healthcare system. It comprised of six sub-sections (audiologist's demographics, hospital's demographics, audiology staffing, resources, hearing assistive devices, and services provided) totaling 20 questions. It included both closed-ended (18 questions) and open-ended questions (2 questions) (See Additional file 1 for the survey instrument).

Data collection procedures

The audiology departments of the various public healthcare system hospitals were contacted, and the answering audiologists were provided with information about the survey. The audiologist who was available and willing to participate in the survey was recruited as a participant. Verbal consent was obtained from all participating audiologists before the completion of the telephonic survey. All telephonic surveys were completed during a single phone call and the approximate time of completion was 15-20 minutes. Data for this study were collected over a three-week period, and the response rate was 100% as all attempted calls were answered, and all 100 audiologists completed the survey.

Data analysis

The data were captured in Microsoft Excel (2017), and Statistical Package for Social Sciences SPSS (Version 26) was used to analyze the data. Descriptive statistics were used to define the audiologists' demographical characteristics (Table 2); and their perceptions of their audiology department's staffing, resources, hearing devices, and services provided.

The responses from the open-ended questions were transcribed and coded into central themes for the purpose of thematic analysis. Hence, common emerging trends amongst audiologists' responses were identified.

Results

Demographic characteristics of participating audiologists are summarized in Table 2. Most audiologists were community service therapists (43.0%), had less than two years of experience as an audiologist (56.0%), and had a bachelor's degree in Audiology (97.0%).

Table 2
Demographic characteristics of audiologists (n = 100)

Current position	n and %	Years of experience as an audiologist	n and %
Community service therapist (either dual-qualified speech-language pathologist and audiologist or audiologist)	43.0	Less than 2 years	56.0
Production level audiologist	33.0	2 to 5 years	14.0
Production level dual-qualified speech-language pathologist and audiologist	18.0	5 years, 1 day to 10 years	17.0
Appointed or acting chief audiologist	6.0	10 years, 1 day to 15 years	10.0
Highest qualification level		More than 15 years	3.0
Bachelor's degree in audiology	97.0		
Master's degree in audiology	3.0		

Audiologists' perceptions of staffing

The average number of permanently employed audiologists per hospital in this sample was 1.8 audiologists per hospital (range: 0-14; 1.8 SD; n=100), and the average number of community service audiologists per hospital was 1.0 audiologists per hospital (range: 0-3; 0.7 SD; n=100).

Audiologists' perceptions of hearing healthcare resources

The majority (82.0%; n=82/100) of the audiologists perceived their hospital not to have adequate resources to render efficient audiology services to patients, and these 82 audiologists were then asked a series of follow-up questions to expand their perceptions of their hospital's available audiology resources. Their results are divided into three categories: *audiology screening equipment (*Figure 1*), diagnostic audiology equipment (*Figure 2*), and information systems and technology (*Figure 3*).*

The most frequently reported resources that were not available included hearing aid verification software (75.6%; n=62/82), Noah modular software (58.5% n=48/82), a high-frequency tympanometer (51.2%; n=42/82); an automated auditory brainstem response (AABR) screener (50.0%; n=41/82) and a video otoscope (48.8%; n=40/82). The most frequently reported types of equipment that audiologists perceived required repairs, maintenance, or calibration were the screening audiometer and diagnostic acoustic immittance equipment (15.9%; n=13/82), followed by the visual reinforcement audiometer (VRA) and diagnostic pure tone audiometer (14.6%; n=12/82).

Audiologists' perceptions of the costs, repairs, and maintenance of hearing devices

Slightly more than half (52.0%; n=52/100) of the audiologists perceived that their hospital followed the Uniform Patient Fee Schedule (UPFS) system for the payment of both pediatric and adult hearing devices. This is a system whereby patients within the public healthcare system are billed according to their income classification [27]. In comparison, 48.0% (n=48/100) perceived that their hospital did not follow the UPFS system. All 48 audiologists whose hospital did not utilize the UPFS system perceived that their hospital fully covered the pediatric and adult hearing device costs. Thus, all patients requiring hearing devices received them for free, regardless of their income classification at the hospitals where these 48 audiologists were employed.

More than half (59.0%; n=59/100) of the audiologists perceived that their hospital's pediatric and adult patients are required to cover all hearing aid repairs and/ or replacement costs of hearing aid devices post-warranty expiration. Comparatively, all audiologists whose hospitals provided pediatric and adult (CIs) and implantable bone conduction hearing devices reported that the patients (pediatric and adult) were fully liable for all the device-related costs (repair and replacement costs) incurred post-warranty expiration, as their hospitals were unable to cover these costs.

