INTRODUCTION
According to the World Health Organization (WHO), approximately 1.1 billion youth (12-35 years) worldwide are at risk of hearing loss due to exposure to noise from unsafe listening habits, which include prolonged use of personal music players at very high volume. Research has revealed that the highest volume outputs of some personal music players are in excess of 113 dBA. 46% of 16-34 year-olds in developed countries spend 3-6 hours per day listening to music players. When volume settings are at maximum, exposure levels can exceed limits of permissible average and peak sound levels, increasing the risk of permanent hearing damage.

The growing popularity and accessibility of smartphones have made it possible for youth, even in developing countries, to be exposed to the dangers of excessively loud noise. In addition, the lack of hearing protection device (HPD) use during concerts and sports events is common.

NOISE-INDUCED HEARING LOSS RISK IN THE YOUNGER WORKFORCE
According to Statistics South Africa (StatsSA), while there is a decreasing trend in employment in the mining and construction industries, the available opportunities are increasingly being taken up by young people. With up to 80% of mine workers exposed to dangerous noise levels, the additional non-occupational noise exposure significantly adds to the risk of noise-induced hearing loss (NIHL) for the majority of the mining industry’s young personnel. This requires employers to reconsider seriously some of the current strategies used in the management of NIHL risk.

Significant inroads have been made to improve safety and reduce noise exposures in mining. However, several reports have highlighted that miners remain at higher risk of developing NIHL than workers in other industries. Additional research has also questioned the success of hearing conservation programmes (HCPs) in the mining industry and has called for innovative risk management strategies to deal effectively with the challenge of the increasing prevalence of NIHL. The difficulty in managing the risk of NIHL for mine employees may be compounded by additional hazards that are not inherent to the immediate mining environment, such as recreational noise and excessive use of personal audio devices.

INTERNATIONAL EFFORTS TO ENCOURAGE SAFER LISTENING HABITS
In an attempt to manage the pandemic effectively, the WHO recognised that maximum noise exposure levels should not be limited to occupational environments but should be extended beyond the workplace. The WHO collaborated with the International Telecommunications Union (ITU) to publish a non-binding global standard for limiting the output of different types of music players. The new standard calls for these devices, including smartphones and audio players, to be made safer for listening with regard to both their manufacture and use. Launched on World Hearing Day (3 March 2018), the standard recommends that personal audio devices include a sound-allowance function, volume-limiting options, general information and guidance, and a personalised profile.

The implementation of the WHO-ITU standard will, undoubtedly, take time. It is important to be aware, nevertheless, that the current pressures to reach ‘zero harm’ targets in South Africa require mining companies to invest in immediate measures. They are also expected to collaborate with other industry players to improve practices for these new demands for a holistic approach to the management of NIHL.

A HOLISTIC APPROACH TO RISK-DETERMINATION PRACTICES
For accurate risk determination, non-occupational risk factors are equally important. This can be challenging to employers because, traditionally, NIHL risk management strategies are not holistic in their approach. Conventional risk assessment focuses on data analysis intrinsic to the immediate work area. The primary objectives of noise surveys are to measure, describe and assess occupationally-related environmental noise for the purpose of determining risk for NIHL. Age, gender and noise exposure outside the work environment are not usually considered as determinants for effective HCPs.

Global risk profile
The global risk profile (GRP) allows for a more holistic approach to NIHL risk determination and management. The GRP is a tool that makes the risk of NIHL observable, based on international standards (ISO1999), and has been recognised as best practice by the European Agency for Safety and Health at Work (EU-OSHA). In addition to age, gender and previous noise exposure, the GRP considers current noise exposure and duration to estimate the expected hearing damage as a function of hearing protection. Essentially, the GRP calculates the probability that an employee will have a hearing loss exceeding 40 dB if he/she does not use
a HPD. The result is a concrete representation of the risk, using graphs and percentages, where the employee is made aware of the effect of noise exposure and the importance of HPD use.

**Awareness for behaviour modification**

Safety awareness training in HCPs is crucial to workers; however, disappointing post-training results\(^\text{14,26,27}\) indicate the need for new strategies, such as behaviour modification.\(^\text{28-30}\) Behaviour modification is more than managing individual employee perceptions. It entails awareness-raising, at all levels of the organisation, about the dangers of excessive noise exposure and HPD use in, and outside, the work environment.\(^\text{29,30}\) Using personal profile data, practitioners can identify leading indicators and create customised individual and group interventions. More personalised engagement affords the opportunity to digest learning material, thus affecting changes in entrenched personal perceptions and beliefs about noise and HPDs.\(^\text{26,28,30}\) Employers are therefore challenged to develop worker engagement strategies that go beyond the immediate work environment, such as awareness education in communities and schools.

**Pro-active preventive surveillance through innovation**

Pro-active preventive strategies should allow for the detection of changes in the ear before they are noticeable on the pure tone audiogram (PTA). This requires the use of innovative technology that is more sensitive to minute changes in the inner ear structures. Otoacoustic emission (OAE) is a technique that established its value in clinical settings in the 1970s.\(^\text{31}\) As an objective test (as opposed to subjective PTA), it does not require participation from the employee. It evaluates the integrity of the outer hair cells (OHCs)\(^\text{31}\) – the structures in the inner ear that are most vulnerable to noise.\(^\text{17}\) Its recent application in hearing conservation has proven to be more effective in identifying risk for NIHL than conventional methods.\(^\text{32-35}\)

The outer hair cell scan (OHC-scan™), developed by HearingCoach International, uses the digital interpretation of the OAE test results to display and represent the OHC damage for the employee in the form of percentages.\(^\text{25}\) This is a simple way to interpret the results for employees and to share information regarding their hearing damage and the possible impact that excessive noise exposure can have on their hearing in the future.\(^\text{20}\) Regular repeat measurements allow for the monitoring of changes. Changes regarded as OHC damage shifts are categorised accordingly to indicate different levels of action.\(^\text{24,25}\)

**CONCLUSION**

Current legislation, economic realities and technological limitations pose a challenge regarding the feasibility of incorporating new and unfamiliar strategies within existing practices. Nevertheless, additional approaches are required in order to effect the desired ‘zero harm’ targets outlined in the mining industry milestones for 2024. At the Mine Health and Safety Summit, regulators called for the elimination of NIHL in the South African mining industry by 2024.\(^\text{15}\) Employers are now required to adopt codes of practice (COP) to strengthen hearing conservation programmes that will ensure no deterioration in hearing greater than 10% PLH shift.\(^\text{14,36}\)

In the interest of ‘zero harm’, employers need to evaluate immediate costs against long-term benefits to the industry, and society at large. There is a need to improve capacity in organising, implementing and evaluating HCPs in a holistic manner in order to improve current practices. Moreover, it should be emphasised that healthy hearing and communication ability are the responsibilities of the individual.\(^\text{26,29}\) Innovative solutions, such as the programme developed by HearingCoach International,\(^\text{25}\) can be used to add valuable data and design strategies to improve existing HCPs.

This is not an argument for the replacement of existing legislative requirements for hearing conservation. Rather, it is an urgent to consider strategies to improve the effectiveness of HCPs through the introduction of technology and innovative practices. The goal is to identify and improve on the elements that have continued to compromise the effectiveness of HCP, resulting in persistent poor performance in NIHL prevention.

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