OCCUPATIONALhealth

SOUTHERN AFRICA

Volume 29, Issue 2, 2023

ISSN 2226-6097



OFFICIAL JOURNAL

South African Society of Occupational Medicine (SASOM)

South African Society of Occupational Health Nursing Practitioners (SASOHN)

Southern African Institute for Occupational Hygiene (SAIOH)

An accredited journal of the Department of Higher Education and Training (RSA)

Front cover
Profile series,
oil and enamel on plate,
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http://www.lenahugo.com/Portfolio/Home.html

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Volume 29, Issue 2, 2023

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Audit Bureau of Circulations of South Africa 2019

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From the Editor . . .

Scholarly research



Gill Nelson,
Editor-in-Chief

Occupational Health Southern Africa has a publication misconduct policy, which addresses plagiarism, duplicate publication, salami slicing, and ethical approval (http://occhealth.co.za/documents/Policyonpublicationmisconduct.pdf). However, this is only one aspect of scholarly integrity, defined as *"the total set of explicit and implicit professional standards and characteristics that describe an ethical, upstanding member of the scholarly community."*[1] While I have discussed this issue in editorials, in one way or another, several times in the past,[2-4] two different topics regarding publication integrity are currently in the news. The first is the use of artificial intelligence (AI) and the second is the role of editors and publishers in assessing the validity of submitted research manuscripts.

There have been many debates about the use of AI in writing up research, and academic institutions, journals, and others are developing policies. *Occupational Health Southern Africa* will soon follow suit. In the meantime, the International Committee of Medical Journal Editors (ICMJE) has updated the Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals to include the use of AI.[5] Authors are now required to disclose if and how they have used AI, such as ChatGPT. However, *"chatbots…should not be listed as authors because they cannot be responsible for the accuracy, integrity, and originality of the work…"*.

On several occasions, I have tested the validity of answers provided by ChatGPT, only to find that the information provided is incorrect. For example, I asked where the 1930 Johannesburg Pneumoconiosis Conference was held and received an 'answer' in only a few moments. Upon querying the source, it referred to a book written by one of my colleagues, but such a book does not exist. After pointing this out, I was directed to an issue in a journal – the information was not there either. ChatGPT is not (yet) 'all-knowing', as demonstrated when both versions (ChatGPT-3 and ChatGPT-4) recently failed a gastroenterology exam.[6]

So, while we all need to embrace rather than fear AI in academia, it is important not to assume that the 'facts' it provides are correct. Biases in answers provided by AI have also been reported.[7] Nevertheless, AI is a very useful tool for improving grammar, sentence construction, and other aspects of writing.

Publication integrity is an integral part of scholarly integrity, and can lead to the spread of inaccurate or even "*harmful information*"; and one of the many roles of editors and publishers is to *"publish research findings that are reliable and have valid conclusions"*.[8] Editors rely totally on the robustness of the research process that led to the submission of the paper for publication. These steps include the critical review of the research proposal by a committee of experienced researchers who are knowledgeable about the research topic; a thorough review of the ethical considerations by a certified/recognised ethics committee; and the systematic conduct of the study, including the use of validated tools, the appropriateness of statistical methods used in the analysis of the data, and the correct interpretation of the results from the analysis by the researcher(s). Editors cannot check any of these aspects of the research and assume that the authors have integrity and are ethical in the conduct of their studies. Neither can the reviewers of the papers, although some do identify some aspects of research misconduct, such as plagiarism and salami slicing.

When there is evidence of research misconduct, the publisher should retract that paper, as advised by the Committee on Publication Ethics (COPE) (https://publicationethics.org/). If this is not done timeously, incorrect research findings or other information can quickly be disseminated through the scientific community. RetractionWatch, which effectively names and shames guilty authors (and institutions), regularly updates its website, listing the details of papers that have been retracted from peer-reviewed journals. There are currently more than 40 000 retracted papers on the database (https://retractionwatch.com/).

Earlier this month, Springer retracted an article that was published in the *Archives of Sexual Behavior*. One of the authors was Michael Bailey, a respected scientist. They reported the results of a survey of more than 16 000 parents who had shared that their children had *"suddenly declared a transgender identity after extensive exposure to social media and peer influence"*.[9] Activists, which included *"prominent genital surgeon and president of the World Professional Association for Transgender Health, an advocacy organization that promotes sex changes for minors"*, condemned the paper and demanded that the editor be fired. Despite a letter of support for the paper from 2 000 researchers and academics, Springer retracted it. The reason they provided for doing so was that there was improper participant consent, as the parents did not specifically consent to the findings being published in a peer-reviewed journal, although they consented to the publication of the results of the survey. If Springer applies this to the thousands of papers it has published, very many will be retracted. We should be cautious of adopting this 'new' approach, which is the direct consequence of bullying by those who don't like to read research findings that challenge their personal narratives.

Both these issues are concerns for the future of academic publishing, although one is notably more harmful than the other.

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2023
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Durban ICC
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PROGRAMME

TIME	TOPIC	PRESENTER
14:00	Welcome and purpose of the session	**Mr Nikisi Lesufi:** Senior Executive: Environment, Health, and Legacies - Minerals Council South Africa
14:05	South African mining industry's framework in preventing and managing HIV, AIDS and TB	**Dr Lindiwe Ndelu:** Chief Director for Occupational Health: Mine Health and Safety Inspectorate (MHSI) - Department of Minerals and Energy (DMRE)
14:15	Response of the world of work to the new NSP	**Prof Norbert Ndjeka:** Chief Director: TB Control & Management - National Department of Health
14:25	Taking Masoyise beyond the mining industry and learning from other industries	**Dr Joni Musabayana:** Director: International Labour Organization (ILO) South Africa
14:35	Key note address: HIV response in the world of work and the role of the United Nations in the fight against HIV and TB	**Mr Nelson Muffuh:** Resident Coordinator: South Africa - United Nations
14:50	Launch of Masoyise 2023-2024 strategy	**Dr Thuthula Balfour:** Head: Health - Minerals Council South Africa
15:00	Messages of support for the new Masoyise 2023-2024 strategy Testimonial	**Mr Charles Mkhumane:** Health and Safety Officer - National Union of Mineworkers (NUM) Organised labour representative **Ms Ntombi Zweni:** Masoyise Health Programme beneficiary
15:15	Q&A	**All**
15:25	Vote of thanks and closing remarks	**Mr Brian Ncube:** Programme Manager: Mining Regulations - MHSC

Letter to the Editor

The last issue of *Occupational Health Southern Africa* (Issue No. 1, 2023) included the regular report from the Southern African Institute for Occupational Hygiene (SAIOH) to its members. In the report, SAIOH states that, following an assessment by the Occupational Hygiene Skills Forum (OHSF), the Wits School of Public Health MSc Med in Exposure Science programme does not meet *"the qualification criteria at the Registered Occupational Hygienist (ROH) level"*, which is a *"50% occupational hygiene subject content"*.

As the team that developed the Exposure Science curriculum, we are concerned about this outcome. The way in which it is phrased suggests that our NQF Level 9 graduates would not qualify to be certified as registered occupational hygienists (ROHs). In a letter addressed to us on 13 December 2022, the Occupational Hygiene Skills Forum (OHSF) phrased this differently: *"… if a candidate completed qualifications that did not address measurement before enrolling for the ES programme, their knowledge there-of may be lacking. Occupational Hygiene certification assessments administered by SAIOH focus extensively on the technical details of measurement"*.

In response to our request for further clarification on the 50% occupational hygiene subject content, the OHSF, through the PCC Exco, explained that *"the ES programme meets the OH requisites as far as health effects and control measures are concerned"*, but *"identification and measurement of OH exposure"* are not fully covered. Apparently, the 50% requirement relates primarily to allocated time, since, as an example, it is mentioned that only 15–20% of the Wits Exposure Science programme is dedicated to noise and hazchem measurements – much less than in the Occupational Hygiene Training Association (OHTA) courses or other SAIOH-recognised programmes. In our programme, however, we focus on the assessment of exposure, which includes, and goes beyond, measurements. For example, we have a full-week course on computational exposure assessment (understanding and applying exposure models).

Although we expected a positive OHSF evaluation outcome, we are not disappointed that our programme does not meet the OHSF criteria. Instead, in addition to the effect on the careers of our graduates, we are concerned about SAIOH's implicit distinction between occupational hygiene and exposure science and the associated required skills of a high-profile professional, e.g. a registered occupational hygienist (ROH).

In short, the two-year MSc Med Exposure Science programme was launched in 2019 because we believe that we can offer industry graduates with the skills to understand and interpret measurement results, beyond traditional compliance testing. The programme comprises 11 one-week courses and a mandatory research project. The key pillars of the programme are understanding the exposure process (from source to receptor) and integration of all exposure pathways (aggregate and cumulative exposures) over the lifetime of an individual (the 'exposome').

It is interesting to note that our programme meets all the curriculum requirements and learning objectives as proposed by the European Chapter of the International Society of Exposure Science (ISES). Surprisingly, a stand-alone higher educational programme does not exist in Europe.[1] For an overview of the work titles of the courses, please refer to our article, published in this journal in 2019, where we explain the relationship between occupational hygiene and exposure science.[2]

Universities in other countries also recognise the intersection between occupational hygiene and exposure science, e.g. the University of Michigan, on its website, states that *"Exposure Science (ExS) underpins several of the disciplines comprising the Environmental Health Sciences. When applied to occupational health, ExS falls within the Industrial Hygiene (IH) domain. Considering IH in the broader context of ExS, the contributions IH professionals are making in modern global society (within and beyond the boundaries of the workplace), and our evolving understanding of health risks as a function of time/life-stage, we have adopted the hybrid term Exposure Science-Industrial Hygiene (ExS-IH) to describe our academic program"*.

While we do not wish to start a public debate on the SAIOH OHSF decision, we believe that *Occupational Health Southern Africa* readers will benefit from an update of our 2019 paper, based on our experiences and those of our graduates, and the further developed curriculum. It is crucial that occupational hygiene in South Africa keeps pace with international developments, and we are proud to contribute to this through the development and roll out of a science-based training and learning programme in the field of exposure science.

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Milly Ruiters, National Chief Inspector Occupational Health and Safety (OHS): Department of Employment and Labour

Milly Ruiters, a registered occupational hygienist, joined the Inspections and Enforcement Services Branch at the beginning of April 2023 as the new Chief Inspector of Occupational Health and Safety (OHS). Ms Ruiters is the first Chief Inspector with an occupational health and hygiene-related qualification. During the last 20 years, the position of Chief Inspector was occupied by men; Ms Ruiters is the second woman in this position.

Born in Promosa, Potchefstroom, Ms Ruiters matriculated in 1997. She holds several degrees: a BSc in Biological Science, a BSc Honours degree in Industrial Physiology, an MSc degree in Occupational Hygiene, and a Master of Business Administration (MBA) – all from North-West University (NWU). Ms Ruiters has two additional postgraduate qualifications, viz. a certificate in project management (University of Pretoria) and a diploma in ergonomics (Rhodes University). Before being appointed as Chief Inspector OHS, she was employed by the Compensation Fund as Chief Director: Medical Benefits.

Her previous experience in the Department of Employment and Labour was as a Senior Specialist (Director) in Occupational Health and Hygiene from 2009 until 2017. Prior to that, she was Manager for Medical Services at the Nuclear Energy Corporation of South Africa (NECSA) from 2004 until 2009. She was also employed at Denel, from 2001 until 2004, as an occupational health and hygiene officer.

Ms Ruiters has more than 22 years' experience in the medical field, specialising in occupational health, hygiene, and medical aid for injured workers. During her 22-year career, she has managed occupational hygienists, occupational health nurses, radiographers, occupational medical practitioners, medical doctors, and labour inspectors.

Ms Ruiters has a passion for the prevention of injuries and diseases and her primary focus will be to promote prevention through active partnerships with the Compensation Fund licencees (Rand Mutual Assurance and the Federated Employers Mutual Assurance Company), as well as all the social partners. Another of the major tasks that she will be focusing on is the Occupational Health and Safety (OHS) Bill amendment and promulgation.

The Decent Country Work Programme, signed between South Africa and the International Labour Organization (ILO), and launched by the Minister of Labour on 29 September 2010, encapsulates what Ms Ruiters and her team will focus on and implement over the next five years. In doing so, she will need to rely on the tripartite structures, which include the Advisory Council for OHS and, most importantly, those of you who seek to make a difference in OHS. Be the change you want to see!

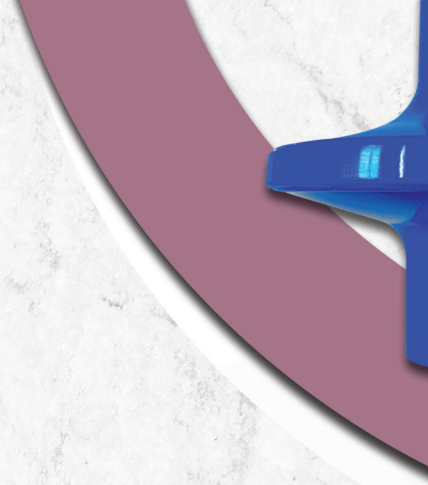


Milly Ruiters
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Milly Ruiters can be contacted at milly.ruiters@labour.gov.za

ACKNOWLEDGEMENT
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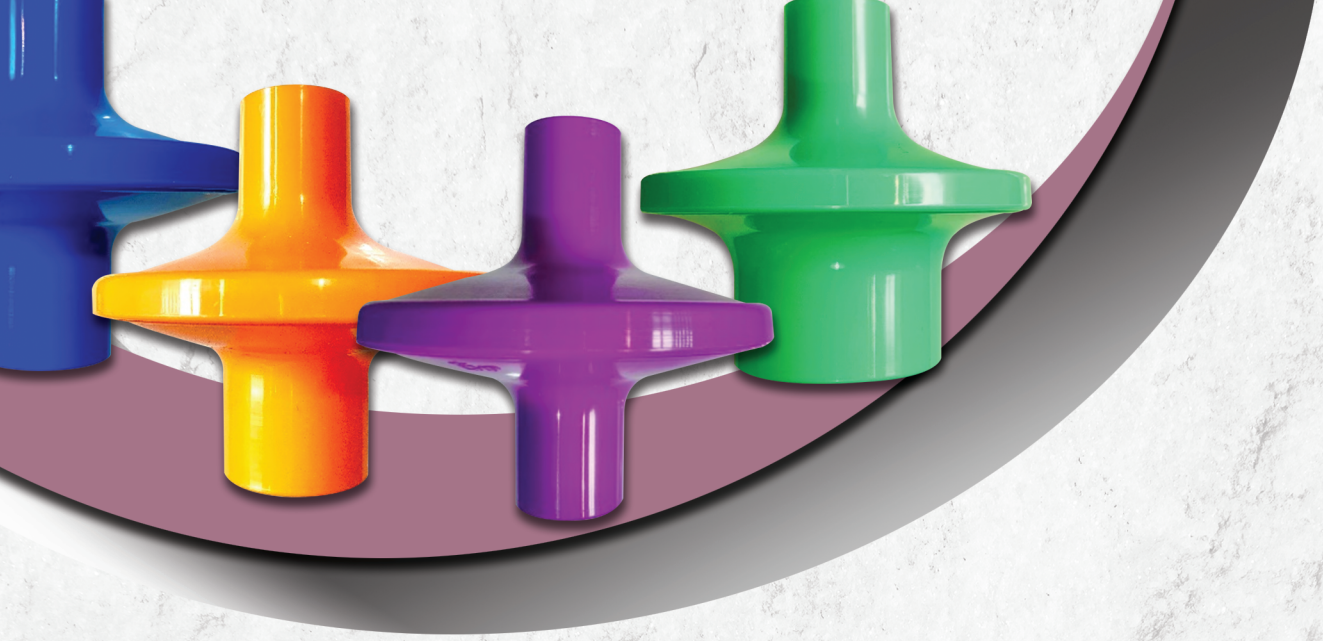
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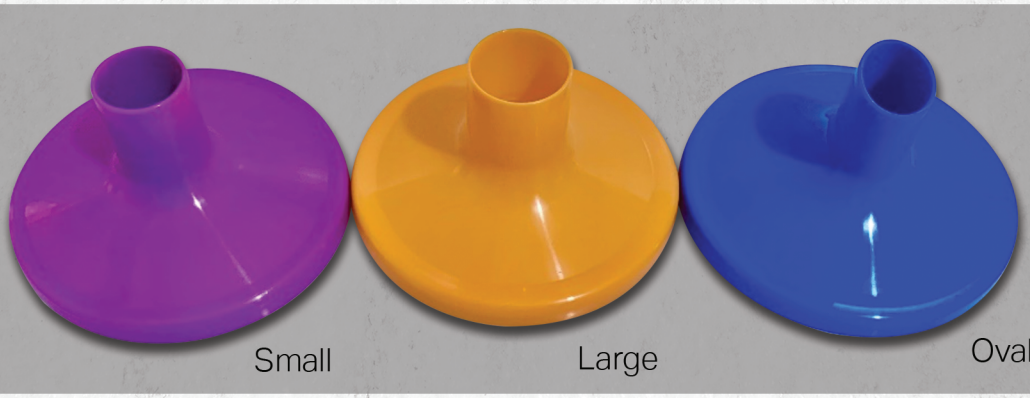
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		EasyOne Pro
		EasyOne Pro LAB
	Schiller	SpiroScout
		SPIROVIT SP-1 G2

Product Code	Spirometer	Model
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		ALPHA 6000
		In2itive
	Micro Medical	All models
	Schiller	SP-260
	MH	LA303
	COSMED	microQuark
		Quark Spiro
		Pony FX
	CONTEC	All models

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	Jaeger	MasterScope
		MasterScreen
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		Spiro Pro
	Vyaire	Vyntus SPIRO PC
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	AME	Short Adaptor
	IQ TeQ	Short Adaptor
	ORCAwave	Short Adaptor
	MSG	Short Adaptor
	Thor/Spirosonic	All models

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Appointment of new Tshiamiso Trust CEO

Johannesburg, 8 May 2023

The Tshiamiso Trust is delighted to announce the appointment of its new Chief Executive Officer (CEO), Dr Munyadziwa Kwinda, effective 1 June 2023. Dr Kwinda is a highly qualified health professional and an expert in bioethics, health, and medical law. Currently registered with the Health Professions Council of South Africa (HPCSA) as a medical practitioner, specialising in family medicine, Dr Kwinda holds both science and medicine degrees from the University of Venda and the University of KwaZulu-Natal, as well as postgraduate qualifications in family medicine, and bioethics and health law. He also holds a postgraduate degree in law.

With 20 years' working experience, including years of experience in clinical care, Dr Kwinda has held various management positions at senior, executive, and non-executive levels. In addition to senior positions at hospitals in Limpopo, he has held several positions at the HPCSA, including that of Ombudsman, Acting Chief Operations Officer, and Acting Registrar/CEO.

In a non-executive capacity, Dr Kwinda has also served on various boards and committees, including the South African Medical Association (Board member and National Councillor), the Medical and Dental Professions Board at the HPCSA (Vice-Chairperson), Council, Governance, and Audit and Risk Committees at the Vaal University of Technology (member), the Aeromedical Committee at the South African Civil Aviation Authority (Vice-Chairperson), and the National Health Research Ethics Council (member).

"Dr Kwinda's unique combination of skills and experience in medicine, ethics, law, and management makes him the ideal candidate to carry out the Trust's mandate. We are excited to see the work of the Trust go from strength to strength under his leadership and guidance", said Board Chairperson, Dr May Hermanus.

The Trustees also thank Lusanda Jiya, the acting CEO of the Trust, for her solid leadership in this period of change and transition.



Tshiamiso Trust CEO, Dr Munyadziwa Kwinda
Photograph: courtesy of Tshiamiso Trust

ABOUT THE TSHIAMISO TRUST

The Trust was established to give effect to the settlement agreement reached between six mining companies and claimant attorneys in the historic silicosis and TB class action. It is responsible for ensuring that all eligible current and former mine workers, across southern Africa, with permanent respiratory impairment due to silicosis or work-related cardio-respiratory TB (or their dependants where the mine worker has passed away) are compensated. These beneficiaries are front and centre in all that the Trust does.

African Rainbow Minerals, Anglo American South Africa, AngloGold Ashanti, Harmony Gold, Sibanye-Stillwater, and South Deep Joint Venture are Founders of the Trust.

An evaluation of occupational health risk assessment methodologies from South African enterprises: noise risk assessment field study

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Keywords
risk matrix, risk identification, risk analysis, risk evaluation, risk ranking

How to cite this paper
Rikhotso O, Morodi TJ, Masekameni DM. An evaluation of occupational health risk assessment methodologies from South African enterprises: noise risk assessment field study. Occup Health Southern Afr. 2023; 29(2):65-74.

ABSTRACT

Background: The South African occupational health and safety regulations, prescribing risk assessments be conducted by employers, are non-prescriptive with regard to the tools and techniques to be used. Consequently, companies freely adopt the numerous available tools and techniques from which risk management decisions are derived. Thus, risk management, ensuing from the results derived from these tools and techniques, is likely to vary from company to company.

Objective: The objective of the study was to evaluate risk assessment processes and methodologies that are used and recorded in noise risk assessment reports, in four manufacturing companies.

Methods: This was a case study, whereby risk assessment records were obtained from four South African companies with different operational units, from the manufacturing and utilities sectors.

Results: There were inter- and intra-company variations in the processes related to the legal context in which the risk assessments were conducted, the risk assessment tools and techniques used, the risk criteria definitions, the statements about the effectiveness of controls in use, and the risk evaluation outcomes. Inter- and intra-company variations in risk rankings and risk prioritisation outcomes were also observed – a consequence of the risk perceptions of the assessors assigning a risk level to the noise hazard. In some instances, the adopted risk assessment tools and techniques categorised the risk from noise that was at or above regulated health and safety standards as 'insignificant', which those companies used as justification for taking no further measures to eliminate or reduce the risk.

Conclusion: The use of different risk assessment processes, tools and techniques resulted in some facilities categorising noise as an insignificant hazard, which may contribute to high noise emissions and uncontrolled exposures.

INTRODUCTION

The management of health and safety at work is a challenge faced by all companies.[1] Risk prevention starts with a comprehensive assessment of risks, followed by a judgment about the probability of ill health, and implementation of preventive measures to minimise the severity of these risks. Some companies have implemented complementary occupational health and safety (OHS) systems, such as the International Organization for Standardization (ISO)/South African National Standard (SANS) 45001, to manage inherent risks.[2] The ISO/SANS 45001 system relies on the assessment of risk, but does not guarantee a safe and healthy workplace, although it facilitates the standardisation of methods for the identification of hazards and risks by industry type, risk prioritisation, and implementation of control measures.[3]

The field of risk assessment and risk management, although less than five decades old, has seen the development and introduction of new and sophisticated analytical tools and techniques across different sectors.[4] The iterative steps of assessing risks to health include: a) a definition of the extent of the assessment, b) gathering of exposure information, c) exposure assessment, d) identification of actions, e) recording of the assessment, f) implementation of identified corrective actions, and g) review of the assessment.[5]

Risk assessments are conducted by employers, worldwide, to fulfil legal obligations.[6-15] Occupational health risk assessments conducted by employers in South Africa in both the manufacturing and utilities sectors are designed to comply with health regulations, such as the Noise-Induced Hearing Loss (NIHL), Lead, Hazardous Chemical Agents, Hazardous Biological Agents, and Asbestos Abatement Regulations. The risk assessments prescribed by these regulations are conducted biennially, although reassessments are required for any material process changes that might affect the current risk categorisation.[8-10,12,13,16]

The various health regulations do not prescribe the steps to be followed when conducting a risk assessment. The ISO/SANS 31000 standard, however, offers generic guidance, including that there should be defined risk criteria[17] as a first step in the risk management process. Companies in South Africa are therefore at liberty to select risk analysis and risk evaluation tools and techniques suited to their operations, following the risk identification phase,[18] in the

absence of a national harmonised regulatory guideline. These tools and techniques include bow tie analysis, risk indices, cost-benefit analysis, and cost-and-effect analysis, amongst others.[19]

Equally important is the selection and adoption of corresponding risk matrixes, which can be qualitative, semi-quantitative, or quantitative.[20] A company should select a technique that is consistent with its predetermined risk criteria, and should provide a reason for the choice with regard to relevance and suitability.[19,21] Risk assessment methodologies, tools, and techniques are continuously being developed,[22] and impact downstream risk management processes.

A national framework for the acceptability of risk can provide clarity about risk assessment procedures and clarify the level of risk tolerability, thereby assisting companies to manage risks.[19] Such a framework is, however, absent in South Africa, apart from the prescribed health and safety standards relating to exposure to occupational health hazards.[8-10,12,13] Internationally, the Health Safety Executive (HSE) in the United Kingdom (UK) has published a tolerability of risk framework[23] in which the outcomes of the risk assessment process are required to be recorded in a report.[8-10,12,13]

In this paper, we report the results of an evaluation of noise risk assessment processes and methodologies used by four South African companies from the manufacturing and utilities sectors.

METHODS

Risk-based criteria were used to identify companies for invitation to participate in the study through the review of company annual sustainability reports, as described by Rikhotso et al. (2022).[24] Only companies with historic NIHL case disclosures reported in annual sustainability reports and operating in the manufacturing and utilities sectors were considered for participation in the study.

The annual sustainability reports of 20 companies (19 from the manufacturing sector and one from the utilities sector) were reviewed. Eleven of the 20 companies had reports of NIHL cases and were invited to participate in the study. Four companies participated, viz. an electricity generation company (Company A, with 11 operational facilities), a petroleum refinery (Company B, with two operational facilities), a radioisotope manufacturing company (Company C, with six operational facilities), and a cement manufacturer (Company D, with two operational facilities). An operational facility represents a single plant or business unit of the parent company, and operates as an independent entity.

The four companies submitted their reports from their most recent risk assessments. We evaluated the risk assessment methodologies, the risk prioritisation processes, and the risk treatment processes, in line with SANS/ISO 31000 guidelines, in

Table 1. Health risk assessments conducted in the facilities of the four companies

Company/ facility	Regulation/Act								
	Noise-Induced Hearing Loss Regulations	Regulations for Hazardous Chemical Agents	Lead Regulations	Regulations for Hazardous Biological Agents	Environmental Regulations for Workplaces	Asbestos Abatement Regulations	Ergonomics Regulations	Hazardous Chemicals Act	Reference standards and guidelines adopted to guide risk assessment[§]
Company A									
Facility 1	✓	✓	-	✓	✓	-	✓	-	×
Facility 2	✓	✓	-	-	✓	-	✓	-	×
Facility 3	✓	✓	-	✓	✓	-	✓	-	×
Facility 4	✓	✓	-	✓	✓	-	✓	-	×
Facility 5	✓	✓	-	✓	✓	-	✓	✓*	✓
Facility 6	✓	✓	-	✓	✓	-	✓	-	✓
Facility 7	✓	✓	-	✓	✓	-	✓	-	✓
Facility 8	✓	✓	-	✓	✓	-	✓	-	✓
Facility 9	✓	✓	-	✓	✓	-	✓	-	×
Facility 10	✓	✓	-	✓	✓	-	✓	-	×
Facility 11	✓	✓	-	✓	✓	-	✓	-	×
Company B									
Facility 1	✓	✓	-	✓	✓	-	✓	✓†	×
Facility 2	✓	✓	-	✓	✓	-	✓	-	×
Company C									
Facility 1	✓	✓	-	-	✓	✓	✓	✓‡	✓
Facility 2	✓	✓	✓	✓	✓	-	✓	✓‡	✓
Facility 3	✓	✓	-	-	✓	-	✓	✓‡	✓
Facility 4	✓	✓	-	-	✓	-	✓	-	✓
Facility 5	-	✓	-	-	✓	-	✓	✓‡	✓
Facility 6	✓	✓	-	✓	✓	-	✓	✓‡	✓
Company D									
Facility 1	-	✓	-	-	✓	-	-	-	×
Facility 2	-	✓	-	-	✓	-	-	-	×

✓ present, × absent, * microwave radiation, † X-rays, ‡ X-rays and other radiation types, § e.g. ISO/SANS 31000, internal company risk assessment guidelines

which principles, a framework, and a process for managing risk are provided.[17] The acceptability of risk, especially following risk treatment, was included as one of the defined risk criteria.