Perceptions of the availability of acoustic hearing aids and alternative hearing devices (cochlear implants and conventional and implantable bone conduction hearing devices)

In the case of permanent pediatric bilateral hearing loss (sensorineural, mixed, or conductive), most of the audiologists (89.0%) perceived that two hearing aids were available to patients, 10.0% perceived that only one hearing aid was available to patients, and 1.0% perceived that no hearing aids were available to patients (n=100). In the case of permanent adult bilateral hearing loss (sensorineural, mixed or conductive), most audiologists (69.0%) perceived that only one hearing aid was available to patients, with the remaining 31.0% perceiving that two hearing aids were available to patients (n=100). For a permanent unilateral sensorineural, mixed, or conductive hearing loss, most of the audiologists perceived that acoustic hearing aids were available for children (93.0%) and adults (81.0%) (n=100).

Regarding hearing devices alternative to hearing aids, the majority of the audiologists perceived that conventional bone conduction hearing devices were available for both pediatric (64.0%) and adult (63.0%) patients (n=100). In terms of implantable bone conduction hearing devices, only 5.0% and 6.0% perceived that they were available to the pediatric and adult patients at their hospitals, respectively (n=100). Concerning CIs, only 5.0% (n=5/100) of the audiologists perceived that they were available to both the pediatric and adult patients at their hospital.

Perceptions of Hearing Screening and Aural Rehabilitation services

Hearing screening services (newborn/ infant and adult)

Almost half (49.0%; n=49/100) of the audiologists perceived that their hospitals were not offering any newborn/ infant hearing screening services. Of those hospitals perceived to provide screening services (51.0%; n=51/100), 41.2% (n=21/51) of the audiologists perceived that universal newborn hearing screening (UNHS) services (screening directed at the whole population) were provided. In comparison, 58.8% (n=30/51) of the audiologists reported that targeted hearing screening services were provided by their hospitals (e.g., risk-based screening – screening based on established risk factors).

In terms of adult hearing screening, most audiologists (97.0%) perceived that their hospital provided no high-risk based adult hearing screening services (e.g., for patients exposed to ototoxic or vestibulotoxic medication, exposed to recreational noise, patients with chronic health conditions, etc.), while 3.0% noted that their hospital provided these services (n=100).

Aural Rehabilitation services

Pediatric aural re(habilitation) services were perceived by audiologists to be offered by 66.0% of the hospitals' post-hearing aid fitting, whilst adult aural rehabilitation services were perceived by audiologists to be offered by only 41.0% of the hospitals (n=100). Following implantable bone conduction hearing device fitting, 4.0% of the hospitals were perceived by audiologists to offer both pediatric aural re(habilitation) and adult aural rehabilitation services (n=100). Following cochlear implantation, 5.0% of the hospitals were perceived by audiologists to offer pediatric aural re(habilitation) services and, 6.0% were perceived to offer adult aural rehabilitation services (n=100).

In terms of audiologists' perceptions regarding the professional(s) providing aural rehabilitation services at their hospital, most audiologists (70.0%; n=49/70) perceived that the audiologists provided aural rehabilitation services at their hospital, 34.3% (n=24/70) stated that it was the speech-language pathologist and 22.9% (n=16/70) stated that it was joint sessions involving both professions (multiple options could be selected).

Perceived challenges hindering hearing healthcare service delivery within the workplace

The most prominent central themes for perceived challenges hindering hearing healthcare service delivery that emerged from the open-ended qualitative responses (in order of importance) are *resource challenges (equipment, human resource, financial and infrastructural), challenges related to ENT specialist service provision*, and *patient appointment non-adherence*. These central themes, together with descriptions and illustrative quotes from audiologists, are summarised in Table 3.

Table 3
Central themes, descriptions, and illustrative quotes from audiologist reports of challenges perceived

