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Management of occupational noise induced hearing loss in the mining sector in South Africa: Where are the audiologists?

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Abstract: Objective: This study was conducted to explore the scope of practice for occupational audiologists in the mining industry and the audiologists' involvement in hearing conservation programmes in South African mines. Additionally, this study investigated the mining industry's role in the audiologists' involvement, and assessed the audiologists' levels of preparedness for working in occupational audiology. **Methods:** In-depth, qualitative telephone and face-to face interviews were conducted with seven occupational audiologists involved in the management of occupational, noise-induced hearing loss (ONIHL) in the South African mining sector. Snowball sampling was utilized to recruit possible participants for this study. Data were analysed using inductive thematic analysis. **Results:** The following themes were identified: scope-context misalignment, juniorization of the experts, audiologists are important... but for what?, and limited training in occupational audiology. **Conclusions:** Our evidence highlights important gaps in HCPs in South Africa. The fact that the audiologists responsible for the management of ONIHL are only minimally and peripherally involved may play a significant role in the lack of progress reported in the management of ONIHL in the South African mining sector.

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Background

The audiology profession in South Africa (SA) is less than 100 years old, with only six of the country's 26 universities offering the training. The training of professional audiologists in SA has its origins at the University of the Witwatersrand¹. The first programme was established in 1938 by Pierre de Villiers Pienaar, who established the Speech, Voice and Hearing Clinic in the University of the Witwatersrand^{1,2}. Approximately 200 audiologists graduate each year. These audiologists have to work in government hospitals as part of a compulsory year of community service. Post-community service, the majority of audiologists go into private practice, with a small number retaining government hospital jobs. This migration from government is influenced by a number of factors such as the structure and availability of government posts, which are accompanied by poor working conditions and resource constraints. Graduates register with the Health Professionals Council of South Africa (HPCSA) and are regulated by this council, with no involvement from South African Society of Occupational Health Nursing Practitioners (SASOHN). Consequently, their practice tends to neglect occupational health, specifically occupational noise induced hearing loss (ONIHL).

The prevalence of ONIHL remains one of the challenges in occupational health management in SA³. However, this challenge is not one of the South African Health Department's targeted priorities. Although the burden of disease that dictates health priorities includes conditions that are prevalent in the mining industry such as HIV/AIDS and TB, not enough attention is paid to this part of health - occupational health. Therefore, assessment and management of ONIHL is a neglected public health issue.

Currently, ONIHL falls under the purview of the Department of Labour as part of their occupational health and safety mandate, with no oversight or accountability to the HPCSA or the Speech Language and Hearing Professions professional board, which is responsible for regulating the scope of practice of professionals dealing with ear and hearing function. The result of this fragmented structure is that there is no audiologist-led, structured, and well-coordinated hearing conservation program within the South African mining industry.

The American Academy of Audiology promotes audiologists as the principal advocates and supervisors of programs that manage the hearing health of people exposed to hazardous noise⁴. Audiologists are tasked with “designing, implementing and coordinating occupational and community hearing loss prevention programmes. These roles require the identification and amelioration of noise-hazards, the diagnosis of hearing loss, offering recommendations and counselling on the use of hearing protection, employee education, and training and supervising of non-audiologists performing monitoring audiometry in occupational settings”⁵. However, the American Speech-Hearing-Language Association (ASHA) (1999) reports that few audiologists serve as consultants in the mining industry, and even fewer are involved in noise measurements, the training of occupational hearing conservationists, or hearing conservation programme audits and evaluations. In SA, there is a dearth of literature on the involvement of audiologists in the management of occupational exposure to hazardous noise in the workplace.

Current evidence indicates that the South African mining industry is aware of the existence of audiologists and their role in the management of occupational exposure to excessive noise. According to section 43 of Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) audiologists are ‘competent persons’ in carrying out baseline-hearing level surveillance of people exposed to occupational noise in the workplace⁶. This document also states that occupational medical personnel and medical practitioners specializing in otorhinolaryngology are ‘competent persons’ as long as they are registered with the HPCSA. Furthermore, audiometrists are also listed as ‘competent persons’: “A person with a qualification in audiometric techniques obtained from an institution registered with the South African Qualification Authority or any of its structures in terms of the South African Qualifications Authority Act, 1995 (Act No. 58 of 1995), and registered with the South African Society for Occupational Health Nursing” (SASOHN).