Document analysis

Document analysis was used to evaluate the health risk assessment reports.[25] According to Bowen (2008),[25] document analysis can be systematically applied in the evaluation of documents that are in print or electronic form. To aid the evaluation, the READ approach[26] to document analysis was used in extracting meaningful data from the reports by following the iterative steps of 1) readying the materials, 2) extracting the data, 3) analysing the data, and 4) distilling the findings. Themes were identified and the outcomes were tabulated to report on the regulatory context, risk assessment tools and techniques used, risk assessment criteria, risk assessment processes, risk prioritisation outcomes, and risk assessment document quality aspects.

Ethical clearance for the study was obtained from the Tshwane University of Technology (TUT) Research Ethics Committee: FCRE 2020/10/015 (FCPS 02) (SCI).

RESULTS

Even though the different health regulations require individual risk assessments, companies conduct a single risk assessment for all regulated occupational health hazards, a practice that was observed for all of the four participating companies. Twenty-one risk assessment reports were evaluated, covering the period 2018 to 2021.

Establishing the regulatory context

South African legislation requires companies to conduct risk assessments. OHS hazards covered by the NIHL Regulations, the Regulations for Hazardous Chemical Agents (for various agents, excluding lead and asbestos), the Lead Regulations, the Asbestos Abatement Regulations, the Environmental Regulations for Workplaces (for lighting, heat, cold stress, and ventilation), and the Ergonomics Regulations were addressed in the risk assessments of all four participating companies (Table 1).

Risk assessments were conducted in all facilities for compliance with the Regulations for Hazardous Chemical Agents and the Environmental Regulations for Workplaces. Most of the facilities conducted risk assessments for compliance with the Ergonomics Regulations (n = 19, 90.5%) and the NIHL Regulations (n = 18, 85.7%), while fewer conducted risk assessments for hazardous biological agents (n = 14, 66.7%), or hazardous chemicals (n = 7, 33.3%). In only one facility was a risk assessment conducted for the assessment of lead, while in one other asbestos was considered as a hazard. Ten (n = 10, 47.6%) operating facilities from Companies A and C indicated the reference documents used for the adopted risk assessment methods, whereas none was mentioned for Companies B and D.

Risk assessment techniques/tools

The consequence/probability matrix risk assessment technique was used by 18 of the 21 facilities (85.7%) (Table 2). Two facilities used checklists, and no information could be found for one facility. The consequence/probability matrix allows risk assessors

Table 2. Risk assessment techniques/tools and outputs for each facility

Company/facility	Risk assessment technique/tool	Output in risk assessment report
Company A		
Facility 1	Consequence/probability matrix	Rating for each risk
Facility 2	Consequence/probability matrix	Rating for each risk
Facility 3	Consequence/probability matrix	Rating for each risk
Facility 4	Consequence/probability matrix	Rating for each risk
Facility 5	Consequence/probability matrix	Rating for each risk
Facility 6	Consequence/probability matrix	Rating for each risk
Facility 7	Consequence/probability matrix	Rating for each risk
Facility 8	Consequence/probability matrix	Rating for each risk
Facility 9	Consequence/probability matrix	Rating for each risk
Facility 10	NI	NI
Facility 11	Consequence/probability matrix	Ranked list of risks with significance levels† defined
Company B		
Facility 1	Consequence/probability matrix	Rating for each risk
Facility 2	Consequence/probability matrix	Rating for each risk
Company C		
Facility 1	Consequence/probability matrix	Rating for each risk*
Facility 2	Consequence/probability matrix	Rating for each risk*
Facility 3	Consequence/probability matrix	Rating for each risk*
Facility 4	Consequence/probability matrix	Rating for each risk*
Facility 5	Consequence/probability matrix	Rating for each risk*
Facility 6	Consequence/probability matrix	Rating for each risk*
Company D		
Facility 1	Checklist	List of control failures and action list
Facility 2	Checklist	List of control failures and action list

NI: not indicated, * rating for each risk with explanatory text in executive summary of report, † options for significance levels include insignificant, low, medium, high, moderate, and acceptable

to rate and rank each of the risks, in terms of significance level. Checklists enable the company to list control failures and develop action lists.

Risk assessment criteria

To establish internal (OHS management system) and external (legal) compliance, companies define the risk criteria aligned to the selected risk assessment techniques. The risk criteria reflect a company's willingness to accept (or not) a certain level of risk in view of internal risk management policies, which state the objectives, values, and resources dedicated to risk management.

Most of the facilities described all five of the risk assessment criteria (consequence measurement, probability expression, risk level determination, risk categorisation/prioritisation, and risk treatment (n = 14, 66.7%)) (Table 3). Each criterion has an associated scale, which assists in determining the level of risk. Company C was most 'compliant' in this regard (assessed the risk, using all five criteria in Table 3), followed by company B. Company D described only the risk level determination and risk treatment criteria in the risk assessments in both of its facilities. Company B excluded the risk treatment criterion.

Although risk assessments should include clear frameworks for determining risk tolerability, as described by the UK's HSE,[23] none of the participating companies addressed this. This criterion was not expected to be included, as there is no national guideline in which risk tolerability is comprehensively described.

Risk assessment process

Risk assessments are conducted in phases (risk identification, risk analysis, and risk evaluation), with the information collected during each phase used in the ensuing phases. The risk assessment processes followed by each company, which comprise the three phases, are shown in Table 4.

Risk identification, which involves identifying and recording risks (a basis for the entire risk assessment process), was an established practice in all companies. During the risk analysis phase, current exposure controls are identified and their effectiveness assessed, using qualitative, semi-quantitative, or quantitative approaches. Companies A, B and C identified and recorded current controls as part of the risk assessment process, but Company D had no record of doing this. Company C assessed the effectiveness of the control measures as a business practice; however, there was variability between the facilities in Company A in this regard (only n = 7, 63.6% assessed control effectiveness). Companies C and D did not include assessing the effectiveness of controls in use as part of the risk analysis phase.

Companies A (10 facilities), C (one facility), and D (all facilities) used qualitative risk assessments. Company B used a combination of semi-quantitative and quantitative risk assessments. Company C used all three risk analysis assessment methods, viz. qualitative, semi-quantitative, and quantitative. Uncertainties and sensitivities associated with the respective risk analysis techniques were not recorded in any of the companies' risk assessment reports.

Table 3. Risk assessment criteria included in the reports of each facility

	Risk assessment criterion					
Company/facility	**Consequence (of exposure) measure**	**Probability* (of exposure) expression**	**Risk level determination**	**Risk categorisation/ prioritisation**	**Risk treatment**	**Risk tolerability**
Company A						
Facility 1	✓	×	×	×	✓	×
Facility 2	✓	✓	✓	✓	✓	×
Facility 3	✓	✓	✓	✓	✓	×
Facility 4	×	✓	✓	×	✓	×
Facility 5	✓	✓	✓	✓	✓	×
Facility 6	✓	✓	✓	✓	✓	×
Facility 7	✓	✓	✓	✓	✓	×
Facility 8	✓	✓	✓	✓	✓	×
Facility 9	✓	✓	✓	✓	✓	×
Facility 10	×	×	×	×	×	×
Facility 11	✓	✓	✓	×	×	×
Company B						
Facility 1	✓	✓	✓	✓	×	×
Facility 2	✓	✓	✓	✓	×	×
Company C						
Facility 1	✓	✓	✓	✓	✓	×
Facility 2	✓	✓	✓	✓	✓	×
Facility 3	✓	✓	✓	✓	✓	×
Facility 4	✓	✓	✓	✓	✓	×
Facility 5	✓	✓	✓	✓	✓	×
Facility 6	✓	✓	✓	✓	✓	×
Company D						
Facility 1	×	×	✓	×	✓	×
Facility 2	×	×	✓	×	✓	×

* changed to 'likelihood' in 2020 SANS 31010, ✓ present, × absent

None of the companies recorded the status of previous or current decisions regarding risk treatment and the priority thereof during risk evaluation. Nonetheless, the risk assessment records for all four companies (all facilities) outlined proposed control solutions for identified risks.

Noise risk analysis outcomes

The inter- and intra-company risk analysis comparisons are shown in Table 5. Companies A, B and C had variable consequence and probability/likelihood ratings, which affected their risk priority rankings. Such variations are expected when different risk assessment criteria are used to determine the level of risk. The risk priority rankings in four facilities (5, 7, 8, and 9 of Company A) were inconsistent with the risk matrices (consequence and probability ratings).

At Company B, where both semi-quantitative and quantitative risk analysis techniques were used, the variation was consistently assigned two similar consequence, probability/ likelihood, and risk priority scores, highlighting an advantage of these techniques over the qualitative approach. Inter- and intra-company variation also extended to whether the untreated and residual noise risk was interpreted as low, medium, or high, which is critical for informing employers about the need to institute additional control measures.

The companies used different risk matrices, which are listed, together with their corresponding descriptors, in Supplementary Table 1. The table provides an overview of Companies' A, B and C risk matrices from which consequence and probability ratings, risk priority rankings, and/or risk scores were derived, for the risk analysis outcomes in Table 5. Company A facilities (other than Facility 11) used risk ranking/ categorisation to determine actions for control. To make decisions regarding the implementation of additional controls at Company B, an additional matrix, which included the hazard rating, exposure rating, and exposure bands, was used in decision-making for appropriate corresponding action. Company C's risk matrix comprised the calculated risk scores (consequence x probability ratings) for rating the risk, which determines the priority of control. It is important to note that the risk matrix outcomes and interpretations are influenced by the risk assessor.

Risk assessment documentation quality aspects

The risk assessment results should be clearly documented in the report. The extent of the assessed risk assessment reports regarding the content and quality aspects are shown in Table 6. The 12 criteria are aligned with the SANS 31000 guidelines.[17]

The companies' risk assessment reports had several discernible quality-related shortcomings. Addressing all the report quality aspects (shown in Table 6) increases confidence in the risk assessment process, the outcomes of which employers use to make risk treatment decisions. The 'discussion of results' and 'conclusions' support the outcomes of the risk analyses and locate the risk assessor's practical knowledge and experience, regarding the credibility of

Table 4. Health risk assessment processes followed in each facility

Company/ facility	Risk assessment process										
	Risk identification*	Risk analysis						Risk evaluation and decisions			
		Controls assessment		Assessment method			Uncertainties and sensitivities	Decision on risk treatment	Priorities for treatment	Activity status	Treatment paths
		Current controls identified	Control effectiveness	Qualitative	Semi-quantitative	Quantitative					
Company A											
Facility 1	✓	✓	✓	✓	-	-	×	×	×	×	✓
Facility 2	✓	✓	×	✓	-	-	×	×	×	×	✓
Facility 3	✓	✓	✓	✓	-	-	×	×	×	×	✓
Facility 4	✓	×	×	✓	-	-	×	×	×	×	✓
Facility 5	✓	✓	×	✓	-	-	×	×	×	×	✓
Facility 6	✓	✓	✓	✓	-	-	×	×	×	×	✓
Facility 7	✓	✓	×	✓	-	-	×	×	×	×	✓
Facility 8	✓	✓	×	✓	-	-	×	×	×	×	✓
Facility 9	✓	✓	✓	✓	-	-	×	×	×	×	✓
Facility 10	✓	✓	×	✓	-	-	×	×	×	×	✓
Facility 11	✓	✓	×	-	✓	-	×	×	✓	×	✓
Company B											
Facility 1	✓	✓	×	-	✓	✓	×	×	×	×	✓
Facility 2	✓	✓	×	-	✓	✓	×	×	×	×	✓
Company C											
Facility 1	✓	✓	✓	✓	✓	✓	×	×	×	×	✓
Facility 2	✓	✓	✓	✓	✓	✓	×	×	×	×	✓
Facility 3	✓	✓	✓	✓	✓	✓	×	×	×	×	✓
Facility 4	✓	✓	✓	✓	✓	✓	×	×	×	×	✓
Facility 5	✓	✓	✓	✓	-	-	×	×	×	×	✓
Facility 6	✓	✓	✓	✓	✓	✓	×	×	×	×	✓
Company D											
Facility 1	✓	×	×	✓	-	-	×	×	×	×	✓
Facility 2	✓	×	×	✓	-	-	×	×	×	×	✓

* risks recognised and recorded, ✓ present, × absent

Table 5. Inter- and intra-company methodological comparisons of noise risk analysis outcomes

Company/facility	Consequence (severity) rating	Probability (likelihood) rating	Risk priority ranking and/or risk score	Risk matrix priority ranking interpretation (risk categorisation and/or prioritisation)
Company A				
Facility 1*	2	2	III	Low – minor or no action required
	3	3	IV	Medium – action required, probably at administrative level
Facility 2	4	1	II	High – strong mandatory action required
		3	IV	Medium – action required, probably at administrative level
Facility 3	6	2	II	High – strong mandatory action required
Facility 4	NI	NI	NI	Low – minor or no action required
Facility 5	4	B	III†	Medium – action required, probably at administrative level
Facility 6	4	3	NI	Low – minor or no action required
Facility 7	4	B	III†	Medium – action required, probably at administrative level
Facility 8	4	2	III†	Medium – action required, probably at administrative level
Facility 9	4	2	III†	Medium – action required, probably at administrative level
Facility 10	NI	NI	NI	Acceptable§
Facility 11‡	NI	NI	Low, medium, high**	Not indicated
Company B				
Facility 1 – hazard inventory	2	D	2D	Medium – second priority
Facility 1 – task appraisal	3	C	3C	Medium – third priority
		D	3D	Medium – first priority for action
	3	E	3E	High – first priority for action
Facility 2 – hazard inventory	2	D	2D	Medium – second priority
Facility 2 – task appraisal	3	C	3C	Medium – third priority
		D	3D	Medium – first priority for action
Company C				
Facility 1	3	1	3††	Very low priority
Facility 2	4	2	8††	Low priority
Facility 3	NI	NI	Low§§	Low priority
Facility 4	4	2	8††	Low priority
Facility 5	NA	NA	NA	NA
Facility 6	3	1	Low§§	Low priority
Company D				
Facilities 1 and 2	NI	NI	NI	NI

* risk matrix considered inherent and residual risk, † risk priority ranking inconsistent with risk matrix descriptors, § risk assessment report omitted the risk matrix explaining 'acceptable' risk, ‡ consultant risk matrix used in the assessment, ** risk matrix used only categorised risks and proposed specific control measures for each assessed risk, †† risk scores, §§ no risk score shown on source document, NA: not applicable, NI: not indicated

Table 6. Risk assessment report quality aspects

Quality aspect	Company A	Company B	Company C	Company D
Objectives and scope	✓	✓	✓	×
Risk criteria application	✓	✓	✓	×
Limitations, assumptions, and justification of hypothesis	×	×	×	×
Assessment methodology	✓	✓	✓	×
Risk identification results	✓	✓	✓	✓
Data, assumptions, and their sources and validation	×	×	✓	×
Risk analysis results and their evaluation	✓	✓	✓	✓
Sensitivity and uncertainty analysis	×	×	×	×
Discussion of results	×	×	×	×
Conclusions	×	×	×	×
Recommendations	✓	✓	✓	✓
References	✓	×	×	×

✓ present, × absent

sources of information and factors (consequence and probability descriptors), considered during the risk analysis process. These methodological aspects also facilitate alignment of the risk assessment, by ensuring that the objectives defined during the risk identification phase have been met. Although not explicitly mentioned in the respective risk assessment reports, it is assumed that conclusions relate to priority rankings, based on the stated risk assessment objectives.

DISCUSSION

Regulatory context

Noise risk assessments were conducted by the four participating companies within a regulatory context. In doing so, employers fulfil the legal duty described in Section 8 of the Occupational Health and Safety Act.[7] With the inspection and enforcement strategy of the Department of Employment and Labour being dominantly self-regulatory in South Africa, it is conceivable that these companies also conducted risk assessments to demonstrate conformance to their own internal standards and guidelines. The latter are voluntary but give workers assurance that health and safety risks are addressed systematically and comprehensively, whilst also complying with regulatory requirements. To achieve the aims and intended outcomes of a voluntary OHS system, organisations need to take effective preventive and protective measures to eliminate hazards and minimise risks.[3]

Risk assessment techniques/tools and risk assessment criteria

The risk assessment techniques[19] selected by the participating companies determine the different inputs (consequence of exposure, probability of exposure) and outputs (rating of each risk, ranked list of risks with significance levels, list of control failures, and action list). The outputs for the consequence/probability techniques, as observed for Companies A, B and C, included either a combination of a rating for each risk or a ranked list of risks with significance levels. Company D's risk assessment output produced a list containing inadequate controls or a list of risks.[19] Regardless of the technique or tool selected, they should increase the understanding and management of risks.[27]

In practice, the consequence/probability matrix is a useful tool for ranking risks and identifying the sources,[19] which fosters the correct risk perception by assessors, and provides a visual platform for communicating the magnitude of the risk. At the same time, the outcomes derived from interpreting the matrix indicate the company's commitment to reducing the identified risk.[28] When using the consequence/probability matrix, however, its intended applications must be defined, as different matrices for safety, environment, health, and economic risks may exist within a company.[28] Constraints of the consequence/probability matrix includes being unable to aggregate risks, difficulties in defining consequence/probability rating criteria unambiguously, subjectivity, and variation in scale interpretation between assessors,[19] as observed in Companies A, B and C.

Using a checklist as a risk assessment tool (Company D) is also useful during hazard and risk identification, and for the assessment of the effectiveness of controls. However, its use inhibits imagination in risk identification, as it only addresses known hazards or risks, and encourages 'tick the box' behaviour whilst also tending to be observation-based, which can result in the omission of hazards or risks being recorded if they are not seen.[19]

The output of the risk assessment techniques adopted by the companies should have had an overall risk criterion (risk tolerability) guided by local legal requirements; this was absent across all four participating companies. In this regard, the consequence/probability matrix and checklists adopted by the respective companies were limited to risk rating and ranking, risk prioritisation, and recommendation for risk treatment, against the backdrop of a regulatory environment in South Africa without a national guideline for the tolerability of risks.

In South Africa, there are prescriptive health and safety standards, rather than regulations, for various occupational health hazards that are used as criteria for tolerability of risk.[7,29] The UK, through the HSE, provides regulatory guidance on the definition of tolerability of risks,[23] which considers risk estimation uncertainties and costs required to reduce the risks.[30] The tolerability of risk, when applying the 'as low as reasonably practicable' principle, requires employers in South Africa to spend a large amount of money to reduce risks that are rated as high and unacceptable. Less significant risks are less costly to reduce.[23,30] In the absence of legal guidance, companies should develop internal tolerability criteria, which none of the companies did. In developing such criteria, companies should consider the nature, probability/likelihood and consequences of the risk, types of exposure databases, measures of risk analysis, the available methods for risk assessment, regulatory requirements, organisational factors such as the safety culture and work flexibility, and individual factors such as risk perception and values.[31] The tolerability of risk criteria should also be aligned with the company's risk management framework, which should be specific with regard to the scope of the activity being considered, and the regulatory requirements against which legal compliance is measured.[17] Although not all risks can be eliminated or removed, the risk criteria provide decision-makers with a tool to decide on the tolerability of residual risks.[31]

Company risk assessment processes

Risk assessments are conducted systematically and iteratively, and should be supplemented with additional investigations as the need arises.[17] Hazard and risk identification, a prelude to the entire risk assessment process, was conducted across all the participating companies. All identified hazards should be accompanied by the identification and assessment of existing design, human process, and system controls. The identification of exposure controls in a risk assessment suggests that measures taken by the employer have not been efficient in mitigating exposure. This applies particularly to reliance on personal protective equipment (PPE) such as hearing protective devices, the use of which is affected by low worker acceptance and usage.[32] The existing controls, when assessed during the risk analysis phase, have an impact on the final risk level, based on judgements about whether they are adequate and effective.[3,19] This practice was applied at Company C (all facilities) and nearly all operational facilities of Company A (except Facility 4), whilst being absent at Companies B and D. Judgements on the adequacy and effectiveness of existing controls require proper assurance processes to increase confidence about such judgements.[19] The bow tie analysis,[33] an example of a tool for assessing the adequacy and effectiveness of existing controls, is available for use by assessors.

The use of qualitative, semi-quantitative, or quantitative risk analysis assessment methods plays a role in the ranking of risks,[19] as each method may yield a different risk outcome. The quantitative method is considered to be the most accurate method, provided that there are sufficient data to calculate an absolute value of risk.[31]

Only Companies B and C used quantitative methods. Regardless of the risk analysis method used, a company must develop a procedure to use in assigning hazard and risk rankings.[28]

When conducting a risk assessment, the influence of uncertainty must be addressed[34] to increase trust in the outcome. None of the participating companies included an assessment of uncertainty in their risk analysis phases. This opens the risk assessment process to criticism that the numbers used to express risk are dependent on assumptions,[35] whilst disregarding ethics, values, justice, and fairness.[36] The probabilities used in risk assessment are also subjective, leading assessors to make judgements that overestimate or underestimate risks. This highlights the importance of background knowledge when assigning consequences and probabilities.[35] Other criticisms of risk assessments are that they involve some guesswork on the part of assessors, and that decision-makers can manipulate the results to justify a conclusion that suits their agendas or wallets.[36] Risk assessments are further complicated by scenarios where occurrences of hazards with low probability, but which carry catastrophic consequences, need to be weighed against those with higher occurrence probabilities but less serious consequences.[37] Another criticism is the variance in adverse health effects between individuals due to confounding factors such as general health, proximity to the hazard, experience, weather conditions, and visibility.[28] These issues highlight the potential limitation of inadequately conducted risk assessments with regard to risk management. Such criticism adversely influences the attitudes of decision-makers when interpreting risk assessment results, especially regarding the implementation of feasible and effective risk treatment options.[38]

Noise risk analysis outcomes

The risk analysis that accompanies qualitative assessments, as adopted at Company A, is dependent on the perception of the assessor who subjectively makes decisions based on personal circumstances, such as field or practical experience – a potential contributing factor to the observed inter- and intra-company variations. The results of each risk analysis inform the decisions to 1) do nothing, 2) consider risk treatment options, 3) conduct additional risk analysis, 4) maintain existing controls, or 5) reconsider objectives.[17] In making judgements about risk treatment, following risk evaluation, company decision-makers are required to consult additional information sources and combine this with outcomes from the risk evaluation phase.[4] However, the associations between the risk assessment and decision-making processes are not always clear,[22] as demonstrated in the risk evaluation outcomes of Companies A, B and C (Table 5).

Amidst a plethora of other health hazards, results from a risk assessment should enable prioritisation of decisions regarding which hazards should be reduced; it is impossible and uneconomical to eliminate all hazards.[28] In view of the finite resources available for risk reduction, Griesmeyer and Okrent (1981)[39] posited that a risk management approach that has an allowance for uncertainties, internalisation of residual risk costs, modest risk aversion, and cost-effective reduction of residual risk, should be conducted. The risk ranking matrices allow for priority-setting and enable informed decision-making as it is done by technical or subject-matter experts, using professional judgement within an explicitly defined framework.[40] Inaccurately ranked risks have a societal effect in that technological risk, such as noise, can become acceptable, resulting in society bearing the associated costs that arise.[39] Risk assessment should consider the worst likely health effects.[28] Risk acceptability should thus be addressed in the context of the availability of technology to reduce risks.[39]

Risks that are rated as high should trigger immediate corrective action, whilst discretionary action may be considered for those with low ratings.[28] Internal tolerability of risk criteria, which none of the participating companies had, enables decision-making about the acceptability of residual risks, following the entire risk assessment process.[41] From a technical and legal perspective, risk analysis methods that rate noise levels that exceed the noise rating limit as anything other than intolerable cast doubt on such methods.[42]

Risks rated as medium also require further consideration, using tools such as cost-benefit analysis. However, this should be done with caution as excessive cost estimates that make risk reduction measures unaffordable can discourage employers from introducing controls to reduce levels.[30,39] High cost estimates for proposed risk reduction measures should spur employers to find simpler, more effective risk reduction measures.[30]

Companies that assign noise as a low risk, as observed in some facilities in this study, are within their methodological bounds to do so. Such risk acceptance may be reflective of societal preferences, with economic considerations being a major factor. Risk acceptance should, however, not be based solely on perceived risk and societal acceptance, but should also consider alternatives such as cost effectiveness.[39]

In cases where consequences of risk are unacceptable and impossible to reduce, the magnitude of the risk and the control measures required to prevent occurrence of the hazard should be considered.[30] A multidisciplinary approach should be employed for identifying risk-reduction strategies, normally within the prescripts of the risk-reduction priority scheme (hierarchy of control). If more than one risk-reduction strategy is being considered, the effect of each strategy should be weighed carefully, as this is helpful in the assessment of the acceptability of residual risks.[41] Additionally, worker hazard profiles can be developed to prioritise implementation of workplace exposure controls.[43] Instances where noise is rated as low create dilemmas as there is currently no clear way of treating low risks, and they are either completely ignored or under-emphasised.[35]

Risk ranking models involve a degree of subjectivity where decisions are made amidst missing data and uncertainties. The subjective nature of risk ranking models becomes more apparent when setting priorities for control,[40] demonstrable for Companies A, B and C (Table 5). The subjectivity and resultant inconsistencies have an eroding effect on the trust that employers derive from risk assessments. Risk ranking should therefore be complemented by cost-benefit analysis. When used together, a comprehensive and robust risk analysis can be produced.[40] None of the participating companies' risk assessments included cost-benefit analyses to complement the risk rankings. This is an opportunity for improvement for these companies.

In accordance with the UK's Health and Safety Executive framework on tolerability of risk, a risk regarded as tolerable does not imply that it is acceptable but refers to society, as a whole, being willing to accept the risks for their benefit, provided the risk is adequately controlled. Benefits include employment, lower cost of production, and personal convenience. Nevertheless, these risks should still be reduced using appropriate controls, to a point where they fall within a tolerable range, with the ultimate goal of reducing the risk to the lower end of the broadly acceptable region. This is in line with the 'reasonably practicable' principle.[23]

Risk assessment document quality aspects

To ensure that the risk assessment process complies with expected quality aspects, the completeness, accuracy, and identification of sources of data uncertainties and model/method uncertainties should

be mentioned,[19] a practice that was absent in all the participating companies. Health-related regulations prescribe that records that are kept, regarding risk assessments, should include the recording of information such as sources of exposure, adverse effects of exposure, extent of exposure, nature of work processes, and any reasonable deterioration in, or failure of, any control measures.[8-10,12,13] These aspects were omitted by some of the participating companies (not reported in this paper). The complexity of each risk assessment and internal company reporting requirements influenced how these factors were recorded.[19] These factors vary over time and become important during the monitoring and risk assessment review process.[19] None of the participating companies' risk assessment records included a discussion of the results of the assessment, nor were sensitivity and uncertainty analysis mentioned – these are additional opportunities for improvement.

CONCLUSION

The motivational context for conducting risk assessments across the participating companies stems from the legal duty imposed on employers, by health regulations within the Occupational Health and Safety Act, to assess health risks attached to performed work. The risk identification, control effectiveness assessment, and risk assessment tools and techniques varied across the companies – a result of an absent national prescription or directive for conducting health risk assessments. Inter- and intra-company company variations are anticipated amidst such an operating environment. Risk assessment tools and techniques that assign a low or insignificant risk to noise have a detrimental effect on noise control efforts, desperately required for the South African manufacturing and utilities sectors, to stop the scourge of NIHL. Similarly, risk assessment techniques that assign a high risk to noise should implement risk treatments to eliminate, substitute, or out-engineer noise emission sources. Risk assessment techniques employed by the corresponding companies require optimisation with regard to the impact of control effectiveness, uncertainty, and sensitivity, and use of qualitative, semi-quantitative, and quantitative risk methods.

KEY MESSAGES

1. Risk assessment processes, tools, and methodologies differ between companies and internally, to the detriment of noise abatement interventions.
2. The absence of a tolerability of risk framework in South Africa undermines the effectiveness of risk assessment processes.
3. The risk assessment as a decision-making tool in risk management is diminished by the potentially poor or inappropriate methodology used.

DECLARATION

The authors declare that this is their own work; all the sources used in this paper have been duly acknowledged and there are no conflicts of interest.

