In Pursuit of Preventive Audiology in South Africa: Scoping the Context for Ototoxicity Assessment and Management

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Aim: The study explored the South African healthcare context for ototoxicity assessment and management from the audiologists’ perspectives. Materials and Methods: This was done through a survey research methodology that adopted a cross-sectional research design. South African audiologists were recruited from professional associations databases using specific inclusion criteria; and 31 audiologists from across the country participated. The study used an 18-item web-based survey guided by the Health Professions Council of South Africa (HPCSA) (2018) guidelines. Data were analyzed through both descriptive and inferential statistics. Results: Findings revealed serious contextual challenges influencing the implementation of assessment and management programs within the South African context. Over two-thirds of the participants engage with ototoxicity monitoring and management, but the practices adopted are not aligned to international standards nor the national HPCSA guidelines on assessment and management of patients on ototoxic medications. Findings speak to the frequency of practice; the referral pathways audiologists use; prevention and promotion methods used; availability of resources for the implementation of ototoxicity assessment and management; barriers to ototoxicity assessment and management; the influence of language and culture in ototoxicity assessment and management; as well as information management practices within this context. No relationship could be established between knowledge regarding ototoxicity, communication, caseload, and ototoxicity assessment and management on the chi-square. Conclusion: Implications for strategic planning, budget allocation, collaborative multidisciplinary within the same institution approaches; training; policy formulation; and translation of policies and guidelines into practice are raised by these findings.

Keywords: Assessment, context, current, guidelines, hearing loss, management, ototoxicity, pathways, practices, referrals, South Africa

INTRODUCTION

Pharmaco-vigilance is an important aspect of the pharmacological treatment of disease. In low- and middle-income (LAMI) countries such as South Africa, where the burden of disease is high with resource constraints dictating healthcare priorities, and where medications used to treat life-threatening conditions such as tuberculosis (TB) and HIV/AIDS may comprise of proven ototoxic medications due to resource constraints; it is important for the audiology community to remain involved and vigilant in the execution of their preventive audiology role. Within...
the audiology field, pharmaco-vigilance comprises ototoxicity assessment/monitoring and management. Although ototoxicity monitoring is gaining momentum within the South African research and clinical communities, evidence suggests that significant gaps still exist in terms of nationalized consistent, and systematic implementation of standardized protocols that allow for establishment of solid evidence base for efficient evidence-based practice in this field. Current evidence on ototoxicity monitoring reveals nonsystematic, noncomprehensive, and nonstrategic program implementation that is not sustainable. This is fundamentally due to a number of factors that emanate from contextual realities of an LAMI country.

South Africa has and continues to experience significant health challenges, despite the government’s goals toward universal healthcare coverage through a new model of healthcare delivery called National Health Insurance (NHI). Some of these challenges include well-documented lack of appropriate skills particularly within the public health sector; demand: capacity challenges evidenced by unfavorable professional-to-patient ratios that are coupled with existing incongruence between healthcare practitioners’ demographic profiles (language and culture) to that of the population served; infrastructural constraints where access to healthcare services by over 80% of the population is severely compromised by limited well-functioning public health facilities; general lack of resources for the size of the population requiring health services; challenges with translating knowledge and policies into practice for various reasons including linguistic and cultural diversity quandaries; as well as limited use of alternative service delivery models such as task-shifting and tele-practice. Ototoxicity assessment and management have to occur in the presence of all these challenges, over and above competing with life-saving healthcare priorities.

Ototoxicity is defined as drug-induced hearing loss that presents as a high-frequency hearing loss, which may be accompanied by tinnitus and/or vertigo. It is well established that many drugs (e.g., aminoglycoside antibiotics; certain antimalarial medications, some chemotherapeutic drugs, etc.) are capable of inducing ototoxicity; but are however usually reserved for treating life-threatening conditions such as TB. The World Health Organization now estimates that about 6.1% of the world population is living with disabling hearing loss, the causes of which include the use of ototoxic medications. Ototoxic medications such as aminoglycosides continue to present controversy in the medical world, as they remain considerably toxic to the inner ear and significantly impact the affected individual’s quality of life.

Although ototoxicity is not a life-threatening disease, it affects communication and health-related quality of life indicators with significant occupational and social consequences. In children, ototoxicity can impact language, speech, social, and cognitive development which could negatively impact on school performance and psychosocial functioning. Consequently, the aim of ototoxicity assessment and management should be early identification, continual monitoring, minimization, and/or prevention of hearing impairment and planning of appropriate rehabilitative measures.