Central theme	Description	Illustrative quotes
Resource challenges: Equipment challenges Human resource challenges Financial challenges Infrastructural challenges	Shortage of equipment (screening and diagnostic audiology equipment as well as information systems and technology) and unrepaired, non-serviced, and uncalibrated equipment. Shortage of audiology staff within the workplace, including a shortage in community service therapists, production level therapists, and chief therapists/ head of audiology department. Budgetary constraints within Audiology Departments in terms of the hearing device, consumables, equipment, and maintenance and repairs budget. Insufficient space for the audiology department and the challenge of having either one room utilized for multiple purposes (i.e., therapy/ consultation rooms, office space, hearing aid fitting room, and a hearing evaluation room) or having to share space with speech-language therapists or other rehabilitation professionals.	*'Lack of audiology equipment which leads to unnecessary referrals to institutions outside the catchment area, which then increases waiting times and the caseload for basic assessments to be conducted for both adults and pediatric patients'* *'No permanent speech therapist and audiologist employed at the hospital, the Department is run by community service therapists, so there is a lack of continuity of services'* *'The challenges stem from the limited budget. Therefore, there are not enough funds for more hearing aids, equipment, and equipment repairs.'* *'Space is limited in the Department'*
Challenges related to ENT specialist service provision	Shortage of ENT professionals across the hospitals and provinces, flawed referral system to ENTs, limitations in ENT service provision, a lack or miscommunication between ENTs and audiologists, and poor patient follow-up.	*'ENT follow-up with patients is poor - a lot of middle ear conditions that could be prevented or treated are often neglected, and there is poor teamwork between the audiologists and ENTs.'* *'No/ limited access to an ENT. Referral to ENT clinic is problematic, and the ENT services are limited, e.g., They can't do tympanoplasties'* *'No qualified ENT in the Province, managing middle ear pathology is challenging.'* *'No ENT close by. Closest ENT is 3 hours away, and the waiting list is 3-4 months. There are a lot of patients with middle ear pathology. During COVID-19, patients' transport is prioritized, and audiology services are not a top priority, so patients need to arrange their own transport, which many cannot afford.'*
Patient appointment non-adherence	Nonattendance of appointments and follow-up appointments	*'Poor patient follow-up: patients tend to miss their hearing aid follow-up appointments'* *'The distance of the hospital from patient's residence - so poor follow-up of patients and they do not come for hearing aid follow-ups.'* *'Patients don't really attend their aural rehabilitation appointments; they attend one or two and then stop due to travel and distance costs'* *'Low patient adherence to appointments and follow-ups because of their financial constraints and geographic location'*

Discussion

A comprehensive range of audiologists' perceptions regarding hearing healthcare resources and services in SA's public healthcare system were obtained in this survey study. On average, the perceived number of permanently employed (1.8) and community service audiologists (1.0) per hospital were relatively low in this study. Evidence suggests that 78% of countries across Africa have a ratio of less than one audiologist per million people, whereas 52% of countries across Europe have more than ten audiologists per million [14]. Within SA particularly, previous studies revealed that the estimated ratio is 8.3 audiologists per million people [1, 15] and a shortage of audiologists within South African public sector hospitals [28]. While SA appears to have more available audiologists per million than many other countries within Africa, there is still a shortage of audiologists compared to other world regions such as Europe. Therefore, the current study's findings confirm that within SA, a significant barrier towards hearing healthcare service delivery is the lack of human

resources, which is also an overall challenge experienced throughout Africa. Furthermore, there is an unequal distribution of audiologists between the private and public health sectors in SA [23, 29]. A recent study conducted on the speech therapy and audiology workforce in SA revealed that a mere 22% of qualified speech therapists and audiologists are employed in the public sector [29]. Within the public healthcare sector, challenges to human resources include the international migration of professionals or national migration to the private sector, freezing of government posts, and attrition [23, 30]. Naturally, human resource shortages negatively impact service delivery and patient accessibility to hearing healthcare services such as early hearing detection and intervention (EHDI) services, provision of assistive hearing devices, and aural rehabilitation [9, 28, 31]. A maintainable workforce within the public healthcare sector is therefore central to delivering these hearing healthcare-related services.

In addition to the shortage of audiology staff, audiologists in this study perceived that there is also a shortage of ENT specialists within the public sector and across the hospitals and provinces. Within SA, an estimated ratio of 4.6 ENTs per million people has previously been reported [1, 15], which confirms the shortage of ENTs within SA when likened to European countries where more than 70% have more than 50 ENTs per million [14]. Furthermore, audiologists in the current study perceived that ENT service provision within the public sector is limited due to a lack of resources. These findings are consistent with a study conducted in 2009 on the availability of ENT, audiology, and speech-language therapy services across 18 countries in Sub-Saharan Africa, which revealed a severe shortage of these trained hearing healthcare professionals, and also a lack of hearing healthcare resources in these countries [32]. Consequently, individuals in Sub-Saharan Africa have minimal or no access to the simplest and most basic hearing evaluation and rehabilitation resources and the simplest hearing restoration surgeries, for instance, ventilation tubes and tympanoplasties [32].

In addition to trained professionals, basic hearing healthcare services also requires specific equipment and infrastructure, resulting in limitations in hearing healthcare service delivery in low-resource settings, including SA [15, 32, 33]. This challenge was confirmed in the current study, where most (82.0%) of the audiologists perceived that their hospital did not have adequate resources to render efficient audiology services to patients. Furthermore, in their open-ended responses, resource challenges (in terms of the hospital's audiology department's equipment, staffing, finances, and infrastructure) were identified as the most central challenge perceived by audiologists.