AUTHOR CONTRIBUTIONS

Conception and design of the study: OR, TJM, DMM
Data acquisition: OR
Data analysis: OR
Interpretation of the data: OR
Drafting of the paper: OR
Critical revision of the paper: TJM, DMM, OR

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Hairdressers in Johannesburg: knowledge, attitudes and practices regarding occupational health

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Keywords
hair products, chemical hazards, PPE, hairdressing

How to cite this paper
Mphaga KV, Rathebe PC, Utembe W. Hairdressers' knowledge, attitudes, and practices regarding occupational health and safety, Johannesburg. Occup Health Southern Afr. 2023; 29(2):75-82.

ABSTRACT

Introduction: Hairdressers are exposed to hazardous chemicals in haircare products, which can cause adverse respiratory, skin, and reproductive effects. The incidence of these effects can be reduced with good occupational health and safety (OHS) knowledge, attitudes, and practices (KAP).

Objective: The objective of the study was to assess Johannesburg hairdressers' knowledge, attitudes, and practices towards occupational health and safety.

Methods: Three hundred and eighty-three hairdressers were recruited into this cross-sectional study. They were categorised into employees/wage earners (earning a salary or wage, n = 151), or business owners (self-employed, n = 232). Data were collected using an interviewer-administered questionnaire. The data were analysed using Statistical Package for Social Sciences (SPSS) version 26. Frequency tables were generated and chi-square tests were used to test differences between KAP amongst business owners and wage earners.

Results: Most of the study participant were female (n = 237, 61.9%). A higher proportion of business owners than wage earners knew that hairdressing was hazardous to their health, in general (n = 44, 29.1% and n = 120, 51.7%, respectively), and with regard to specific health risks such as asthma, cancer, and skin diseases. However, more of the wage earners than the business owners had good attitudes towards the wearing of personal protective equipment (PPE) such as gloves, (n = 143, 94.7% and n = 210, 90.5%, respectively). Overall, wage earners practised better OHS than business owners, e.g. 67.5% (n = 102) and 55.2% (n = 128) reported that they wore gloves, respectively.

Conclusion: Wage earners had poorer OHS knowledge than those who owned or operated hairdressing salons. Both had good attitudes towards OHS, but self-employed hairdressers had poorer OHS practices. Training, including workshops and seminars, is needed to improve KAP regarding OHS amongst all hairdressers, regardless of their employment status.

INTRODUCTION

Hairdressers improve the aesthetics of their customers' hair, through the application of haircare products such as shampoos, conditioners, relaxers, bleaches, dyes, sprays, and perfumes. The demand for hairdressing services has increased exponentially over the past decade due to changing fashion trends.[1-2] Hairdressers' health is often compromised as the products they use expose them to many potentially hazardous chemicals,[3-4] which may cause adverse health effects such as skin disorders, breathing problems, reproductive disorders, congenital disabilities, and cancer.[5-8] Chemicals in haircare products enter the body mainly through dermal, inhalation, and ingestion routes.[8] Hairdressers are also potentially exposed to chemicals in nail products because they often share their work environments with nail technicians.[6]

Everyone in South Africa has the right to an environment (including the work environment) that is not harmful to their health and wellbeing, in terms of the Constitution and the Occupational Health and Safety Act No. 83 of 1993. However, this is difficult to monitor in many sectors, including the beauty industry, as there is no national reporting system that accurately reflects the extent of occupational diseases associated with hairdressing and other occupations. Self-employed workers and those in the informal sector are at high risk from exposures to hazardous chemicals, as they usually operate from unconventional and unprotected workplaces such as homes and public spaces that are difficult to regulate or monitor.[9-12] A local study, published in 2013, reported that most haircare product consumers were unaware of the health risks associated with exposure to such products.[12]

Poor occupational health and safety (OHS) is often associated with a lack of resources, inadequate guidance, insufficient training opportunities, lack of cooperation (between employers and employees), language barriers, and poor educational background.[10-11] Knowledge and attitudes are some of the most critical enablers of, or barriers to, OHS compliance.[10-13] Human factors such as lack of knowledge and interest, negative attitudes, unsafe behaviour, and incompetence are associated with most work-related accidents.[11,14] Hairdressers' OHS knowledge, attitudes, and practices (KAP) are often influenced by demographic, social, cultural, and economic characteristics,[15-17] such as sex,[18] age,[16] educational background,[5,16] work experience,[19-20] working hours, and business ownership.[20] In a study conducted in France by Deschamps et al. (2014), self-employed hairdressers had lower overall health than those who were wage earners.[21] The authors attributed this to wage earners' *"longer working hours, fewer protective measures and the absence of preventive medicine in the work-place".*[21]

The aim of our study was to assess Johannesburg hairdressers' knowledge, attitudes, and practices towards OHS, and compare these in self-employed hairdressers who run or operate their own businesses, and employed hairdressers who earn a wage or salary and typically work under supervision.[22]

METHODS

A cross-sectional study was conducted amongst hairdressers in Johannesburg to assess their OHS KAP. The population in this area is young and growing, partly due to the influx of new homeowners attracted by improved housing, land value, recreational facilities, and convenient transport to various places of work.[23] The study population comprised hairdressers aged 18–65 years, working in beauty salons in Johannesburg South. A register of salons was obtained from the Environmental Health Department of the City of Johannesburg, Region F South. Additional salons in the same area, not listed in the register, were identified during data collection. A sample size of 383 was calculated, using EPINFO (Centers for Disease Control and Prevention), which was increased to 400 in anticipation of non-responses. Convenience sampling was used to select potential participants.

Data collection

A questionnaire was developed, based on information from published studies. After conducting a pilot study, the self-administered questionnaire contained 38 closed-ended questions and comprised four sections: socio-demographic characteristics, OHS knowledge, OHS attitudes, and OHS practices. Content validity was performed by four environmental health practitioners from the City of Johannesburg, whose work entailed inspecting hairdressing salons from a health and safety point of view. Participants were only recruited after they had signed a written informed consent form.

The study was approved by the Research Ethics Committee (REC) of the Department of Environmental Health at the University of Johannesburg (clearance number: REC-827-2020). Permission to utilise the hairdressing salon register was granted by the City of Johannesburg.

Table 1. Socio-demographic characteristics and associations with employment status (N = 383)

Characteristic	Employment status				p value
	Formally employed n = 151		Self-employed n = 232		
	n	%	n	%	
Sex					
Female	111	73.5	126	54.3	< 0.001
Male	40	26.5	106	45.7	
Age (years)					
18–24	18	11.9	11	4.7	0.033
25–29	51	33.8	96	41.4	
30–44	75	49.7	110	47.4	
≥ 45	6	3.9	15	6.5	
Missing	1	0.7	0	0	
Education					
None/primary	32	21.2	31	13.3	0.021
Secondary	106	70.2	167	72.0	
College/tertiary	11	7.3	34	14.7	
Missing	2	1.3	0	0	
Facility					
Formal structure	111	73.5	148	63.8	0.033
Informal structure*	38	25.2	83	35.8	
Missing	2	1.3	1	0.4	
Experience (years)					
< 1	4	2.6	17	7.3	0.023
1–2	23	15.2	20	8.6	
3–5	67	44.4	88	37.9	
6–10	46	30.5	76	32.8	
> 10	11	7.3	31	13.4	
Skills training					
Hairdressing school	8	5.3	32	13.8	0.024
Friend/family	94	62.3	125	53.9	
On the job	49	32.4	72	31.0	
Missing	0	0	3	1.3	

Data analysis

The Statistical Package for Social Sciences (SPSS Inc., Chicago, USA), version 26 was used for data analysis. Continuous variables, such as age and years of work experience were categorised to provide better context for data analysis and interpretation. Frequency tables were generated and chi-square analysis was used to test differences in responses to questions between the wage earners and business owners. A p value of less than 0.05 was considered as the cut-off point for statistical significance.

RESULTS

Socio-demographic characteristics

Four hundred hairdressers were invited to participate; 383 agreed (95.8% response rate). Two hundred and thirty two of the hairdressers (60.6%) were self-employed (salon owners/operators); and 151 (39.4%) were employed by others (salaried or wage earners) (Table 1). Although most of the participants were female (n = 237, 61.9%), the proportion of males in the self-employed group was higher than that in the employed group (n = 106, 45.7% and n = 40, 26.5%, respectively). Nearly half of the employed participants in both groups were 30 to 44 years of age. More than 70% of the participants in both groups had a secondary school education as their highest qualification. The proportion of self-employed participants (n = 34, 14.7%) with a college or tertiary education was twice that of the employed participants (n = 11, 7.3%). Most of the participants worked out of formal structures. A higher proportion of self-employed hairdressers (n = 83 , 35.8%) worked from informal structures than did employed hairdressers (n = 38, 25.2%). A higher proportion of self-employed than employed participants had worked for more than 10 years (n = 31, 13.4% and n = 11, 7.3%, respectively). The proportion of self-employed study participants who had received training from hairdressing schools (n = 32, 13.8%) was more than double that of the employed participants (n = 8, 5.3%). Most of the participants in both groups had been trained by friends/family or 'on the job', viz. 94.7% and 67.7% of the employed and self-employed hairdressers, respectively.

Employment status was significantly associated with sex, age group, education, facility type, experience, and training. A larger proportion of women than men were wage earners. A higher proportion of wage earners than business owners were younger than 25 years, had less than secondary school education, operated from formal structures, and had less than six years' working experience. However, a higher proportion of self-employed participants than wage earners had formal training.

OHS knowledge

As shown in Table 2, several aspects of OHS knowledge were associated with employment status. A statistically significantly larger poportion of business owners than wage earners knew that there are health and safety risks associated with hairdressing, such as exposure to hazardous chemicals; and cancer, asthma, and skin problems. There were no differences in knowledge about

Table 2. Associations between OHS knowledge and employment status (N = 383)

Knowledge	Formally employed n = 151		Self-employed n = 232		p value
	n	%	n	%	
Hairdressing is dangerous to health and safety					
Yes	44	29.1	120	51.7	< 0.001
No	107	70.9	111	47.8	
Missing	0	0	1	0.4	
Some hairdressing activities expose you to hazardous chemicals					
Yes	67	44.4	137	59.1	0.005
No	84	55.6	95	40.9	
Some haircare products may cause cancer					
Yes	69	45.7	136	58.6	0.012
No	82	54.3	95	41.0	
Missing	0	0	1	0.4	
Some haircare products may cause asthma					
Yes	70	46.4	147	63.4	< 0.001
No	81	53.6	84	36.2	
Missing	0	0	1	0.4	
Some haircare products may cause skin diseases					
Yes	84	55.6	158	68.1	0.011
No	67	44.4	73	31.5	
Missing	0	0	1	0.4	
Some haircare products may cause reproductive problems					
Yes	46	30.5	72	31.0	0.951
No	103	68.2	159	68.6	
Missing	2	1.3	1	0.4	
Trained on hairdressing health and safety					
Yes	36	23.8	62	26.7	0.536
No	114	75.5	169	72.9	
Missing	1	0.7	1	0.4	
Hand washing with water and soap can prevent these chemicals from getting into your body					
Yes	117	77.5	174	75.0	0.501
No	33	21.8	58	25.0	
Missing	1	0.7	0	0	
It is necessary to wear gloves when working with haircare products					
Yes	120	79.5	187	80.6	0.786
No	31	20.5	45	19.4	
Hairdressing activities require you to wear a mask					
Yes	94	62.3	172	74.1	< 0.001
No	57	37.7	60	25.9	
It is important to read product labels before use					
Yes	113	74.8	186	80.2	0.217
No	38	25.2	46	19.8	
Understand what is written on the product label					
Yes	108	71.5	182	78.4	0.104
No	43	28.5	49	21.1	
Missing	0	0	1	0.4	

reproductive issues. Nevertheless, knowledge about these issues was generally poor, ranging from 29.1% to 68.1%. The proportions of participants in the two groups that had received health and safety training were similarly low, viz. 23.8% and 26.7% of wage earners and business owners, respectively.

With regard to protecting themselves, a high proportion of both groups knew that hand washing was important (77.5% and 75.0% of wage earners and business owners, respectively), and that they should wear gloves (79.5% and 80.6%, respectively). However, a smaller proportion of wage earners (62.3%) than business owners (74.1%) knew that they should wear masks (p = 0.014). The importance of reading product labels with regard to the contents, and the understanding thereof, was known by more than 75% of particpants from both groups; the differences were not statistically different.

OHS attitudes

Only attitudes regarding the necessity of having a hairdressing qualification and washing hands after handling products were significantly associated with employment status. A significantly larger proportion of the self-employed participants (n = 125, 53.9%) said that it was necessary to have a hairdressing qualification, than the wage earners (n = 57, 37.7%) (Table 3). Most participants from both groups (≥ 90%) said that gloves and/or masks should be worn during hairdressing activities; the differences between the two groups were not significant. Likewise, high proportions of both groups said that hands should be washed – after each client and after handling products (81.9% to 92.0%). The proportions of each group that had positive attitudes towards wearing eye protection and/or aprons ranged from 72.4% to 83.4%. Again, differences were not statistically significant. More than 70% of participants from both groups took information on product labels seriously.

OHS practice

There were several associations between OHS practices and employment status, viz. the wearing of goggles (p = 0.019), gloves (p = 0.018) and/or masks (p = 0.023), and washing hands before and/or after clients (p < 0.001 and p = 0.013, respectively). Most of the participants (70.5%) did not have a health and safety policy in the salons. Most did not wear personal protective equipment (PPE) in the form of aprons and goggles (66.1% and 68.7%, respectively), but most did wear gloves (60.1%). A larger proportion of the business owners than the wage earners wore masks (30.1% and 19.2%, respectively), but hand washing was practised by a larger proportion of the wage earners than the business owners. Overall, practices regarding closing containers and mixing haircare products in well-ventilated spaces was good (81.7% for both practices, overall).

Table 3. Associations between OHS attitudes and employment status (N = 383)

Attitude	Formally employed n = 151		Self-employed n = 232		p value
	n	%	n	%	
Necessary to have a hairdressing qualification					
Yes	57	37.7	125	53.9	
No	90	59.6	98	42.2	< 0.001
Missing	4	2.7	9	3.9	
Wearing gloves when performing hairdressing duties					
Yes	143	94.7	210	90.5	0.310
No	8	5.3	22	9.5	
Wearing mask when performing hairdressing duties					
Yes	140	92.7	208	89.7	0.310
No	11	7.3	24	10.3	
Washing hands after each client					
Yes	139	92.0	201	86.6	0.101
No	12	8.0	31	13.4	
Washing hands after handling haircare products					
Yes	134	88.7	190	81.9	
No	16	10.6	41	17.7	0.058
Missing	1	0.7	1	0.4	
Wearing eye protection (goggles)					
Yes	116	76.8	168	72.4	0.336
No	35	23.2	64	27.6	
Wearing apron					
Yes	126	83.4	176	75.9	0.088
No	25	16.6	55	23.7	
Missing	0	0	1	0.4	
Taking information written on the product label seriously					
Yes	118	78.1	169	72.8	0.223
No	32	21.2	62	26.7	
Missing	1	0.7	1	0.4	

Table 4. Associations between OHS practice and employment status (N = 383)

Practice	Formally employed n = 151		Self-employed n = 232		p value
	n	%	n	%	
Have a health and safety policy					
Yes	12	7.9	33	14.2	0.178
No	100	66.2	170	73.3	
Missing	39	25.9	29	12.5	
Wear an apron					
Yes	47	31.1	80	34.5	0.533
No	102	67.6	151	65.1	
Missing	2	1.3	1	0.4	
Wear goggles					
Yes	54	35.8	59	25.4	0.019
No	92	60.9	171	73.7	
Missing	5	3.3	2	0.9	
Wear gloves					
Yes	102	67.5	128	55.2	0.018
No	49	32.5	103	44.4	
Missing	0	0	1	0.4	
Wear a face mask					
Yes	117	77.5	160	69.0	0.023
No	29	19.2	70	30.1	
Missing	5	3.3	2	0.9	
Wash hands before each client					
Yes	120	79.5	154	66.4	< 0.001
No	27	17.9	77	33.2	
Missing	4	2.6	1	0.4	
Wash hands after each client					
Yes	123	81.5	165	71.1	0.013
No	26	17.2	66	28.5	
Missing	2	1.3	1	0.4	
Wash hands after handling haircare products					
Yes	123	81.5	174	75.0	0.159
No	28	18.5	57	24.6	
Missing	0	0	1	0.4	
Read haircare products label before use					
Yes	101	66.9	149	64.3	0.570
No	49	32.4	82	35.3	
Missing	1	0.7	1	0.4	
Follow all safety procedures on the product label					
Yes	125	82.8	178	76.7	0.106
No	24	15.9	53	22.9	
Missing	2	1.3	1	0.4	
Close containers of haircare products when not in use					
Yes	128	84.8	185	79.7	0.170
No	21	13.9	45	19.4	
Missing	2	1.3	2	0.9	
Prepare (mix) haircare products in a well-ventilated space					
Yes	130	86.1	183	78.9	0.065
No	19	12.6	46	19.8	
Missing	2	1.3	3	1.3	

DISCUSSION

Most of the employed hairdressers in this study were young, had low levels of education, limited work experience, and learnt hairdressing from family or friends. Globally, hairdressing is characterised by a young workforce.[24-27] Hairdressing is viewed as a talent-based occupation for those who dropped out of school.[28] Supporting this is the high number of unqualified hairdressers (refers to anyone who performs the functions of a hairdresser but has not qualified as such) in South Africa.[28]

Hairdressing is a female-dominated sector[21] and has traditionally been perceived as feminine in nature.[29] Although both occupational categories were dominated by women, the vast majority of employed participants were women, while a smaller majority of business owners were women. Similar findings were reported by Verheul et al. (2006) in Europe and the United States.[30] They reported that self-employment was more common among men than women, and concluded that women prefer waged employment because it provides regular income, stability, and social security. In general, self-employment is viewed as more challenging (due to its unpredictable income and long working hours) than working for someone else. In this regard, men are thought to be more risk tolerant than women.[31,32]

Employment status was significantly associated with sex, age, education, facility type, work experience, and skills training in our study. Similar findings were reported in a French study by Deschamps et al. (2014), in which it was reported that socio-demographic characteristics differed between employed and self-employed hairdressers.[21]

Rendering hairdressing services from an informal structure was more common for those who were self-employed. A previous study in Johannesburg by Mpye (2013) found that most self-employed hairdressers where operating from the street.[33] In the same study, it was found that many self-employed hairdressers used to work from formal structures, but were forced onto the street due to high costs and rentals.[33] Assessing the relationship between employment status and socio-demographic factors is crucial, as studies suggest that they influence OHS knowledge, attitudes, and practices.[10-11,15-17]

OHS knowledge regarding chemical hazards

In our study, significantly more self-employed participants stated that hairdressing was hazardous to their health and safety than those who were employed. This is in contrast with a study conducted in Tanzania by Bigambo (2017), where a little more than half (52.2%) of the participants indicated that hairdressing was safe.[25] A significantly higher proportion of employed than self-employed participants were unaware that hairdressing activities were associated with health problems such as cancer, asthma, and skin diseases. In general, knowledge about these health risks was low. This is in line with previous studies, which found that most participants were unaware that hairdressing activities exposed them to cancer, asthma, and skin diseases.[17,34] However, our findings were inconsistent with those from studies conducted in Egypt (2020)[35] and western Nepal (2012),[24] which found that most participants were aware of diseases associated with hairdressing.

Around 25% of the participants in our study said that they were not trained on hairdressing health and safety. Different findings have been reported elsewhere. For example, Khalaf et al. (2020) reported that only 5.3% of the hairdressers in a study in Egypt received occupational health and safety training,[35] while Sedhain et al. (2012) reported that, in western Nepal, 81.7% of study participants attended such training.[24] Our findings could be attributed to employers' unwillingness and/or inability to provide OHS training as well as poor access to safety information by employees in small-scale enterprises.[11,36] This could be related to the fact that there is no forum in South Africa where hairdressers can get health and safety information. Such forums exist elsewhere in the world, such as in the USA, where the California Healthy Nail Salon Collaborative (HNSC), which is made up of authorities, salon workers, and their employees, lobbies for support for worker safety and health.[37]

The association between employment status and OHS knowledge about wearing masks was statistically significant in our study. More than two-thirds of our study participants knew that they should wear masks. In contrast, in a study reported by Olaoye et al. (2019) in Nigeria, more than half (51.4%) of the participants were unaware that masks could protect them from chemical exposure.[38] The high level of knowledge about masks in our study could be attributed to the fact that the study was conducted during the COVID-19 pandemic when wearing of masks was mandatory for all.

In general, employed participants in our study had poorer OHS knowledge than the business owners, which might be associated with lower educational level, less work experience, and learning hairdressing from family or friends. Lack of OHS knowledge amongst employed participants was anticipated because salon owners appoint hairdressers based on their technical skills, and often neglect OHS educational and training backgrounds.[27,33]

These findings suggest that employers within the hairdressing industry could be in contravention of Section 8 of the Occupational Health and Safety Act No. 85 of 1993, which stipulates that it is the employer's responsibility, not the employee's, to provide OHS training. These non-compliances may also be attributed to the fact that hairdressing salons that operate from unconventional places such as homes, roadsides, and informal market places are unregulated.[11] Similar to other occupations in the informal sector, hairdressers often work under informal arrangements that do not provide labour protection.[11,33]

OHS attitudes

More self-employed participants than business owners did not think it was necessary to have training. This finding was expected as the majority of the participants did not have a hairdressing qualification. Hairdressing is generally not a well-respected profession in South Africa,[39] as it is perceived to be a profession for those who struggled at school, and most people are not aware that hairdressing requires a high level of intellectual capability.[28]

Most of our study participants had good attitudes towards washing their hands after each client. A study conducted in Tanzania by Kirunda (2006) had similar findings; 95% of the participants had good attitudes towards washing hands between clients.[27] We also found that attitudes towards washing hands after handling hair-care products were positive in a high proportion of hairdressers. In a Nigerian study by Eyo et al. (2016), a similarly high proportion (81.3%) of the participants had positive attitudes towards washing hands after each client.[19] Similarly, a high proportion of hairdressers in our study (76.8% to 83.4%) had positive attitudes towards the use eye protection and aprons. Attitudes towards OHS measures such as PPE and hand hygiene may be influenced by the provision of PPE, facilities, and appropriate supervision.[18]

OHS practices

Hairdressers are exposed to several hazards due to the nature of their work. Hence, the present study assessed hairdressers' OHS practices. Most of our study participants reported that they were not using

eye protection. This result was consistent with findings from a study by Bigambo (2017) in Tanzania, where 78.7% of the hairdressers indicated that they had never used eye protection.[25]

Contrary to this, most of the hairdressers in our study said they wore gloves during hairdressing activities. Nemer (2009), in a study in Palestine, also found that most (92%) of the participants reported they wore gloves.[34] This could be influenced by the fact that gloves are included in the packaging of many haircare products. While most of our study participants said that they wore masks, Nemer (2013, 2009) reported that only 11% of the hairdressers in a Palestinian study were using masks.[7,34] Again, the use of masks reported in our study may be linked to the mask mandate implemented during the COVID-19 pandemic.

Our finding that more wage earners than business owners were using PPE suggests that, to some degree at least, employers are fulfilling their legal mandate, stipulated in Section 8 of the Occupational Health and Safety Act No. 85 of 1993, to provide PPE to their employees. Workers usually wait for the employer to provide them with PPE, rather than taking the initiative to acquire their own, suggesting that employers were providing PPE. However, the business owners also need to use PPE.

Overall, it appeared that the self-employed participants' OHS practices were poor, which may be attributed to the fact that most of them view OHS as an unnecessary expense rather than an investment.[10]

Strengths and limitations

Because of the cross-sectional design of this study, no causal associations could be established. We relied on participants' responses and assumed that they provided truthful answers. Nevertheless, this study was one of the first attempts to assess hairdressers' OHS knowledge, attitudes, and practices in Johannesburg, South Africa. The findings can inform OHS policies and regulations in the hairdressing industry.

CONCLUSION

Employed hairdressers were less knowledgeable about occupational risks and protective measures than those who were self-employed. More employed participants than self-employed had good attitudes towards OHS and good OHS practices. Nonetheless, there is an urgent need to address poor OHS knowledge, attitudes, and practices within the hairdressing sector by increasing monitoring and providing regular training, workshops, and seminars. Future studies may consider utilising observational and qualitative approaches, as they may reveal deeper insights about OHS in this worker population.

KEY MESSAGES

1. Overall, OHS knowledge was average, but business owners (self-employed hairdressers) had better OHS knowledge than wage earners.
2. Attitudes towards OHS were good in both employment groups.
3. There is room for improvement regarding OHS practices among both employed and self-employed haidressers.
4. OHS knowledge, attitudes, and practices may be improved with formal training and workshops.

DECLARATION

The authors declare that this is their own work; all the sources used in this paper have been duly acknowledged and there are no conflicts of interest.

ACKNOWLEDGEMENTS

We would like to acknowledge study participants, without whom this study would not have been possible.

AUTHOR CONTRIBUTIONS

Conception and design of the study: KVM, WU
Data acquisition: KVM
Data analysis: KVM
Interpretation of the data: KVM, WU, PCR
Drafting of the paper: KVM, WU, PCR
Critical revision of the paper: KVM, WU, PCR

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Respirable crystalline silica dust exposure and regulated occupational respiratory diseases in the Zambian copper mining sector: a review and recommendations

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Keywords
silica exposure, occupational diseases, mining, health programme

How to cite this paper
Sifanu M, Kalebaila KK, Hayumbu P, Nabiwa L, Linde SJL. Respirable crystalline silica dust exposure and regulated occupational respiratory diseases in the Zambian copper mining sector: a review and recommendations. Occup Health Southern Afr. 2023; 29(2):83-87.

ABSTRACT

Background: Exposure to respirable dust is widespread in the mining industry. One of the significant components in dust is respirable crystalline silica (RCS), which causes pulmonary silicosis; RCS exposure is also associated with tuberculosis. The health effects of exposure to RCS in Zambian copper miners are unclear.

Objectives: This review describes RCS exposure, associated occupational respiratory diseases, and existing dust exposure management programmes in the Zambian copper mining industry. Research gaps are also identified.

Methods: Online search engines (Google Scholar, PubMed, and Web of Science) were used to identify relevant published literature, and governmental databases and websites were searched for information.

Results: Only two studies have reported RCS dust exposure in the Zambian copper mining industry, and seven studies describe related diseases. The Zambian Ministry of Health reports on only two occupational respiratory diseases: silicosis and tuberculosis (TB). Zambia does not have an occupational health policy or programmes that protect workers in dusty operations from exposure to RCS.

Conclusion: Little is known about exposure to RCS and related occupational diseases in the Zambian copper mining industry. The absence of legislative guidelines for an RCS monitoring programme places copper miners at risk of developing respiratory diseases because of high and uncontrolled RCS levels. An RCS management programme should be developed and implemented to investigate the exposure of miners to RCS, and to promote the implementation of control measures.