In South Africa, an LAMI country with limited resources for basic healthcare and basic services, there has not been standardized practice for ototoxicity assessment and management until the recently published Health Professions Council of South Africa (HPCSA) guidelines “Audiological management of patients on treatment that includes ototoxic medication.” Until these guidelines, audiologists had been adapting protocols from high-income countries like the United States of America to suit the South African population. This led to inconsistent, nonstandard, noncomprehensive, and nonsustainable strategies that lacked risk: benefit assessments and risk: benefit decisions when it came to ototoxicity management options. Contextual applicability and practicability of the HPCSA guidelines require exploring, hence this study exploring the South African healthcare context for ototoxicity assessment and management, as perceived by audiologists.

**Materials and Methods**

**Aims and objectives**

The primary aim of the study was to explore the South African healthcare context for ototoxicity assessment and management, as perceived by audiologists. The specific objectives were as follows:

- To establish the referral pathways in place for patients with ototoxicity
- To explore the availability of resources for implementation of ototoxicity assessment and management practices
- To explore barriers to ototoxicity assessment and management
- To explore the influence of language and culture in ototoxicity assessment and management
- To explore the information management measures available for ototoxicity assessment and management in the South African context.
- To explore if there is a relationship between categorical variables.
Research design
A quantitative survey research methodology with a cross-sectional research design was adopted. The current methodology allowed for wider access to participating audiologists from different provinces of South Africa; therefore, better generalizability of findings.

Participants
Through a nonprobability purposive sampling strategy, 31 participants were recruited following specific inclusion/exclusion criteria. Access to potential participants was obtained via the South African Speech Language Hearing Association (SASLHA) as well as the South African Association of Audiology (SAAA). These associations allowed the researchers access to their members’ contact details to distribute the survey to audiologists registered with the associations who are also all registered with the HPCSA. Furthermore, assistance was obtained from various heads of audiology departments at public and private hospitals to send out the survey to various members of their staff.

To be included in the study, participants needed to meet the following inclusion criteria:

- All participants were required to be registered with the HPCSA as an audiologist or audiologist/speech therapist
- The audiologists were to be a graduate from a South African University that offers the audiology degree.
- All participants were to have been practicing audiology in either private and/or public setting.

Participants meeting the following criteria were excluded from the study:

- Participants who only practice in pediatric audiology were excluded from the study.
- Participants who were speech-language therapists and audiologists who were only practicing in speech-language therapy were excluded from the research study.

Sample size
The current research aimed to recruit a minimum of 50 participants but only succeeded in obtaining 31 participants.

Data collection
An online survey that provided the researchers access to a larger population was used in the current study. The online survey was an 18-item based survey containing closed and open-ended questions, and was guided by the HPCSA guidelines for otoxicity monitoring and management. The questionnaire addressed aspects including demographic information, otoxicity assessment, and management practices, the referral pathways, availability of resources, as well as facilitators and barriers to otoxicity assessment and management. Furthermore, the possible influence of language and culture in the process, and the informational management and the quality measures available for the South African context were included in the survey [Table 1].

Ethical considerations
Prior to commencement of the study, ethical clearance was obtained from the University’s Human Research Ethics Committee (Non-Medical) (Protocol Number: STA_2019_04). The study adhered to the Helsinki Declaration of 1975, as revised in 2008 as far as ethical considerations were concerned.

Data collection procedures
Once ethical clearance was obtained, the researcher contacted SASLHA and SAAA so that the online survey could be sent out to practitioners who are registered with the associations. Once permission was obtained from all relevant authorities, the surveys were sent out to the participants through the use of Google drive. In addition to the surveys, all participants received a cover letter explaining the purpose of the research project and a guarantee of confidentiality. Participants provided informed consent by completing the online survey. Once all surveys were completed, the researcher commenced with data analysis.

Data analysis

Methods of analysis and presentation of data
Data were analyzed using both descriptive and inferential statistics. Descriptive statistics gave numerical and graphical procedures to summarize the data in a clear and understandable way and the chi-square (χ²) test was used to assess if there were any relationships between categorical variables (P = 0.05). Here, the researchers aimed to establish if there was a relationship between categorical variables—communication, caseload, knowledge regarding otoxicity and otoxicity assessment and management. The descriptive analysis information is represented in the form of modes, medians, and averages.

Reliability and validity
The study ensured reliability by administering the same questionnaire in the survey for all the participants. In addition to this, reliability was guaranteed by conducting a pilot study to test the tool (self-developed surveys) prior to the main study to determine its feasibility, adequacy, reliability, and validity. Validity was difficult to obtain from this study because it is an online survey and the responses may not reflect the
actual practices, however the big samples size was aimed at addressing this limitation—to generalize the results of the study.

