THE NOISE-INDUCED HEARING LOSS MILESTONES: PAST AND FUTURE

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Abstract

Introduction:
At the 2003 Mine Health and Safety Summit, the milestones for elimination of Noise-induced Hearing Loss (NIHL) in the mining industry were agreed on. The first milestone, December 2008, has passed and the next one in 2013 is looming. The study sought to answer the questions: Did we reach the 2008 milestone? What should the industry do now about hearing conservation that will ensure that there is no deterioration in hearing greater than 10% amongst noise-exposed miners? How can we ensure that the industry achieves the 2013 milestone? What else should the industry aim for to achieve "zero harm" to workers' hearing?

Methods:
A retrospective study was conducted on the Rand Mutual Assurance (RMA) NIHL compensation claims from 1998 to 2008 to determine if the 2008 milestone was achieved. The number and costs of NIHL compensation claims in different commodities and workplaces were collated. A secondary analysis of the ages of employees compensated after 2008 was conducted. A complementary retrospective analysis of audiogram data investigated the percentage loss of hearing (PLH) shift in different homogeneously exposed groups and occupations at two gold mines.

Results and Discussion:
The compensation claims analysis indicated a significant decrease in NIHL claims from 1998 to 2008 but the milestone was not achieved. The reason for not achieving the milestone may be either that claims have not been submitted timeously as required by Instruction 171 and that the current submissions are a result of pre-2003 noise exposure or that employees who were baselined are still developing NIHL owing to ineffective hearing conservation programmes in place in the mining industry.

On the basis of best practice for hearing conservation, recommendations are made for leading indicators in hearing conservation programmes and for reducing the risks of NIHL in order to achieve the 2013 milestone.
Keywords: hearing conservation, leading indicators, NIHL milestones

Introduction

The South African mining industry has committed itself to the Mining Charter that requires employers to "implement systems focused on the continuous improvement of the industry's health performance"(DMR 2010). A well known call in the mining industry is for "zero harm" to the health of the mining workforce by identifying risks and implementing prevention strategies for disease and injuries. The hearing health of the workforce and the prevention of Noise-induced hearing loss (NIHL) is the focus of this article and we contend that overexposure to noise and the development NIHL continues to be a widespread and serious health hazard that can be prevented.

Excessive noise exposure can lead to permanent hearing loss and poor verbal communication, and can reduce the ability to recognise warning signals, which can lead to accidents. Noise-induced Hearing Loss (NIHL) is one of the most prevalent work-related diseases and injuries in the industrialised world, but it is also completely preventable.

At the 2003 Mine Health and Safety Summit, the milestones for elimination of NIHL in the South African mining industry were agreed on. The first milestone, December 2008, has passed and the next one in 2013 is looming. The questions the mining industry needs to ask are: Did we reach the 2008 milestone? What should the industry do now about hearing conservation that will ensure that there is no deterioration in hearing greater than 10%? How can we ensure that the industry achieves the 2013 milestone? What else should the industry aim for to achieve "zero harm" to workers' hearing?

Milestone One was that, after December 2008, the hearing conservation programmes implemented by the industry must ensure that there is no deterioration in hearing greater than 10% amongst occupationally exposed individuals. In order to evaluate whether the 2008 milestone was reached and what the next step should be, an understanding of "no deterioration in hearing greater than 10%" is necessary. The 10% refers to Percentage Loss of Hearing (PLH), which is the current metric of hearing loss in the mining industry and determines the eligibility for compensation for an occupational disease.

The history of the use of PLH is that pre-2001 a different method of calculating the eligibility of miners for compensation for hearing loss existed, namely Instruction 168. Under the Instruction 168 legislation only four frequencies of the audiogram were used in a formula that arrived at a percentage of Permanent Damage (PD) to the hearing, and compensation was paid when 2% deterioration in PD occurred. In 2001, Instruction 171 was introduced and under the new method five frequencies on the audiogram are used with weighted, actuarially designed tables to calculate the PLH. The introduction of the new legislation allowed employers until December 2003 to "baseline" all existing employees and to pay all due compensation up to that point. There was therefore a clean slate and from that point forward deterioration of more than 10% PLH would be eligible for compensation. Not all employers complied with that cut-off date. Non-compliance with the cut-off date meant that the baseline PLH was regarded as zero PLH regardless of previous noise exposure.