INTRODUCTION

Mining activities involve extracting minerals from the earth's crust, during which workers are exposed to mineral dust,[1] including crystalline silica.[2] Exposure to respirable crystalline silica (RCS) causes pulmonary diseases such as silicosis, and is associated with chronic obstructive airways disease, tuberculosis (TB), and lung cancer.[3,4] Silicosis and the other pneumoconiosis are diseases associated with exposure to respirable mineral particles that damage the lungs. Respirable crystalline silica results in the formation of scar tissue that interferes with gas exchange.[3,5] Workers in dusty jobs such as drilling, crushing, tramming, and tipping are exposed to RCS and are, therefore, susceptible to developing silicosis. Unfortunately, most mine workers in southern Africa work in poorly controlled environments, where exposure to high levels of RCS increases their risks of developing silicosis and TB.[6]

Zambia is noted for its mineral wealth, particularly copper, and the mining industry contributes more than 50% of foreign earnings for the country.[7] More than 73 000 people are employed in the Zambian copper mining industry, making up 2.4% of the total workforce in the southern African extractive industry.[7]

Mining in Zambia

There are four underground copper mines in the Copperbelt province of Zambia, viz. Konkola Mine, Mufulira Mine, Nchanga Mine, and Nkana Mine, located in Chililabombwe, Mufulira, Chingola, and Kitwe districts, respectively. There are also four open-pit mines, namely, Lumwana, Kansanshi, and Kalumbila in the North-Western province and Nchanga Mine in the Copperbelt province. Even in open-pit mining, a substantial amount of dust is emitted during operations.[8] Miners working in dusty operations have been observed to work without respiratory protective equipment, which increases the risk of dust exposure.[9]

Crystalline silica exposure limits

Regulatory agencies in many countries have developed exposure limits to protect workers from the negative consequences of exposure to RCS. These limits specify the highest level of RCS to which employees may be exposed for a predetermined length of time (eight hours),[10] and range from 0.025–0.1 mg/m^3.[11–14] The health-based threshold limit value (TLV®), published by the American Conference of Governmental Industrial Hygienists (ACGIH), is 0.025 mg/m^3.[15] The USA's Occupational Safety and Health Administration (OSHA) enforces an RCS permissible exposure level (PEL) of 0.05 mg/m^3 for all mining and non-mining industries.[16]

Mining legislation in Zambia

Although there is a framework and guidance for creating an occupational health and safety department in Zambia, the Occupational Health and Safety Act of 2010 focuses on health and safety of workers.[17] The Zambian Mines and Minerals Development

Act of 2015 focuses on creating an occupational health and safety department in a workplace,[18] and there is no legislation for workplace air monitoring. The Zambian copper mining industry does not have a PEL, or any other limit, for RCS exposure. International mining companies in Zambia use the voluntary exposure limits of industrialised nations.

The objectives of conducting this review were to describe RCS exposure and related occupational respiratory diseases (silicosis, chronic obstructive diseases, TB, and lung cancer) in the Zambian copper mining industry, to describe existing dust exposure management progammes in the Zambian mining industry, and to identify research gaps.

METHODS

Data on miners' exposure to RCS are not readily available for the Zambian mining sector and it is not easy to access exposure data and job records from the mining houses. For this review, we searched Google Scholar, PubMed, and Web of Science. The search terms used were 'respirable crystalline silica exposure', 'occupational respiratory diseases', 'dust exposure management', 'monitoring programmes', 'Zambian mining industry', 'control of RCS exposure', 'regulated occupational diseases in Zambia', and 'control of occupational diseases in Zambia'. Articles from the databases were scrutinised for relevance, based on the aims of the published studies.

Second, official databases and websites, such as that of the Ministry of Health and the Ministry of Mines, were searched for information about miners' exposure to RCS and occupational diseases in the Zambian copper mines. The Ministry of Mines website was searched to learn more about RCS exposure in the Zambian mining industry because the Mine Safety Department (MSD) is responsible for all matters pertaining to safety and health of persons employed in exploration, mining, and mineral processing operations. The Occupational Health and Safety Institute (OHSI), a division of the Zambian Ministry of Health, keeps track of occupational illnesses by publishing information in the Ministry's yearly annual health statistical reports, which are available online. The annual reports for the years 2019 to 2021 were scrutinised for statistics on occupational diseases.

RESULTS

Only nine studies from the scientific literature met the inclusion criteria and provided information about RCS exposure and/or cases of occupational respiratory diseases within the Zambian copper mining industry (Table 1). None addressed the issue of health policies, RCS risk assessment implementation, or dust suppression methods.

Studies on RCS exposure measurements in Zambia

Only two papers focused on quantifying RCS exposure concentrations. Hayumbu et al. (2008)[19] reported respirable dust and RCS exposure among Zambian copper miners. Mean concentrations of total respirable dust were above 5 mg/m^3 at the two mining sites: 0–7.76 mg/m^3 and 0–6.94 mg/m^3, respectively. The mean RCS exposures were 0.143 mg/m^3 (0–1.30 mg/m^3) and 0.06 mg/m^3 (0–0.32 mg/m^3) at the two mines, respectively; these concentrations exceeded the OSHA PEL.[19] There were poor dust monitoring strategies at both mines, which prevented identification and control of high exposures that may increase risk of disease. The authors recommended establishing an accredited national respirable dust and RCS laboratory to provide effective monitoring, and implementing mine-dust control measures. The second study, published by Mchaina and Misra (1983),[20] investigated the relationship between dust exposure and the development of pneumoconiosis in two mines, more than 40 years ago. Total respirable dust ranged from 0.320 mg/m^3 to 2.43 mg/m^3 at the one mine, and from 0.505 mg/m^3 to 4.00 mg/m^3 at the other; the percentages of silica in the respirable dust samples were 31% and 41%, respectively. Using a cumulative dust exposure matrix, the authors calculated that the probability of contracting pneumoconiosis was 13%.

Studies on occupational respiratory diseases in Zambia

Three papers provided results from the analysis of health surveillance data from the OHSI,[21–23] concluding that there was an association between silicosis, TB, and exposure to respirable dust. Ngosa and Naidoo (2016)[21] reviewed the medical data of 357 in-service miners, and calculated a dose response risk for pulmonary tuberculosis (PTB) among underground copper miners exposed to RCS. The median RCS dust level was 0.3 mg/m^3; the overall prevalence of PTB was 9.5%. There was a significant association between RCS exposure and PTB (OR 6.4, 95% CI 1.8–23). The authors concluded that there was a significant increase in disease prevalence with cumulative respirable silica dust exposure ($p < 0.01$).

According to Mulenga et al. (2005),[22] occupational illnesses such as silicosis and TB have been recorded among workers in the Zambian copper mining industry since the early 1960s. They investigated silicosis and TB trends in Zambian copper mines before and after the onset of HIV/AIDS, and reported that, prior to the epidemic (1960–1970), the number of silicosis cases exceeded that of TB cases. The prevalence of silicosis decreased from 28.6% prior to the epidemic, to 12.4% in the period 1992–2002, but the prevalence of TB increased from 37.1% to 86.1%.

Dust exposure among Zambian miners has been associated with cases of occupational lung diseases and two studies have shown that underground miners are more susceptible to silicosis than open-pit miners. An analysis of mine worker medical records from January 2004 to December 2008, obtained from the OHSI database, compared silicosis in the underground and open-pit mines, where the proportions of silica in the rock being mined and in the airborne dust samples collected were similar. There were fewer silicosis cases in the open pit than in the underground mines (Figure 1(a)).[23] For each year spent working underground, miners were 14% more likely to develop silicosis than those involved at open-pit mining. This may be attributed to better natural ventilation in the open-pit mines.

A cross-sectional study conducted in 2019 on 168 mine workers at Konkola Mine in Chililabombwe, also showed that underground miners[24] were more likely to contract silicosis and other occupational diseases, such as TB, than those working in open-pit mines (Figure 1(b)). The prevalence of silicosis in underground miners was 38%; in open-pit miners, it was 10%. The predictors of silicosis were duration of employment, occupation, and work area.

Laima et al. (2012)[25] investigated lung function impairment among open-pit miners at Nchanga Mine in Chingola district. More than a quarter (27%) of the miners had lung impairments, of which 3.3% were severe, 4.0% were moderate, and 19.7% were mild. In a more recent study, Chanda-Kapata et al. (2016)[26] reviewed literature on the burden of TB in Zambian mines in order to guide focused interventions. The authors advised that dust control measures be strengthened through engineering controls and anti-smoking programmes. They concluded that there was not

enough research in Zambia's mining sector to fully understand the burden of TB and other risks associated with dust exposure in the mining environment.

Mwaanga et al. (2019)[27] conducted research on the effects of air pollution from mining operations on human health, plants, animals, and infrastructure in the North-Western and Copperbelt provinces. They concluded that research should be conducted by interdisciplinary research groups in order to understand better the health effects of pollution from the mines.

Information from official databases and websites

The OHSI and Mine Safety Department did not have any documentation on RCS exposure in the Zambian copper mining industry. The annual health statistical reports from the Ministry of Health did not have statistics for occupational diseases, other than for TB where it was reported that there was a reduction in the prevalence from 49% in 2019 to 43% in 2021.[28] RCS exposure and occupational respiratory disease surveillance in Zambia is monitored by the OHSI of the Ministry of Health, but no statistics are reported.

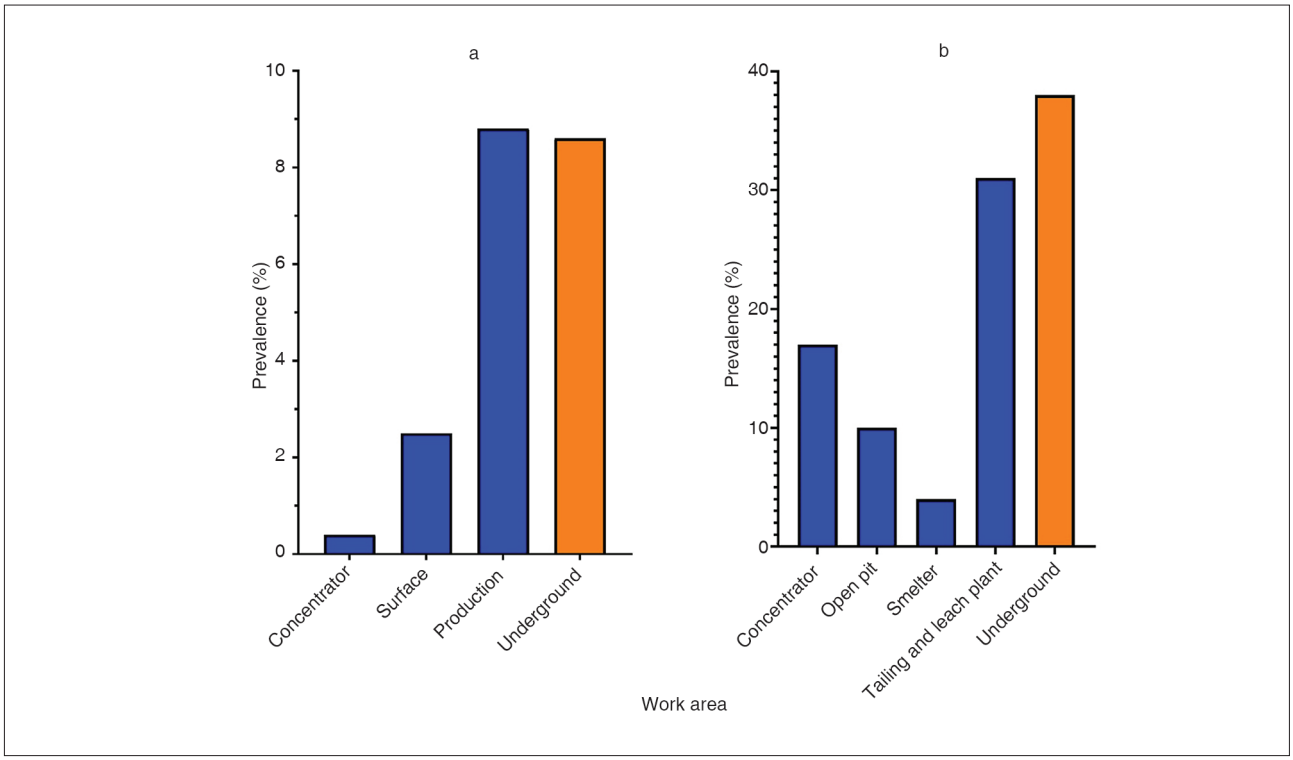
Programmes for controlling RCS exposure and occupational diseases in Zambia

The Zambian Occupational Health and Safety Act of 2010 focuses on the general welfare of workers in terms of health and safety, but there are no policies or programmes guiding employers on how to manage exposure to dust.[29]

The lack of a stringent system to protect miners exposed to RCS has also been observed in other southern African countries, with the exception of South Africa, which has a National Programme for the Elimination of Silicosis.[6] Brouwer and Rees[30] reviewed the silicosis elimination programme from the point of reducing exposure to RCS. They indicated that concentrations of exposure and the numbers of silicosis cases in mining and non-mining industries are decreasing.

Table 1. Studies on RCS exposure and occupational respiratory diseases in the Zambian copper mining industry

Authors, year	Topic	Measured exposure	Conducted health surveillance	Analysed health surveillance data	Reviewed literature
Hayumbu et al., 2008 [19]	RCS exposure	✓	-	-	-
Mchaina and Misra,1983[20]	RCS exposure, pneumoconiosis	✓	-	-	-
Ngosa and Naidoo, 2016[21]	Pulmonary tuberculosis	-	-	✓	-
Mulenga et al., 2005 [22]	Silicosis, tuberculosis	-	-	✓	-
Sitembo, 2012[23]	Silicosis	-	-	✓	-
Zimba et al., 2019[24]	Silicosis	-	-	-	✓
Laima et al., 2012[25]	Lung function impairment	-	✓	-	-
Chanda-Kapata et al., 2016[26]	Tuberculosis	-	-	-	✓
Mwaanga et al., 2019[27]	Mine air pollution	-	-	-	✓



(a) adapted from Sitembo (2012),[23] (b) adapted from Zimba et al. (2019)[24]
Data represent silicosis prevalence in different work areas from 2004 to 2008; surface and underground operations are represented by blue and orange bars, respectively

Figure 1. Prevalence of silicosis cases per work area as reported in two studies in the Zambian copper mining industry

The South African mining industry has also developed a code of practice (COP) for an occupational health programme on personal exposure to airborne pollutants from which other countries in the region can learn.[31] The COP highlights sampling strategies that should be implemented within a scheduled area. The steps for an occupational hygiene programme include:

1. Risk assessment, and identification of homogenous exposure groups
2. Sampling and analysis methodologies, which focus on quality control
3. Personal exposure monitoring of miners in dusty jobs
4. Integration of the hierarchy of control measures, starting with the most exposed workers in dusty work areas
5. Reporting and recording whether the workplace facility is fit for workers in terms of compliance with health and safety standards

Zambia and other countries in southern Africa can learn from South Africa's occupational health regulations and programmes: for example, the establishment of medical surveillance programmes, monitoring of dust concentrations in the work environment, and the introduction of controls to reduce dust levels. The focus should be on measuring respirable dust and RCS exposures for miners working in dusty areas.[31]

The non-existence of national monitoring programmes in Zambia is worrying. A similar COP to that in the South African mining industry should be replicated for countries in the region to guide hygienists on sampling dust concentrations and exposures. There is a need for Zambia to establish a dust measurement system, which should be ISO 175025-accredited (a standard for testing laboratories) to analyse dust samples for respirable dust and RCS.

The following are recommendations to improve the reporting of RCS exposure and occupational respiratory diseases in Zambia:

- Develop and implement a national programme to monitor closely the exposures of respirable dust and RCS, and occupational diseases
- Implement risk assessments in workplaces as a first step towards protecting workers from hazards
- Conduct empirical studies on respirable dust, RCS exposure, and associated diseases in mining (and non-mining sectors) involving dusty activities
- Establish effective control measures for respirable dust suppression in copper mining and other industries that involve respirable dust exposure
- Establish a national database for the reporting and comprehensive documentation of respirable dust and RCS exposure of workers in the country's mining and related industries
- Establish training programmes to educate miners on the risks associated with RCS exposure, including silicosis and TB
- Train workers on the use and management of PPE that can protect them from exposure to RCS until more effective control measures can be implemented
- Establish a national dust laboratory to provide effective dust control measures for miners

There is a need for more studies on RCS exposure in Zambia so that the Occupational Health and Safety Act of 2010 can be updated with guidelines on workplace air monitoring programmes. This will facilitate standardised monitoring in the mining sector. Currently, each mining house conducts sampling in accordance with its own standards and capacity.

CONCLUSION

Although Zambia has been mining copper for more than a century, remarkably little is known about the prevalence of silicosis and, specifically, the relationship between the length of RCS exposure and silicosis occurrence among mine workers. Only nine studies have investigated exposure to RCS and related occupational respiratory diseases in the Zambian copper mining industry in the last 40 years. Overall, the literature showed that workers in the copper mines in Zambia are exposed to high concentrations of RCS. There are no regulations and programmes governing RCS exposure in the Zambian copper mining industry, and only two occupational respiratory diseases (TB and silicosis) are reported. Tuberculosis is monitored and reported in the Ministry of Health's annual statistics. Silicosis is monitored by the OHSI under the Ministry of Health, but no statistics are currently reported. It is challenging to monitor RCS exposure in the mining industry due to the lack of legislation governing workplace air monitoring in the Zambian Occupational Health and Safety Act of 2010.[17] Therefore, data on RCS exposure concentrations are scarce, and only available from research that has been conducted in the mines.

The studies identified in the literature review do not provide a true reflection of the status of RCS exposure and respiratory diseases in the Zambian copper mining industry, and do not provide information about trends in the levels of RCS or the prevalence of diseases such as TB and silicosis. Zambia needs to create a standardised RCS monitoring programme to protect miners in the copper mining industry, by investigating exposure to RCS in dusty work areas. Considering that only TB has been the focus of occupational respiratory diseases in the mining industry,[29] there is a need for annual respirable dust and RCS monitoring programmes that can be used as motivation to strengthen the management of silicosis and other respiratory diseases. Recommendations from this review can be used as the first step in protecting workers from RCS dust exposure.

FUNDING

The study was funded by the Copperbelt University, Africa Centre of Excellence for Sustainable Mining (ACESM).

KEY MESSAGES

1. There is limited scientific literature describing research that has been conducted on RCS exposure and occupational respiratory diseases in the Zambian copper mining industry.
2. There is a need to update the Zambian Occupational Health and Safety Act of 2010 on workplace air monitoring.
3. There is a need for Zambia to strengthen occupational health regulations regarding RCS exposure and monitoring programmes, in line with countries like South Africa.

DECLARATION

The authors declare that this is their own work; all the sources used in this paper have been duly acknowledged and there are no conflicts of interest.

ACKNOWLEDGEMENTS

We would like to thank Alex Simpande of Copperbelt University, School of Mathematics and Natural Sciences, Zambia for proofreading.

AUTHOR CONTRIBUTIONS

Conception and design of the study: MS, KKK, PH, SJLL
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Drafting of the paper: MS, LN, SJLL
Critical revision of the paper: MS, KKK, PH, SJLL

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African trypanosomiasis: lessons for occupational health practitioners

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How to cite this paper
Frean J, Ross M. African trypanosomiasis: lessons for occupational health practitioners. Occup Health Southern Afr. 2023; 29(2):88-89.

INTRODUCTION

Occupational medical practitioners in non-endemic areas globally, not only in southern Africa, should be aware of the exposure to, and the symptoms, diagnosis and treatment of, trypanosomiasis in workers from endemic areas in Africa. Human African trypanosomiasis (HAT) comprises two insect vector-borne protozoan diseases. Morphologically, the pathogenic trypanosome species are indistinguishable, but the two diseases differ in their tsetse fly vector species, geographic distribution, maintenance host reservoirs, and clinical features. After an initial haemolymphatic stage, without treatment, the disease invariably progresses to central nervous system invasion and death; the rapidity of progression varies according to the type of HAT. Although 97% of cases in Africa are caused by *Trypanosoma brucei gambiense* (West African trypanosomiasis (WAT) – the chronic variety), which is found in 24 countries in west and central Africa,[1,2] this report focuses on the more severe, acute type (incubation period < 1–3 weeks, occasionally longer) caused by *Trypanosoma brucei rhodesiense*. This is East African trypanosomiasis (EAT), sporadically transmitted in 13 countries in east Africa.[1] Uganda is the only country that has both types of HAT. While WAT typically has a long incubation period of several months to years in endemic populations, it is important to note that travellers acquiring this form of disease almost invariably have a more acute presentation, with an incubation period of less than a month in 75% of cases.[3]

OCCUPATIONAL RISK OF HUMAN AFRICAN TRYPANOSOMIASIS

Cases of trypanosomiasis acquired in sub-Saharan Africa by travellers from non-endemic areas in Africa, Australasia, Europe, and North and South America have been described.[4-7] A review of 68 cases reported in the literature and from personal communication over a 20-year period (1990–2010) comprised travellers to, and immigrants and occupational cases from, endemic countries in Africa.[4] The majority of cases of HAT occur in local residents in endemic areas, although these can be occupational in origin. As outlined by the World Health Organization (WHO), those most exposed to the tsetse fly and, thus, trypanosomiasis live in rural areas and are engaged in agriculture, fishing, animal husbandry, or hunting.[1] A case-control study of WAT in Guinea indicated that workers were more likely to be infected with *Trypanosoma brucei gambiense* than non-working residents, since they walked twice as far and had more occupational sites where exposure could occur, mostly in mangrove forests.[8] Although an earlier case-control study in Zambia did not show an association of infection by *Trypanosoma brucei rhodesiense* (EAT) with main occupation, there was an increased risk of infection with fishing as an auxiliary occupation.[9] The review of people returning to non-endemic areas with HAT from 1990 to 2010 revealed that, of 19 cases of WAT, eight were occupational (seven expatriates and one military case) while, of 44 cases of EAT, four were listed as occupational (three soldiers and a researcher).[4] In a review of 21 cases of EAT acquired in five African countries, who were medically evacuated to Johannesburg from 2004 to 2018, seven (33%) were occupationally exposed: two game ranchers, two involved in nature conservation, one UK soldier on a military exercise, one pilot, and one church-related traveller.[7] Amongst 49 cases of WAT and EAT diagnosed in non-endemic countries from 2011 to 2020, four (28%) of the 14 WAT and 15 (43%) of the 35 EAT cases were occupationally exposed.[10] To date, the only case of WAT seen in Johannesburg had worked in the forestry industry in Gabon.[11] She had been referred for investigation of a suspected brain tumour and the diagnosis of WAT was serendipitous.

DISCUSSION

All recent clinical and laboratory experience around trypanosomiasis in South Africa relates to evacuated EAT cases. In Johannesburg, there is a WHO-supplied regional stock of the relevant medicines, and the high level of clinical care and laboratory expertise required for successful management are available. There have been some recurring problems in the areas of initial clinical assessment, laboratory investigation, and treatment, here summarised.[7]

- Lack of local awareness of trypanosomiasis, and non-recognition of the pathognomonic skin lesion (the trypanosomal chancre) leads to persistence with ineffective treatment, such as antibiotics and antimalarials. Malaria, tick bite fever, and bacterial sepsis are frequent clinical misdiagnoses. Patients often rapidly progress to multi-organ failure during prolonged delays.

- Laboratory diagnosis problems include false-negative microscopy in early stages of illness when the parasites may be scanty, but also because suspected malaria is often misleadingly anticipated by clinicians and the laboratory.
- Clinical management problems frequently start with evacuation administrative delays, despite the need for urgent treatment; this is sometimes because medical insurance companies resist authorising emergency evacuation due to misdiagnosis, or misassessment of clinical severity.
- The medicines currently used for treatment are toxic, and ideally should be given in an intensive care unit by clinicians experienced in treating the disease; patients are often extremely ill on arrival, and ventilation and haemodialysis may be required.

Fifty years ago, three cases of EAT were described in miners who came to work in South Africa from areas in the tsetse fly belt of northern Botswana and Malawi.[12,13] The mine medical practitioners initially suspected and treated them for malaria, typhoid, or tuberculous meningitis until trypanosomes were identified in blood, bone marrow and cerebrospinal fluid (CSF), and the appropriate treatment was given. The conclusion that, in a non-endemic area, *"the diagnosis of trypanosomiasis is not always considered, because it is rare to occur in our environment"*, is still relevant for occupational physicians today.[12] What can be done to reduce the occupational risk of HAT? Working in conservation, hunting, and tourism in game reserves in transmission areas is the major work-related exposure risk for EAT, given its zoonotic nature. Tsetse flies are aggressive and bites are not easily prevented, but use of insect repellents and avoiding dark blue or black clothing, which is attractive for the flies, is advised; fortunately, only a small percentage of tsetse flies are infected. Not all EAT patients remember a tsetse bite, and not all develop the characteristic chancre. The most important advice to impart to those occupationally at risk is to be aware that disease transmission exists in that geographical location, and if they become ill with malaria-like symptoms, but have negative malaria test results, to remind the healthcare professional about the possibility of trypanosomiasis. East African trypanosomiasis is a dangerous and rapidly progressive disease, treatment is not widely available, and health insurance that will cover emergency evacuation, if required, is highly recommended.

CONCLUSION

The WHO's global health goal includes the interruption of transmission of trypanosomiasis (zero cases) by 2030, with controlling flies as the primary strategy.[1] Recently, Ebrahim and colleagues identified volatile sex pheromones in tsetse flies that control their mating behaviour, and could thus be used in tsetse fly traps to make them more effective in controlling transmission of trypanosomiasis in sub-Saharan Africa.[14] Given that it is a zoonosis involving wild game, EAT will never completely be eliminated, but reducing the already low burden of human disease is desirable. Effective drug treatment will also contribute to accelerated elimination of WAT. A major development is the replacement of the toxic injected agents, which have been the only treatment options available since the 1920s, with an effective, orally administered and safe compound, fexinidazole. The WHO now recommends this medicine for treatment of first-stage and non-severe second-stage WAT.[15] Clinical trials of fexinidazole for EAT are expected to be concluded soon.

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Exposure science

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How to cite this paper
Brouwer D, Masekameni DM. Exposure science. Occup Health Southern Afr. 2023; 29(2):90-93.

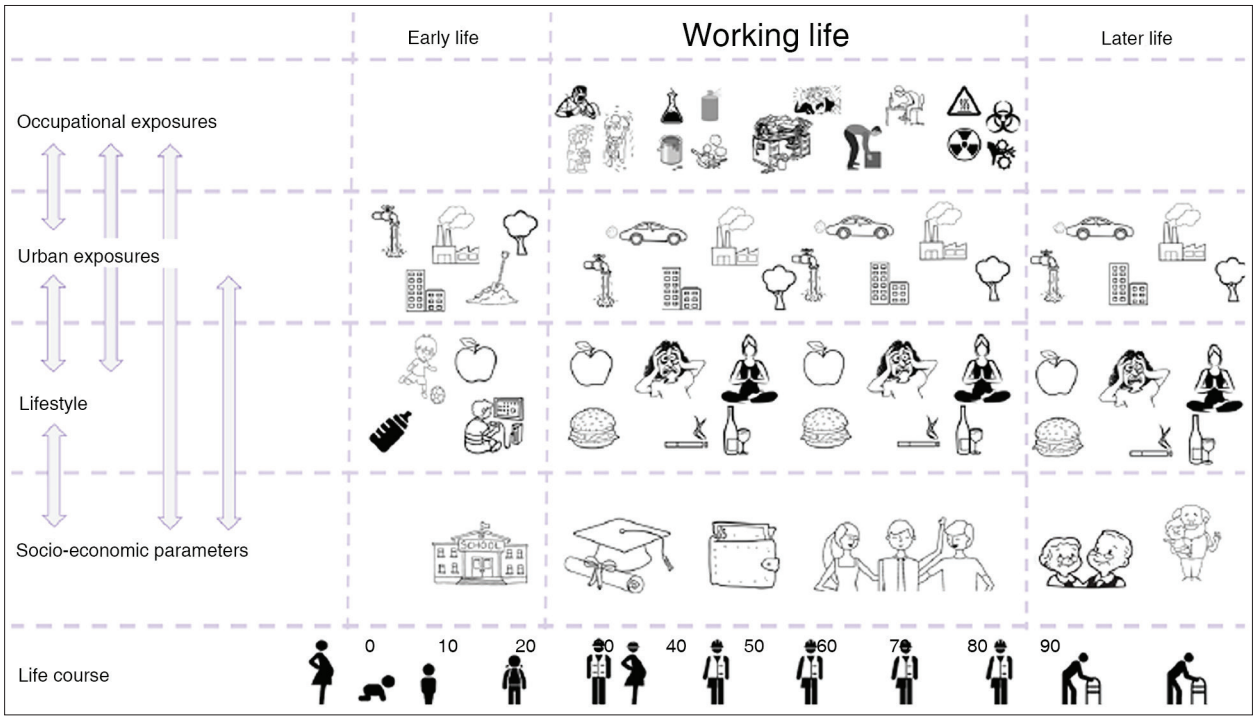
INTRODUCTION

Exposome and exposure science are relatively new concepts that are gaining popularity in occupational health since most occupational health effects/diseases are noncommunicable.[1] The exposome encompasses all nongenetic risk factors experienced during a person's lifetime and its relation to biological responses. It is subdivided into the so-called external exposome – focusing on environmental stressors – and the internal exposome – focusing on biological markers of the interaction between the stressor and the person/receptor.[2] Exposure science supports the external exposome by mapping the environmental stressors' pathways from source to receptor, enabling the identification of determinants of exposure and leverage points for interventions to control/prevent exposure.[3]

Challenges in mapping the exposome, especially in low- and middle-income countries (LMICs), have been identified but, at the same time, the need for exposure scientists has been indicated.[4] The call for exposure scientists coincided with the start of the first training and learning programme in the field of exposure science in Africa, at the University of the Witwatersrand in Johannesburg, South Africa.[5] Four years later, many of our MSc Exposure Science students have graduated, and the curriculum has evolved. As a follow-up to our previous paper, published in 2019,[5] we would like to share these developments with the readers of *Occupational Health Southern Africa* and all occupational health professionals.