RESULTS AND DISCUSSION

Description of the sample
A total of 31 participants responded to the survey. A total of 74% (n = 23) of the participants had an undergraduate degree in audiology or speech pathology and audiology; with the rest (n = 8) having obtained a postgraduate degree in audiology (either a Master’s degree or a Research Doctorate). The level of qualifications in the current sample is representative of the South African audiology community which has more practitioners with an undergraduate qualification than post-graduate qualification, as a postgraduate qualification is not a requirement for HPCSA registration for practice in this country. Of the total sample, 71% (n = 22) of the participants reported to work in the public health sector, with a third 29% (n = 9) working in the private health sector. The fact that a majority of the sample was in the public sector is a positive finding for the current study as this is the sector that provides clinical services to at least 80% of the South African population—so evidence from this group has greater impact in terms of guidelines implementation to the majority of the country’s citizens, than if it was private practitioners who see less than 20% of the country’s citizens. It is acknowledged that this sector placement profile in the current sample has no relationship to the actual placement of audiologists in the South African context, but merely a feature of who completed the survey.

Frequency of practice in ototoxicity assessment and management
As far as participants’ frequency of practice in ototoxicity assessment and management was concerned, as depicted in Figure 1, findings indicated that more than half (81% [n = 25]) of the participants reported practicing mostly within this field. This implies a significant need for appropriate monitoring and management programs as the need seems to be high within this context.

This high need for ototoxicity assessment and management services is supported by the high burden of disease as well as the reported increased need for prescription of ototoxic medications within this LAMI country context. Such findings raise implications for proper planning for this clinical service provision extending from personnel to equipment and assistive devices.

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| Section | Motivation |
|---------|------------|
| Section A: Demographic Information (3 questions) | This section was used for administrative and demographic profile purposes. In addition, it allowed the researcher to compare public and private settings in terms of ototoxicity assessment and management practices. |
| Section B: Ototoxicity Assessment and Management Practices (9 questions) | This section allowed the researcher insight into the process of early identification of ototoxicity, if it was conducted within the suggested time frame and whether audiological monitoring was carried out as per the guidelines. In addition, it allowed insight to the type of equipment used and access to it. Lastly this section provided information on the grading criteria used. |
| Section C: Facilitators and Barriers to Ototoxicity Assessment and Management (2 questions) | This section allowed the researcher information on what audiologists felt were facilitators and barriers to ototoxicity assessment and management in their respective contexts. |
| Section D: Referral Pathways used for patients with ototoxicity (6 questions) | This section allowed the researcher information regarding whether there is an effective referral system for patients with ototoxicity. |
| Section E: Prevention and Promotion—(2 questions) | This section allowed the researcher information regarding prevention and promotion measures in place for patients with ototoxicity. |
| Section F: Resources available for ototoxicity assessment and management practices (6 questions) | This section allowed the researcher to gather information on resources available for the assessment and management of ototoxicity. |
| Section G: Institutional policies on the use/handling of assistive devices (4 questions) | This section gathered information on what the current institutional policies are on the use/handling of assistive devices in patients with ototoxicity assessment and management practices. |
| Section H: Role of Language and Culture in Ototoxicity assessment and management (1 question) | This section gathered information on what the audiologists felt was the influence of linguistic and cultural diversity on assessment and management of ototoxicity. |
| Section I: Information management and quality control (2 questions) | This section gathered information on how ototoxicity records were handled and managed. |
The referral pathways audiologists use for patients with ototoxicity

Current findings revealed that a large majority of the participants (94%, n = 29) refer patients and book them for follow-up evaluations and management when diagnosed with ototoxicity. This is an expected finding due to the nature of repeated measures conducted in ototoxicity monitoring. The referrals are made to different health care professionals with 58% (n = 23) of the participants reporting relying on referral letters, with only 42% (n = 17) managing to make telephonic and/or face-to-face referrals. A referral letter as a referral system might not be the most efficient for ototoxicity monitoring where early detection and early intervention are key to prevent occurrence and/or progression of hearing loss. Lack of direct professional contact, allowing for detailed discussion of the patients’ medications and consequent ototoxic changes may lead to delayed medical intervention, long after permanent and significant damage has occurred. The HPCSA[15] guidelines suggest that referral systems should be efficient, and be prompt to medical and audiological evaluations to confirm the presence of ototoxicity and to prevent exacerbation of ototoxic signs and symptoms.

As depicted in Figure 2, a large majority of participants 68% (n = 21) reported referring patients for follow-up within the same facility or referred them to the nearest primary healthcare facility with an audiologist. Key to the referral facilities was the presence of an audiologist and/or an Ear, Nose, and Throat (ENT) Specialist. This is of concern as demand: capacity as far as these two practitioners are concerned within the South African context is challenging. Furthermore, for ototoxicity monitoring and management, close collaboration with physicians and pharmacists is also important.[1]

For contextual relevance, current findings indicating referrals to TB focal points, nearest tertiary/district hospital, as well as nearest primary healthcare facilities are in line with HPCSA[15] recommendations; and are also aligned to the re-engineered primary health care strategy that the South African government has adopted.[6] However, sufficient evidence exists that indicates lack of appropriate resources at these levels of care for ototoxicity assessment and management. These findings therefore highlight a need for South African department of health to deliberate on resourcing these facilities, on route to the implementation of the NHI.