In order to evaluate whether the milestone was achieved, an analysis of the compensation records is necessary. The analysis needs to take into account the above mentioned changes in measurement. The milestone presumed that new or improved methods of hearing conservation would be used to prevent hearing loss, not merely a change in the way in which the hearing loss was reported.

In order to answer the question of what the industry should do now about hearing conservation that will ensure that there is no deterioration in hearing greater than 10% and what else should the industry aim for to achieve "zero harm" to workers' hearing, the industry needs to look at what best practice for hearing conservation stipulates.

Best practice indicates, firstly, that a hearing conservation co-ordinator/manager should be in charge of ensuring that an integrated and continually improving hearing conservation programme exists at a mine (Franz, 2005). Secondly, best practice requires that leading indicators of early NIHL be used to address the impact of poorly fitting hearing protection

devices (HPDs) and of non-compliance with wearing HPDs (Schulz, 2011) and of hearing conservation programme success. Thirdly, best practice stipulates that a risk assessment be conducted to prioritise the high risk workplaces and the employees at risk in these workplaces. Finally, best practice indicates that noise control engineering should be implemented to reduce the risk of noise exposure (Franz, 2005).

The last question, which asks how the industry can ensure that the 2013 milestone is achieved, requires an analysis of the noise sources and a prioritising of indicators of reduced risks from noise sources as well as an implementation of engineering and other methods that can reduce the noise levels and the risk of NIHL.

The current research therefore conducted the studies outlined in the following methodology in an attempt to answer the abovementioned questions.

Methods

A retrospective study was conducted on the Rand Mutual Assurance (RMA) NIHL compensation claims database from 1998 to 2010. The number and costs of NIHL compensation claims in different commodities and workplaces were extracted from the RMA database and analysed per year. The number of claims per 100 000 workers was analysed. An analysis of post-2008 claims was conducted for cost to the industry and the age of compensated workers.

A complementary retrospective analysis of audiogram data from a gold mine investigated the PLH shift in different occupations and different homogenously exposed groups (HEGs) for two mines (CSIR, 2007). The results of the analysis are reported in the next section.

Results and Discussion

The compensation claims analysis indicated a decrease in NIHL claims from 1998 to 2001. The claims then increased dramatically in 2002, and then began a downward trend to a significant decrease in 2008 (Figure 1). However, the 2008 milestone of "no deterioration greater than 10%" was not achieved (Figure 2).

