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RESEARCH

Practices employed by audiologists in the management of adult patients with multidrug-resistant tuberculosis in South Africa

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Introduction: Aminoglycosides used for treating multidrug-resistant (MDR) tuberculosis are ototoxic, leading to a need for audiological monitoring. While audiologists monitor ototoxicity, currently there are no guidelines on monitoring in the South African context. Therefore, the findings of this study might help to motivate the establishment of a more in-depth ototoxicity monitoring policy, which facilitates uniformity among audiologists managing patients with MDR tuberculosis. Therefore, the study aimed to describe the audiological practices employed by audiologists in the management of adult patients with MDR tuberculosis in South Africa.
Method: A descriptive survey design was used. A questionnaire was developed and included elements of the American Speech-Language and Hearing Association (1994) guidelines for monitoring ototoxicity. Ninety-three audiologists contributed data to this study. Descriptive statistics were used in the analysis of the data.
Results: Sixty-eight percent (%) of the respondents were aware of the international guidelines, 93% provided pre-treatment counselling and 87% conducted a baseline assessment. Nineteen per cent of the respondents conducted high-frequency audiometry, while 74% carried out a monthly evaluation, 72% performed a full audiological assessment after the cessation of the MDR tuberculosis treatment, and 96% conducted post-treatment counselling. Modifications to the international guidelines include not conducting speech and immittance audiometry, as well as testing certain frequencies. The reasons for these modifications include limited specialised equipment, time constraints, large caseloads and understaffed departments.
Conclusion: There are no explicit guidelines on ototoxicity monitoring in South Africa. Consequently, audiologists are having to modify the international guidelines. Thus, there is no consistency in managing patients with MDR tuberculosis. This highlights the need for South Africa to develop context-relevant ototoxicity monitoring guidelines to appropriately manage patients with MDR tuberculosis.

Keywords: aminoglycosides, audiologist, high-frequency audiometry, ototoxicity

Introduction

Tuberculosis is one of the leading causes of mortality among human immunodeficiency virus (HIV)-infected patients.[1] Moreover, the HIV/acquired immune deficiency syndrome (AIDS) epidemic has increased the incidence of tuberculosis, and is a contributing factor to the rising prevalence of MDR tuberculosis.[1] South Africa is one of five countries with the largest number of incident cases of tuberculosis (410 000–520 000), mainly owing to the emergence of multidrug-resistant (MDR) tuberculosis.[2] MDR tuberculosis occurs if a patient is not treated for tuberculosis, or when the treatment regimen of a tuberculosis patient is inadequate or incomplete, i.e. the patient defaults on the treatment regimen, with the result that stronger or more resistant bacilli survive and prosper.[3]

MDR tuberculosis is defined as resistance to isoniazid and rifampicin, which requires long-term treatment of injectable aminoglycosides.[4] Aminoglycosides are recommended as they are active against various multidrug-resistant Gram-negative bacilli. However, they are toxic to the eighth cranial nerve, resulting in ototoxicity.[5] Ototoxicity refers to hearing loss or vestibular dysfunction arising from the use of ototoxic drugs.[6] MDR tuberculosis treatment has the ability to destroy the basal hair cells of the basilar membrane, required for high-frequency hearing, and later progresses to affect the frequencies associated with speech communication.[7] The high and ultra-high frequencies are the most affected as the treatment progresses, with a notable deterioration in hearing sensitivity between the baseline assessment and the post-treatment evaluation.[8] However, methods are not currently being utilised to protect the deterioration of patients' hearing against the effects of ototoxic medication in South Africa. Thus, the need for the appropriate detection and management of ototoxicity is reliant on effective audiological monitoring.

Audiological monitoring is required for two purposes, i.e. to detect ototoxic changes which affect speech frequencies, and to monitor ototoxic changes once the treatment regimen is complete.[9] One of the many responsibilities of an audiologist includes the planning and implementation of an auditory monitoring programme for ototoxicity.[10] The reported proportion of patients with hearing loss was greater in programmes where standardised hearing assessments were conducted. This suggests that patients who undergo a standardised method of treatment benefit more by knowing their hearing status as it is monitored from the commencement of treatment, and not when irreversible damage to the auditory system has occurred.[7] Internationally, the American Academy of Audiology (AAA)[11] position statement and American Speech-Language-Hearing Association (ASHA)[12] clinical practice guidelines assist audiologists in implementing appropriate ototoxicity monitoring regimes. The ASHA[12] proposed a method of audiological evaluation for ototoxicity monitoring, where specific criteria to identify ototoxicity are used, as well as the timely identification of at-risk patients,