WORKING LIFE EXPOSURES IN THE EXPOSOME CONTEXT

The working life and associated exposures make up a major part of the total lifespan, however, from a health-risk evaluation perspective, it has been considered, until now, in isolation from urban/residential/consumer exposures and factors such as lifestyle, behaviour, and socio-economic status. Thus, it makes sense to define the working life exposome, including (non)occupational exposures that may be directly or indirectly influenced by, or interact with, an individual's working life in relation to health.[6] For example, quite often, occupation is a determinant of socio-economic status, which may affect lifestyle (consumer preferences) and residential exposure. Figure 1 depicts the working life exposures in the exposome context.



Source: Pronk et al., 2022[6]

Figure 1. Working life exposures in the exposome context

Therefore, health-risk assessment needs a more holistic approach and exposure scientists should go beyond occupational-related exposure assessment (often limited to the stressor's intensity or concentration at the receptor's breathing zone over time). Nonetheless, occupational exposures are typically higher and more frequent than residential ones, requiring special attention. Moreover, in many cases, the stressors' sources are in close vicinity of the receptor, reducing the source-receptor trajectory and simplifying interventions in this pathway to minimise exposure. This makes occupational hygiene a specific feature of exposure science.[5]

THE EXPOSURE SCIENCE CURRICULUM

The Wits School of Public Health two-year MSc (Med) part-time programme is a National Qualifications Framework (NQF) level 9 qualification, and comprises 11 modules or course weeks, and 125 South African Qualifications Authority (SAQA) credits. In addition, students need to complete the mandatory research project (60 SAQA credits). The key pillars of the programme are: 1) understanding the exposure process (from source to receptor) to develop interventions, and 2) integration of all exposure pathways (aggregate and cumulative exposures) over the lifetime (the 'exposome').

The first curriculum that we developed matched the keywords of occupational hygiene, i.e. anticipation, recognition, identification, evaluation, and control of potential risk due to exposure to harmful stressors in the workplace. Residential and consumer-related exposures were also included. Currently, the (location of the) source and the processes that determine release, emission, and transport to the receptor form the backbone of the curriculum. Since exposure is determined by the characteristics of the stressor in the receptor's micro-environment, and the duration and activity of the receptor in those micro-environments, a priori distinguishing worker, resident, and consumer exposures only encourages silo-thinking. The first-year courses of the MSc introduce concepts and fundamentals of exposure science, risk assessment, and exposure control to the students; in the second year, the courses focus on the application of what was taught during the previous year. An overview of the courses is presented in Table 1.

An example of a first-year course is Exposure Control 1. In this course, we emphasise that effective implementation of an intervention depends not only on the efficacy of exposure control method, but also on the economic feasibility or efficiency (financial resources) and social acceptance (stakeholder engagement/consultation) of the intervention (Figure 2). Moreover, during the Exposure Control 1 course, the other domains are highlighted, including implementation science. In the 2nd year course – Exposure Control 2 – we focus on the efficacy aspects of an intervention. To facilitate a systematic, transparent, and balanced selection of an effective exposure control intervention in real-world practice, we introduce multi-criteria decision analysis (MCDA).

An example of a second-year course is Computational Exposure Assessment. In this course, we introduce mechanistic and empirical models and their software implementations (tools), followed by demonstrations and practical sessions. The underlying models of the tools, i.e. most often source-receptor models, refer to exposure pathways and exposure determinants that are taught during the first year. Most important, however, is that students understand when and how the models/tools need to be applied, their pros and cons, the interpretation of the results, and how these can be used to understand exposure and supplement or replace time-consuming and often high-cost measurements.

The tools that are highlighted vary from simple or tier-1 stand-alone tools for workplace or consumer exposures, such as ECETOC Targeted Risk Assessment (https://www.ecetoc.org/tools/tra-main/), to complex probabilistic multi-media models (such as MERLIN (https://merlin-expo.eu/), which integrates exposures through multiple exposure pathways and media (air, water, soil, food) in combination with pharmacokinetic modelling to estimate internal uptake. The Tier-1 approaches set a basis for the need for a more complex Tier-2, where real-time monitors

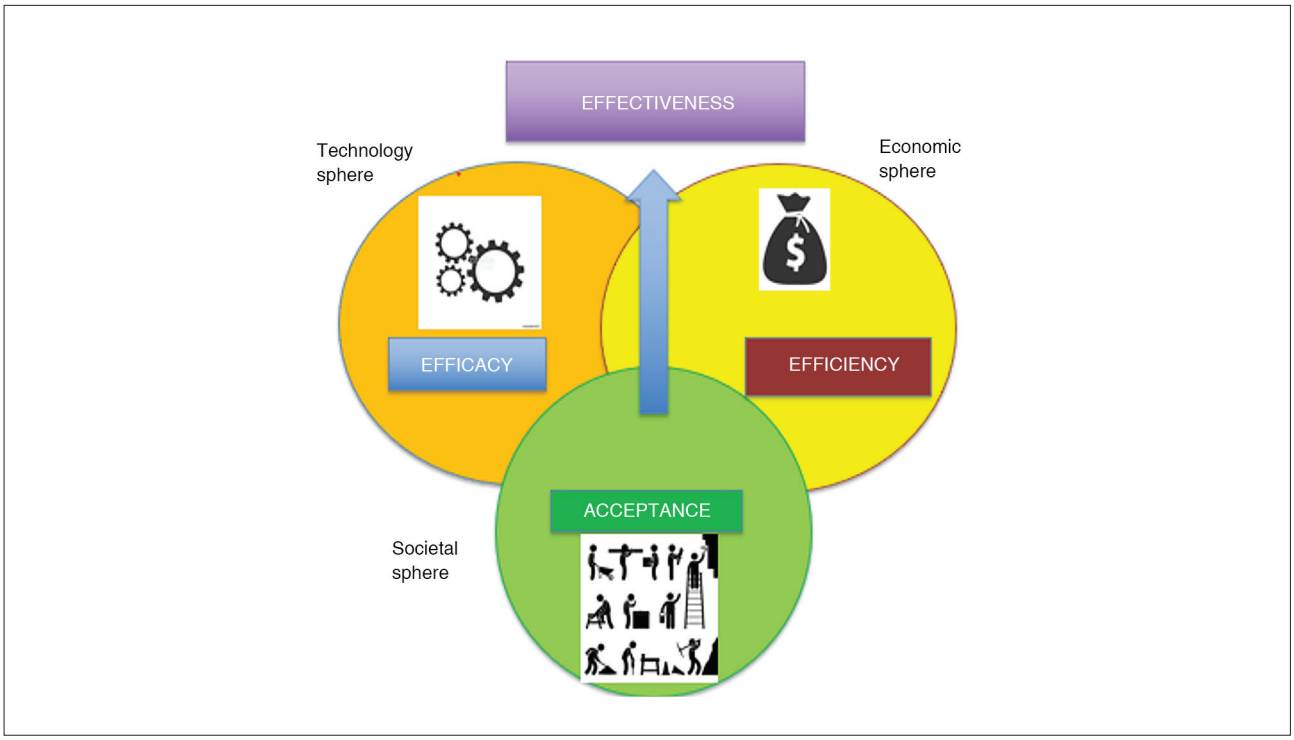


Figure 2. Graphical representation of content of the MSc Exposure Science, Exposure Control 1 course: the three domains that determine the effectiveness of an intervention in real-world practice

Table 1. MSc Exposure Science courses provided over the two-year study period

Course name	Theme(s)	Learning outcomes
Introduction to Occupational and Environmental Science	**Basic principles of exposure science and exposome, occupational, and environmental health:** Toxicology – biological monitoring (BEIs, ethics, integration with ambient monitoring), and environmental health. Basic epidemiologic concepts for exposure assessments.	To understand the pathway of occupational and non-occupational exposure from source to receptor (worker or member of the public) and the resulting health outcomes. To describe toxicology in the context of occupational and environmental health. To understand approaches assessing and controlling occupational and non-occupational hazards. To understand basic epidemiologic concepts of exposure assessment. To explain the link between an exposure event and health outcome.
Exposure Science 1	**Mechanisms and processes from release at the source to immission at the receptor:** Characterisation of environmental, consumer, and workplace exposures. Relationships between outdoor-indoor exposure; water, air, and soil as transport media. Aggregated and cumulative exposures.	To understand the principles of exposure science. To define mechanisms and processes from release at the source to immission at the receptor. To determine exposure pathways for the different stressors. To know and understand the concept of hazard and source mapping.
Exposure Induced Health Outcomes	Inhalation and particle deposition; lung disease. Toxicology (omics and in-vitro), ergonomics and shift work, noise/vibration and associated diseases, non-ionizing radiation and health effects, heat and cold-stress, pathogen transmission, communicable diseases.	To understand health risk assessment and risk management methods and systems with respect to the interaction between stressors and receptor and potential key health outcomes.
Fundamentals of Risk Assessment	Regulatory risk assessment and probabilistic risk assessment; introduction to comparative risk assessment and alternatives assessment; life cycle (inventory) and assessment; risk assessment/prioritisation tools; exposure-induced risk and health status; exposure-induced risk and vulnerable groups.	To understand the differences between 1) deterministic and probabilistic approaches, 2) the various types of risk assessment methods and objectives. To follow a structured approach to arrive at a logical conclusion about the health risks in a working environment. To know key elements of a comprehensive occupational hygiene risk assessment. To select and use appropriate risk assessment tools.
Exposure Control I	Principles of (risk and) exposure control. Interventions along the exposure pathway. Implementation of technology; cost effectiveness-interventions at receptor; selection of control measures. Different types of controls are introduced according to the hierarchy of controls with practical examples. Selection or identification of controls through stakeholder engagement, cost-effectiveness analysis, and other tools such as multi-criteria decision analysis.	To understand and apply the basic principles behind controlling a workplace hazard. To understand the various spheres (technology, economic, societal) relevant for the effectiveness of interventions. To understand the hierarchy of controls. To understand and apply methods of selecting appropriate exposure controls.
Exposure Pathway Assessment Methods I	Stressor's assessment and measurement strategies; uncertainty/variability; quality issues; stressor's specific assessment: noise, including mapping; surface and skin contamination; development of exposure scenarios; research methodology.	To understand stressor's variability at various stages of the exposure pathway. To be able to develop exposure scenarios and to objective-specific measurement strategies. To understand research methodologies and apply these to writing a research protocol.
Data Analytics and Data Analysis	Data exploitation, (pre)processing, and statistical methods to analyse data – to support exposure pathway analysis, efficacy testing, and compliance testing.	To understand and be able to apply: data pre-processing, data cleaning, data exploration, and methods to visualise and describe data. To analyse and interpret and report different types of data and exposure science measurement results (sampling vs time series), direct-reading instrument (DRI) outputs. To understand and apply parameter variability and statistical (parametric and non-parametric) tests. To understand the concepts of and be able to make compliance and other decisions based on data analysis in exposure science. To have basic knowledge about the superficial operating principles of the ExpoStats data analysis engine, and between worker/group variation. To gain experience with the analysis of exposure determinants.
Exposure Science II	In-depth assessment of the physical and/or chemical processes that are responsible for the release, emission and transport of different stressors. Aerosol physics; track-in dust and resuspension; intrusion of ambient particles; source apportionment; transmission of pathogens; fundamental of skin exposure and inadvertent oral exposure. Exposure factors and time-activity patterns in micro-environments.	To have knowledge and understanding of the various release processes in order to develop interventions/controls. To assess track-in dust and resuspension. To identify the intrusion of ambient particles in buildings. To conduct and determine source apportionment. To understand and apply methods to time-activity patterns.
Computational Exposure Assessment	Overview of emission, transport, immission, and air quality models and tools. Theoretical and practical exercises exploring: human exposure model (HEM), using AERMOD; EXPLUME; TRIM/APEX; AIRQplus; MERLIN; consumer exposure model (CEM); indoor air modelling fundamentals; lung deposition modelling; IAQX-GPS/PM/SLAB; CONTAM 3.2; box models; ECETOC TRA v3, Stoffenmanager 4.5, and ART 1.5; ECETOC-TRA. Overview of dermal exposure/penetration models, e.g. IH Skinperm, RiskofDerm, DREAM.	To understand the fundamentals of models, e.g. the underlying physical relationship of parameters. To determine the pros and cons / strengths and weaknesses of models. To understand the development from model to tool. To be able to select and apply the appropriate models/tools for exposure science related objectives.
Exposure Control II	Efficacy and effectiveness of exposure controls, hierarchy of controls. Exposure control through design, elimination and substitution; engineering and administrative controls; efficacy of ventilation for the reduction of pathogen aerosols transmission (case/ practical); concepts of personal protective equipment (PPE).	To have knowledge and understand the principles of prevention (through design), elimination and substitution. To understand the limitations of administrative controls. To have knowledge of the various types of ventilation and their uses and limitations. To understand the principles of indoor air quality assessment, to determine (in practical setting) air changes per hour and to understand its limitations. To understand the principles of PPE and their limitations.
Research Protocol	General aspects of research methodologies and preparation; conduct, analysis, and reporting of research (results).	To develop a research protocol related to exposure science.

are widely introduced and the use of Monte Carlo simulations are integrated into the content teaching and demonstrations; and Tier-3, where a holistic integration of point estimates concentrations, parameter distributions, and high-quality data output are used to derive risk estimates for decision-making processes.

DISCUSSION

The USA can be considered the cradle of exposure science, since the 2012 publication by the National Academy of Science clearly positioned exposure science among the emerging fields of science supporting 21st century human and ecological risk assessment.[7] Understandably, most of the exposure science-oriented teaching and learning (T&L) programmes are in the USA, at the Master's level, e.g. University of Michigan,[8] University of Washington,[9] and University of South Florida,[10] and at PhD level, e.g. Rutgers University,[11] and John Hopkins University.[12] At Master's level, the universities link their former industrial or occupational hygiene T&L programmes, emphasising the relationship between occupational hygiene and exposure science. Remarkably, no exposure science T&L programme currently exists outside the USA, apart from the Wits programme on the African continent.

In the European Union, the European Chapter of the International Society of Exposure Science recently published a framework for developing an exposure science curriculum.[13] If we compare the proposed curriculum with our MSc Exposure Science curriculum, we observe many similarities. However, our programme emphasises exposure control rather than the assessment of aggregated/cumulative exposure. Therefore, our graduates have the skills to convert exposure assessment results into intervention options to eliminate or reduce exposures emanating from various sources, including the workplace. In our view, this is the ultimate goal of occupational hygiene, environmental health and other aligned fields. In closing, our MSc programme embraces the need to understand the source-to-receptor pathway in order to develop effective interventions, e.g. starting with the concept of 'safer by design', minimising dependency on interventions at the receptor.

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The role of occupational health and safety and the private sector in pandemic prevention: the One Health approach in Africa

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BACKGROUND

The global population, according to Worldometer, reached 8 billion in November 2022, and is expected to reach 9 billion in 2037.[1] In 2020, Africa had 1.34 billion people – about 17.2% of the global population.[1] Eastern and western Africa represent about 59% of the African population. The International Labour Organization (ILO) estimates that there are approximately 3.3 billion working people worldwide.[2]

More than a billion individuals work closely with animals worldwide. Over 60% of human disease pathogens originate from domestic animals and wildlife, 75% of emerging human infectious diseases originate from animals, and 80% of bioterrorism concerns have their origin in animals.[3] Thus, humans are vulnerable to physical, emotional, and social wellbeing risks. Humans and animals share exposures to biological, chemical, physical, and psychosocial environmental hazards. Animals expose humans to zoonotic infections and, in turn, humans expose animals to reverse zoonoses such as tuberculosis and influenza.[4] Consideration must be given to the person, the animal, and the workplace environment to improve occupational health and safety (OHS) for workers, their families, and the public in general.

Definition of occupational health and safety

The ILO defines OHS as *"the science of the anticipation, recognition, evaluation, and control of hazards arising in or from the workplace that could impair the health and well-being of workers, considering the possible impact on the surrounding communities and the general environment"*.[5] It is important to note that the OHS discipline protects workers, visitors, communities, and the environment, and requires a multi-disciplinary approach. It is misleading to define OHS as a field of public health in which trends in illnesses and injuries in the worker population are studied, and regulations and strategies to prevent them are proposed and implemented.[6] This second definition assumes that public health is the entry point and ignores the fact that OHS is a broad discipline, emanating from various disciplines such as engineering, chemical, industrial hygiene, etc., which, at times, are not connected to public health. Under the United Nations, public health is a mandate of the World Health Organization (WHO), and the ILO leads OHS. At the country level, ministries responsible for health take leadership on public health issues, while the ministries responsible for labour assume leadership in OHS matters. At the industry level, the private sector promotes and implements OHS measures more than the public sector, due to the need to comply with OHS standards. Consequently, for an effective workplace pandemic response, and recognising the importance of integrating OHS in this aspiration, the private sector should be included in all OHS programmes and initiatives, as this is where good practical OHS skills – essential to protect workers, the community, and the environment – are located.

ONE HEALTH

The Centers for Disease Control and Prevention (CDC) defines One Health as *"a collaborative, multisectoral, and transdisciplinary approach – working at the local, regional, national, and global levels – with the goal of achieving optimal health outcomes recognising the interconnection between people, animals, plants, and their shared environment"*.[7] The One Health definition recognises the importance of multi-sectoral and transdisciplinary cooperation to prevent and control pandemics.

Challenges of implementing One Health

Regional coherent policies and strategies

Recently (in May 2023), the African Union Development Agency-New Partnership for Africa's Development (AUDA-NEPAD) conducted a literature review, and found that 70% of African countries fell below the average of 15 pieces of OHS legislation compared to Canada, which has more than 800 OHS-related pieces of legislation.[8] Some African countries have set occupational exposure limits (OELs), such as South Africa, Zimbabwe, Kenya, Namibia, and Lesotho. However, some countries have unofficially adopted international OELs. Only South Africa has published a list of biological exposure indices (BEIs). Inadequate policy reforms limit the advancement of internal exposure monitoring, which is essential for biological monitoring of exposure and of effect. The lack of internal exposure assessments weakens exposure control programmes for chemical and physical stressors.[8] Moreover, in 2023, the ILO reported that only 21 countries had developed a Decent Work Country Programme (DWCP),[9] 12 of which have expired. As of February 2023, Africa has 19 active DWCPs, and another 11 are being drafted.[9] If we are to be effective in combating any future pandemics, we need to prepare both public and private sector workplaces and develop action plans to prevent and mitigate disease transmissions – as part of the business continuity plan and according to the results of risk assessments and epidemiological situational analysis reports.

Appetite for integration-willingness and knowledge of the importance of integration

There is a lack of good research and/or data on the contribution of economically active people to the outbreak of diseases. The unavailability of data contributes to the emerging and re-emerging of

diseases. There is also limited funding to collect and analyse data for research about how commuting workers contribute to pandemics. However, the COVID-19 pandemic revealed many disease-spreading platforms, such as public and private transportation, including private lift clubs. When disease trends are not tracked and reported, the world loses the battle against emerging and re-emerging infectious diseases that have the potential to turn into pandemics.

OPPORTUNITIES AND KEY AREAS THAT REQUIRE INTEGRATION

One-stop border posts

The one-stop border post (OSBP) concept refers to the legal and institutional framework, facilities, and associated procedures that enable goods, people, and vehicles to stop in a single facility, where they follow controls, in accordance with regional and national laws, to exit one country and enter another. The process drastically reduces the time taken to travel across the border (from 4–5 days to a few hours–3 days),[10] increases trade, and reduces congestion in ports of entry. Countries may realise the economies of scale by using a single facility, which strengthens cross-border surveillance systems, promotes joint cross-border management systems, and reduces unnecessary congestions and contact times. This is a perfect model for reducing or curbing cross-border diseases.

Mental health

Mental health preparedness and response during and after disease outbreaks are integral to health emergency preparedness, response, and resilience (HEPR). Most of the countries that participated in the survey (n = 116, 89%) reported that the mental health and psychosocial support (MHPSS) response was included in their national COVID-19 response plans. However, only 17% of these countries have ensured funding for this. African regions have the highest percentage of countries reporting MHPSS integration with no additional funds for this activity.[11] In Africa, 64% of countries lack mental health legislation or have legislation that is outdated and fails to adequately promote the rights of people with mental disabilities.[12] Nigeria recently enacted a law on mental health, similar to the South African Mental Health Care Act. The law promotes a more organised and structural process for managing mental health in the country, allows for the creation of a Department of Mental Health Services in the Federal Ministry of Health; and makes provision for a Mental Health Fund. Mental health laws ensure protection for those with mental health conditions against discrimination, regarding housing, employment, and medical and social services.[13] Any pandemic requires a public-private partnership that leverages and adapts practices to promote essential elements that foster wellbeing before, during, and after the disaster.[14]

Private sector engagement

In workplaces, the diversity of jobs held by migrants, the rapid expansion of travel for business and pleasure, and the increasing distances travelled to and from work accelerate the spread of infectious diseases. It is anticipated that these population movements will persist, driven by economically active citizens. Therefore, multisectoral, multi-disciplinary, and transdisciplinary approaches to disease prevention and control should be adopted; the multi-sectoral approach should include the private sector.

By March 2022, the South African mining industry's (SAMI's) COVID-19 vaccination rate was higher than 77%, compared to 37%, 12%, and 57.5% for the general South African, African, and global vaccination coverage, respectively.[15] The chambers of mines, trade and commerce in southern African countries are critical for coordinating national-level private sector interests, as most mining and non-mining companies and contractors are affiliated with these institutions. The national chambers of mines are represented regionally by the Mining Industry Association of Southern Africa (MIASA). The business chambers and business councils are critical platforms for reaching mining and non-mining companies, to advocate for and improve emergency prevention, preparedness, and responses to disease outbreaks.

CONCLUSION

The AUDA-NEPAD, the African Union-Interafrican Bureau for Animal Resources (AU-IBAR), and the African Union-Pan African Veterinary Vaccine Centre (AU-PANVAC), in partnership with the Food and Agricultural Organization (FAO), the WHO, and AU Regional Economic Communities (RECs), joined forces to implement the One Health approach in pandemic prevention, preparedness, and response.

This is a multi-sectoral and transdisciplinary project using an integrated One Health approach, recognising the role of animals, humans, and the environment in spreading infectious diseases. The project has three components, viz. i) strengthening regional surveillance systems, ii) strengthening regional laboratory systems, and iii) developing regional and national capacity in and beyond the current One Health setting. The partnership recognises the role of the private sector in pandemic prevention, preparedness, and response, taking lessons from COVID-19, where workers comprise the most tested and vaccinated population in the world. Although most of the global workforce is employed in the public sector,[16] the private sector champions OHS. Capacitating the private sector and its OHS experts will play a major role in curbing future pandemics. Civil society organisations and communities will be greatly capacitated as key partners in prevention, preparedness, and response.

ACKNOWLEDGEMENTS

The World Bank funds the Southern African TB and Health Systems Support (SATBHSS) project: P155658 and P173228. For more information, visit www.satbhss.org and www.nepad.org. AUDA-NEPAD acknowledges the World Bank; the Department of Community Health Studies, Faculty of Health Sciences, Durban University of Technology; the Southern African Institute for Occupational Hygiene (SAIOH); and Sedulitas for their invaluable contributions and support.

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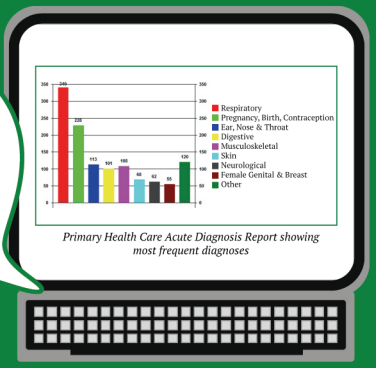
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OSHAfrica commemoration of World Day for Safety and Health at Work, 28 April 2023

Thuthula Balfour: Vice President of OSHAfrica; Head of Health, Minerals Council South Africa
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This paper was presented at the virtual commemoration of the World Day for Safety and Health at Work.

BACKGROUND AND HISTORY

The World Day for Safety and Health at Work (WDSHW) was initiated by the International Labour Organization (ILO) in 2003 at the request of trade union movements. This day is set aside to promote the prevention of occupational accidents and diseases, globally. It is an awareness-raising campaign intended to focus international attention on the magnitude of the problem and on how promoting and creating a safety and health culture can help reduce the number of work-related deaths and injuries. It is a tripartite commemoration/celebration for trade unions, employers' organisations, and government representatives.

The theme for WDSHW 2023 was, *A safe and healthy working environment is a fundamental principle and right at work*. This was the first time that safety and health were celebrated as fundamental rights. The theme arose from a decision of the International Labour Conference (ILC), in June 2022, to include '*a safe and healthy working environment*' in the ILO's framework of fundamental principles and rights at work. The 2023 celebration provided an ideal opportunity for safety and health practitioners to ensure that safety and health receive the requisite attention to improve employees' wellbeing.

In 1998, the 86th Session of the International Labour Conference adopted the 'ILO Declaration on Fundamental Principles and Rights at Work' with the eight conventions. The declaration covered freedom of association and the effective right to collective bargaining; the elimination of all forms of forced and compulsory labour; the effective abolition of child labour; and the elimination of discrimination in respect of employment and occupation. On 11 June 2022, the ILC amended this declaration by adding a safe and healthy working environment as a fifth principle and right.

The Declaration on Fundamental Principles and Rights contains the core principles that ILO member states are required to respect, by virtue of their membership, even if they have not ratified the ILO's conventions in which they are expressed. This means that all 10 conventions must be implemented by ILO members, regardless of ratification. The fundamental rights conventions are presented in Figure 1.

ILO CONVENTIONS

The ILO conventions are divided into three categories, viz. governance, technical, and fundamental conventions.[2] There are four governance conventions that are important for the functioning of the international labour standards. Examples of these are Convention No. 81 of 1947 on Labour Inspection, and Convention No. 122 of 1964 on Employment Policy. The ILO also has numerous technical conventions, covering a range of subjects, which provide technical guidance. Examples are Convention No.1 of 1919 on Hours of Work (Industry), and Convention No.3 of 1919 on Maternity Protection. The earliest fundamental convention was Convention No. 29 of 1930 (Forced Labour Convention). Convention No. 105 of 1957 (Abolition of Forced Labour Convention) cancelled some parts of the Forced Labour Convention of 1930.