Current findings as depicted in Table 2 provide an explanation as to why multidisciplinary case management for ototoxicity is challenging within this context. A number of barriers were listed that negatively influence the effective implementation of this approach. Although all participants believe that the approach is vital in ototoxicity assessment and management, contextual challenges were identified as impeding its efficiency. Only 31% (n = 7) of the participants reported to have successfully worked within a multidisciplinary approach for assessment and management of ototoxicity. Majority of the participants (69%, n = 24) felt that the approach was not effective due to barriers depicted in Table 2. Lack of trust among professionals as well as poor communication were the most commonly reported barriers, as well as limited knowledge about

![Figure 2: Referral Pathways used by participants in patients with ototoxicity](image)

**Table 2: Barriers to effective multidisciplinary approach**

| Barriers to effective multidisciplinary approach                           | %  |
|---------------------------------------------------------------------------|----|
| Lack of trust among professionals                                          | 19 |
| Poor communication among clinicians                                       | 16 |
| Lack of knowledge in ototoxicity                                          | 13 |
| Large caseloads                                                           | 13 |
| Hectic schedules of clinicians                                          | 10 |
| Referrals to audiologists once a hearing loss has developed               | 6  |
ototoxicity among professionals and high workloads. Previous studies have reported on these barriers in this context.[21,22] These barriers are easy to remediate through education and training, as well as definition of scopes of professions for all professions involved.

**Prevention and promotion methods used in ototoxicity assessment and management**

As far as the prevention and promotion methods used in ototoxicity assessment are concerned, results as depicted in Table 3 show that different strategies for prevention and promotion are used. The strategies used include provision of informational counseling to patients, conduct screening for patients at risk for ototoxicity as well as providing continued professional development to healthcare practitioners.

These prevention and promotion methods are appropriate on face value for the context, and are consistent with recommendations by the HPCSA[15] guidelines which suggest that audiologists should have prevention and promotion methods to promote their role in ototoxicity assessment and management. The linguistic and cultural diversity influences on prevention and promotion initiatives and activities have, however, not been accounted for within this context. Khoza-Shangase and Mophosho[23] strongly argue for the importance of considerations of the influences of language and culture in the provision of Speech Language and Hearing services within the South African context, which current authors argue determines health seeking and health intervention adherence behaviors. Joubert, Sebothoma and Kara[24] support the notion of the need for different promotion and prevention methods to advocate for the role of audiologists within the medical field as well as among patients for the South African context.

**Availability of resources for implementation of ototoxicity assessment and management**

**Caseload**

Current results show that ototoxicity takes up on average 15% of the participants’ caseload. Whether the patients are seen depends on the availability of staff and the resources at the site during the referral. Over 50% of the participants indicating having a waiting list that includes patients on ototoxic treatment; although all participants reported prioritizing patients on MDR-TB treatment and new patients. The results showed that at sites where the staff is limited, waiting lists are long, affecting booking dates, particularly the repeated measures (monitoring) aspect of the ototoxicity program. This demands that capacity reality has a significant impact on the efficiency of an ototoxicity monitoring program, and is not in line with minimum standards and guidelines. Implications about early detection, identification, monitoring, diagnosis, and treatment are raised; and a need for effective resource planning is highlighted.

**Availability of equipment**

As far as availability of equipment and the resources to calibrate this equipment is concerned, the results as shown in Figure 3 indicate that significantly more resources (55%) are allocated toward procuring new equipment for assessment of ototoxicity and calibrating it, with only 29% allocation for assistive devices for this population. Inadequate budget allocation has a significant impact on success of such a program. In an already resourced constrained setting, lack of planning for repairs of equipment renders services paralyzed, patients not sufficiently monitored, early detection and therefore early preventive measures impossible; and consequently hearing impaired patients not even provided with assistive devices when the eventuality comes for that intervention. Although the goal of an ototoxicity monitoring program should be to eliminate and/or minimize the need for assistive devices, current evidence from the South African context calls for a need for sufficient budgeting for assistive devices.[25-27]

![Figure 3: Budgetary allocation for ototoxicity assessment and management](image_url)
In terms of the institutional policies on the use of equipment:

- **In terms of how many times the equipment was calibrated:**

  As far as the frequency of calibration is concerned, the results as shown in Figure 4 indicate that equipment is mostly calibrated within the suggested time frames. Majority, 90% \((n = 27)\), of the participants reported calibrating their equipment once a year (without biologic calibration); 7% \((n = 2)\) reported calibrating annually and also performed daily biologic calibration, with one participant reporting biennial (taking place every other year) calibration. It is important to note that extended time periods without calibration are due to budget constraints.