pre-treatment counselling, baseline measures, monitoring evaluations at sufficient intervals to document the progression of hearing loss or fluctuations in sensitivity, and follow-up evaluations to determine the post-treatment effects. Therefore, the roles and responsibilities of audiologists in an ototoxicity monitoring programme include patient education; and baseline, monitoring and post-treatment audiological assessments which inform physicians if an ototoxic-induced change in hearing has been detected, as well as providing aural rehabilitation in the form of amplification and counselling. According to the ASHA,[12] the roles and responsibilities of audiologists are as follows:

- Designing and implementing an ototoxicity monitoring programme.
- Identifying patients who are at risk of ototoxic hearing loss.
- Collaboration between the audiologist and medical team concerning patient management and in-service training.
- The implementation of appropriate rehabilitation measures.

Patient education generally occurs during pre- and post-treatment counselling as patients are made aware of the usual signs and symptoms of hearing loss, the need for communication strategies and the synergistic effect of noise exposure and ototoxic drugs.[10]

In addition, the ASHA[12] has recommended a baseline assessment which must include:

- An in-depth case history.
- An otoscopic examination.
- Immittance audiometry.
- Pure-tone audiometry.
- Speech audiometry.
- Otoacoustic emission (OAE) and/or an auditory brainstem response (ABR) tests.

The follow-up evaluations include all of these tests, with the exception of speech audiometry. However, these guidelines have been developed for the American context. Thus, they can only serve as a guide to South African audiologists.

The policy developed by the South African National Department of Health, i.e. *Management of drug-resistant tuberculosis: policy guidelines 2010,*[13] and the guidelines developed by the Health Professions Council of South Africa (HPCSA), *A guideline for planning STA services at all levels of health care,* are the only context-relevant guidelines available to South African audiologists.[14] The policy developed by the South African National Department of Health[13] provides audiologists with an outline of the process involved in the management of patients with MDR tuberculosis. The Department of Health policy includes aspects which are relevant to ototoxicity, such as the need for a baseline assessment. However, it does not reveal the battery of tests to be used for basic audiological testing, or even ototoxicity monitoring. Thus, the Department of Health needs to review and/or amend the audiological aspects of the current policy to ensure that audiologists across the country have standardised and more specific guidelines to follow in the audiological management of patients with MDR tuberculosis.

The current HPCSA guideline was developed to facilitate rehabilitation service planning and implementation at all levels of health care. The guidelines contain aspects relating to the audiological management of a patient undergoing ototoxic treatment. This guideline is not specific to the assessment and/or management of a patient with MDR tuberculosis. However, it advises audiologists to be aware of indicators relating to ototoxicity, such as the percentage of baseline audiograms completed upon the initiation of ototoxic medication (i.e. within 24 hours), the percentage of patients with signs or symptoms relating to ototoxicity, patients who received medical intervention within 24 hours, and audiological intervention at least six weeks post cessation of ototoxic treatment. However, this guideline does not mention pre-treatment counselling or topics which need to be addressed during this crucial time in the management of a patient with MDR tuberculosis. This guideline fails to provide audiologists with the specific battery of tests that should be utilised when conducting ototoxicity monitoring, or how to assess patients who may be non-responsive. Moreover, the guideline does not mention post-treatment management, with the exception of hearing aid fittings and follow-up evaluations at specialised tuberculosis hospitals. While, this guideline serves the purpose of making speech-language therapists and audiologists aware of the services that are needed at the different levels of care, it is evident that specific guidelines for ototoxicity monitoring are required.

There are financial constraints to the healthcare system in developing countries, such as South Africa, because of competing budgetary demands from life-threatening and/or communicable diseases. In addition, patients with HIV/AIDS are at higher risk of developing tuberculosis and MDR tuberculosis,[1,15] and minimal audiological services are available.[16] However, it is important for audiologists to know that they are ethically obligated to follow evidence-based best practice guidelines. Audiologists are responsible for providing a service that is within their scope of practice, or to make other arrangements to make access to the service possible. Therefore, this study aimed to describe these practices so that the information can be used to devise contextually relevant, evidence-based ototoxicity monitoring protocols for patients with MDR tuberculosis. Furthermore, the findings of this study may help to motivate the establishment of a more in-depth South African National Department of Health and HPCSA ototoxicity monitoring policy, allowing for uniformity among audiologists managing patients with MDR tuberculosis in South Africa.