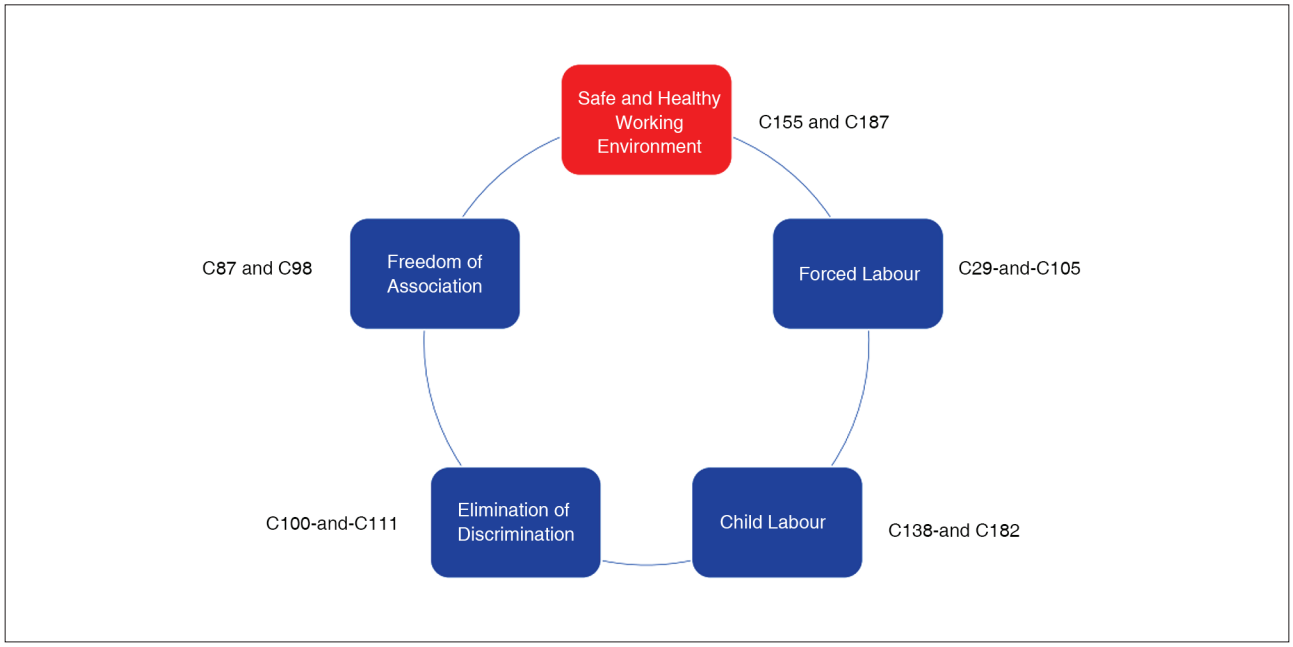


Figure 1. ILO fundamental rights and the associated conventions[1]

New conventions on occupational safety and health

In 2022, the Occupational Safety and Health Convention No.155 of 1981[2] and the Promotional Framework for Occupational Safety and Health Convention No.187 of 2006[3] became fundamental conventions.

Occupational Safety and Health Convention No. 155 (1981)

This convention introduced a policy approach to occupational safety and health (OSH). It emphasised the need to consider OSH as a matter of national concern. In addition to defining the objectives and basic principles of a national policy, the convention also defines the actions required at both national and enterprise levels.

Promotional Framework for Occupational Safety and Health Convention No. 187 (2006)

Convention No.187 aims to promote a preventive safety and health culture and to progressively achieve a safe and healthy working environment. It emphasises the need to ensure that priority is given to OSH in national agendas, and to foster political commitments in a tripartite context for the improvement of OSH. It defines the elements and functions of national policies, systems, and programmes, and discusses the monitoring, evaluation, and improvement of national OSH systems.

Ratification of Convention No. 155 and Convention No. 187

With the elevation of the two occupational safety and health conventions, it is worth noting how many countries in Africa have ratified the conventions (Table 1). Conventions No. 155 and No.187 have been ratified by only 18 (33.3%) and 17 (31.5%) African countries, respectively. Nine countries (16.7%) have ratified both conventions.

STATE OF THE OSH RESPONSE IN AFRICA

It is noteworthy to see how African countries have responded to the implementation of Conventions 155 and 187 (Table 1). In 2023, the ILO published a booklet titled, *Implementing a safe and healthy environment: where are we now?*[6] The booklet provides information on the global implementation status of some of the key provisions contained in Conventions 155 and 187. Some of the key elements analysed were the existence of a national authority responsible for OSH and a national tripartite body on OSH; the inclusion of key provisions, e.g. workers' right to remove themselves from dangerous work situations, and the requirement to establish joint OSH committees at the workplace level; the development of a national policy and national programme on OSH; and the establishment of a national recording and notification system for occupational accidents and diseases. This was a desktop study on a sample of countries representing low- to high-income countries and according to regions. Some findings from the paper are summarised below.

National authority responsible for OSH

Of the sub-Saharan African countries sampled, all had OSH housed in departments of labour.

National tripartite body for OSH

The proportion of members with tripartite OSH bodies was 70% in low-income countries, compared to 85% in high-income countries. Morocco was a case study as it has established the Council of Occupational Medicine and Prevention of Professional Risks, which is set up as a consultative entity. It is responsible for all matters related to OSH and the prevention of occupational accidents and diseases, and is organised as a tripartite and intergovernmental structure.

Right to remove oneself from dangerous work

Provisions in law for the right to remove oneself from dangerous work were present in 54% of countries in Africa compared to 94% in Europe and Central Asia.

Joint OSH committee at workplace

Africa did well and performed best with 80% of countries having joint OSH committees at the workplace. Djibouti was a case study as a health and safety committee must be created in all industrial enterprises, buildings, and public services employing at least 50 workers, including those with temporary contracts. Zambia was also a case study, as an employer of 10 or more persons at any workplace must establish a health and safety committee, consisting of an equal number of members, with at least two representing the employer and two representing the employees.

National OSH policy

Few African countries (39%) had a national OSH policy, compared to 57% in Europe and Central Asia. However, Zimbabwe was notable as it introduced its National Occupational Safety and Health Policy in August 2014, with a vision to prevent occupational accidents, injuries, diseases, and fatalities in the country.

National programme on OSH

Only 24% of countries in Africa had national programmes, compared to 47% in Europe and Central Asia.

Table 1. African countries that have ratified Conventions No. 155 and No. 187

Ratification of C155		Ratification of C187	
Algeria	**Nigeria**	Burkino Faso	**Rwanda**
Cameroon	**Rwanda**	**Cote d'Ivoire**	**Senegal**
Cote d'Ivoire	**Senegal**	Guinea	**Sierra Leone**
Ethiopia	Seychelles	**Malawi**	**Somalia**
Gabon	**Sierra Leone**	**Mauritius**	Togo
Lesotho	**Somalia**	Morocco	Tunisia
Malawi	South Africa	**Niger**	**Zambia**
Mauritius	**Zambia**	**Nigeria**	
Niger	Zimbabwe		

Country names written in bold have ratified both conventions[4,5]

NATIONAL NOTIFICATION OF ACCIDENTS AND DISEASES

While 90% of the 187 ILO members have established a reporting system, only 41% of these had provided data to the ILO in the previous five years. In those with no recording system, 38% were low-income countries, 31% were lower-middle-income countries, 25% were upper-middle-income countries, and 6% were high-income countries. There was, thus, a strong correlation between income status of countries and reporting, which could be due to resources available in countries to implement these systems.

IMPLEMENTATION OF CONVENTIONS

The practical implementation of Conventions No. 155 and No. 187 is discussed, using examples from South Africa, in sectors covered by the Mine Health and Safety Act No. 29 of 1996 (MHSA). Both Conventions No. 155 and No.187 describe a framework to improve health and safety at work based on the complementary roles played by governments, employers and workers. The conventions emphasise the importance of employer and worker participation, through express provisions on consultation and cooperation in decision-making and implementation processes. This was displayed during the consultation process for the MHSA Amendment Bill of 2022, which included extensive tripartite consultations at the Mine Health and Safety Council (MHSC) and the National Economic Development and Labour Council (Nedlac) – a national statutory body governed and mandated by the National Economic Development and Labour Council Act No. 35 of 1994.

Convention No.155 provides for the protection of workers and their representatives from undue disciplinary measures because of lawful actions taken in accordance with the national OSH policy. This is included in the MHSA as the right to refuse dangerous work. Organised labour is very vocal at all forums about the need for employers to recognise and promote this right. Some mining companies incentivise employees to exercise this right as it leads to fewer injuries at work.

According to Convention No. 187, the national OSH system shall include an authority or body, or authorities or bodies, responsible for occupational safety and health, designated in accordance with national law and practice. The MHSA makes provision for the establishment of the MHSC, which is a tripartite entity that advises the Minister of Mineral Resources on all matters relating to safety and health in the industry.

Convention No. 155 provides for the establishment and application of procedures for the notification of occupational accidents and diseases, by employers and, when appropriate, insurance institutions and others directly concerned, and the production of annual statistics on occupational accidents and diseases. The Department of Mineral Resources and Energy (DMRE) has, over the years, regulated the submission of occupational safety and health data in the form of the South African Mines Reportable Accidents Statistics System (SAMRASS) for safety, and annual medical reports and health incident reports for occupational health. This enables the department to produce credible and accurate data on the state of safety and health in the mining industry.

FOCUS AREAS FOR AFRICA

Based chiefly on the outcomes of the ILO study and recognising the challenges on the continent, the following are areas of focus for Africa and OSHAfrica:

- Ratification of Conventions No. 155 and No. 187
- Legalising the right to remove oneself from dangerous work
- Developing national OSH policies
- Establishing national programmes on OSH
- Recording and notification of accidents and diseases
- Integration across departments and between prevention and compensation
- Developing policies for small, micro-enterprises, and the informal sector

CONCLUSION

Taking everything into account, the following can be concluded:

- The recognition of occupational safety and health is a major achievement and should be utilised to catalyse activities to promote safety and health.
- Africa needs to strengthen its response to meet the requirements of Conventions No. 155 and No. 187.
- Best practice (case studies) exist in Africa and countries must learn from each other.
- Through OSHAfrica and relevant partners, we need to raise the bar on our dialogues and tracking of our progress towards ensuring that occupational safety and health are lived as fundamental rights on the continent.

ACKNOWLEDGEMENTS

I humbly acknowledge Simphiwe Mabhele, a specialist at the ILO, for providing information on this topic.

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13th IOHA International Scientific Conference

Dublin, Ireland
June 2024

The Occupational Hygiene Society of Ireland (OHSI) and the British Occupational Hygiene Society (BOHS) are privileged to jointly host this conference and to contribute to its successful outcome.

The conference theme has been confirmed as - 'Protecting workers from health hazards: Advancing in this changing world'.

The conference aims to promote occupational hygiene and worker health protection by the minimisation of worker exposure to hazardous agents globally through plenary sessions, keynote lectures, parallel talks, workshops, poster presentations and professional development as well as networking opportunities and social functions.

A strong Global media campaign will publicise the main causes of occupational disease throughout the conference.

More information including venue, dates and abstract submission arrangements will be announced very soon. Please mark your diaries for June 2024 in Dublin, Ireland!

Edited by Dr Thomas P Fuller
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XXII Symposium of Polish Association of Industrial Hygienists – Current Issues in Industrial Hygiene

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Each year, the Polish Association of Industrial Hygienists (PTHP) organises a scientific and training symposium. From 14 to 16 September 2022 a symposium, with the theme *Current Issues in Industrial Hygiene*, took place in Lodz, Poland. The conference topics focused on the understanding and prevention of negative health effects caused by exposure to harmful factors in the work environment. Conference attendees included industrial hygienists, employees of universities and research institutes, control authorities, occupational medicine service providers, laboratory professionals, and occupational health and safety specialists. Participants had the opportunity to take part in nine thematic sessions:

1. Amendment of EU rules and policies on substances that are toxic to reproductive processes, carcinogenic, or mutagenic
2. Exposure to ionising radiation
3. Selected chemical, dust, physical and biological hazards in the work environment
4. Chemical safety
5. New forms of learning and working as a challenge for students, employees, and employers
6. Methodologies for the assessment of work environments
7. Occupational hygiene and medicine for employees
8. Improving the effectiveness of personal respiratory protection in the light of new products and IT tools
9. Exposure to electromagnetic radiation from industrial equipment

Leading lectures were delivered by specialists in occupational hygiene and medicine.

There was also a poster discussion session that mainly focused on the development of new methods for evaluating various chemical compounds in the working environment.

Approximately 100 professionals participated in the conference. They had the opportunity to expand their knowledge and exchange experiences in the field of occupational hygiene. As the information presented during the symposium was positively accepted, the PTHP management is already planning the next symposium in 2023.

Growing the occupational hygiene workforce in New Zealand

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In New Zealand, deaths related to occupational health are estimated at 750–900 a year. In addition, there are an estimated 5 000–6 000 hospitalisations each year. To put this into perspective, a worker is 15 times more likely to die from a work-related disease than from a workplace accident.[1] To address this, WorkSafe New Zealand (the Government health and safety regulator) released a strategic plan for work-related health where, ultimately, fewer people should experience work-related ill-health.[2] Part of the strategic plan is to support building the capacity and capabilities of professional health and safety workforce groups, with occupational hygienists being the priority. This was the beginning of the Occupational Hygienist Workforce Development Project, which started in 2018.

This programme of work is jointly managed by New Zealand Occupational Health and Safety (NZOHS) and the Health and Safety Association of New Zealand (HASANZ), the umbrella organisation representing workplace health and safety professions, which aims to raise professional standards and connect businesses with trusted health and safety professionals.

There are two phases to the project. The first phase spanned the period 2018 to 2021. The second phase commenced in 2021 and will continue until 2024. The objectives of the project are:

- to grow the critical mass of health and safety professionals to ensure that more occupational hygienists are available to support New Zealand industries
- to enhance education pathways, thereby improving capabilities and ensuring that accurate, high-quality advice is given to employers
- to create opportunities for established occupational hygienists to continue their professional development, networks, and career aspirations.

In 2018, at the beginning of Phase 1, NZOHS had 85 members. By 2021, three years later, this number had increased by 48% to 126 (Figure 1). Buoyed by the success of Phase 1, an additional three years of funding was provided to continue the project by WorkSafe, New Zealand's primary workplace health and safety regulator. One year into Phase 2, there was already a 25% increase in membership, from 126 to 157 (Figure 1).

The activities in the project are broadly categorised as follows:

Grow the number of qualified and experienced occupational hygienists in New Zealand

- *Scholarships* – award and administer scholarships for candidates to obtain Master's degrees in occupational hygiene from an institution recognised by the International Occupational Hygiene Association (IOHA), or the International Certificate in Occupational Hygiene. Since 2018, 23 scholarships have been awarded.
- *Internship programme* – a summer pilot project recruited two business hosts and two interns; both interns secured full-time work with their hosts. The internship programme continues.
- *Mentoring* – there are currently nine mentor/mentee relationships underway; the aim is to increasing this to 20 per year.

Increase technical and specialist occupational hygiene capability

- *Specific technical training* – NZOHS delivered Occupational Hygiene Training Association (OHTA) modules to 199 students, from 2019 to 2022.
- *Training/trainer competency framework* – 15 NZOHS full and fellow members attended a 'Train the Trainer' course to improve the quality of trainers and training experience for the delivery of the OHTA modules.
- *Specialist training* – with limited access to specialised courses in New Zealand, NZOHS arranged courses for members in local exhaust ventilation (LEV), mining industry, and ethics. NZOHS also developed and runs the Commit2Fit (C2F) courses for training competent respirator-fit testers.
- *New Zealand occupational hygiene qualification* – NZOHS and HASANZ have been meeting with universities in New Zealand and Australia to discuss the establishment of a Master's level occupational hygiene course in New Zealand, which is currently underway.

Increase wider occupational hygiene knowledge and attract others into the profession

- *Co-profession core understanding* – each year, NZOHS delivers two Basic Principles in Occupational Hygiene (W201) courses, directed at other health and safety professionals to increase their understanding of occupational hygiene.
- *Attraction* – to explain the role and value of occupational hygienists to other disciplines, NZOHS and HASANZ developed a career pathway document and conference collateral; increased NZOHS web presence through a rebranded website, social media, external presentations, and electronic newsletters; added occupational hygiene to the Government priority careers list; and listed occupational hygiene as a scarce skill shortage for New Zealand work visas, meaning it is now easier to get a work visa if you have those skills.
- *Improving the profile of occupational hygiene* – NZOHS delivered presentations to other health and safety professional bodies, and is actively engaging with other HASANZ member associations. NZOHS is holding its annual conference in May 2023.
- *Strategic planning, systems, and procedures* – there are ongoing improvements to our systems and processes, with a view to aligning them to ISO 17024:2012 and, possibly, a future IOHA National Accreditation Recognition certification scheme.

There has been a tremendous effort in the last five years to grow the occupational hygiene workforce in New Zealand. With significant gains made already and further support for growth, the future of the occupational hygiene profession in New Zealand is looking good.

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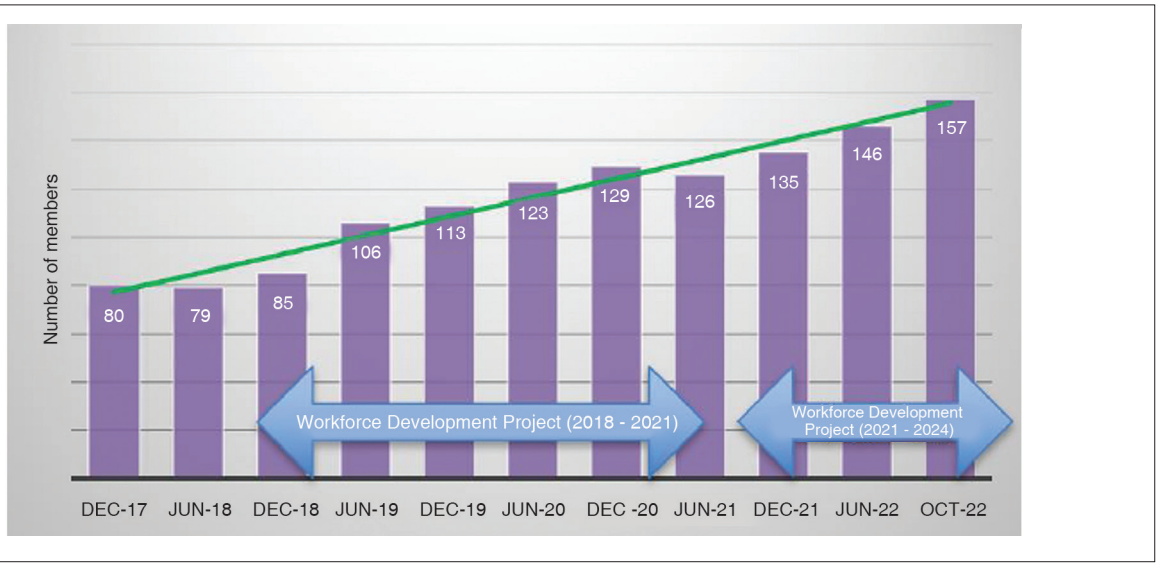


Figure 1. NZOHS membership, December 2017–October 2022

SOFHYT cooperates with other international organisations to increase occupational hygiene awareness

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The French Society of Occupational Hygienists (SOFHYT) has been collaborating with Workplace Health Without Borders (WHWB) to organise health and safety training for French-speaking students in low- and medium-income countries. WHWB's goal is to provide workers with occupational health technical assistance, training, and skills development to help them increase capacity in occupational hygiene and local infrastructure, to manage and improve health conditions in their workplaces.

In 2020, WHWB approached national industrial hygiene associations to extend their offer of training programmes to non-English-speaking countries. The SOFHYT was quick to embrace the initiative.

The SOFHYT members have translated into French the Occupational Health and Safety Awareness Course, originally developed by the Occupational Hygiene Association (OHTA). Tutorials were recorded and study material was prepared in French. During the last few years, the material was improved and updated, and the training now includes pre-recorded e-learning modules on Google Classroom™, as well as sessions with instructors. The training is conducted entirely online and in French. At the end of the seven-week course, participants are able to recognise common workplace hazards, implement the hierarchy of controls, and recognise when to seek additional technical assistance.

Three training cycles have already been completed. Approximately 50 students have completed the programme to date. Attendees have come mainly from Senegal, Burkina Faso, Democratic Republic of Congo, and the Ivory Coast. These countries have high prevalence rates of occupational injuries.[1] A paradigm shift will unavoidably require the involvement of many actors over multiple years, but initiatives like those of WHWB/SOFHYT may plant the seed.

Feedback from students has been enthusiastic and most ask for more in-depth training. This health and safety awareness training will be repeated regularly in 2023. In parallel to this initiative, the SOFHYT also proposed an e-learning training programme on the Fundamentals of Occupational Hygiene, for French participants. This module is based on the OHTA W201 programme, and has been summarised and presented in English by Steven Verpaele from the Belgian Society of Occupational Hygiene (BSOH) and the Belgian Centre for Occupational Hygiene (BeCOH).

Several SOFHYT members translated this module into French during the summer. The training was presented via Microsoft Teams for three days, to 10 students. Participants included new occupational hygienists, environmental health and safety officers, occupational physicians, and toxicologists. All were eager to know more about occupational hygiene. This first session was considered a success, and feedback from participants was very positive.

In 2023, the SOFHYT is planning a new training programme on the basics of occupational hygiene. This may be more tailored towards France with references to French regulations practices.

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Upcoming annual Asian Network Occupational Hygiene Conference

The 2023 annual Asian Network Occupational Hygiene (ANOH) Conference will be held at the Acacia Hotel, Alabang, Metro Manila, Philippines from 26 to 30 August 2023. The conference is being organised by the Industrial Hygienist Association of the Philippines Inc. (IHAP) in conjunction with the ANOH. The title of the conference is *Collaborate, innovate, adapt for the future of industrial hygiene in Asia*. The conference will include presentations covering a wide variety of technical issues in industrial/occupational hygiene.

INDUSTRIAL HYGIENISTS ASSOCIATION OF THE PHILS. (IHAP) INC.

The programme will include:

- Professional courses: 26 and 27 August 2023
- Symposium – keynote speakers, concurrent sessions, trade show, and gala dinner: 28– 30 August 2023

The importance of medical reports in the COID claim adjudication process

The Compensation for Occupational Injuries and Diseases Act (COID Act), Act No.130 of 1993 as amended, provides for compensation for disablement caused by occupational injuries or diseases sustained or contracted by employees in the course of their employment, or for the death resulting from such injuries or diseases; and for matters connected therewith on a 'no fault' basis.

For benefits to be provided under the COID Act, each claim must be adjudicated and processed in line with the Rand Mutual Assurance (RMA) process. Adjudication is the process whereby the decision is taken to accept or reject liability for paying benefits, following an accident or occupational disease. This is taken in compliance with Section 45 of the COID Act No. 130 of 1993 as amended, which requires that Rand Mutual Assurance (RMA) consider every claim brought to its attention and make a liability decision on each case.

The Act defines an accident as:

- An incident or occurrence arising out of, and in the course of, an employee's employment; and
- Resulting in a personal injury, illness, occupational disease, or the death of the employee.

Claims must be proven by varied materials of evidence, including but not limited to medical evidence, and evidence that the injury was caused by an accident arising of, and in the course of, an employees' employment.

In occupational diseases, acceptable evidence must be provided to RMA that the employee has the occupational disease and that the substances or hazards that caused the occupational disease are present in the workplace.

For liability to be accepted based on a sound clinical diagnosis, the following set of medical criteria must be satisfied in all cases:

Causality

This requires that each of the following criteria is met to a reasonable degree of medical probability:

- A causal event took place.
- The person who experienced the event has the condition (injury/impairment/disease).
- The event could cause the condition.
- The event caused or materially contributed to the condition within medical probability.

Chronology

The series of events leading to the injury or occupational disease must have a chronological sequence that justifies the link to the cause. In essence, the cause must precede the effect.

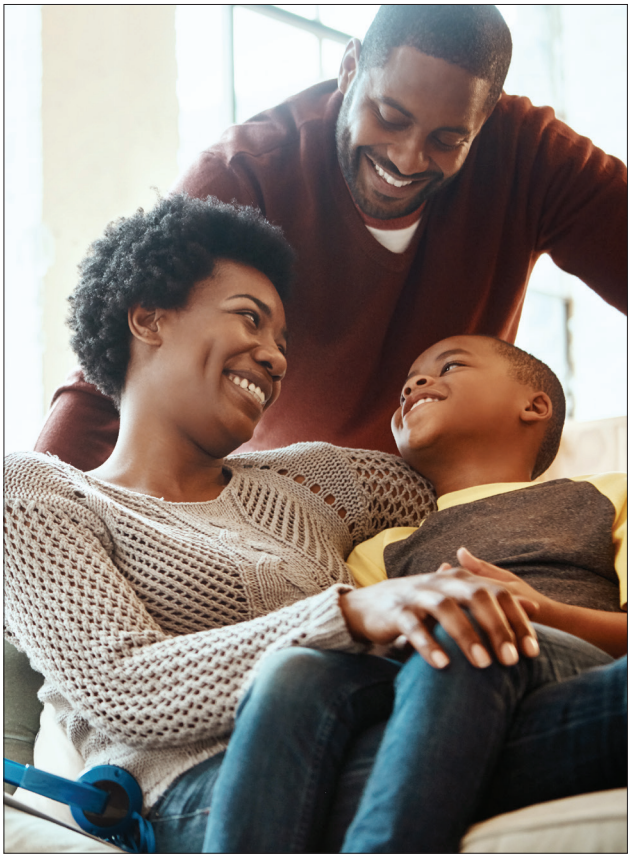
Biological plausibility

From what is known of toxicology, chemistry, physical properties, or other attributes of the studied risk or hazard, does it make biological sense to suggest that exposure leads to the disease?

Employees are entitled to their claims being considered, provided that the employer and medical professionals have followed the prescribed processes for the submission of the required documents



Photograph: courtesy of RMA



Photograph: courtesy of RMA

within specified time periods. Claims for occupational injuries and diseases must be reported as soon as possible. The Act states that injuries need to be reported within seven (7) days of the accident, whereas claims for occupational diseases must be reported within fourteen (14) days of the diagnosis being made by the medical professional. The information contained in the claim forms and medical reports must be as accurate and complete as possible, to allow speedy adjudication and disbursement of benefits.

In terms of Section 74(3), the Commissioner may defer payment for medical aid provided to the beneficiary if, in the opinion of the Commissioner, any report submitted is not completed in a satisfactory manner. Medical professionals must ensure that medical reports submitted give pertinent professional and unbiased medical information, to assist RMA in arriving at a decision based on sound medical advice. Withholding critical medical information may jeopardise the employee's chance of fair compensation.

Medical service providers are required to submit progress medical reports with every consultation subsequent to the first medical report. Such reports must be furnished in the manner and at the time and intervals specified or prescribed, or as requested by the Commissioner from time to time (Section 74(2), COID Act). For employees on long-term in-hospital or outpatient treatment, a progress medical report must be provided at least monthly, until the claim has reached a point where no further improvement or deterioration is expected.

A final medical report must be submitted once the patient's condition reaches maximum medical improvement. The final medical report must indicate the level and extent of any objective residual functional or anatomical impairment that resulted from the injury or disease, and any future expected complications, if any. RMA provides additional adjunct reporting templates to final medical reports for different body systems to be completed, specifically for the level of amputation and range of motion, which is found on the RMA website.

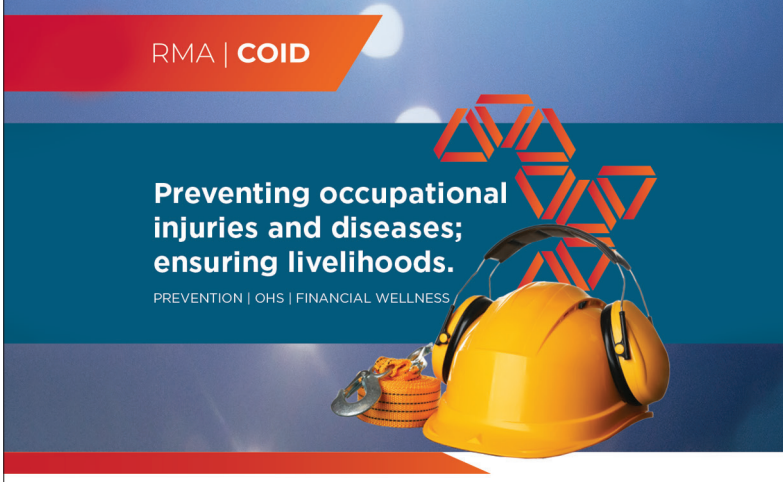
Healthcare professionals are expected to make clinical diagnoses of occupational diseases, based on evidence-based medical guidelines, as guided by the medical scientific community and updated from time to time. Healthcare providers are required to provide an independent, unbiased assessment of the patient's medical condition, institute medically appropriate treatment based on agreed, expert consensus-driven protocols, and always observe the patient's best interest principle.