Dr. de W. Oosthuizen compiled the Guidelines for a Hearing Conservation Programme for the mining industry⁷, which details the role of occupational audiologists in the management of ONIHL. According to this document, this role is limited to conducting medical surveillance, thereby significantly reducing the role of occupational

audiologists. The limited role of occupational audiologists is inconsistent and not in compliance with ASHA’s⁸ scope of practice as described above.

Therefore, this study aims to investigate the role of occupational audiologists in hearing conservation in the South African mining sector. This work is part of a larger study titled: Occupational Noise Induced Hearing Loss in South African Mines: From Policy Formulation to Implementation and Monitoring. The aim of this study was to explore the involvement and role of occupational audiologists in HCPs in the South African mining industry.

Methods

Study design

In-depth interviews were conducted for this qualitative study. Qualitative research uses a naturalistic approach in seeking to understand phenomena in context-specific settings without the influence of the researcher, eliminating manipulation of the phenomena of interest and allowing it to unfold naturally^{9,10}. Furthermore, qualitative research seeks to illuminate, understand and explore a phenomena in its native context¹¹. This study sought to illuminate and understand the involvement and role of audiologists in HCPs in the South African mining sector. Therefore, a qualitative approach was suitable for achieving this objective.

Sample size and sampling strategy

A sample size of seven occupational audiologists was obtained and interviewed for the study. The number of audiologists is relatively small; however, this in itself is a finding of this study, as it indicates the very limited involvement and employment of trained audiologists in the South African mining industry. When recruiting participants for this study, we discovered that the South African mining industry prefers to employ audiometrists over audiologists for occupational audiology work. Therefore, our small sample size validates the importance of the study, as it attests to the absence of occupational audiologists in the mining sector. Since this study consists of a small sample, its findings cannot be generalized to a larger population. However, this study is based on in-depth interviews, and according to Dworkin¹², “in-depth interview work is not as concerned with making generalizations to a larger population of interest and does not tend to rely on hypothesis testing but rather is more inductive and emergent in its process.”

Due to the small number of occupational audiologists in the South African mining industry, snowball sampling was used to recruit participants. Snowball sampling is a strategy where participants approach other people who meet the inclusion criteria defined by the researcher, and request that they also participate in the study¹³. Snowball sampling was particularly important in this study as occu-

Table 1. Profile of participants.

Participant	Nature of affiliation to the mine	Years as occupational audiologist	Gender	Age
1	Private company affiliated with a mine	2.5	Male	36
2	Private practice affiliated with a mine	5	Female	32
3	Employed at a mine	8	Female	36
4	Private contractor at a mine	12	Female	43
5	Private practice affiliated with a mine	21	Female	47
6	Private contractor at a mine	37	Female	62
7	Private company affiliated with a mine	8	Female	40

pational audiologists are rare and difficult to locate. Therefore, we took advantage of the social networks of identified participants to expand the set of potential participants, allowing a series of referrals to be made within a circle of acquaintances¹⁴). However, snowball sampling is limited in that it does not recruit a random sample. Therefore, the sample used in this study may not be representative of a larger population¹⁵). Participants were initially identified through a Google search for occupational audiologists in the mining sector. These audiologists were contacted via email and phone, and were requested to participate in the study and to suggest other study participants.

Inclusion criteria

Participants were required to be occupational audiologists who have worked in the mining industry for more than 6 months. Participants had to be aware of HCPs implemented in the mines. Additionally, participants had to be occupational audiologists either in private practice and contracted to the mines, or in private companies affiliated with the mines. The participants' profile is shown in Table 1.

In-depth Interviews:

Interview questions were formulated based on the available literature and analysis of regulatory documents, policies, and acts on the management of ONIHL in the mining industry. The interview structure followed the recommendations by Rubin and Babbie¹⁶), where the interviewer possesses a plan of inquiry as well as a set of questions. Furthermore, Kerlinger and Lee¹⁷) recommend that similar questions be grouped together in order to maintain cohesion and order. Research questions focused on undergraduate training, occupational experience, workload, and involvement in HCPs. All of the interviews were conducted in English and were audio-recorded.

Ethical considerations

All procedures contributing to this work complied with the relevant national and institutional guidelines for research on human subjects, and adhered to the Helsinki

Declaration of 1975 as revised in 2008¹⁸). Furthermore, approval was obtained from the University of the Witwatersrand Human Research Ethics committee (Medical; Protocol number M160264). Ethical issues such as confidentiality and the right to withdraw from the study were discussed with the participants. However, anonymity was not guaranteed due to the use of snowball sampling in this study. Participants were made aware that all information given to the researcher would be kept confidential.