  Regular calibration affords reliable and valid test results, and therefore efficient ototoxicity monitoring under ideal conditions.\(^{[13]}\)

- **In terms of fitting of amplification after diagnosis of hearing loss:**

  As far as provision of amplification was concerned, the results as depicted in Figure 5 indicated that most of the participants 71% \((n = 22)\) fit devices immediately or within 1–3 months of final diagnosis; 13% \((n = 4)\) fit in 4 months to a year, and 16% \((n = 5)\) fit devices depending on the stock available and the waiting list for the whole facility—not just the ototoxicity assessment and management clinic.

  The above results seem to be institution and resource-availability specific, but are however positive because they adhere to the HPCSA\(^{[15]}\) guidelines—for those patients diagnosed. This means that diagnosed patients are fitted within reasonable time frames, therefore impacting positively on their overall quality of life.

In terms of whether unilateral or bilateral assistive devices are fitted when bilateral hearing loss has been diagnosed, the results in Figure 6 indicate that majority, 61% \((n = 19)\), of the participants fit unilaterally only due to budgetary constraints. Bilateral fitting was only reported by 32% \((n = 10)\) of the sample, and only in severe degrees of hearing loss.

The nature of ototoxicity, because it is systemic, is that patients present with bilateral hearing impairment, requiring bilateral amplification for optimal benefit.\(^{[29]}\)

Current findings therefore reveal a gap in the efficacious rehabilitative management of patients in this population due to financial constraints. This unilateral fitting was reported by audiologists from both the public and private health sector, signifying the high costs involved in hearing aid procuring, be it state or medical aid financed. Within the South African context, a majority of medical aids (medical funders) restrict fitting to one hearing aid per 24 months.

### Barriers to ototoxicity assessment and management practices

Current results revealed a number of barriers to ototoxicity assessment and management, as shown in Table 4. A majority of the participants (68% \([n = 21]\))...
reported that the high caseloads, limited personnel, lack of equipment accompanied by lack of resources were key barriers. Moreover, more participants (19% \([n = 6]\)) reported that poor collaboration and communication with other healthcare professionals negatively impacted ototoxicity assessment and management practices. Just under half of the participants (42% \([n = 13]\)) reported barriers that were patient-specific: patients are often unaware of the audiological symptoms thus do not attend audiological monitoring, patients mainly focus on the life-threatening conditions they suffer from with minimal attention to possible quality of life issues, and patients live far from the institutions thus cannot access ototoxicity monitoring within the necessary time frames.

These barriers are common in LAMI contexts and have been previously reported in the current context. Harris \textit{et al.} \cite{29} stated that LAMI countries have financial pressures, which lead to an unequal distribution of services, resources, and staff allocation. The shortage of staff and the inadequate facilities impact the delivery of audiological services, thus causing a paucity in this field. In addition, Khoza-Shangase and Jina \cite{21} stated that even though South African general practitioners are aware of the ototoxic effects of medications sometimes prescribed and they are also aware of the audiological services available; they appear to not use these services. This shifts some of the responsibility to the patient to report some of the early symptoms; but if patients are not aware of these symptoms, early detection will not occur—precluding preventive measures from being implemented. Immediate and nearby access to audiological services requires governmental intervention as the documented high poverty and unemployment levels in this context do not allow for additional financial demands on patients to access ear and hearing care.

### Table 4: Barriers to ototoxicity assessment and management practices

| Barrier                                                                 | Percentage of participants |
|------------------------------------------------------------------------|---------------------------|
| High caseloads, limited personnel, lack of funding and limited equipment | 68\% \((n = 21)\)          |
| Poor communication and collaboration with the multidisciplinary team. Lack of knowledge among team members of both ototoxicity as well as the protocols to follow on patients with ototoxicity. | 19\% \((n = 6)\)          |
| Patient awareness of the audiological symptoms, patients focus on the life-threatening conditions they suffer from; patients live far from the institutions | 42\% \((n = 13)\)          |

The influence of language and culture in ototoxicity assessment and management

When participants were asked if they believe that linguistic and cultural diversity that exists between audiologists and patients within the South African context has any influence on ototoxicity assessment and management, results indicated, as depicted in Figure 7, that almost half (48\% \((n = 15)\)) of the participants believed that there were no language and cultural barriers that negatively impacted ototoxicity assessment and management practices. In addition, 45\% \((n = 14)\) of the sample reported that language diversity is a barrier to ototoxicity management; and this specifically impacted counseling. These participants reported using interpreters, but felt that this breaches confidentiality of the patients. Of the 7\% of the participants that reported that culture poses as a barrier, they believed that patients would not report symptoms earlier due to the underlying cultural beliefs which affected the early detection process, and that cultural beliefs sometimes impact the patients’ compliance with the management practice.