The Health Professions Council of South Africa (HPCSA) endorses the use of objective physiologic hearing screening measures, namely AABR and otoacoustic emission (OAE) (distortion-product OAE (DPOAE) or transient-evoked OAE (TEOAE)) screening equipment as part of an infant hearing screening protocol which is aligned with international guidelines [34–36]. However, at least 50% of audiologists in this study perceived that their hospital did not have an AABR screener, and 30% and 26% did not have a TEOAE or DPOAE screener, respectively. Additionally, in their open-ended responses, audiologists perceived that the lack of screening equipment in their hospitals was a challenge hindering hearing healthcare service provision. Newborn/infant hearing screening is a service that would typically be impacted by the absence of screening equipment such as an AABR or DPOAE screener. Both of these screening measures are easy to perform in newborns and infants and are successfully used for UNHS programs [37, 38]. Consequently, due to lack of screening equipment, only 30.0% of audiologists in this study perceived that their hospital provided targeted hearing screening services, and 21.0% perceived that their hospital provided UNHS.

UNHS is a viable means of reducing the burden of hearing loss and has become the standard of care for newborns in most developed countries [39]. It has since proven efficient in identifying infants born with hearing loss at the correct time to ensure that they are treated most adequately through early hearing amplification, thereby maximizing the infants' linguistic competence and literacy development [36, 40]. A recent South African study on UNHS in the public healthcare sector confirmed that the insufficient number of audiologists within the public healthcare sector to perform hearing screening and limitations with screening equipment were factors hindering the implementation of UNHS [41]. Comparably, findings from the current study also suggest that a shortage of audiologists and limitations in screening equipment are barriers to the execution of UNHS across South African public sector hospitals. Since a dearth of specialist workforce hinders attempts to make hearing healthcare available and equitable to all individuals, task sharing is a possible solution for ameliorating this situation [14, 42]. Recruiting nursing staff or trained hearing screeners to conduct hearing screening is an example of task sharing and could be beneficial within the public sector since audiologists would have additional personnel to assist them with the screening [41]. The successful use of non-specialist staff to conduct infant hearing screening has been previously demonstrated within SA's public healthcare system as well as in other African countries such as Nigeria and Zambia [1, 43–45]. Moreover, to the authors' knowledge, the most recent national newborn hearing screening study conducted in SA's public sector was in 2008 and reported that approximately 7.5% of the public hospitals across the country provided some form of infant hearing screening, and less than 1% provided UNHS at the time of the study [28]. It can therefore be assumed that very few advancements have been made within the past 12 years in the field of UNHS within the South African public healthcare system.

More than a third of audiologists perceived that their respective hospitals did not have but required diagnostic DPOAEs, TEOAEs, auditory steady state response (ASSR), or auditory brainstem response (ABR) equipment, and 41.46% of audiologists perceived that their hospitals did not have access to VRA equipment. Thus, the implication would be that many public sector hospitals in SA are not optimally equipped to conduct diagnostic pediatric audiological assessments. According to the Joint Committee on Infant Hearing's (JCIH) 2007 position statement, which are endorsed in SA as well by the HPCSA; ABR/ASSR, DPOAE, and/or high-frequency tympanometry (1000-Hz probe tone) equipment are required to appropriately diagnose infants less than six months [34–36]. Additionally, ABR/ASSR and behavioral audiometry (including VRA) are required as part of the audiological test battery to appropriately diagnose children between 6-36 months [34–36]. The absence of these types of equipment at a hospital would imply that pediatric patients would need to travel to referral hospitals that have access to the required equipment. However, this could delay the hearing loss diagnosis and subsequent hearing intervention due to the possibility of long waiting lists at most referral hospitals, traveling distances between the hospitals, and the cost and time implications for a patient's family.