Overservicing, prolonged and unjustifiable hospital admissions, providing treatment that is not clinically justifiable, and instituting experimental, non-proven treatment modalities are not acceptable and ethical. Healthcare providers are always advised to adhere to established, well-researched, scientifically proven protocols when dealing with COID beneficiaries. Deviations from ethical best practices may lead to partial or total non-payment of invoices.

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ATS/ERS 2019 Spirometry Standards explained: how Vitalograph's new product range bring these to life

Just over a year ago, the American Thoracic Society (ATS) and European Respiratory Society (ERS) updated their spirometry standards after more than 15 years. The need for this update was due to advancements in technology and quality assurance approaches. In this article, we summarise the major changes in the guidelines and show how we have incorporated these recommendations into our new software (Spirotrac 6), desktop spirometer, and handheld spirometer.

What has changed?

The ATS/ERS have made 11 updates to their spirometry standards, including a new list of contraindications, adherence to ISO 26782 standards with a ± 2.5% accuracy error, updated quality assurance procedures, and operator training and competency. There is also a focus on using devices that measure both expiration and inspiration, and updated manoeuvre acceptability and repeatability criteria. New requirements for uniform cues and operator feedback, withholding times for bronchodilators, and a grading system for spirometry quality were added. Standardised operator feedback options were developed for synoptic reporting.

Relative contraindications

The 2005 ATS/ERS spirometry standards did not include any contraindications. The new standards include a list of relative contraindications, based on available evidence. The previous contraindication of spirometry testing within one month of a myocardial infarction was changed to one week. Operators should consider the new list when deciding to perform spirometry, and determine if the benefits outweigh the risks for the patient.

Spirometer accuracy and quality assurance

One major change in the spirometry standards is the tighter accuracy requirement for spirometers, now at ± 2.5%. All spirometers must be validated according to the ISO 26782 standard, which includes new specifications for validation testing. Daily calibration verification using a 3 L syringe is required, regardless of the flow sensor type, and the use of a bacterial and viral filter during testing is recommended. The Fleisch pneumotachograph technology has been proven to meet these standards and is reliable and robust. Bacterial and viral filters are effective in preventing microbial transfer to the flow head, and calibration verification and recalibration are required daily.

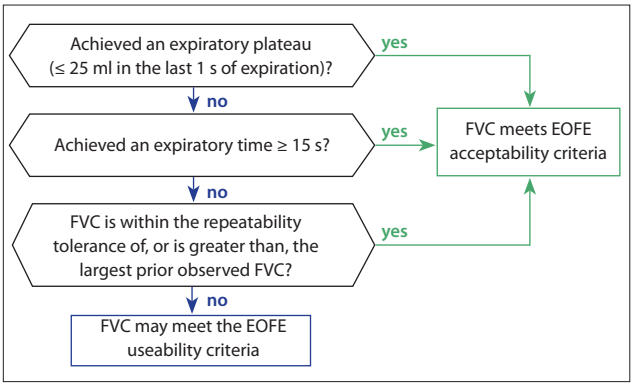


Figure 1. Flowchart outlining the EOFE acceptability for FVC

Inspiration as well as expiration

The updated guidelines for measuring forced vital capacity (FVC) focus on modern spirometers that measure both inspiratory and expiratory flow. The guidelines provide a detailed step-by-step procedure for performing FVC manoeuvres, including four distinct phases: maximal inspiration, a 'blast' of expiration, continued complete expiration for up to 15 seconds, and inspiration at maximal flow back to maximum lung volume. However, the inspiration to total lung capacity at the end is optional. There is no longer a minimum forced expiratory time (FET), and an acceptable FVC can be less than six seconds if it meets other criteria.

Forced expiratory volume in one second (FEV_1) and FVC are now evaluated individually for acceptability, and the concept of 'usable' measurements has been introduced. Figure 1 shows a flowchart outlining end of forced expiration (EOFE) acceptability for FVC. The EOFE is no longer the end of the recommended test procedure, and a maximal inspiration after the forced expiration is emphasised. A satisfactory EOFE is required to ensure that a true FVC has been achieved, and the criteria for repeatability are straightforward. The aim is to achieve a minimum of three acceptable FEV_1 and FVC measurements, with the difference between the two largest acceptable values being less than or equal to 150 ml for patients older than 6 years, and less than or equal to 100 ml or 10% of the highest value for those aged 6 years or younger.

Our software simplifies the repeatability calculation by automatically displaying the difference between the two largest, acceptable FEV_1 and FVC values on the live testing screen (Figure 2). The new Spirotrac 6 software also includes a revamped analysis tab with detailed feedback during testing, including a traffic light classification scheme for meeting the minimum three acceptable measurements within the age-related criteria (Figure 3). The analysis tab also provides useful information such as a pictogramme comparing the measured values to predicted values, and system interpretation based on the Global Initiative for Chronic Obstructive Lung Disease (GOLD) and ATS/ERS guidelines.

Operator feedback

The guidelines require spirometer manufacturers to provide feedback on test quality. We offer in-test prompts and post-test analysis to help identify acceptable and repeatable FEV_1 and FVC measurements, as well as the new EOFE.

During testing, a green notification bar appears when a plateau or 15 seconds has been achieved. After the test, the software analyses the effort against criteria such as start of test, cough-free, and EOFE.

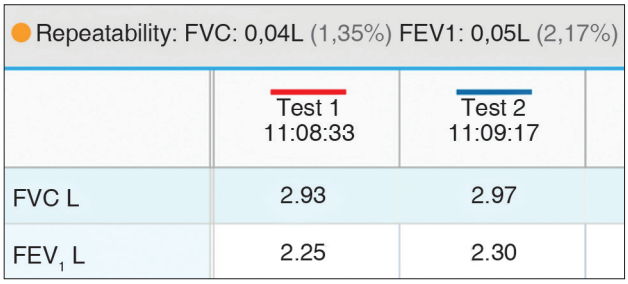


Figure 2. Repeatability feedback in Spirotrac 6

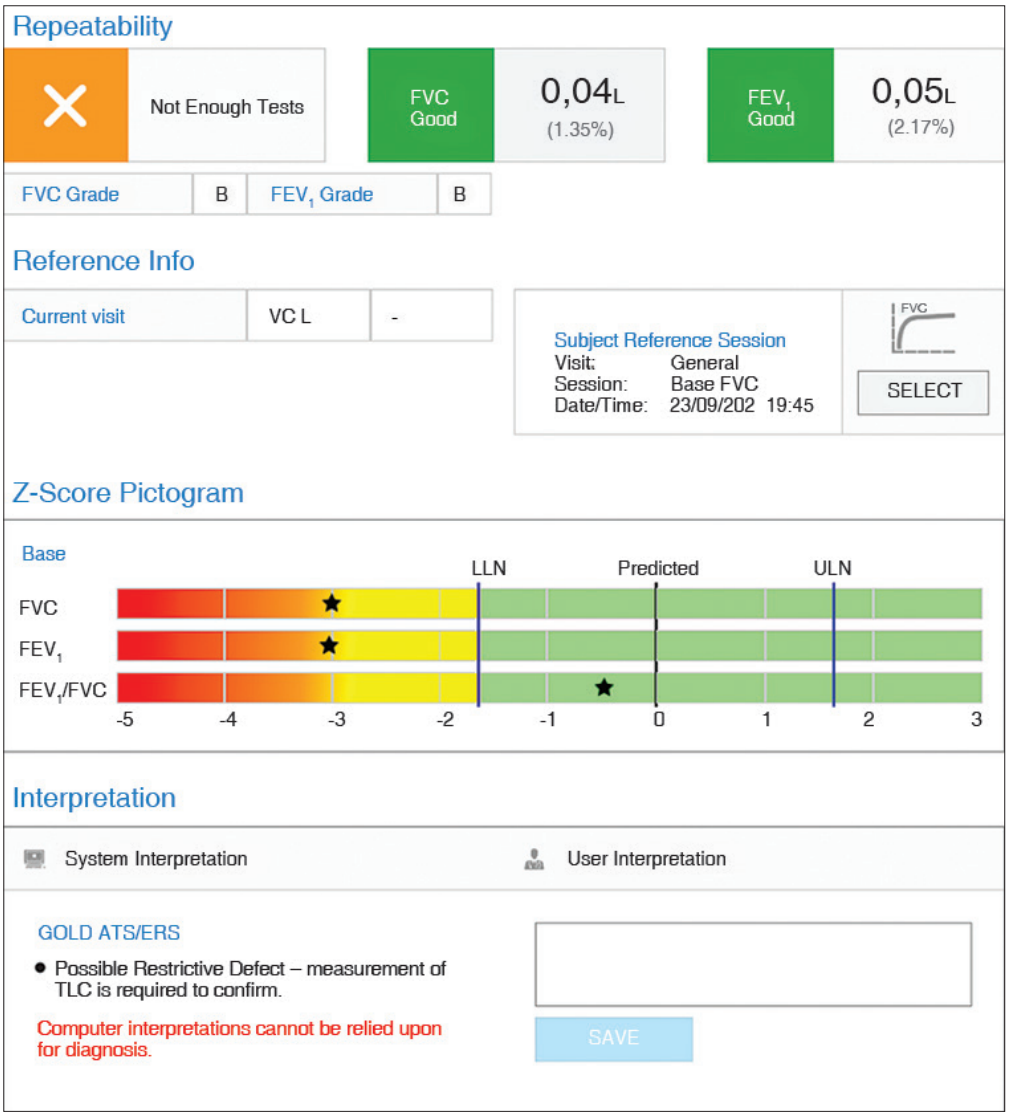


Figure 3. Spirotrac 6 analysis tab

A clear accept/usable/reject scheme is used to display a summary quality message, and feedback is provided under the 'guidance' button, explaining why a criterion was not met and offering suggestions for improving the technique. See Figures 4 and 5 for examples.

Operators can override the acceptability designation for individual FEV_1 and FVC measurements and the entire test on our new spirometers, giving them control over which results to report.

Bronchodilator responsiveness testing

Reversibility testing is now called bronchodilator responsiveness testing to avoid implying complete reversal of airway obstruction. It reports both percentage and absolute changes in FEV_1 and FVC compared to pre-bronchodilator values.

Grading

The ATS/ERS recommend using a grading system for FEV_1 and FVC to inform the interpreter about the level of confidence with the results that represent the best effort of the subject at the time. The repeatability between the two highest FEV_1 and FVC values is used to determine the grades A to F, with 'U' denoting 'usable'. Tables 1 and 2 show the grading system for age 6 years and younger, and for ages above 6.

Standardised operator comments and reporting

Operator comments are crucial for interpreting spirometry results. Synoptic reporting, which uses structured checklists, helps clinicians produce more complete and consistent medical reports. Standardised operator comments enable a more rapid and thorough means of generating meaningful comments to guide interpretation, regardless of the operator.

We recommend using the ATS Standardised Report form with the Global Lung Initiative (GLI) reference equations for all ages. Our reporting capabilities have been expanded to allow customised reports.

Connectivity is more important than ever, and the standards require that spirometers are able to export data to electronic medical records (EMRs). All our spirometers will be supplied with Vitalograph Connect as standard. This new middleware software eliminates the need to scan reports by providing the bidirectional ability to interface directly with major EMRs.

The ATS/ERS Standardisation of Spirometry 2019 Update has brought changes to performing and reporting spirometry. Spirometers must meet ISO 26782:2009 standards with accuracy of ± 2.5%. The GLI reference equations are recommended, and FEV_1 and FVC should be assessed separately. EOFE is the new end-of-forced-manoeuvre parameter. Spirometers should provide better feedback to operators, and bronchodilator responsiveness testing replaced reversibility testing. Vitalograph's new spirometers implemented changes to improve results.

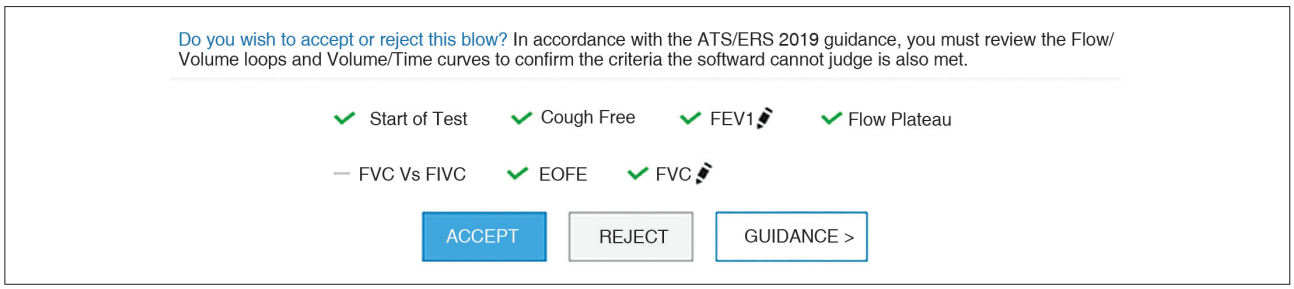


Figure 4. Post-manoeuvre test quality feedback

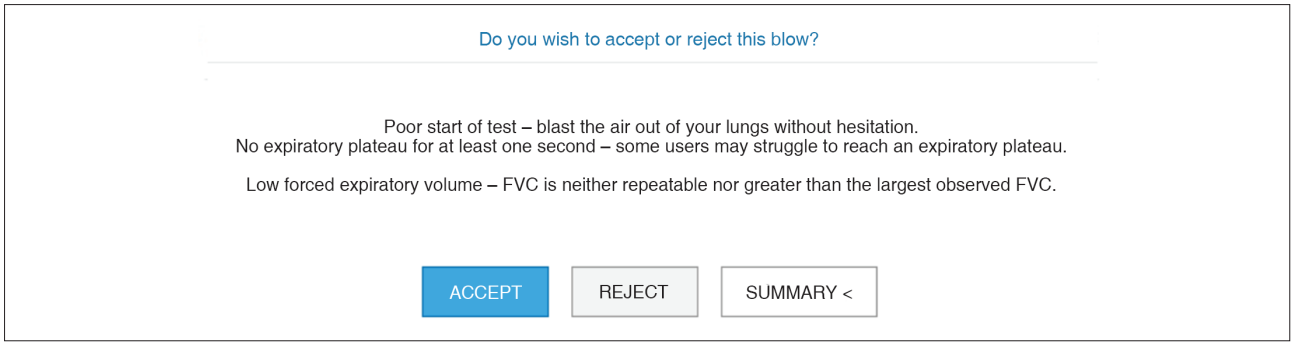


Figure 5. Sample guidance regarding test quality

Grade	Number of Measurements	Repeatabilty: Age ≤ 6 yrs
A	≥ 3 acceptable	Within 0.100 L*
B	2 acceptable	Within 0.100 L*
C	≥ 2 acceptable	Within 0.150 L*
D	≥ 2 acceptable	Within 0.200 L
E	≥ 2 or 1 acceptable	> 0.200 L* n/a
U	0 acceptable AND ≥ 1 usable	n/a
F	0 acceptable AND ≥ 0 usable	n/a

* Or 10% of the highest value, whichever is greater

Table 1. Grading system for FEV_1 and FVC for patients aged ≤ 6 years

Grade	Number of Measurements	Repeatabilty: Age > 6 yrs
A	≥ 3 acceptable	Within 0.150 L
B	2 acceptable	Within 0.150 L
C	≥ 2 acceptable	Within 0.200 L
D	≥ 2 acceptable	Within 0.250 L
E	≥ 2 or 1 acceptable	> 0.250 L n/a
U	0 acceptable AND ≥ 1 usable	n/a
F	0 acceptable AND ≥ 0 usable	n/a

Table 2. Grading system for FEV_1 and FVC for patients aged > 6 years

Summary

- The ATS/ERS Standardisation of Spirometry 2019 Update has introduced some key changes to how spirometry should be performed and reported.
- Spirometers must meet the ISO 26782:2009 standards and meet an accuracy of ± 2.5%.
- The default set of reference values for all ages should be the GLI reference equations.
- FEV_1 and FVC should be assessed for acceptability and repeatability separately, and can be reported from separate manoeuvres.
- End of test (EOT) has been replaced by end of forced expiration (EOFE) to define the end of the forced manoeuvre.
- Patients are no longer required to blow out for at least six seconds, and there is no need to blow out beyond 15 seconds.
- A grading system for FEV_1 and FVC has been introduced to quantify the quality of the measurements.
- Spirometers should provide enhanced feedback to the operator.
- Reversibility testing has been renamed bronchodilator responsiveness testing.
- Vitalograph's new spirometers have implemented the suggested changes to help operators get the best results for their patients.

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ICOH2024 Congress: Second announcement – registration and call for abstracts now open

The second announcement for the upcoming 34th International Congress on Occupational Health of the International Commission on Occupational Health (ICOH) – ICOH2024 (to be held in Marrakesh, Morocco, from 28 April to 3 May 2024) – was launched at the end of March 2023, listing the keynote and plenary speakers. Registration is now officially open and occupational health and safety practitioners across a wide range of fields of expertise are invited to register to participate in the congress and take advantage of the early-bird fee. Abstracts can be submitted for consideration as oral or poster presentations, under the 51 topics that are listed on the website and the second announcement for Free Paper Sessions. There are other benefits such as reduced fees for students and for congress participants from low- and middle-income countries (LMICs). Although the programme of the Global Policy Forum is still under development, the theme has been announced: *Strategies to improve occupational health and safety policies and implementation in LMICs*. Please access the official congress website (www.icoh2024.ma) to download the second announcement (https://www.icoh2024.ma/2nd%20Announcement%20ICOH%202024%20.pdf) and for more information on the developing scientific programme, key dates, grants and awards, venue, social activities, accommodation options, etc. The congress is in the process of being accredited for continuing medical education (CME) points, and the abstracts of the oral and poster presentations will be published as congress proceedings in a special online supplement of *Occupational Medicine* (impact factor: 5.629). https://academic.oup.com/occmed



News from the SASOM National Office

- The South African Society of Occupational Medicine (SASOM) is represented by its Chair, Prof. Daan Kocks, on the Technical Committee on Ergonomics of the Department of Employment and Labour.
- On 9 May 2023, Prof. Kocks convened and chaired an occupational health-focused academic programme hosted by the Department of Public Health Medicine of the University of Pretoria (UP), in collaboration with Sefako Makgatho University, the University of Limpopo, and the World Health Organization (WHO) Collaborating Centre, the Gauteng Department of Health, and SASOM. The topic was 'An approach to work-related asthma in the South African setting', presented by Drs Merveilis Tengem and Elré Sauerman, with Dr Geoffrey Tafaune (member of the SASOM Executive Committee (ExCo)) as discussant, and closing remarks by Prof. Kocks. The scientific paper on which the presentation was based was authored by Prof. Mohamed Jeebhay of the University of Cape Town and can be accessed at http://dx.doi.org/10.13140/2.1.4804.1604
- SASOM held its ExCo meeting at the end of May 2023.
- Following the success and positive feedback received from the 2022 SASOM Annual Congress presenters and participants, the 2023 SASOM Annual Congress will once again be held in a virtual format of four sessions across four months (the last Fridays in June, July, August, and September 2023). The overarching theme of the 2023 congress is *Occupational Health Practice in 2023 – Shining a light on the shadows of medicine*. The scientific content of the first two sessions is under development, which are sub-themed *Good Practice for Occupational Health Medical Practitioners* (OHMPs) and *Updates in Legislation, Compensation, and Ethics in Occupational Health*, respectively.
- SASOM is represented on the organising committee of the upcoming conference of the ICOH Scientific Committee (SC) on the History of the Prevention of Occupational and Environmental Diseases – 7th International Conference on the History of Occupational and Environmental Health – to be held at the University of KwaZulu-Natal, from 15 to 17 November 2023. SASOM will present a poster on the history of the Society

and is awaiting the outcome of an abstract submitted for consideration as an oral presentation on the history of occupational health in South Africa. For more information and submission of abstracts, please access the official congress website: https://icohhistory.ukzn.ac.za

- The 2023 ICOH midterm meeting and associated conference was held in Angers, France, in mid-May 2023. Claudina Nogueira (ICOH Vice President for SCs and SASOM ExCo member) participated and presented on site, and Prof. Kocks (SASOM Chair and ICOH National Secretary for South Africa) was one of a handful of ICOH National Secretaries who were invited to participate, for the first time, in selected sessions of the meeting; he attended virtually. A report on the ICOH midterm meeting will be published in the SASOM news section in the next issue of *Occupational Health Southern Africa*.

Free online courses on research methods

The Research Office of the Faculty of Health Sciences of UP has compiled and uploaded a list of support courses in biostatistics and epidemiology, to assist postgraduate students and supervisors alike with their research work. Topics included in the courses are research methodologies, scientific writing, research ethics, qualitative research, implementation science, evidence synthesis, and molecular modelling. Most of the courses listed are available free of charge. The information is available in the public domain and can be accessed at: www.up.ac.za/media/shared/538/Research%20services%20and%20support/Research%20Capacity%20Building/free-online-research-methods-courses_updated.zp234278.pdf

Occupational health webinars around the world

- In February 2023, Workplace Health Without Borders (WHWB) hosted a two-part webinar on silica dust exposure among workers from processing engineered/artificial stone countertops. Part A was titled 'Engineered stone countertops: How big is the problem?' (accessible at https://www.youtube.com/watch?v=eExSoROWN6s&t=161s). Part B was titled 'Controlling exposure to silica and advocacy' (accessible at https://www.youtube.com/watch?v=ZWeaweT4Vaw&t=13s).
- WHWB hosted a webinar on 11 April 2023, titled 'Dark Winter – past lessons to inform future health', presented by Dr Raina MacIntyre (physician, epidemiologist and professor of Global Biosecurity at the University of New South Wales in Australia, and adjunct professor at Arizona State University in the USA), who shared insights into historical biological attacks, laboratory accidents and epidemics, and the COVID-19 pandemic. Dr MacIntyre also provided a glimpse into new frontiers of biosecurity from her recently launched book, *Dark Winter* (accessible at https://www.youtube.com/watch?v=oNkMx-FeNnE). This webinar follows her first WHWB webinar presented in December 2020, where she shared her views on SARS-CoV-2 transmission and respiratory protection (accessible at: https://www.youtube.com/watch?v=Tr-G0FivoYM).
- Also on 11 April 2023, the World Bank hosted a webinar titled 'Supporting home as a workplace: New approaches to planning and design', drawing on experiences from Delhi and Ahmedabad in India, and reflecting on planning and design practices that have effectively supported livelihood activities. More frequently, homes, especially across the global South, double up as places of work. This has profound implications for how houses and settlements are designed, and also for how cities should be planned.
- WHWB hosted a webinar titled 'Climate Change and Health' in collaboration with Women in Informal Employment: Globalizing and Organizing (WIEGO) on 27 April 2023, to mark World Day for Safety and Health at Work, held on 28 April every year. The webinar, composed of six presentations, shared recent research insights on the intersections of climate, health, and informality from WIEGO and WHWB researchers, and presented testimonies from workers in informal employment who are on the frontline of current climate struggles, as these relate to occupational health and safety (accessible at: https://www.youtube.com/watch?v=SghxByLLf4s).
- The ICOH SC on Emergency Preparedness and Response in Occupational Health organised a webinar titled 'Emergency preparedness in the cold and wet', in January 2023.
- The ICOH SC on Occupational Medicine has hosted two webinars this year, viz. Health Promotion in the Workplace (16 March 2023) and Occupational Musculoskeletal Disorders (3 May 2023).

SASOHN Academic Workshop: *Challenges of Change*
Hosted by: SASOHN KZN Inland Region

Gillian Lotze: SASOHN KZN Inland Chairperson
e-mail: gillian.lotze@mweb.co.za

INTRODUCTION

On 18 May 2023, the KwaZulu-Natal (KZN) Inland region proudly presented a successful South African Society of Occupational Health Nursing Practitioners (SASOHN) Academic Day to 60 delegates at the Anew Hotel in Hilton, KwaZulu-Natal. The event was well supported by sponsors and exhibitors with an exceptional line-up of highly distinguished speakers. The theme of the day was *Challenges of Change*, and each topic spoke to this theme in a relevant and poignant manner.

OPENING ADDRESS

The event was opened by regional chairperson, Gillian Lotze, with the following welcoming address:

> *"Welcome everybody, it's wonderful to see such an amazing turnout! I'd like to congratulate you for investing in yourselves today, and I want to thank you all for your support – especially those who have travelled long distances to get here. We're very proud to share with you our beautiful KZN Midlands and hope you get to see some sites before you have to leave today or tomorrow. We have an exceptional line-up of speakers and some amazing exhibitors. I hope you leave here today with a bit more knowledge, and that you feel connected, enriched, and inspired to continue your invaluable work of changing the lives of others, and making the world a better place. Our theme,* 'Challenges of Change'*, came to us as a result of our acknowledgment of the times we are living in right now. Life has changed drastically over the last three years, and none more so than for us nurses. Change is frightening, unpredictable, uncomfortable, and risky, but is also necessary. If we are to stay relevant in these turbulent times, we need to be flexible, and resilient. Adaptability is the new currency and requires us to be open to new ways of working, learning, and communicating. Our exceptional line-up of speakers will be sharing with us the latest research and trends in their various fields, and I'm looking forward to hearing their valuable insights into how we can shift our perspectives in the way we deliver nursing care in the occupational health setting."*

SASOHN KWAZULU-NATAL INLAND EXECUTIVE COMMITTEE

Gillian Lotze: Chairperson
Tony Mthiyeni: Vice-Chairperson
Kathryn Olive: Educational Representative
Kim Arnold: Secretary
Penny Wheeler: Treasurer
Sandra Koekemoer: Public Relations Officer
Sharon Severn: Member Without Portfolio

PRESENTATIONS

Ms Lotze then introduced the first speaker, Dr Makhosazane Dube, who spoke on the 'Evolution of nursing education'. She spoke about the reforms and milestones in nursing education, the phasing out of legacy qualifications, and the National Qualification Framework (NQF) and articulation pathways. The second speaker of the day was Dr Nellie Naranjee, who gave an interactive presentation highlighting the nurse's role in integrating recent evidence-based research with everyday clinical practice. She mentioned the barriers to accessing research and encouraged nurses to improve their utilisation of research in order to maintain relevance and keep abreast of latest trends. The last speaker of the first session, Dr Daniel Fiandeiro, an emergency medicine specialist, spoke about 'Innovations in digital health'. He discussed the benefits and challenges of digital health technology and systems, as well as telemedicine and artificial intelligence. He then spoke about a mobile application that assists with the tracking and management of Workman's Compensation Act (WCA) claims and various online courses for medical personnel.

Session Two was hosted by Tony Mthiyane, who introduced Prof. Nceba Nqaleni. His topic was 'Traditional medicine and its role in wellness'. He spoke about the advantages of traditional medicine and highlighted the importance of thorough history-taking along with openness to patient usage of, and collaboration with, traditional healers. The next speaker was clinical pathologist, Dr Hellen Hlongwane, who spoke about 'Antimicrobial stewardship' (AMS). She covered the aims of AMS programmes, highlighting their importance, core elements and strategies – in both hospitals and the community. She also explained how these programmes are implemented and assessed to evaluate their efficacy. The last speaker in Session Two was Dr Sujatha Hariparsad, whose topic was the 'Occupational health practitioner's duty of care – ethical and legal challenges'. She covered core ethical principles and issues of dual loyalty. In addition, she touched on practical cases and demonstrated ways that occupational health practitioners can ensure that they act ethically in all situations.

After breaking for lunch and allowing the exhibitors an opportunity to showcase their companies and hand out prizes, Sr Robyn de Wet presented her Master's thesis – a study investigating the 'Knowledge, attitude and perception of occupational health nurses towards the testing of cannabis in the workplace'. She educated the audience on the cannabis plant, its usage, and what constitutes impairment. She briefly covered the implications of the recent legislative changes, and the future of cannabis testing and training. The final speaker of the day was clinical psychologist, Alistair Mork-Chadwick, who spoke about 'Adjusting to change'. He highlighted the four character traits that make it difficult to adjust to change, and then demonstrated how to develop a growth mindset, flexibility, and emotional resilience.