Khoza-Shangase and Mophosho \cite{23} argue for concerted efforts by the South African Speech Language and Hearing professions to increase their attention to the influence of linguistic and cultural diversity in the provision of speech-language therapy and audiology services within the South African context. These authors partly base their argument on evidence from global health which indicates that groups who do not form part of the dominant culture have worse health outcomes than the dominant populations—with language as an example of a barrier to health care. \cite{30} South African audiologist’s careful deliberations around and considerations of the influence that language and culture can have on ototoxicity programs are highlighted.
by current findings. In addition, the lack of formal interpreters in staff establishments in both public and private healthcare in South Africa possibly means that a number of patients receive less than optimal clinical care due to a language barrier. Hunter-Adams and Rother\(^{[31]}\) argue that the lack of official medical interpreters in South Africa has become a norm, and that the effects of this have been to essentially silence the patients’ voice. Literature highlights that with language barriers, patients are less likely to report symptoms, comply with treatment, seek medical care or follow-up appointments or receive preventative services;\(^{[23,31]}\) and these are key to a successful ototoxicity program.

Information management for ototoxicity assessment and management

In terms of the information management available for ototoxicity, the results depicted in Figure 8 show that almost half of the sample (49% \([n = 15]\)) reported using paper to record and store clinical data, with the other half reporting using both paper and electronic database.

An efficient data management system in an ototoxicity monitoring program is one that allows for a comparative analysis of repeated measures to be able to detect changes early. This is easier and more efficiently done in an electronic system. Combination of systems may create challenges and raise margins of error in the collation and analysis of data. An electronic system further accommodates a migration-prone health care system, which the South African context is.\(^{[32]}\)

Relationship between categorical variables

Due to the small sample sizes in all the other variables, chi-square could only be performed between knowledge regarding ototoxicity, communication, caseload, and ototoxicity assessment and management. Findings revealed that there was no significant correlation between all these variables in the current study.

CONCLUSION

Over three-quarters (81% \([n = 25]\)) of the participants in this study reported practicing mostly within this field of ototoxicity assessment and management. This indicates a significant demand for this clinical service within the South African context. Over and above assessment and management, the clinical service demand was found to also include prevention and promotion activities such as provision of informational counseling to patients as well as providing continued professional development to healthcare practitioners.

This demand is met with significant challenges. One of these challenges is the demand: capacity quandary where patients diagnosed with ototoxicity cannot promptly be booked for follow-up assessment and management (including medical management by attending physicians and/or pharmacists). This demand: capacity challenge leads to increased workloads for team members which reduces and/or eliminates direct contact for case discussions among practitioners. In this study, the fact that 58% of the participants reported relying on referral letters, with only 42% \((n = 17)\) managing to make telephonic and/or face-to-face referrals is evidence of this challenge. Referrals, when made, are not always to within the facility where the patient receives treatment—as seen in at least a third of the sample. In a resource-constrained country, with high levels of poverty and unemployment, lack of comprehensive in-house or in-facility management of patients within programs such as ototoxicity assessment and management is problematic. The impact of transport costs as well as time costs on patients cannot be underestimated; however, referrals were made to ensure multidisciplinary management of patients. This multidisciplinary approach was, nonetheless, found to be non-effective within this context by 69% of the sample; due to barriers such as lack of trust among professionals; poor communication; as well as limited knowledge about ototoxicity among professionals and high workloads. With participants reporting that ototoxicity assessment and management comprises 15% of their caseload is significant for planning within this context. The fact that current findings revealed over 50% of the participants indicating having a waiting list that includes patients on ototoxic treatment is of serious concern; even though all participants reported prioritizing patients on MDR-TB treatment and new patients in their scheduling.

Resource constraints have a significant impact on ototoxicity programs. Current findings revealing budgeting that does not seem congruent with the needs of the service raise important implications for hospital
management as well as healthcare programs where ototoxicity medications are a known risk, such as oncology and TB programs. Budgeting has to include procurement and repairs of equipment; as well as sufficient budgeting for assistive devices where patients have been diagnosed with hearing impairment. Due to the bilateral nature of ototoxic hearing loss, bilateral fittings should be budgeted for instead of the unilateral and insufficient fitting budget currently allocated.