Succeeding the detection and diagnosis of a hearing loss, necessary hearing intervention services are required for both the adult and pediatric populations. The insufficient accessibility of hearing devices such as hearing aids and CIs for individuals with hearing loss constitutes one of the barriers to hearing healthcare service delivery worldwide, and this barrier is also experienced in SA's public healthcare system [5]. In this study, only 31.0% of audiologists perceived that an adult patient with bilateral hearing loss would receive two hearing aids in their hospital setting. Similarly, a study by Pienaar et al. (2010) found that South African adult patients diagnosed with bilateral hearing loss within a public sector hospital were often fitted monaurally due to resource shortages [46]. The benefits of binaural hearing aid fittings for bilateral hearing loss are evident with regard to listening effort, binaural summation, improved localization abilities, spatial hearing, release of masking, source segregation, speech reception in noise, and the avoidance of head-shadow effects [47–49]. As such, patients with bilateral hearing loss tend to be more satisfied with binaural hearing aid fittings than monaural hearing aid fittings for their bilateral hearing loss [50]. Possible barriers to the provision of hearing aids within the public healthcare sector include budgetary constraints as well as structural constraints since each public healthcare setting can only cater to the population of patients residing within its pre-determined geographical/ catchment area [32, 51, 52]. As with the provision of hearing aids, the provision of CIs within SA's public healthcare sector also faces challenges. Since CIs are considered to be a privileged intervention in SA, there is minimal public funding available for this intervention, and hence a severely restricted number of individuals who adhere to CI criteria are implanted within SA's public healthcare sector [53, 54]. Therefore, the majority of the individuals requiring CIs have to either have sufficient finances or access to private medical aid to afford this intervention and the costly lifelong maintenance demands thereafter [21]. This, therefore, explains why only 5.0% of audiologists perceived that cochlear implantation would be possible for patients requiring this intervention at their hospitals.

Patients who access hearing devices within the public sector further require lifelong maintenance of their devices (such as earmould repairs, replacement, retubing; supply of hearing aid batteries; hearing aid adjustments, repairs, and replacements) [52, 55–58]. The South African Department of Health is responsible for covering all costs relating to the payment of hearing assistive devices and the subsequent maintenance, repairs, and re-issuing of assistive devices and the necessary assistive device consumables according to the individual's income and UPFS classification [27]. However, this study indicated that follow-up care following the fitting of hearing devices is perceived to be limited by many audiologists working within the public sector as pediatric and adult patients are perceived to be liable for covering all hearing device repairs or replacement costs once their device's warranty has expired. These findings are consistent with a previous study conducted within SA's public sector which revealed hearing devices, in particular, hearing aids fitted within the public sector, are not sufficiently cared for and are underutilized, with financial constraints serving as the greatest barrier towards adequate hearing aid utilization and maintenance [52]. Therefore, it is evident that accessing and maintaining hearing devices within SA's public healthcare sector is often challenging.

Appropriate and effective amplification followed by aural rehabilitation services has the potential to reduce the negative effects of hearing loss [46]. It has been demonstrated that adult aural rehabilitation within a South African public healthcare setting effectively contributes to positive patient-perceived benefits post-hearing aid fitting [46]. Only 41.0% of audiologists perceived that their hospitals provided adult aural rehabilitation services post-hearing aid fitting within the current study. This confirms the findings from a previous South African study on adult aural rehabilitation services, which found that these services were not optimally provided in SA and that improved aural rehabilitation services were required so that the adult hearing impaired population in SA could benefit from it [59].

This study's findings suggest that based on the perceptions of audiologists employed within South African public sector hospitals, hearing healthcare resources are strained within the South African public healthcare system. This, in turn, influences hearing healthcare service delivery and exacerbates the burden of hearing loss. Hearing healthcare should therefore be prioritized by increasing financial

allocations to audiology departments. This would enable the procurement of necessary hearing resources and the placement of more audiologists within audiology departments. Ultimately, the burden of hearing loss can be addressed by promoting awareness and advocating for hearing healthcare in SA, advancing towards a reduction in the risk factors that contribute to disabling hearing loss, and promoting early identification and intervention services [1].

A possible limitation of this study is that 43.0% of participants were audiologists completing their obligatory community service year, and 56.0% had less than two years of experience. Audiologists' position in the hospital, their years of experience, and whether they are permanently employed or community service audiologists are all factors that could potentially influence their perceptions of the hearing healthcare resources and services within the hospital. A study conducted in China on the perceptions of patient safety culture among healthcare employees also found that socio-demographic characteristics such as healthcare workers' years of experience and their position and education level influenced their overall perceptions [60]. Nevertheless, this is the first national study conducted in SA's public sector to describe audiologists' perceptions of hearing healthcare resources and services, and since the sample was representative of audiologists employed within South African public sector hospitals, results can be generalized.

Data obtained from this study should be utilized to direct national policy on the improvement of hearing healthcare resources and service provision within SA at a national level, and particularly within the public healthcare sector, to ensure that the country is able to efficiently deliver hearing healthcare services to all patients requiring such services.

Conclusions

In general, hearing healthcare resources and services that are required to address the burden of hearing loss are perceived by audiologists to be lacking within the South African public healthcare sector. These include equipment and human resources, and services such as UNHS and adult aural rehabilitation interventions. Therefore, efforts should be made to upsurge hearing healthcare resources, including increasing the financial budgets allocated to audiology resources so that increased diagnostic and screening audiology equipment and hearing devices can be procured where required, and additional audiologists can be employed within the South African public sector hospitals where needed.