Method

Aims

The aim of the study was to describe the audiological practices employed by audiologists in the management of adult patients with MDR tuberculosis in South Africa.

Objectives

The study objectives were to describe specific criteria used in identifying ototoxicity and the pre-treatment and baseline audiological practices, and to describe the ototoxicity monitoring protocols, and post-treatment and audiological management practices employed by audiologists.

Study design

A descriptive survey design was used in the study, with a quantitative method of analysis.

Study population

Stratified sampling was used, and audiologists in South Africa were targeted.

Inclusion criteria

Inclusion criteria were audiologists with a year or more of working experience to ensure that they were familiar with the protocols and guidelines pertaining to the audiological management of patients with MDR tuberculosis. They also had to have had experience working with patients diagnosed with MDR tuberculosis.

Exclusion criterion

Audiologists who did not have any experience working with patients diagnosed with MDR tuberculosis were excluded from the study.

Description of the respondents

A total of 205 respondents completed the questionnaire. However, only 93 respondents were eligible to participate when the selection criteria were applied. Some respondents failed to answer some of the questions. However, because of the poor response rate, a decision was taken to include questionnaires in which more than 90% of the questions had been answered. This resulted in all 93 questionnaires being included. Therefore, there is variation with respect to some of the presented results. A description of the respondents in the study is provided in Table 1.

Data-collection tool

A questionnaire (Appendix A) developed by the researcher, in consultation with the ASHA[12] and AAA[11] guidelines for ototoxicity monitoring, was used for data collection. This was used to gain understanding of and/or to identify the audiological practices utilised by South African audiologists in comparison with international audiologists. It helped the researcher to identify areas of ototoxicity monitoring that are being followed or modified by audiologists in South Africa. The questionnaire contained 64 questions, of which 15 were open-ended and 49 closed-ended questions, which addressed various aspects, including background information, baseline monitoring, periodic monitoring, post treatment, as well as the audiological management of patients with MDR tuberculosis.

Table 1: Demographic profile (*n* = 93)

Characteristics	*n*	%
Gender		
Female	83	89
Male	10	11
Age		
22–30 years	67	72
31–39 years	23	25
40–41 years	3	3
Work experience		
1–3 years	37	40
3–5 years	27	29
5–10 years	19	20
>10	10	11
Work setting		
Community health clinic	5	5
District hospital	21	23
Regional hospital	12	13
Provincial hospital	45	48
Private hospital	3	3
Private practice	7	8

Data-collection procedure

Upon receiving ethical clearance (HSS/1449/013 M) from the University of KwaZulu-Natal Humanities and Social Sciences Research Ethics Committee, and adherence to the ethical principles of the World Medical Association Declaration of Helsinki, the pilot study was conducted. The information documents, consent forms and questionnaires were emailed to eight audiologists, informing them of the study. The questionnaire was used in the pilot study, and a comments form was utilised to record comments and suggestions. The respondents who participated in the pilot study were not included in the main study. Upon amendment of the questionnaire, the information documents, containing the web address of the survey, were posted to audiologists on the HPCSA database. In addition, audiology associations, such as the South African Association of Audiologists and the South African Speech-Language-Hearing Association, were also asked to send out a broadcast email pertaining to the study, including the web address needed by the respondents to access the questionnaire. Audiologists were given a month in which to respond to the survey. Letters and emails reminding them of the study were sent out two weeks after the initial communication.

Data analysis

The data from the questionnaires were captured on an Excel® spreadsheet and analysed using Stata® version 13. A descriptive method of analysis was used to interpret the results. Some of the "Yes" or "No" questions were tabulated or converted into graphs and frequency counts. Open-ended questions were analysed thematically. During the data analysis, it was accepted that participants' responses to some of the questions would vary as some of them did not answer all of the questions.

Results

Sixty-eight (73%) of the 93 respondents indicated that they conducted ototoxicity monitoring at the time of the study. Seventy-four respondents (80%) were aware of the ototoxicity monitoring guidelines.

According to Figure 1, 50 (68%) of the 74 respondents were familiar with the ASHA and AAA guidelines used for ototoxicity monitoring.