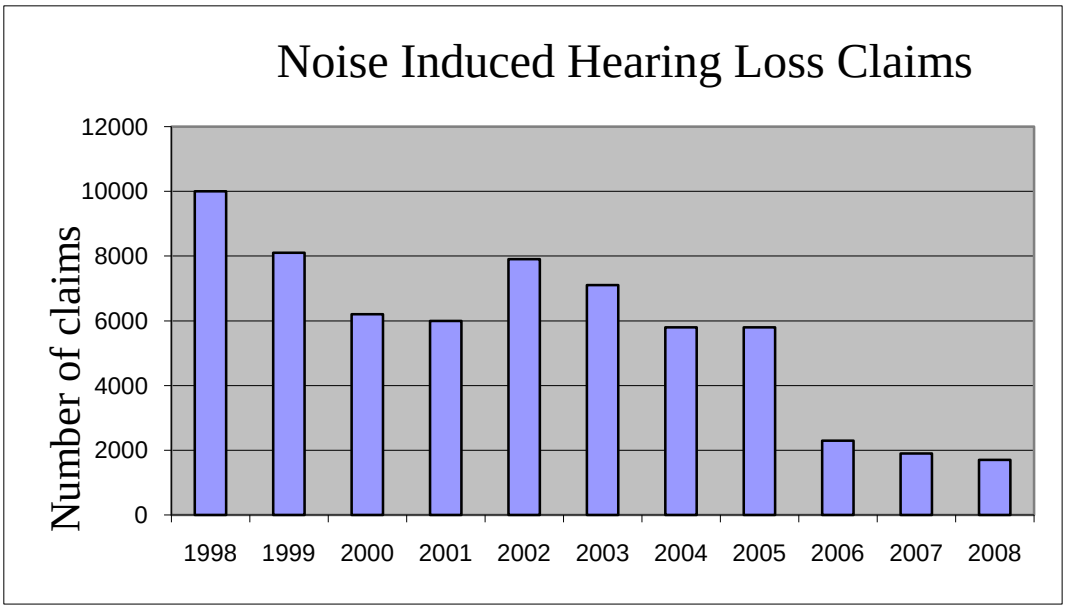

Figure 1 Noise-induced Hearing Loss claims registered with RMA from 1998 to 2008

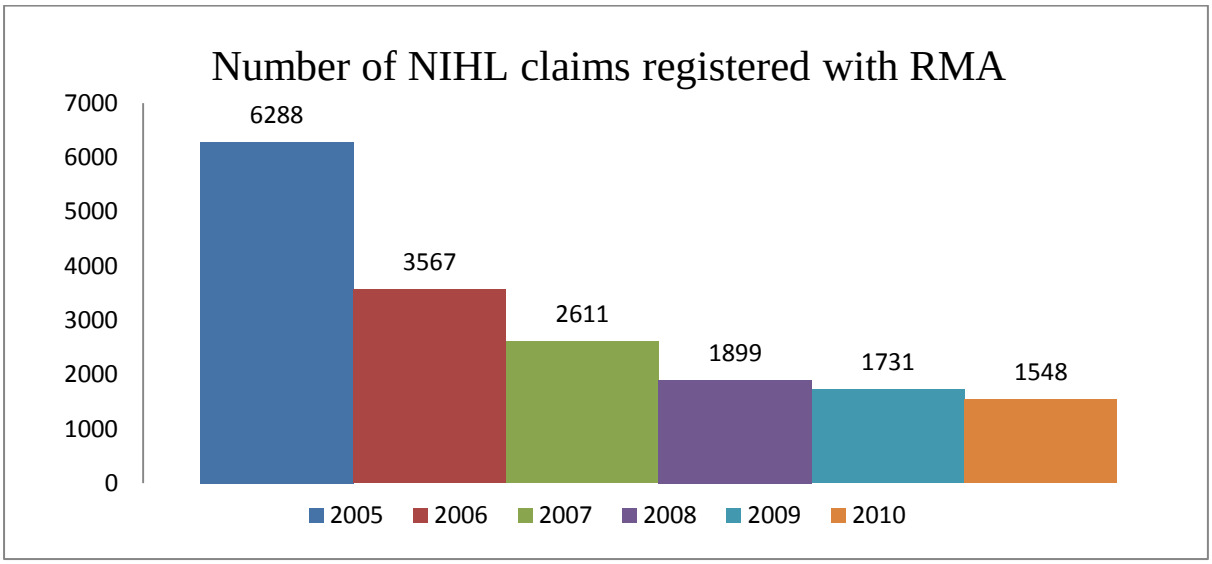

Figure 2 Noise-induced Hearing Loss claims registered with RMA from 2005 to 2010

The probable reason for the increase in NIHL compensation claims in 2002 is that the "baseline" process resulted in companies adhering to Instruction 171, which resulted in a flood of submissions. The possible reason for not achieving the milestone may be either that claims were not submitted timeously as required by Instruction 171 and that the current submissions are a result of pre-2003 noise exposure or that employees who were baselined are still developing NIHL owing to ineffective hearing conservation programmes in place in the mining industry.