Abbreviations

CIs
cochlear implants
ENT
ear, nose, and throat
SA
South Africa
I-CVI
item content validity index
AABR
automated auditory brainstem response
TEOAE
transient evoked otoacoustic emission
DPOAE
distortion product otoacoustic emission
ENG/VNG
electronystagmography/videonystagmography
ASSR
auditory steady state response
ABR
auditory brainstem response
VRA
visual reinforcement audiometry
UPFS
Uniform Patient Fee Schedule

UNHS
universal newborn hearing screening
EHDI
early hearing detection and intervention
HPCSA
Health Professions Council of South Africa
OAE
otoacoustic emission

Declarations

- **Ethics approval and consent to participate**

Research and ethical approval for this study was obtained from the Research Ethics Committee of the Faculty of Humanities, University of Pretoria (HUM005/1019) before any participants were recruited for this study. Informed consent was obtained from all participants prior to data collection

- **Consent for publication**

Not applicable. No identifying data from any individual person is contained in the manuscript.

- **Availability of data and material (data transparency)**

The data supporting this study's findings are available on request from the corresponding author (AB). The data are not publicly available due to their containing information that could compromise the privacy of research participants.

- **Competing interests**

None

- **Funding**

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- **Authors' contributions**

All authors contributed to the study's conception and design. AB performed material preparation and data collection, and analyses were performed by MG and AB. AB wrote the first draft of the manuscript, and all authors commented on previous versions. All authors read and approved the final manuscript.