Table 2: Audiological tests used during the baseline assessment (*n* = 81)

Tests	*n*	%
An otoscopic examination, immittance audiometry, air conduction testing, bone conduction testing, high-frequency audiometry, speech reception testing, speech discrimination testing, otoacoustic emissions and auditory brainstem response	65	80
An otoscopic examination, immittance audiometry, air conduction testing, Eustachian tube function, speech reception testing, speech discrimination testing and otoacoustic emissions	10	12
An otoscopic examination, immittance audiometry, air conduction testing, high-frequency audiometry speech reception testing, otoacoustic emissions and auditory brainstem response	6	7

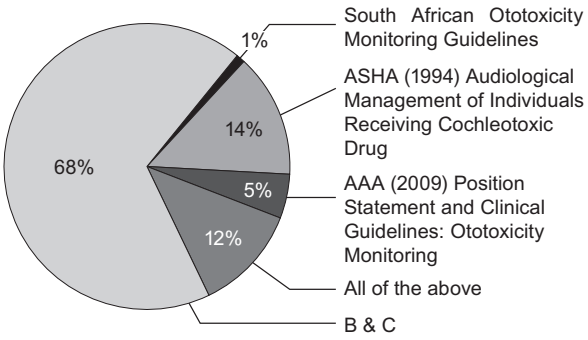

Figure 1: Awareness of the available protocols and guidelines (n = 74)

Seventy-two (87%) of the 83 respondents conducted a baseline assessment prior to administration of MDR tuberculosis treatment, while 11 (13%) respondents indicated the following reasons for not doing so:

- The patient was only referred once a complaint about hearing loss had been received.
- There was a shortage of staff.
- Infrastructure that met the requirements of the Occupational Health and Safety Act was not in place.
- There was only one booth.
- There was no ventilation.
- There was a lack of space.
- The patient was referred from the tuberculosis hospital (out of town), which did not have an in-house audiologist. Therefore, it was considered impractical to conduct a baseline assessment.

Nine (12%) of the 72 respondents conducted the baseline assessment within 12 hours of administering aminoglycoside treatment, while 33 (46%) did so within 24 hours, 5 (7%) within 48 hours, 13 (18%) within 72 hours, and 12 (17%) after 72 hours of treatment.

As reflected in Table 2, 65 (80%) of the 81 respondents indicated that they conducted the battery of tests to be used during the baseline assessment, including an otoscopic examination, immittance audiometry, air conduction testing, bone conduction testing, high-frequency average (HFA), speech recognition threshold, speech detection threshold, OAE and ABR. However, of the 81 respondents, 65 (80%) indicated that they did not perform HFA when conducting the baseline assessment.

Fifty-six (72%) of the 78 respondents said that they would perform a full audiological assessment if changes to the hearing sensitivity were experienced. Seventy (91%) of 77 respondents indicated that periodic testing was not conducted 2-3 days per week for those patients receiving MDR tuberculosis treatment. Fifty-two (74%) of these 70 respondents reported that they performed assessments monthly, and the remaining 18 (26%) stated that assessments were carried out fortnightly.

Seventy-two (97%) of the 74 participants indicated that ototoxicity monitoring would be easier for audiologists if South African guidelines and/or protocols were available, while 2 (3%) participants did not believe that it would be easier even if this was the case. Fifty-three (72%) of the 74 respondents indicated that a full

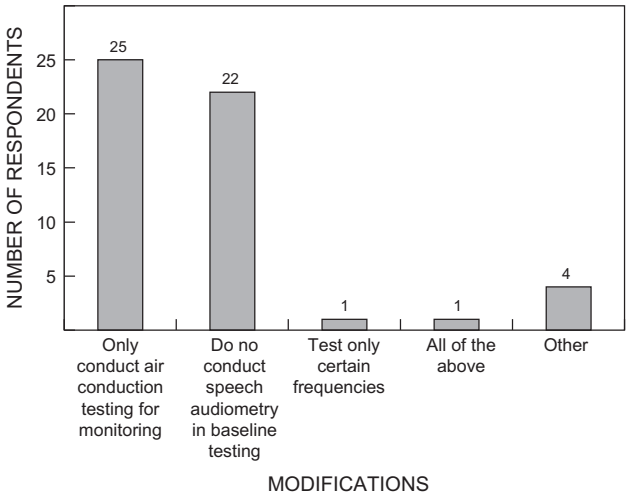

Figure 2: Modifications made to the international guidelines (n = 42)