The results of the analysis of the costs of NIHL claims at RMA from 1998 to 2007 indicate that the costs were greatest in the platinum and gold industries (Table 1). The platinum industry experienced a peak in 2005 of almost 90 million rand payout in one year. After 2005 there has been a steady decrease in costs. The other commodities did not show any significant changes in the costs of NIHL claims between 1997 and 2007.

Table 1 Costs of Noise-induced Hearing Loss compensation claims for the commodities in the industry

Year	GOLD	PLATINUM	COAL OPENCAST	COAL UNDERGROUND	DIAMONDS	MINERAL MINES	SHAFT SINKING
1998	R 66 013 380	R 37 586 797	R 193 206	R 1 986 753	R 425 818	R 693 176	R 3 870 573
1999	R 37 363 965	R 38 938 335	R 577 623	R 2 389 042	R 1 098 751	R 875 814	R 2 994 070
2000	R 21 721 472	R 46 306 795	R 543 587	R 2 436 636	R 515 843	R 574 371	R 3 112 409
2001	R 27 972 900	R 41 628 991	R 721 502	R 2 192 371	R 870 179	R 751 174	R 2 815 290
2002	R 32 147 036	R 31 449 581	R 1 388 294	R 2 806 369	R 941 572	R 606 407	R 4 118 758
2003	R 29 548 065	R 26 183 423	R 961 432	R 1 056 322	R 1 391 844	R 771 367	R 2 056 055
2004	R 38 860 654	R 49 821 153	R 949 875	R 1 114 459	R 2 419 865	R 3 900 348	R 4 029 768
2005	R 42 980 468	R 86 852 705	R 2 235 102	R 1 672 145	R 1 120 150	R 2 927 401	R 5 316 248
2006	R 17 086 000	R 47 419 729	R 1 944 756	R 2 453 315	R 2 743 072	R 1 112 546	R 5 188 111
2007	R 20 868 763	R 25 228 727	R 1 906 988	R 1 298 746	R 801 168	R 1 563 173	R 4 375 532

Table 2 Noise-induced Hearing Loss claims per 100 000 employees in various workplaces

NIHL claims per 100 000 employees	2005	2006	2007	2008	2009	2010
Underground (Gold)	1287	641	611	661	582	524
Underground (other)	2214	1309	800	315	361	268
Opencast	323	259	212	110	144	263

The workplace with the highest NIHL claims per 100 000 employees is deep underground mines that are not gold mines (Table 2). This confirms the results in the costs analysis, that the platinum mines were the most severely affected by NIHL claims in 2005 and have had dramatic reductions in the number of claims per 100 000 employees since then. The probable reason for very high numbers of claims in the platinum industry in 2005 is the slump in the gold industry and peak in the platinum industry that took place in that year and that resulted in a large number of previously gold miners moving to the platinum mining industry in that period. It can be argued that the platinum industry inherited the hearing losses. It is also possible that the system that Instruction 171 envisages, where a worker will only have one "baseline" for his whole working life and all hearing loss changes will be compared to the baseline, was not successfully implemented when workers changed commodities. The lack of detailed information in the NIHL claims database made it difficult to determine the exact reason for this finding.

Table 3 Age categories of Noise-induced Hearing Loss claimants since 2008

Commodity	Age of NIHL claimants since 2008				
	<30 years	30-39 years	40-49 years	50-59 years	>60 years
Gold	5	70	453	594	57
Platinum	0	22	129	212	33
Coal	0	6	42	63	24

Since the 2008 milestone, there are claimants for NIHL compensation under 40 years of age in all of the main commodities (Table 3). Also, in the age categories where miners have longer years of service, the number of claims is considerably higher. These miners have hearing loss far beyond what would be expected for their age as a result of the normal age-related degeneration of their senses. The reason for these claims may be that the years when little or no hearing conservation practices were implemented have left a legacy of hearing loss. Additionally the hearing conservation programmes in operation today are not effective enough to prevent all hearing loss.