Data analysis

Transcribed data was analysed through inductive thematic analysis. Inductive thematic analysis is a process of coding data "without trying to fit it into a pre-existing coding frame, or the researcher's analytic preconceptions. In this sense, this form of analysis is data-driven"¹⁹). Themes that emerged from this data were analysed using the steps recommended by Braun and Clark¹⁹): familiarization with the data, generation of initial codes, searching for themes, reviewing themes, defining themes, and writing-up findings. Representative verbatim quotations are used to support the presented findings.

Trustworthiness

In order to address any biases or subjectivity in the handling and analysis of data, the authors acknowledge that "all research is subject to researcher bias"²⁰). Therefore, a peer reviewer served as a mirror and assisted in reflecting responses to the interviews. Also, the authors made use of the "community of practice"²¹) to share the process and findings with a group of colleagues who are experienced researchers and are familiar with the role of occupational audiologists. Furthermore, while transcribing the interviews, the researcher contacted participants when further clarification or additional information was required, and this information was in turn given by the participants.

Results and Discussion

The following themes were identified in the data: scope-context misalignment, juniorization of the experts, audiologists are important, but for what?, and limited

training in occupational audiology. These themes are discussed below.

Theme 1: Scope-Context misalignment

Participants were asked to briefly discuss their typical caseload in order to ascertain their everyday involvement at the mines. Participants indicated that their caseload consisted of ear pathologies, hearing tests, and occasional hearing aid fitting.

"I get a very varied, interesting case load. I get a lot of middle ear pathology. Because we're mining in SA, the deepest in the world up to 5 kilometers, we get a lot of Eustachian tube problems and therefore a lot of middle ear pathology. You see a lot of ototoxicity, multidrug resistant TB, the influence of HIV. Very interesting and very varied caseloads. (P6)

Similarly, participant P2 has a varied caseload.

"Diagnostic hearing tests. I'm not so much involved with the counselling anymore because of the language barrier. I fit aids, not on a daily basis. Yes, we do see pathology, but not so much. We see a lot of cases but the main part of it is the hearing test."

Likewise, participant P3, who is an in-house audiologist, shared her caseload:

"Well, I'm situated at the occupational house centre, so we do the hearing medicals of the employees. So, I see all the people that have shifts in hearing when we're comparing to their baseline audiogram. So, I work out then if it seems noise induced hearing loss related or whether [there] are other factors contributing to the hearing loss. And then in cases where it's serious, I do referrals to ENT specialist[s] or to general practitioners. I also see the employees or patients that have pathology, wax, ear infections. I basically manage all the patients with regards to working out what the cause might be of the hearing loss." P3

The caseload mentioned by participants does not align with scope of practice of an occupational audiologist. The context in which occupational audiologists work dictates that they should be involved in developing, organizing, and administering HCPs in consultation with other stakeholders to effectively integrate contracted services where needed to supplement the employer's resources^{22,23}. Among other responsibilities, occupational audiologists are tasked with conducting programme audits and evaluations of effectiveness²³; maintaining familiarity with Workers' Compensation regulations and trends, as well as methods of claim evaluation²⁴; and the physical characteristics and methods of selecting HPDs appropriate for workplace demands and wearer needs²⁵. For a detailed scope of practice for occupational audiologists, readers are referred to the report by ASHA⁸.

The scope of practice of occupational audiologists extends beyond the scope of typical clinical audiology. Occupational audiologists should be in the forefront of ad-

vising companies about the auditory and non-auditory effects of noise on the health of the exposed individuals²⁶, as well as the effects of noise on communication and job performance²⁷. Currently, the services offered by occupational audiologists in the mines in SA are not aligned with the scope of practice defined by ASHA⁸.

Theme 2: Juniorizing the experts

Participants were questioned regarding their involvement in decision-making in formulating and implementing HCPs. Participants lamented that they are excluded from this process; however, they are expected to carry out certain tasks without consultation, which leads to the mining industry setting unrealistic expectations for audiologists.