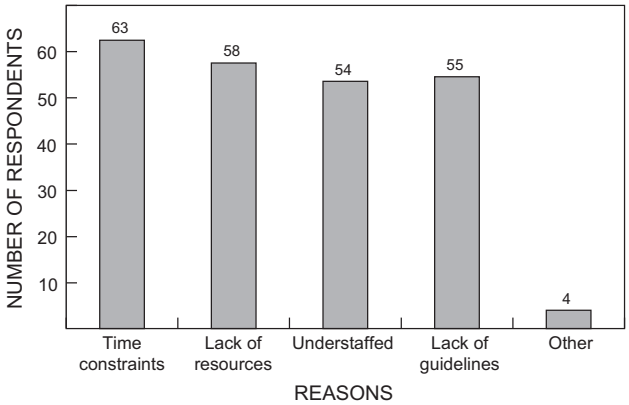

Figure 3: Reasons for modifications to the international guidelines

audiological assessment was conducted after the cessation of treatment. However, the remaining 21 (28%) respondents reported that they would follow-up on the monitoring results only if the need arose. Thirty-three (44%) of the 75 participants conducted follow-up assessments at three months, 6 (8%) at six months, and 1 (1%) at one year. Thirty-five (47%) respondents conducted follow-up assessments at one month, three months, six months and one year.

Figure 2 indicates the modifications that were made to the international guidelines. Twenty-five (60%) of the 42 respondents reported that they only conducted air conduction tests, 22 (52%) that they did not perform speech audiometry, 1 (2%) that only certain frequencies were tested, 1 (2%) that all of the stated modifications were used, and 4 (10%) who had selected "Other" indicated that they did not conduct immittance audiometry..

Figure 3 depicts the reasons given for modifying the international guidelines. Sixty-three (85%) of the 74 respondents reported that they modified the battery of tests owing to time constraints, 58 (78%) because of a lack of resources, 55 (74%) because of a lack of guidelines and 54 (73%) due to the department being understaffed. Four (5%) respondents reported that the main reason the battery of tests was modified was because ototoxicity monitoring was seldom practised, and because the ototoxicity monitoring international guidelines were not suitable in the South African context.

Discussion

The purpose of the present research was to describe the practices employed by audiologists in the management of adult patients with MDR tuberculosis. The study found that ototoxicity monitoring was essential owing to the high incidence of MDR tuberculosis in South Africa.[2] This was attributed to the alarming increase in co-infection with HIV, and the result of low adherence to treatment by patients with tuberculosis in South Africa.[17] Therefore, it can be assumed that a large number of people are on aminoglycoside treatment.

Audiologists need to be aware that the use of aminoglycosides can also cause delayed hearing loss.[18] Consequently, it is suggested that ototoxicity monitoring programmes are needed in order to monitor the audiological status of these patients because of the ototoxic nature of aminoglycosides.[19]

However, only 93 respondents reported that they conducted ototoxicity monitoring in patients with MDR tuberculosis, so it can be deduced that a large number of patients do not receive this audiological service. Furthermore, only 80% of the respondents were aware of the international protocols. Thus, audiologists in South Africa need to follow the international guidelines as they are readily available. However, one of the respondents believed that specific South African ototoxicity monitoring guidelines were available. However, he or she could have been referring to the HPCSA guideline.[14] This suggests that there is a need for audiologists to obtain guidance and training on ototoxicity monitoring, and to be aware of the relationship between MDR tuberculosis and ototoxicity monitoring.

According to the international guidelines, the baseline assessment should be conducted within 72 hours of administering the ototoxic treatment.[11,12] The fact that 17% of the respondents were not compliant in this regard indicates that these patients were not being correctly monitored, and this could have affected the outcome of the results. This would further suggest that a highly efficient patient identification and/or referral system is required for timely assessments.[7] According to the AAA, the following tests are recommended during a baseline assessment: pure-tone thresholds in the conventional frequency range, HFA, tympanometry, speech audiometry and testing of OAEs.[11] Eighty per cent of the respondents were aware of the audiological tests required for baseline hearing assessments when conducting ototoxicity monitoring. In addition, there have been improvements in the battery of tests for patients presenting with ototoxicity. Until very recently, only conventional testing methods, i.e. pure-tone audiometric testing, were used.[20] However, recently, more specific information was gained with the use of HFA and OAEs, which permit the early detection of ototoxic hearing loss.[21] However, 80% of the respondents did not conduct HFA because they lacked the necessary equipment. This highlights the constraints experienced by audiologists relating to HFA and its use in South Africa. HFA enables audiologists to gain threshold information from 8-20 kHz, the frequency region which is initially affected by the use of aminoglycosides.[8] This indicates that it is imperative that HFA is included in the assessment as it covers the upper regions of hearing, which are not usually tested during a conventional audiometric evaluation.[22] However, the necessary specialised equipment required to conduct HFA owing to financial constraints is lacking.[16] In addition, service delivery is greatly affected as high-frequency results provide early identification of ototoxic hearing loss, which reduces the number of patients who are referred to audiologists once irreversible damage to their auditory system has occurred.[10]