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Figures

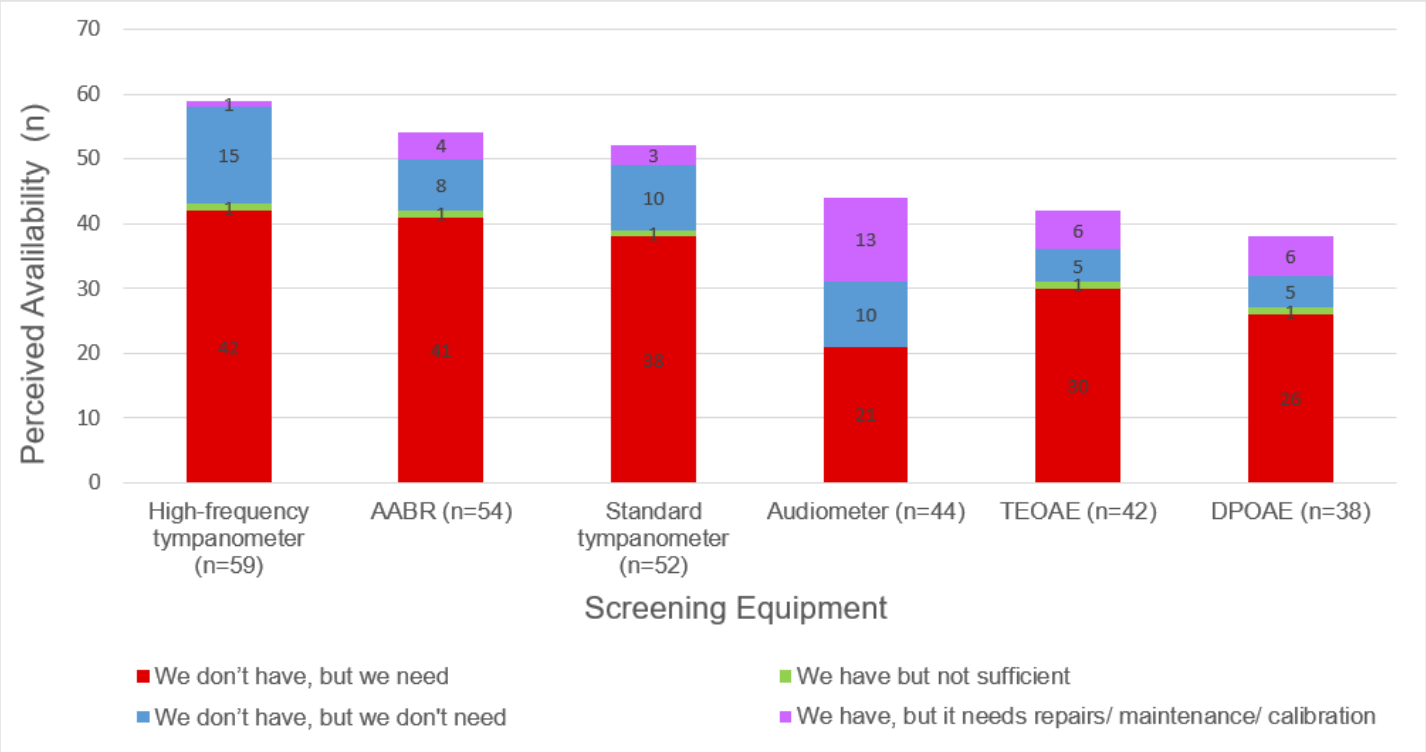

Figure 1

Perceived availability of audiology screening equipment

Legend: The x-axis illustrates the types of screening equipment and the total number of responses for each screening equipment (high-frequency tympanometer, automated auditory brainstem response (AABR), standard tympanometer, audiometer, transient evoked otoacoustic emission (TEOAE), and distortion product otoacoustic emission (DPOAE). The y-axis displays participant responses for

each screening equipment (we don't have but we need, we have but not sufficient, we don't have, but we don't need and we have, but it needs repairs/ maintenance/ calibration).