"...that's what has always been a concern really. People are making decisions about our involvement in certain things but are not involving us in the decision-making processes and that has not really stood well with me." (P5)

P4 stated:

"Everyone is very... you know following the legislation around everything and its big mines we were involved with, but I was never, me as an audiologist, I was never involved or informed about the formulation or the implementation of the hearing conservation programme in the mine. However, I am expected to actively manage the workers who are exposed to excessive noise at the mines." P6 lamented that audiologists' work is given to audiometrists with limited training:

"So that's also something that shocked me recently because now you will find people because of cost are taking an admin person and sending that person for 5-days training and the institution giving the certificate. The person is qualifying as an audiometrist, they are just registering at SASOHN. SASOHN is just keeping the register. They are not seeing if the person is fit to do the job or qualified to do the job as long as they have the certificate. They will put them on the register and that person is doing the testing. Someone who cannot identify pathology, cannot look into someone's ears, cannot really interpret the graph or the depth and that's how it's going. To be honest with you so it's a big challenge and this needs to be challenged. There is a lot of questions with the HCP." (P6)

These findings reveal a serious concern regarding mine management's practices when it comes to human resource protocols, as well as the expertise and scope of practice adherence. The fact that mines can assign an important health and safety role of ensuring minimisation and/or elimination of ONIHL to a non-audiologist with no accredited training in the field raises questions about the political will of the mine's management to deal with ONIHL. It also highlights a gap for the advocacy role of audiology associations in the country, as well as the regu-

latory gap by the HPCSA. Arguably, audiometrists and occupational medical personnel may be ‘competent persons’ in conducting audiometric testing; however, the role of audiologists expands beyond medical surveillance. The role of audiologists begins at the conception and continues into the implementation, monitoring, and evaluation of HCPs. According to ASHA⁸⁾, although a small percentage of audiologists specialize in occupational audiology, occupational audiologists play a leading role in the hearing conservation field. These professionals bring special knowledge about hearing and communication to the OHCP team, and participate in each program component to a greater or lesser extent depending on expertise and the particular employer’s needs and resources⁸⁾. Currently, the role and importance of occupational audiologists is not fully understood in SA, and consequently occupational audiologists are occupying positions below their training and scope of practise.

Theme 3: “Audiologists [are] important ...but for what?”

Participants were asked if they felt that mines’ management were aware of the audiologists’ role and if they received any support from management. Responses indicated that mine management has only a superficial understanding of the audiologist’s role.

“I think they understand that it is very important that there must be an audiologist. But I don’t think they always understand our work. Does that make sense? In my experience, I really never had direct contact with the management”. P1

P5 shared the same sentiments:

“They do understand that there’s someone, but not to the extent you’d want them to. Well they do understand even though sometimes they do confuse one, but it just depends on the level of management because I have been here for long enough. Not all the managers understand what you are about, but some they understand. But some will confuse the audiologist with an audiometrist.”

P7 shared a different experience.

“Well, again I’m in an ideal setting. I do get good support from management. I direct any suggestion or complaints or problems to them and they will discuss it and support where possible. I’ve got quite a leeway. If I say something, they support it if it makes sense. But you know, I previously worked at a big mine hospital in a bigger set-up, and I didn’t have the necessary support I felt I should have had because [of] cost and time. Employees need to go back to work, that’s like the main focus. You can have settings where support isn’t where it should be.”

Poor understanding of the role of occupational audiologists is concerning, as poor support from management has implications not only for the mining industry, but for the individuals exposed to hazardous occupational noise and the states’ resources^{24,25)}. According to ASHA⁸⁾ occupa-

tional audiologists are important in that they advise management on many operational aspects of HCPs such as management’s responsibilities and liabilities under federal, state, and local occupational health and safety regulations and Workers’ Compensation statutes. Furthermore, occupational audiologists can recommend the most successful and cost-effective means of implementing each component of the program, taking into account the advantages and disadvantages of developing in-house resources versus contracting with external service providers²³⁾. Because occupational hearing conservationists such as audiometrists have a limited scope of practice, occupational audiologists are required to supervise OHCs⁸⁾. In addition to the basic components of an effective HCP, occupational audiologists may be involved in forensic activities, such as serving as expert witnesses in hearing loss compensation claim cases and other forms of litigation (such as product liability)⁸⁾. Currently in SA, the scope of practice for occupational audiologists does not reflect the roles described above, which may explain the poor understanding of the role of occupational audiologists in occupations exposed to excessive noise.

Theme 4: “Limited training in occupational audiology”

The participants were asked if their undergraduate training prepared them for their role as occupational audiologists. Only one participant, who trained in America, reported that they had received sufficient training. All participants who trained in SA stated that their training was lacking, and did not equip them with skills needed to execute their duties as occupational audiologists.