Table 4 Costs of Noise-induced Hearing Loss claims since 2008

Post-2008 NIHL compensation costs		
	Rands (Millions)	Number of claims
Gold	42 653 722	1179
Platinum	20 397 867	396
Coal	9 061 924	135

The analysis of the claims and cost of claims since 2008 indicates that the gold mining industry is where most victims of NIHL work (Table 4).

Prediction of time to compensation

A parallel analysis of hearing levels at a gold mine was conducted to determine the average rate of PLH shift that would facilitate a prediction of the time period for miners from baseline to compensation. The analysis used the categories of homogeneously exposed groups (HEGs) in use at the mine, as outlined in Table 5.

Table 5 Homogenously Exposed Groups at a gold mine

HEGs at a gold mine
HEG 1 Shafts and Services
HEG 2 Haulages
HEG 3 Development
HEG 4 Stoping
HEG 5 Roving

The analysis showed that the rate of average PLH shift differed between HEGs (Figure 3).

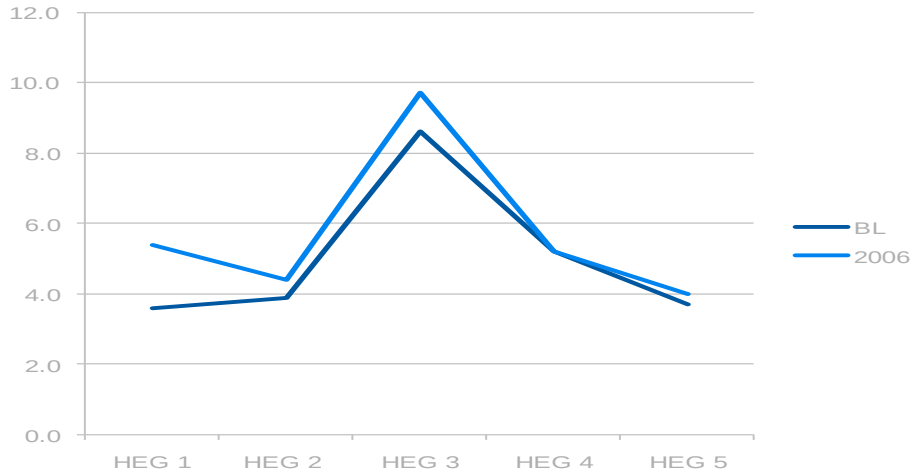

Figure 3 Average PLH for various HEGs from 2003 (baseline – BL) to 2006

Table 6 Comparison of two mines for the average PLH shift in one year for various occupations

PLH shift in 1 year	Mine 1	Mine 2

Drillers	2.2%	2.1%
Loco operators	0.9%	1.4%
Winch operators	1.3%	1.2%
Stopers	1.1%	1.5%

The results indicated that average PLH shifts in one year differ from mine to mine and across various occupations (Table 6). The average deterioration in PLH in one year at the two gold mines was worst for drillers (2.2% and 2.1% respectively). The stopers at mine 2 were the next most at risk for deterioration in PLH and then the loco drivers at mine 2 (1.4%). The results indicate that each mine needs a customised hearing conservation programme for each occupation type and that if effective hearing conservation programmes are not in place the mine in question can expect that between five and seven years from baseline the compensation claims will again begin to increase in number.

Conclusions and Recommendations

To answer the question regarding what the industry should do now about hearing conservation to ensure that there is no deterioration in hearing greater than 10%, the results clearly indicate that hearing conservation programmes need to be commodity specific, mine specific and occupation specific. In particular in large mines, the management and continued improvement of hearing conservation programmes require a great deal of specialised attention and confirm the best practice call for a hearing conservation co-ordinator/manager at every operation.