Current results revealed a number of barriers to ototoxicity assessment and management. Keys to these are high caseloads (68% of the participants reported this), limited personnel, lack of equipment accompanied by lack of resources; as well as poor collaboration and communication with other relevant healthcare professionals. Barriers specific to patients such as distance from the treating facilities; lack of awareness of symptoms and selective focus on the treated condition instead of side effects of medications; were also found to have an influence on ototoxicity assessment and management within the South African context. Most of these barriers seem surmountable with proper and strategic planning.

The undermining of the possible influence of language and culture in the current sample, particularly within the South African context where there is a documented incongruence between healthcare providers and majority of the population requires closer investigation and raises implications for training institutions, as this has significant impact on healthcare outcomes. If practitioners do not believe that language and culture have an influence in their clinical engagements, they are less likely to advocate for transformation of the professions to reflect the diversity of the country; and are also less likely to raise the alarm around lack of official health translators within the South African healthcare system.

The lack of a national systematic electronic data health management system is seen to be influencing ototoxicity assessment and management within the South African context. The fact that half of the sample still uses paper-based data management is a concern for repeated-measures comparisons, as in ototoxicity monitoring, as well as for the migration-prone healthcare system in which South Africa is.

Current findings, although no statistical relationships could be established between the categorical variables, provide an overview scope of some contextually relevant evidence that will contribute toward ototoxicity programs strategic planning, implementation, and monitoring. These findings should be interpreted taking careful cognizance of the identified limitations of the study; which include the small sample size as well as the survey design.

Acknowledgement

The authors would like to acknowledge the South African Association of Audiologists (SAAA) and the South African Speech-Language and Hearing Association (SASLHA) for distributing the survey to professionals who then completed the surveys. The authors would like to acknowledge the National Institute for the Humanities and Social Sciences (NIHSS) for publication costs for this article.

Author contributions

Conceptualization, KKS; Methodology, KKS and NM; Survey, KKS; Formal Analysis, NM and KKS.; Investigation, NM; Writing—Original Draft Preparation, NM and KKS; Writing—Review and Editing, KKS; Supervision, KKS.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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## APPENDIX A: SURVEY

### WHAT ARE THE CURRENT OTOTOXICITY ASSESSMENT AND MANAGEMENT PRACTICES IN SOUTH AFRICA?

*What are the current Ototoxicity assessment and management practices in South Africa?*

Please take a few minutes to fill out this survey on the current practices of South African audiologists for the assessment and management of ototoxicity in adults. All answers from the survey will be kept confidential and used solely for academic purposes. Thank you for your participation.

### Demographics

1. Please state your gender
   - [ ] Male
   - [ ] Female
   - [ ] Other

2. What is your highest level of education?
   - [ ] Master's degree
   - [ ] Clinical doctorate degree (e.g., AuD)
   - [ ] Undergraduate degree
   - [ ] Research doctorate degree (e.g., PhD)
   - [ ] Other (Please specify: ____________________)

3. In what type of setting do you practice?
   - [ ] Private
   - [ ] Public

### OTOTOXICITY ASSESSMENT and MANAGEMENT PRACTICES:

4. Are you involved in ototoxicity assessment and management?
   - [ ] Yes
   - [ ] No

5. On average, how many patients receive baseline assessment prior to treatment initiation or within 24 hours post treatment initiation with ototoxicity medication?
   
   (Please indicate a numeric value)

6. On average, how many patients receive bi-weekly audiological monitoring?
   
   (Please indicate a numeric value)

7. What type of assessment is used to form a baseline audiogram for high-risk patients?
   
   (Please tick all the appropriate answer/s)
   - [ ] Case history
   - [ ] Otoscopy
   - [ ] Immittance testing
   - [ ] Pure Tones (basic standard frequencies)
   - [ ] Pure Tones (including ultrahigh frequencies)
   - [ ] Bilateral DPOAEs
   - [ ] ABR
   - [ ] Other (please specify ____________________)

8. What bi-weekly audiological monitoring components are included?
   - [ ] Bilateral otoscopic examination
   - [ ] Bilateral pure tone air conduction testing (basic standard frequencies)
   - [ ] Bilateral pure tone air conduction testing (including ultrahigh frequencies)
   - [ ] Bilateral DPOAEs
   - [ ] ABR

9. What criteria do you use to determine an ototoxicity shift in hearing due to ototoxicity?
   - [ ] ≥ 20dB pure tone threshold shift at a single frequency
   - [ ] ≥ 10dB shift at two consecutive frequencies or threshold responses
   - [ ] A no response at three consecutive frequencies
   - [ ] Other (please specify ____________________)