“We only had, we had one section, part of a whole thing that we had. It was a handout. It was a section of that handout. So we didn’t have much training in that and we didn’t have any practical training. So the knowledge I have, I accumulated after I graduated.” (P4)

P7 shared a similar experience:

“It’s tricky - yes and no. No in a sense that it was limited. We only did a small module on occupational audiology. It was a small project... assignment. It was the only exposure we had on occupational audiology in terms of occupational noise exposure. So we were not given information on methods to test for noise. We were not given information on how to prevent noise, what types of noise protection devices available. Yes, in a sense that we were given just a module. So we had that exposure to say there is occupational noise. It exists in terms of people getting hearing loss from work. We did a project by going to a workshop where we measured noise levels and we gave them training on how to protect their ears, but it was not with complete understanding.”

P5 highlighted the impact of not being sufficiently trained:

“...and the audiologist, if they are not properly trained, doesn’t know all the legislation, or if they are not sure

what is [in] Section 171. You know if the audiologist makes the mistake, it does cost the mine. It probably will cost the mine a lot of money because if that person is malingering, and that audiologist doesn't know industrial audiometry, doesn't know that I must double-check everything, make sure about the threshold and they miss that, they will probably misdiagnose the percentage and that person will be compensated. So that's one thing I felt in my training in industrial audiology. It's a big responsibility for you as an audiologist.

P1 suggested the following:

Maybe there is a space to do a postgrad in Occupational Audiology. I have not heard of that. I don't see it as a programme or certificate that can be accorded to someone obviously because the demands of our society have not been looking into that. I think it would assist a lot in managing noise induced hearing loss throughout the industries. If we can find a way to ensure that audiologists are given that skill to contribute positively, because at the current moment there isn't a positive or valuable contribution that they can make.

According to ASHA: "Ideally, all graduate audiology programs should emphasize hearing conservation by offering specialized courses and practicum experiences relevant to the skills and knowledge needed by the professional intending to work in the area of occupational hearing conservation. Audiologists-in-training should have extensive practicum experience in working on-site in an occupational setting under the supervision of an audiologist experienced in occupational hearing conservation. This practicum should include activities in all seven of the components of a model HCP"⁸⁾.

Currently in SA, there are gaps in the training of occupational audiologists, as audiologists are trained over a period of 4 years and occupational audiology is not prioritized due to the country's high burden of disease. Limited training in occupational audiology has implications for audiologists in delivering quality service in the management of occupational noise in SA.

In America, after obtaining a graduate degree in audiology audiologists interested in occupational audiology enroll for further certification to supplement their training and expand their skills and knowledge⁸⁾. Audiologists have access to education programmes offered by professional associations such as ASHA, the National Hearing Conservation Association, and the Acoustical Society of America⁸⁾ to name a few. Some universities offer special curricula in occupational audiology to supplement their basic audiology program, with specialized courses and reference materials from other fields such as industrial hygiene, engineering, business, and public health⁸⁾. Therefore, there is a need for local universities to evaluate their training programmes and to offer postgraduate courses to audiologists interested in pursuing a career in occupational audiology.

Conclusion

This study highlights important gaps in the role of occupational audiologists in HCPs in SA. The fact that occupational audiologists, whose scope of practice encompasses ONIHL, are only minimally and peripherally involved in developing and executing HCPs may play a significant role in the lack of progress towards the elimination of ONIHL. Locally, the audiology profession needs to deliberate on strategies to ensure that this area does not remain neglected. Professional bodies that regulate audiology and occupational health need to work together to ensure systematic and efficient provision of services to this part of the population. Additionally, universities training audiologists need to review their curricula to ensure that occupational audiology is afforded the same attention as other aspects of audiology.

Limitations and Suggestions for Further Research

These findings should be considered with an awareness of the limitations of the study. Firstly, the small sample size, which was recruited through snowball sampling, restricts the ability to generalize these findings beyond the study sample. Future research on a larger representative sample, perhaps on audiometrists involved in HCPs in South African mines, may allow the issues uncovered in this study to be further explored. Additionally, confirmation and direct observation of practice through ethnographic studies is required.