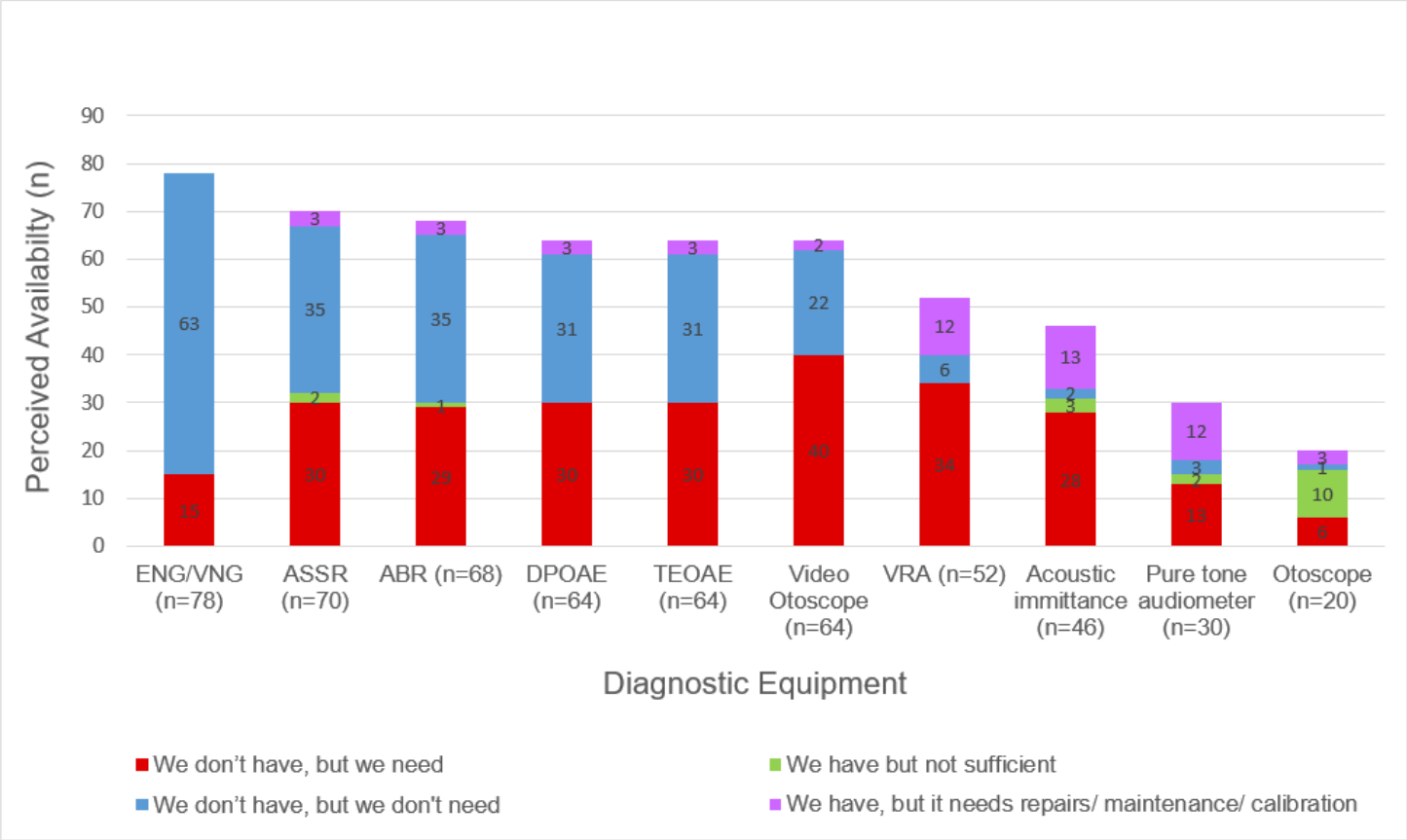

Figure 2

Perceived availability of diagnostic audiology equipment

Legend: The x-axis illustrates the types of diagnostic equipment and the total number of responses for each diagnostic equipment (electronystagmography/ videonystagmography (ENG/ VNG), auditory steady-state response (ASSR), auditory brainstem response (ABR), DPOAE, TEOAE, video otoscope, acoustic immittance, pure tone audiometer, and otoscope). The y-axis displays participant responses for each of the diagnostic equipment (we don't have but we need, we have but not sufficient, we don't have, but we don't need and we have, but it needs repairs/ maintenance/ calibration)

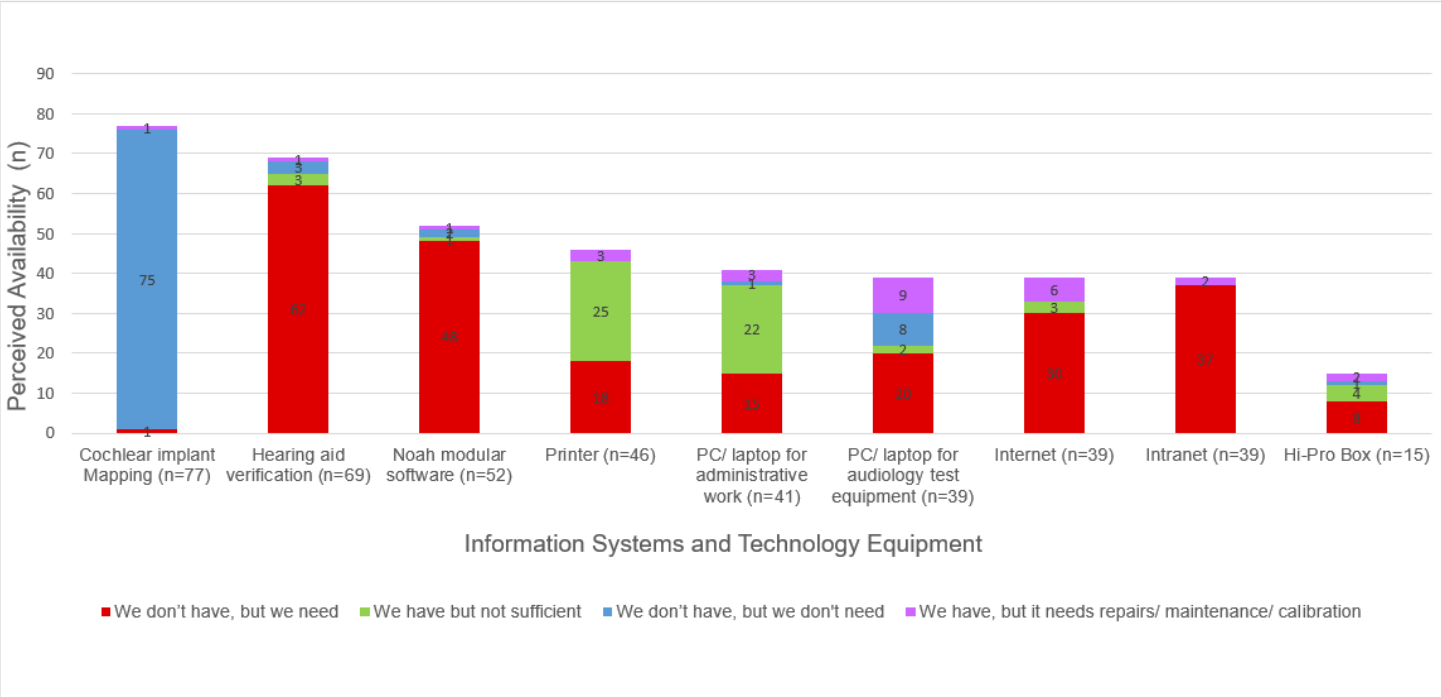

Figure 3

Perceived availability of information systems and technology

Legend: The x-axis illustrates the types of information systems and technology and the total number of responses for each information system and technology (cochlear implant mapping, hearing aid verification, Noah modular software, printer, PC/ laptop for administrative work, PC/ laptop for audiology test equipment, internet, intranet, and hi-pro box). The y-axis displays participant responses for each diagnostic equipment (we don't have but we need, we have but not sufficient, we don't have, but we don't need and we have, but it needs repairs/ maintenance/ calibration).

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