According to the international guidelines, patients undergoing ototoxic treatment need to be monitored 2-3 days a week.[12] In this way, any changes to the auditory system can be detected early, and suitable amendments made to the treatment regime. However, 91% of the study particpants reported that they did not conduct assessments 2-3 days per week. This could be attributed to high caseloads and time constraints. Regardless, South African audiologists are not adhering to international best practice guidelines, and instead are modifying these guidelines in a way that is relevant within the South African context.

Context-relevant standards would allow for easier implementation of ototoxicity monitoring as they would support the needs of professionals and patients involved in the process of MDR tuberculosis management. According to the study, 97% of the respondents indicated that ototoxicity monitoring would be easier for audiologists if South African guidelines and/or protocols were available. Audiologists noted that the international guidelines were not suitable in the South African context, and attempted to modify the guidelines to make them contextually relevant. Fifty-seven per cent of the 74 respondents reported that they made modifications to the international guidelines. The modifications included not conducting speech audiometry, only testing certain frequencies, and not performing immittance audiometry. The inability to complete these tests negatively impacts on the reliability of the results obtained as these tests are used in conjunction with one another to determine the accurate hearing sensitivity of the patient. This impacts on the programme as standard protocol is not being followed, and this then impacts on the results obtained from patients. The use of a standardised method of testing would make it easier to document the progression of ototoxicity. In turn, this would allow for a more efficient referral system to specialised services, and would assist with obtaining the epidemiological statistics needed to improve or gain further insight into ototoxicity. Furthermore, a standardised method of testing would improve clinical case management within a tuberculosis programme as it would provide a scheduled timing of the administration of the treatment, or the possible changes which occur when progression in ototoxicity occurs.[7]

Conclusion

South Africa has one of the highest MDR tuberculosis infection rates in the world, and this has placed considerable strain on the healthcare system, highlighting the need for ototoxicity monitoring. Although audiologists are practising in a way that allows for maximisation of the resources in order to provide high-quality health care, it is clear that they are not fully engaging with the evidence-based practice guidelines, i.e. of the ASHA and AAA. This is required if there is to be a standard method of monitoring patients receiving ototoxic MDR tuberculosis treatment. Consequently, the South African National Department of Health and the HPCSA need to develop appropriate ototoxicity monitoring guidelines for audiologists in order to improve case management and provide standardised audiological services to patients with MDR tuberculosis throughout the country.

Limitations

The findings of this study must be viewed in the context of the small sample size owing to the poor response rate. However, it should be acknowledged that some respondents with dual qualifications practised only speech therapy, while others who were registered with HPCSA were practising abroad. Therefore, the exact number of audiologists practising in the field of ototoxicity monitoring in South Africa could not be determined. A second

limitation was that a number of respondents failed to respond to some of the questions. Finally, more information, such as the impact of modification to the international guidelines, related to the South African context and the possible benefits of the modification to an ototoxicity monitoring program should have been addressed, as this would have provided insight into its application in the South African context.

Clinical implications

Audiologists should utilise HFA and sensitive range for ototoxicity in the South African context, as these have proven to be an effective means of ototoxicity monitoring.[20] Furthermore, the South African National Department of Health and the HPCSA should establish a ototoxicity monitoring protocol which is context relevant.