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References

- 1) Swanepoel dW. Audiology in South Africa. International Jour-

- nal of Audiology 2006; 45: 262-266.
- 2) Aron ML. Perspectives. *The South African Journal of Communication Disorders* 1991; 38(3-11).
 - 3) Strauss S, Swanepoel DW, Becker P, Eloff Z, Hall JWI. Prevalence and degree of noise induced hearing loss in South African gold miners. *International Journal of Audiology* 2012; 18(6): 2025.
 - 4) American Academy of Audiology. Position statement: Preventing noise-induced occupational hearing loss. 2003.
 - 5) American Academy of Audiology. Scope of Practice: Position Statement. *Audiology Today* 1997; 9(2): 12-13.
 - 6) Government Gazette. Safety ACfOHa, editor. Noise Induced Hearing Loss Regulations. Johannesburg: Ministry of Labour; 2003.
 - 7) de W Oosthuizen S. Guidelines for hearing conservation programmes. University of the Free State, Bloemfontein: Provincial Occupational Health Unit; 2006.
 - 8) American Speech-Language-Hearing Association. The audiologist's role in occupational hearing conservation and hearing loss prevention programs [Position Statement]. 2004.
 - 9) Golafshani N. Understanding Reliability and Validity in Qualitative Research. *The Qualitative Report* 2003; 8(4): 597-606.
 - 10) Patton MQ. Qualitative Research. In: *Encyclopedia of Statistics in Behavioral Science*. John Wiley & Sons, Ltd; 2005.
 - 11) Hoepfl MC. Choosing qualitative research: A primer for technology education researchers. *Journal of Technology Education* 1997; 9(1): 47-63.
 - 12) Dworkin SL. Sample Size Policy for Qualitative Studies Using In-Depth Interviews. *Arch Sex Behav* 2012; 41(6): 1319-1320.
 - 13) Penrod J, Preston DB, Cain RE, Starks MT. A discussion of chain referral as a method of sampling hard-to-reach populations. *Journal of Transcultural Nursing* 2003; 14(2): 100-107.
 - 14) Atkinson R, Flint J. Accessing hidden and hard-to-reach populations: Snowball research strategies. *Social Research Update* 2001; 33.
 - 15) Sadler G, Lee H, Lim R, Fullerton J. Recruitment of hard-to-reach population subgroups via adaptations of the snowball sampling strategy. *Nursing and Health Sciences* 2010; 12: 369-374.
 - 16) Rubin A, Babbie ER. *Research methods for social work* Belmont, CA. Brooks/Cole - Thomson Learning; 2005.
 - 17) Kerlinger FN, Lee HB. *Foundations of Behavioral Research*. 4 ed. Carlifonia: Harcourt College Publishers; 2000.
 - 18) World Medical Association. *Declaration of Helsinki*. 2008.
 - 19) Braun V, Clark V. Using thematic analysis in psychology. *Qualitative Research in Psychology* 2006; 3(2): 77-101.
 - 20) Morrow SL. Quality and Trustworthiness in Qualitative Research in Counseling Psychology. *Journal of Counseling Psychology* 2005; 52(2): 250-260.
 - 21) Rossman GB, Rallis SF. *Learning in the field: An introduction to qualitative research*. Thousand Oaks, CA: Sage; 2003.
 - 22) Royster JD, Royster LH. *Hearing conservation programs: Practical guidelines for success*. Chelsea, MI: Lewis; 1990.
 - 23) Driscoll DP, Stewart ND, Anderson RR, Berger E. H., Royster L. H., Royster J. D., Driscoll D. P., Layne MA, editors. *Community noise*. 5ed. Fairfax, VA: American Industrial Hygiene Association; 2000.
 - 24) Dobie RA, Megerson SC, Berger E. H., Royster L. H., Royster J. D., Driscoll D. P., Layne MA, editors. *Workers' compensation*. 5ed. Fairfax, VA: American Industrial Hygiene Association; 2000.
 - 25) Berger EH, Berger E. H., Royster L. H., Royster J. D., Driscoll D. P., Layne MA, editors. *Hearing protection devices*. 5 ed. Fairfax, VA: American Industrial Hygiene Association; 2000.
 - 26) Henderson D, Hamernik R. Biologic bases of noise-induced hearing loss. *Occupational Medicine: State of the Art Reviews* 1995; 10: 513-534.
 - 27) Robinson GS, Casali JG, Berger E. H., Royster L. H., Royster J. D., Driscoll D. P., Layne M. A., editors. *Speech communication and signal detection in noise*. 5ed. Fairfax, VA: American Industrial Hygiene Association; 2000.