10. What criteria do you use to grade the severity of the ototoxicity shift?
    - [ ] Grade 1: threshold shift or loss of 15-25dB relative to baseline
    - [ ] Grade 2: threshold shift or loss at >25-90dB
    - [ ] Grade 3: hearing loss indicates hearing intervention
    - [ ] Grade 4: Indication for cochlear implants
    - [ ] Other (please specify): ____________________

11. What management options are available to offer to patients identified with a shift?
    (Please tick all the appropriate areas)
    - [ ] Inform doctor to explore strategies for medical intervention
Nursing staff to monitor ototoxicity signs and give referrals

Pharmacist to make recommendations for otoprotective treatments such as well as less ototoxic medication

Patient is given hearing aids or other amplification devices

Patient is enrolled into an aural rehabilitation intervention including appropriate clinician

Patient’s hearing is monitored up 3–6 months after termination of medication.

Other (please explain):

Facilitators and Barriers to ototoxicity assessment and management:

12. What, in your opinion, are the facilitators to ototoxicity management in South Africa?

Facilitators and Barriers to ototoxicity assessment and management:

13. What, in your opinion, are the barriers to ototoxicity management in South Africa?

REFERRAL PATHWAYS

14. What procedures are followed for patients that are identified with a shift in hearing due to ototoxicity?

Diagnostic hearing assessment within 24 hours to confirm ototoxicity

Patient is given hearing aids at your practice

Patient is referred to another healthcare facility for hearing aid fitting

Patient is enrolled into an aural rehabilitation intervention program at the practice

Patient is enrolled into an aural rehabilitation intervention program at different healthcare facility

Patient’s hearing is monitored up 3–6 months after termination of medication.

Other (please explain):

15. Do you book follow-up evaluations after the patient has been diagnosed with ototoxicity?

Yes

No

a. If yes, where are the follow-up appointments booked?

Tick the appropriate answers

At a primary healthcare facility?

At the nearest healthcare facility with a medical doctor?

At the nearest health care facility with an Ear, Nose and Throat Specialist?

At any healthcare facility in the province with audiology services?

At the nearest district hospital?

At the nearest tertiary level hospital

b. How are follow-up appointments or referrals made?

Telephonically

Referral letter is sent with the patient?

c. Do you use a multidisciplinary approach to management?

Yes

No

d. In your opinion, is it an effective approach to ototoxicity management, in the South African context?
### PROMOTION AND PREVENTION

e. What promotive and preventative activities related to ototoxicity are you involved in your hospital/practice?

| | | | | |
|---|---|---|---|---|
| | | | | |

f. Are these promotion and preventative measures effective? If not, please state why?

| | | | | |
|---|---|---|---|---|
| | | | | |

### RESOURCES

g. Number of audiology staff at your facility: ____________

h. Number of staff involved in ototoxicity assessment and management: ____________

i. Please provide a description of the case load and how this affects effective assessment and management:

| | | | | |
|---|---|---|---|---|
| | | | | |

j. Is there a budgetary allocation for each of the following?

| | | | | |
|---|---|---|---|---|
| | | | | |

k. Which of the following pieces of equipment do you have available for ototoxicity assessment? Please indicate how many you have of each piece of equipment:

| | | | | |
|---|---|---|---|---|
| | | | | |

- □ Immittance equipment
- □ Pure tones (air and bone)
- □ DPOAES
- □ Other please specify:

l. Have all the pieces of equipment been calibrated?

| | | | | |
|---|---|---|---|---|
| | | | | |

m. How often is equipment calibrated?

| | | | | |
|---|---|---|---|---|
| | | | | |

### 16. INSTITUTIONAL POLICIES

What is your institution's policy on the following for assistive devices?

a) Timing fitting following diagnosis?

| | | | | |
|---|---|---|---|---|
| | | | | |

b) Unilateral versus bilateral fitting:

| | | | | |
|---|---|---|---|---|
| | | | | |

c) Ownership, does the institution own the device or is it handed over to the patient?

| | | | | |
|---|---|---|---|---|
| | | | | |

d) Repairs and replacement of devices?

| | | | | |
|---|---|---|---|---|
| | | | | |

### 17. LANGUAGE AND CULTURE

a) What do you experience as language and culture influences on your ability to manage ototoxicity in your institution/practice?

| | | | | |
|---|---|---|---|---|
| | | | | |

| | | | | |
|---|---|---|---|---|
| | | | | |
18. INFORMATION MANAGEMENT and QUALITY CONTROL

a. How are patient records recorded/documented (indicate all) at the clinic? Please elaborate

☐ Electronic database
☐ Paper database
☐ Other, please specify:

b. How are the results of the ototoxicity monitoring and management recorded? Please explain:

☐ Electronic database
☐ Paper database
☐ Other, please specify:

Thank you for your participation.