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Appendix A: Questionnaire

Section A: *Biographical details*

Please fill in or tick (✓) the relevant answer

1	Age				
2	Gender	Male		Female	
3	The number of years working as an audiologist (excluding community service)	1–3 years	3–5 years	5–10 years	>10 years
3.1	Have you conducted multidrug-resistant tuberculosis monitoring in the last three years?	Yes		No	
4	In which province are you working?	Free State		KwaZulu-Natal	Eastern Cape
		Limpopo		Northern Cape	Mpumalanga
		Gauteng		Western Cape	North West
5	The type of institution in which you work	Private practice	Private hospital	Provincial hospital	
		Regional hospital	District hospital	Community health clinic	
				Other: (specify)	
6	Do you conduct diagnostic audiometric testing?	Yes		No	
7	Do you have access to electrophysiological testing equipment?	Yes		No	
7.1	If yes, please indicate which equipment	Otoacoustic emissions		Auditory brainstem response	Auditory steady-state response
		Immittance audiometry		Other (please specify):	
8	Are you currently assessing patients with multidrug-resistant tuberculosis?	Yes		No	
9	Do you provide ototoxicity monitoring at your institution?	Yes		No	
10	Are you aware of any audiological guidelines and/or protocols for multidrug-resistant tuberculosis ototoxicity monitoring?	Yes		No	
10.1	If yes, please state them in the space provided	a. South African ototoxicity monitoring guidelines			
		b. American Speech-Language-Hearing Association (1994) audiological management of individuals receiving cochleotoxic drug therapy			
		c. American Academy of Audiology (2009) position statement and clinical guidelines: ototoxicity monitoring			
		d. All of the above			
		e. B and C			

Section B: Ototoxicity monitoring (the identification of patients with multidrug-resistant tuberculosis

11	Do you believe that the identification of a patient at risk of hearing loss depends on a good working relationship between the audiologist, physicians and nurses?	Yes	No	
12	Do you think that in-service training, with the staff involved in monitoring patients with multidrug-resistant tuberculosis, is important?	Yes	No	
12.1	If yes, please select which description best conveys the aspects of multidrug-resistant tuberculosis ototoxicity monitoring that need to be addressed during in-service training	a. What ototoxicity is, what audiology is, which audiological tests must be conducted, and the need for counselling and fitting hearing aids		
		b. What ototoxicity is, when ototoxicity occurs, what happens to the ear and its function when there is ototoxicity, which ototoxic drugs are involved in multidrug-resistant tuberculosis, the associated auditory and vestibular problems, and the need for counselling and aural rehabilitation		
		c. The signs and symptoms of hearing loss, the audiological battery of tests used for monitoring, and vestibular assessment and counselling		
		d. None of the above		
12.2	Who do you think should conduct this training?	Community members	Audiologists	Doctors
		Nurses	Other (please specify):	

(*Continued*)

13	Which if these drugs do you think require automatic referral for ototoxicity monitoring?	a. Dihydrostreptomycin, stilpain, asprin and gentamicin b. Tobramycin and kanamycin c. Dihydrostreptomycin, tobramycin, kanamycin, amikacin and gentamicin d. None of the above
14	Do you think that if referrals were made automatically when patients undergo ototoxic drug treatment, there would be an improvement in the current referral system?	Yes / No

Section C: Ototoxicity monitoring (the baseline test)

15	Do you conduct a baseline assessment prior to the administration of multidrug-resistant tuberculosis treatment once the patient has been identified?	Yes	No		
15.1	If yes, when is the patient's baseline assessment performed?	8–12 hours	12-24 hours	24–48 hours	48–72 hours / > 72 hours
15.2	If no, why?				
16	Choose one of the statements which indicates the tests that should be performed during the baseline assessment?	a. An otoscopic examination, immittance audiometry, air conduction testing, bone conduction testing, high-frequency audiometry, speech reception testing, speech discrimination testing, otoacoustic emissions and auditory brainstem response b. An otoscopic examination, immittance audiometry, air conduction testing, Eustachian tube function, speech reception testing, speech discrimination testing and otoacoustic emissions c. An otoscopic examination, immittance audiometry, air conduction testing, high-frequency audiometry speech reception testing, otoacoustic emissions and auditory brainstem response			
17	Do you conduct testing above 8 kHz?	Yes	No		
17.1	If yes, which frequencies are tested?	9 kHz	10 kHz	11 kHz	12 kHz 14 kHz / 16 kHz / 18 kHz / 20 kHz
17.2	If no, please provide the reasons why this is so				
18	Do you perform a re-test to confirm the results?	Yes	No		
18.1	If no, why?				
19	Do you conduct pre-treatment counselling advising the patient of the possible ototoxic effect of multidrug-resistant tuberculosis medication on their auditory system?	Yes	No		
19.1	If no, why?				
20	Choose one statement which reflects the topics covered during pre-treatment counselling?	a. Tinnitus, loss of balance, the pharmacological effects, the synergistic effect on ototoxicity and noise exposure, the occlusion effect, hearing loss and the potential impact on communication ability b. Tinnitus, loss of balance, the synergistic effect on ototoxicity and noise exposure, the occlusion effect, hearing loss and the potential impact on communication ability c. Tinnitus, loss of balance, the synergistic effect on ototoxicity and noise exposure, the occlusion effect, hearing loss, the potential impact on communication ability and the effects of daily living			