The answer to the question: "What else should the industry aim for to achieve 'zero harm' to workers' hearing?" must be found in the known best practice for hearing conservation, namely the use of leading indicators of early NIHL that can address the impact of exposure to high levels of noise and of poorly fitting hearing protection devices (HPDs) and/or of non-compliance with wearing HPDs, a practice clearly not widely implemented in the industry as shown by the compliance figures with best practice reported in recent research conducted by the Safety in Mining Research Advisory Committee (SIMRAC) (Dekker, Franz, van Dyk, Edwards, 2009). Leading indicators can assist to evaluate hearing conservation programme success (Schulz, 2011).

Such leading indicators need to be customised for the operation concerned but some of the better known indicators are known to be measures such as:

- The percentage of exposed workers with threshold shifts per year;
- A 15 dB shift from baseline in at least one frequency 1-6 kilo Hertz (kHz);
- The number of work areas with excessive noise levels;
- The number of workers who work in those work areas;
- The number of workers with a 5 dB shift in at least two of the frequencies 2,3, and 4 kHz;
- The number of HPDs bought per annum; and
- The number of HPDs used per section.

Other improvements to current hearing conservation programmes that will improve prevention strategies and allow for monitoring the success of interventions are, firstly,

implementing risk-based examinations of the ear to ensure that the variations in gender, age, hearing loss, ear canal size and susceptibility to hearing loss are taken into account and then followed up by providing an HPD choice for workers. Another strategy that best practice suggests is the use of ear plug fit testing in order to ensure that the required attenuation is achieved from the HPDs. The use of the Noise Reduction Rating (NRR) as found on the specifications of HPDs is known to be inaccurate and real-world verification of HPD attenuation is essential. There are some commercially available methods of checking the attenuation and the methods all need to be investigated for the South African mining industry (Franz, 2005).

The measurement of Temporary Threshold Shift (TTS) after a working shift, if measured correctly, has the potential to be a powerful indicator to hearing conservation co-ordinators of the effectiveness of HPDs being used and of the compliance of workers with regulations to wear HPDs (Schulz, 2011).

Another measure that the mining industry can implement to ensure no deterioration in hearing occurs is to use current technology such as otoacoustic emissions, which can indicate inner ear damage before the damage is evident on the audiogram and can be used in motivating workers to protect their hearing and in the training of workers on the risks of noise for the development of NIHL.

Another method to further improve hearing conservation programmes would be to include the hearing threshold levels of workers in the risk assessment. In this way the impact of the noise would become a priority and the individual unique response to noise also be taken into account.

Finally, best practice indicates that noise control engineering must be implemented to reduce the risk of noise exposure (Franz, 2005). The last question addressed in this research, of how the industry can ensure that the 2013 milestone is achieved, requires that all noise sources are ranked according to the level of risk they produce to the human ear. Some work on noise control engineering has been conducted on rock drills (Harper, 2008), but there are many sources of high levels of noise in the mining industry, and all occupations (including those with slightly less noise exposure levels) must be identified and addressed. For example, the baseline project conducted by the Safety in Mining Research Advisory Council (SIMRAC) has clearly ranked a number of at risk occupations in the industry and these should be systematically addressed for noise reduction (Edwards, Dekker, Franz, van Dyk and Banyini, 2011).

International initiatives for noise reduction such as those at the National Institute for Occupational Safety and Health (NIOSH) of America should be taken note of and applied to the South African situation. The NIOSH initiative is called “Prevention through Design” (PTD) and this initiative has reduced noise exposures of continuous mining machine operators by 3 dB(A) through the four functional areas of PTD: Practice, Policy, Research, and Education (Kovalchik, Matetic, Smith and Bealko, 2008). More emphasis needs to be given to the engineering controls recommended by best practice such as buying quiet equipment, and using vibration pads, enclosures, barriers and isolation methods. Again, customised programmes are required and a hearing conservation co-ordinator needs to manage all these aspects of both noise control engineering and hearing loss.

If there is enough commitment from the industry to prevent the loss of quality of life that is caused by NIHL, it is possible to achieve the second milestone of reducing the noise exposures from machinery in the industry to below 110 dBA by 2013.

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