Section D: Ototoxicity monitoring (monitoring procedures)

21	Do you apply specific criteria when defining ototoxic hearing loss?	Yes	No
21.1	If no, why?		
22	Do you use a baseline measure to compute any changes in hearing sensitivity?	Yes	No
22.1	If no, why?		
23	Choose the correct statement which indicates significant changes in hearing sensitivity	a. A 20 dB decrease at any one test frequency b. A 10 dB decrease at any two adjacent test frequencies c. Loss of response at three consecutive tests d. All of the above e. A and B only	

(*Continued*)

24	If there is a change in hearing sensitivity, do you conduct a full audiological evaluation?		Yes	No	
24.1	If yes, please indicate which tests are conducted in the space provided				
24.2	If no, why?				
25	What battery of tests is used when testing a non-responsive patient?	a. An objective test b. Behavioural tests c. Testing should not be conducted d. A and B			
26	Do you conduct periodical testing every 2–3 days per week for patients receiving multidrug-resistant tuberculosis treatment?		Yes	No	
26.1	If no, when do you conduct periodical testing?	Weekly	Fortnightly	Monthly	
27	If there is a significant shift in hearing threshold, do you report these findings to the physician?		Yes	No	
27.1	If yes, select the correct statement on what possible changes the physician can make to the treatment regime	a. Scheduled timing of the dosage and a reduction in the dosage b. Reduce the dosage and increase the scheduled timing c. Temporary discontinuation, or a switch to a less ototoxic drug d. A and C e. All of the above			
27.2.	If no, why?				
28	If the physician changes the drug used in the treatment of multidrug-resistant tuberculosis, are you notified or is it documented in the patient file?		Yes	No	
29	If the treatment is changed, do you establish a new baseline for the patient?		Yes	No	
29.1	If no, why?				

Section E: Ototoxicity monitoring (post-treatment management)

30	Do you conduct a full audiological evaluation after the cessation of multidrug-resistant tuberculosis treatment?		Yes	No	
30.1	If no, why?				
31	When should follow-up evaluations be conducted?	3 months	6 months	One year	All of the above
32	Do you think that the management of an adult is different to that of a child?		Yes	No	
32.1	Choose one of the statements which focus on the management of an adult who has hearing impairment due to the effects of multidrug-resistant tuberculosis treatment	a. Hearing aids, assistive listening devices, and counselling of both the patient and family b. Hearing aids, assistive listening devices, an audition, and counselling of both the patient and family c. Hearing aids, assistive listening devices, counselling of both the patient and family, communication strategies, an audition, speech reading and available support groups d. A and B			
33	Do you conduct counselling after the cessation of multidrug-resistant tuberculosis treatment?		Yes	No	
33.1	If no, why?				
33.2	Who do you think should conduct the counselling?				
33.3	If yes, which statement would you select that best suits the topics you would include in your counselling agenda?	a. What ototoxicity is, and the effect that it has on the ear, how to optimise the use of amplification, available assistive listening devices, and the use of audition and speech reading to cope with a breakdown in communication b. The nature and aetiology of hearing loss, the impact that hearing loss has on daily living, how to optimise the use of amplification, available assistive listening devices, and the use of an audition and speech reading to cope with a breakdown in communication c. All of the above d. None of the above			

(*Continued*)

34	When providing counselling, is it conducted in the home language of the patient?	Yes	No
35	Do you provide the patient with informational pamphlets once the counselling is complete?	Yes	No
35.1	If no, why?		
36	Do you believe that ototoxicity monitoring would be easier for audiologists if a South African guideline and/or protocol was available?	Yes	No
37	Do you make modifications to the recommended guidelines?	Yes	No
37.1	If yes, please indicate the type of modifications	a. Only conduct air conduction testing for monitoring b. Do not conduct speech audiometry for the baseline testing c. Test only certain frequencies d. All of the above e. Other (please specify):	
37.2	What are the possible reasons for modifications to the recommended guidelines?	a. Time constraints b. Lack of resources c. Being understaffed d. Lack of guidelines e. Other (please specify):	