SASOHN
SOUTH AFRICAN SOCIETY OF OCCUPATIONAL HEALTH NURSING PRACTITIONERS
Registered Public Benefit Organisation (Reg no 857107915)

Academic Day 2023

"Challenges of Change"

	Time	Topic	Speaker
		Registration	
	08h30	Opening and Welcome Address	Michelle Bester
1.	**08h40 - 09h10**	Addiction - Changing the Narrative	Dr Ruwayda Petrus
2.	**09h15 - 09h45**	Linking Medical Research and Clinical Practice	Dr Nellie Naranjee
3.	**09h50 - 10h20**	Innovations in Digital Health	Dr Daniel Fiandeiro
	10h25 - 10h45	Tea	
4.	**10h45 - 11h15**	Insights into the Use of Traditional Medicines	Prof Nceba Gqaleni
5.	**11h20 - 11h50**	Antibiotic Stewardship	Dr Helen Hlongwane
6.	**11h55 - 12h25**	The Evolution of Education in Nursing	Dr Makhosazane Dube
7.	**12h30 - 12h50**	Student Presentation of Thesis	Sr Robyn De Wet
	12h50 - 13h50	Lunch	
	13h50 - 14h20	**Exhibitors**: 2 min each to present + lucky draw prizes etc.	
8.	**14h25 - 14h55**	Navigating the OH Practitioner's Duty of Care - ethical and legal challenges	Dr Sujatha Hariparsad
9.	**15h00 - 15h30**	Adjusting to Change	Alistair Mork-Chadwick
	15h30	Closing	

Date: 18 May 2023, Venue: Anew Hilton Hotel, Pietermaritzburg

Our Nurses Our Future.

Cost:

Members: R1,600
Non-Members: R2,600
Student/HLM: R1,050
Exhibitor: R2,600

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Photographs: courtesy of SASOHN

EXHIBITORS

The exhibitors gave away some wonderful lucky-draw prizes. A big thank-you goes to the following exhibitors:

1. Ampath Laboratories – one of South Africa's foremost laboratories, with innovative professional and quality pathology and laboratory medicine services to healthcare practitioners and patients.
2. D & R Incorporated – debt specialists providing debt relief to private and corporate employees, particularly with regard to financial rehabilitation.
3. Education for Health Africa – a training institute offering high-quality occupational health-related short courses.
4. Gulf Drug Company – providers of generic equivalents, contributing to high-quality healthcare at affordable prices.
5. H.A.S.S. Industrial/The Ear Institute – a comprehensive range of hearing healthcare services for adults and children, ranging from a quick HearingCheck™ to a full diagnostic hearing evaluation.
6. Kendon Laboratories – providing medical and remedial equipment and supplies.
7. Mi7 – leaders in ambulance and emergency care, education and training, and event medical services.
8. Micromega Publications – focuses on giving life to innovative ideas that have a social impact, by publishing and supplying health and wellness information for South African companies.
9. Midlands Specialist Hospital – a private hospital comprising 274 beds across all major healthcare disciplines, situated in the centre of Pietermaritzburg.
10. Rent2Recover – specialising in a wide range of mobility equipment, including electric wheelchairs, electric scooters, hospital beds, knee scooters, bath lifts, oxygen concentrator machines, and many more. They also have a wide range of medical equipment available for purchase.
11. Royal Rehabilitation Hospital – a private sub-acute rehabilitation facility offering a wide variety of medical services that bridge the gap between acute, sub-acute, and home care.
12. Software 1066 – the home of ClinicSister and SHREQManager software solutions.
13. SOS Optometrist – a fully accredited and licensed optometry practice with a rich history in KwaZulu-Natal, focusing on on-site eye screenings with affordable solutions.
14. SSEM Mthembu Medical – the leading distributor of electro-medical devices and medical consumables throughout southern Africa.
15. Stanyer Electroserve – providing personal yet professional service in the ever-changing world of hi-tech medical equipment.

ACKNOWLEDGEMENTS

We thank our sponsors: Amberglades Retirement Village, Ampath Laboratories; Drinkerbell, Illovo Sugar, Medpak, Occusure, Royal Rehabilitation Hospital, and Wedgewood. The KZN Inland Executive Committee members also extend their sincere thanks to all members, exhibitors, and sponsors for their generous support in making the day a total success.

SAIOH news

As part of our service to members, in this newsletter we provide feedback on the latest developments within the Southern African Institute for Occupational Hygiene (SAIOH). SAIOH exists solely for its members and is reliant on them to continue to serve this noble profession ethically. Therefore, we invite your inputs and feedback on any matters communicated below.

SAIOH PRESIDENT

Naadiya Mundy: SAIOH President
e-mail: president@saioh.co.za



Naadiya Mundy
Photograph: courtesy of SAIOH

Promoting worker health: managing seasonal illnesses through technology and occupational hygiene

Understanding the factors that contribute to the seasonality of infectious diseases, such as influenza, is crucial for effective prevention and control measures in the workplace. Among these factors, humidity and temperature play significant roles in the occurrence and transmission of the influenza virus. In addition to addressing everyday safety concerns, organisations should focus on protecting workers from seasonal illnesses. With advancements in technology, innovative solutions can be employed to promote a healthy environment and minimise the impact of seasonal illnesses on employees in the workplace.

Seasonal patterns of influenza epidemics vary by geographical region. In temperate regions, influenza epidemics exhibit a wintertime seasonality, whereas some (sub)tropical locations experience annual epidemics that align with the rainy season. Other regions exhibit bi-annual incidence patterns, or year-round persistence.[1]

Many illnesses, including respiratory infections, tend to be more prevalent during the winter months, for several reasons:

1. Cold weather: low temperatures do not directly cause illnesses, but they can contribute to conditions that promote the spread of viruses. Cold air dries out the respiratory tract, increasing susceptibility to viral infections. People also tend to spend more time indoors during colder months, in close proximity to one another, increasing the opportunities for viruses to spread.
2. Decreased immune function and drying of respiratory airways: studies suggest that our immune systems are less effective in fighting infections during winter. Factors such as reduced vitamin D levels due to limited sunlight exposure, seasonal fluctuations in immune cell activity, and increased stress levels all contribute to decreased immune function, making individuals more vulnerable to infections. Additionally, low relative humidity levels cause the cells and mucous linings of our airways to dry out, negatively impacting their function as a defence against viral particles and foreign substances. In environments with inadequate moisture, viral particles have a higher likelihood of 'docking' at airway receptor sites, which increases the risk of infection.
3. Indoor crowding: during winter, people tend to spend more time indoors in enclosed spaces to escape the cold. This increased proximity/crowding provides a favourable environment for viruses to spread through respiratory droplets.
4. Inadequate ventilation: indoor environments may have limited ventilation during winter months as windows and doors remain closed to conserve heat. This can lead to inadequate airflow and an accumulation of airborne pathogens, increasing the risk of respiratory infections. For example, as humidity levels increase, so does the decay of viral particles,[2] reducing the amount of viral material suspended in the air. Low relative humidity, such as experienced indoors during winter, promotes the evaporation of droplets and allows larger droplets to remain suspended in the air as aerosols for prolonged periods.[3]
5. Compromised protective measures: during winter, people may be less likely to engage in preventive measures, such as hand hygiene, due to dry skin or the perception that viruses are less prevalent. This can further facilitate the spread of viruses.

It is important to recognise that viruses can be transmitted throughout the year, although certain factors contribute to increased transmission in winter. Therefore, to safeguard worker health, it is important to optimise ventilation, humidity, and temperature by using modern technology, such as real-time monitoring, and enhancing indoor air quality. This proactive approach empowers organisations to identify potential hazards swiftly, evaluate exposure levels, and implement control measures to ensure worker health and safety.

Real-time monitoring involves the utilisation of advanced sensors, instruments, and technology to collect data in real time and provide immediate feedback to the occupational hygiene, health and management team. Promoting good hygiene practices, encouraging vaccination, and maintaining a healthy lifestyle are essential in mitigating infections, regardless of the season. By continuously monitoring indoor air quality, organisations can promptly respond to any deviations from recommended standards, minimise occupational risks, and prioritise the wellbeing of their workforces.

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NATIONAL COUNCIL FEEDBACK

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Strategic plan and objectives

The current SAIOH strategy (five-year) plan is steered by Jaco Pieterse. The strategy is discussed, and progress thereof is evaluated, at each monthly SAIOH Management Board meeting and at the quarterly Council meetings. Several objectives/targets have been met.

The strategy will formally be launched at a special annual general meeting (AGM) in July 2023.

The SAIOH five-year (2023–2027) strategic objectives are:

#1: To maintain and ensure SAIOH's relevance in creating workplaces free of health risks in South Africa, Africa and the Middle East.

#2: To embrace the application and use of 4IR and digital technologies in occupational hygiene practice, e.g. real-time monitoring.

#3: To preserve professionalism and ethical professional practice amongst occupational hygiene practitioners, e.g. through approved ethics courses, certificates, and legal review of ethics procedures.

#4: To develop and build the SAIOH brand in South Africa, Africa, and the Middle East, e.g. through occupational hygiene awareness videos, talks, newsletters, etc.

#5: To contribute to improving training and the continuous development of the occupational hygiene profession in South Africa, Africa, and the Middle East, e.g. the SAIOH Occupational Hygiene Skills Forum (OHSF), occupational hygiene technical workshops, position, and technical papers etc.

#6: To provide and maintain good governance and administrative practices within SAIOH, e.g. through staff meetings, updated conditions of service, memoranda of incorporation (MOIs), financial reports, and the SAIOH quality management system (QMS).

Ethics

SAIOH entered into an agreement with well-known legal advisors, NGO Law, to advise the Institute as required. The first task was to develop an MoI to replace the current Constitution. The MoI will be presented at a special AGM in July 2023. Our legal advisor's next task will be to review the SAIOH Ethics Policy and Procedure(s), thus enabling the Ethics Committee to start its work in earnest. The ethics plan is an important part of the SAIOH strategy.

> ***Note***
> From January 2023, all SAIOH-certified members will be required to provide proof that they have completed an acceptable occupational hygiene ethics training course. A one-year phase-in period was allowed during 2022. The recording of the ethics webinar presented by Terry McDonald of BOHS during the 2021 annual virtual conference was sent to all attendees and those who purchased the recording.

During the 2022 conference, Terry McDonald presented a hybrid Professional Development Course (PDC) on ethics in the occupational hygiene environment. A multiple-choice assessment/test (MCQ) was developed, based on the 2021 webinar. This is in a Survey Monkey format that SAIOH uses. There is a time limit of 30 minutes, and only members who qualified (attended the course) will receive a passcode and access to the test. There will be three opportunities to complete the test at weekly intervals, with the system automatically marking the paper and notifying the candidate of the result. The required mark to pass is 60%.

We will develop a similar MCQ for the 2022 Ethics PDC; delivery date is early 2023, and the same rules will apply. During 2023, further ethics sessions will be offered at the branch workshops, and at the 2023 SAIOH Annual Conference.

SAIOH branch activities

The first Gauteng branch meeting for 2023 took place on 3 March 2023. The SAIOH General Manager, Deon Jansen van Vuuren, gave SAIOH feedback from the last quarter of 2022, and the way forward for 2023, including the SAIOH five-year plan. One hundred and thirteen occupational hygiene practitioners attended this virtual meeting.

The Western Cape branch hosted its first in-person meeting on 10 March 2023. Deon Jansen van Vuuren repeated the presentation given to the Gauteng branch. This was followed by a lively question-and-answer session. There were 32 attendees.

The Gauteng branch held its second meeting on 21 April 2023 at the Draeger SA offices in Sandton. Draeger SA hosted this meeting and conducted a practical and insightful demonstration regarding the differences between FFP2 respirators. This was followed by an online presentation on the new SAIOH strategic (five-year) plan by Jaco Pieterse. Deon Jansen van Vuuren provided some feedback on the planned annual conference in Cape Town (23–26 October 2023). Mr van Ordel gave a presentation on the groundbreaking research of Anglo American to change its carbon footprint by replacing the massive ore haulage trucks' diesel engines with hydrogen-driven engines. There were 25 in-person attendees and 11 joined online.

The Botswana branch, now registered in Botswana as the Botswana Association for Occupational Hygiene (BAOH), held a special workshop via a Microsoft Teams meeting on 2 March 2023 to discuss what is required from them to apply to host the 2024 SAIOH Annual Conference in Botswana.

The BAOH held its first meeting for 2023, online, on 19 April. The presentations were:

- An update of the BAOH strategic plan and development as a national occupational hygiene association (Pheto Mosinyi and BAOH committee members)
- The official bid to host the 2024 SAIOH Annual Conference
- Occupational hygiene as a priority skill in Botswana (by a senior officer in the Botswana Department of Mines)
- Progress on developing contacts and memoranda of understanding (MoUs) with important stakeholders in Botswana
- SAIOH and the way forward in 2023, including the SAIOH five-year plan (by Deon Jansen van Vuuren)
- Risk assessments and female occupational hygiene risks at a diamond mine (BAOH committee member)

Forty-nine occupational hygiene practitioners and other interested persons attended this virtual meeting.

SAIOH financial statements

Audited financial statements for 2021 and 2022 will be presented at the special AGM in July 2023.

SAIOH Technical Committee feedback

The SAIOH Technical Committee's research on welding fumes (the measurement and the analyses thereof) is ongoing. We anticipate completing this soon and finalising a SAIOH technical and position paper in 2023.

Our second technical committee started developing technical procedures and a SAIOH position paper on heat stress management. This committee will continue doing research on heat stress. The aim is two-fold: first, to develop a technical paper, and second, to enable SAIOH to provide comprehensive and relevant proposals to strengthen the newly launched Physical Agents Regulations (PAR) – the old Environmental Regulations for Workplaces.

The Gauteng branch agreed to host a paid workshop on heat stress management in June 2023. Notification will be circulated to our members in due course.

The Council technical co-ordinator is finalising a position paper on real-time monitoring. As soon as the SAIOH Professional Certification Committee (PCC) Exco approves it, it will be circulated to all SAIOH members and stakeholders.

International feedback

The American Industrial Hygiene Association (AIHA) invited SAIOH to be one of its international partners in its exciting hazardous chemical agents (HCA) CARE programme. *Watch this space.*

The Occupational Hygiene Training Association (OHTA) and International Occupational Hygiene Association (IOHA) continue to publish their newsletters. Links are e-mailed to all SAIOH members and published on the SAIOH website: www.saioh.co.za. Please note OHTA's new website: www.ohtatraining.org

Garth Hunter is SAIOH's representative on the IOHA Board and its National Accreditation Recognition Committee (NARC). The Board and NARC held meetings in April and May, respectively.

Annual SAIOH Scientific Conference

The hybrid 2023 Annual Scientific Conference is planned for 23–26 October this year. The conference will be paired with the International Occupational Hygiene Association's (IOHA) meeting (on 22 and 23 October 2023). SAIOH will develop a dedicated webpage for the conference, send out comprehensive conference notifications, and design a flyer. E-mail notifications (Mailchimps) with registration links, sponsorship details, and exhibitor invitations will be sent to out to alleviate administration and registration logistics.

New SAIOH website

SAIOH engaged website developers to overhaul the current website – specifically to allow integration with the Member Management System (MySAIOH). The framework, with the necessary integration, was delivered. The SAIOH administration team, led by Naadiya Mundy, is progressing well with the implementation and population of the new website. Special assistance was enlisted to speed up the completion. The aim is to launch the 'new' website at the special AGM in July 2023.

Communications

SAIOH publishes its newsletter and Presidents' page in two electronic media formats, namely the *Occupational Health Southern Africa* (OHSA) journal, and the *African OS&H* magazine (A-OS&H). These publications are issued every two to three months. The links are sent to all members via our Mailchimp (e-mail notification) system and posted on the SAIOH website.

SAIOH communicates daily with its stakeholders via e-mails, phone calls, and virtual meetings about important news, technical information, legislation changes, new standards, occupational hygiene job opportunities, occupational hygiene products and services, courses, and webinars on occupational hygiene, health, occupational and environmental safety, etc.

FROM THE PROFESSIONAL CERTIFICATION COMMITTEE (PCC)

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Certification assessments

A summary of results from March 2023 written assessments is provided in Table 1.

Table 1. SAIOH PCC certification assessment results (31 March 2023)

Certification category	Written assessments			
	Assessed	Passed	Failed	Pass rate
	n	n	n	%
OH assistant	36	31	5	86.1
OH technologist	17	9	8	52.9
Occupational hygienist	22	15	7	68.2
Total	**75**	**55**	**20**	**73.3**

The Q1 PCC written assessments took place on 17 March 2023; 32 virtual oral assessments were conducted from 21 April to 5 May 2023. Outcomes will be communicated in due course.

Oral assessment improvements

The PCC technical teams continue to revise the PCC oral assessment format and questions in line with the occupational hygiene self-assessment tool. Two PCC technical teams are working in parallel. The first is updating the SAIOH self-assessment tool and revising the PCC oral assessment format, while the second is developing questions and the required answers. Improvements in the assessment format are to ensure that the growing field of occupational hygiene is covered and that the assessment format and tools still are relevant, current, and fair.

Occupational Hygiene Skills Forum (OHSF)

The SAIOH Occupational Hygiene Skills Forum (OHSF) was initiated to coordinate all aspects related to the recognition of occupational hygiene training materials (e.g., the asbestos training courses, and occupational hygiene training providers and institutions), and the development and management of assessment and examination systems, where needed.

The OHSF was instrumental in coordinating the development of a bulk asbestos sampling and analysis training course. Julie Hills, Celia Keet and Karen du Preez spent time and energy developing the course training materials. The team developed asbestos courses, the

most recent (AP103) of which is related to asbestos risk assessments. This training material is now available for registered training providers to use, but the assessments will continue to be administered by SAIOH at a fee per candidate. Please contact Lee Doolan for more information (lee@saioh.co.za).

The OHSF also participates in the W201 MCQ Consortium, comprising Workplace Health Without Borders (WHWB), the American Industrial Hygiene Association (AIHA), SAIOH, and the Australian Institute of Occupational Hygienists (AIOH). This working committee is developing and verifying multiple-choice questions (MCQs), which will be incorporated into a database that will be accessible by all assessment paper developers to use in the OHTA W201 papers. In SAIOH's case, the database will also be accessible for the registered occupational hygiene assistant (ROHA) papers.

Another function of the OHSF is to evaluate applications from tertiary institutions for recognition of their occupational hygiene-related qualifications. The OHSF is progressing well with these accreditations. It has developed a matrix to evaluate the occupational hygiene content in line with the 50% requirement. All tertiary institutions that offer occupational hygiene qualifications are encouraged to contact the PCC administrator for information regarding application for recognition (lee@saioh.co.za).

Details of recognised training providers and recognised qualifications will be available on the SAIOH website (www.saioh.co.za). This will make it easier for students and certification candidates to select suitable occupational hygiene training programmes that meet SAIOH and international requirements.

Resilience in TB and HIV response in the face of the COVID-19 pandemic

Florence Magampa: Occupational Health Programme Manager, MHSC
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INTRODUCTION

Tuberculosis (TB) and human immune virus (HIV) are public health concerns that continue to cause ill health and, if untreated, claim many lives, globally. TB remains the leading cause of death among people living with HIV (PLHIV) according to the World Health Organization (WHO),[1] and this is primarily because HIV weakens the immune system.

It would be, without doubt, a huge breakthrough to end/eliminate both HIV and TB, not only due to their devasting impact on health, but also their socio-economic impacts. This is one of the main reasons that global and national targets were set to end the two epidemics (TB and HIV) by 2030 and 2035, respectively.

The COVID-19 pandemic had devastating impacts on implementation of TB and HIV programmes (particularly on diagnosis and treatment), and on reporting, globally and nationally. Neither global nor national targets were met by 2020, and TB and HIV-related deaths increased from 2019 to 2021.[2,3]

The South African mining industry (SAMI) was not exempt from the setbacks as progress was negatively affected, particularly in 2020 during the hard COVID-19 risk-based restrictions. With more than 450 000 employees in the SAMI in 2020 and 2021,[4] some of whom worked in high-density areas, the impact of COVID-19 on the health and wellbeing – particularly of vulnerable groups such as those with past or present TB, PLHIV, and those with other chronic diseases – could have been much worse. However, it is encouraging that the sector remained resilient throughout the epidemic; some mines have recovered and, in certain instances, surpassed progress made up to 2019.

This report aims to illuminate the sector's resilience in TB and HIV responses during the COVID-19 pandemic, by looking at outcomes from the Department of Mineral Resources and Energy (DMRE) (DMRE 164 data, which are also contained in the Mine Health and Safety Inspectorate (MHSI) Annual Reports).

THE SAMI'S TB AND HIV RESPONSES

The SAMI has a long history of high rates of TB and HIV, especially in the gold sector. Systematic monitoring and reporting on the two diseases in the sector started in 2014, through the Department of Mineral Resources and Energy (DMRE). The mining industry, through the Mine Health and Safety Council (MHSC), holds biennial Occupational Health and Safety (OHS) Summits to review the state of health and safety in mines. In addressing the TB and HIV disease burdens in the sector, the Mining Industry TB, HIV and AIDS Advisory Committee (MITHAC) was established under the auspices of the MHSC to advise the MHSC and the sector on TB, HIV, and AIDS-related policies and regulatory mechanisms. This tripartite alliance (representing the state, mine employers, and organised labour) continues to play a role in developing guidelines, guidance notes, and policy and reporting forms to ensure that the sector can develop, implement, and monitor HIV and TB programmes.

At the 2014 OHS Summit, industry principals agreed on the TB and HIV milestone targets below, to support the National Strategic Plan (NSP) and to accelerate the SAMI's journey to zero harm:

- By December 2024, the TB incidence rate should be at or below the national TB incidence rate; and
- 100% of employees should be offered HIV counselling and testing (HCT) annually, with eligible employees linked to an antiretroviral treatment programme as per the NSP.

Other initiatives were put in place to assist mines integrate monitoring of TB and HIV programmes implementation and stakeholder engagement, which includes contact tracing, such as the Masoyise Health Programme, under the Minerals Council South Africa. The role of organised labour has also been enormous in the fight against TB and HIV. It raised health and safety concerns (which included the high TB rates in the sector and lack of a monitoring system), which then led to outcomes from the Leon Commission of Inquiry into Safety and Health in the Mining Industry.[5] Organised labour also contributes to policy and regulatory mechanisms development, participation in research, and employee education and communication.

THE SAMI'S PERFORMANCE DURING THE COVID-19 PANDEMIC (2020–2021)

The MHSC, through the MITHAC, recently (in March 2023) analysed data from the DMRE 164 TB and HIV reporting template (as revised) for reporting years 2013–2021, with special interest in 2019–2021 (prior to and during the COVID-19 pandemic), to determine the impact of the epidemic on TB and HIV response in the sector (see Figure 1). The following were outcomes:

Reporting (on the DMRE 164 forms)

Reporting on the DMRE 164 form on TB and HIV to the regulator (the DMRE) in 2020 was higher than in 2019, with 775 reports submitted in 2020 compared to 754 in 2019, and continued to increase in 2021 (789 reports).

In as far as TB and HIV compliance indicators are concerned, the following was noted:

Integrated HIV and TB policy

Total compliance with the policy was at 94% in 2019 and, although a decrease of 2.1% was noted in 2020, compliance remained above 90%. Compliance increased from 91.9% in 2020 to 93.7% in 2021, reverting closer to the 2019 performance. The highest-performing commodity in 2021 was the platinum sector at 100%, followed by the coal and diamond sectors – both at 97%.

Integrated HIV and TB programme

Total compliance with the integrated programme was low among reporting mines in 2019, at 59.2%. Compliance decreased further in 2020, by 0.4% to 55.8%. In 2021, however, mines' compliance

improved by 1.8% to 60.6%, surpassing the 2019 performance. The platinum and coal sectors were at performance levels of above 90% in 2021, followed by the gold sector at 86%. The diamond sector was at 11.5% in 2021, which was an improvement of 4.7% from the 2019 performance.

HIV and TB programme budget

The overall compliance on TB and HIV programme budgets by mines was low in the three reporting years (2019–2021). Compliance increased by 1.1% from 2019 to 2020, but decreased by 0.6% in 2021. Generally, all commodities regressed in 2020, with improvements in 2021, with some surpassing the 2019 figures.

Monitoring and evaluation systems for TB and HIV programmes

Total compliance with monitoring and evaluation systems decreased slightly by 0.1% in 2020 (from 57.4% in 2019) and by a further 0.3% in 2021. This calls for urgent improvement by the sector.

SAMI'S 2014 TB AND HIV MILESTONES

- By December 2024, the TB incidence rate should be at, or below, the national TB incidence rate; and
- 100% of employees should be offered HCT annually, with eligible employees linked to an antiretroviral treatment programme as per the NSP.

Progress in achieving the milestones

The SAMI TB incidence rate has been consistently lower than that of the South African general population since 2017 (at 545 per 100 000 population in SAMI vs 738 per 100 000 in the general population), as seen in Figure 2. In 2020 and 2021, the SAMI TB incidence rates were 312 and 225 per 100 000 population, respectively, compared to the general population rates of 554 and 513 per 100 000 population, respectively. With only 18 months left until December 2024, it is likely that the SAMI will reach the TB incidence milestone.

Although the COVID-19 pandemic affected TB screening in the sector during 2020 and 2021, it has remained above 90%. TB treatment has remained above 90% since 2015, with 100% of people diagnosed with TB on treatment in 2021 (based on mines having reported on DMRE 164 reporting templates in that year).

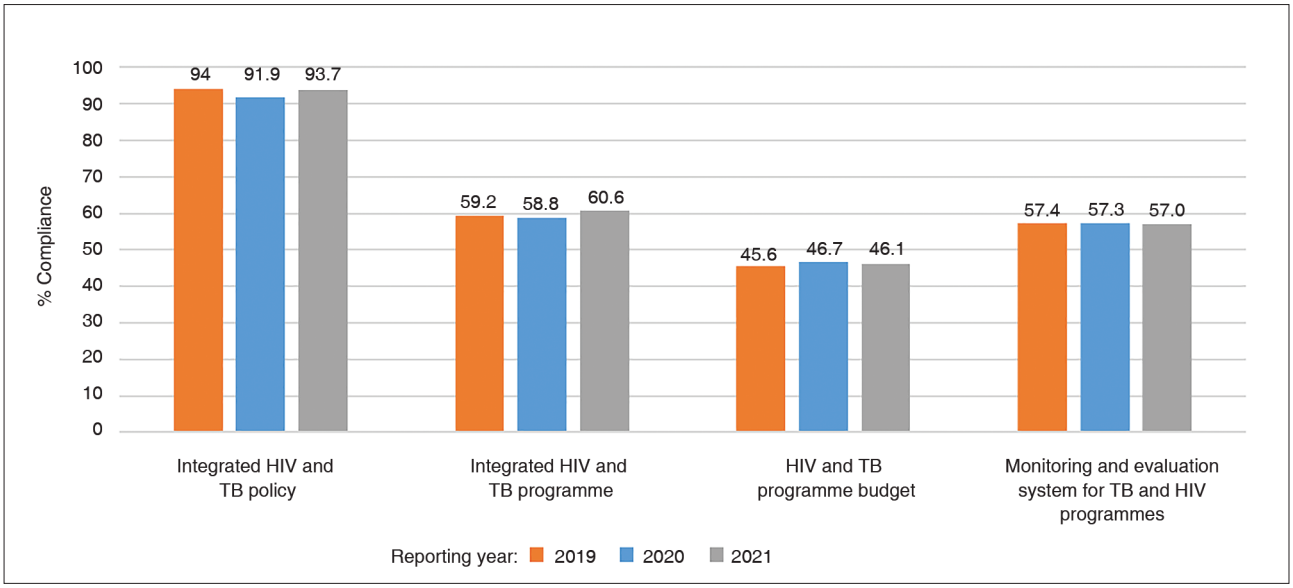
As far as HCT is concerned, the SAMI has not met its target on an annual basis; however, there has been a gradual increase in HIV counselling since 2014 (when it was at 55.7%). In 2020, the sector improved slightly by 0.3% to 73.5%, but regressed to 66% in 2021. HIV testing regressed by 7.1% in 2020 (when it was at 59.1%), but improved substantially to 73% in 2021.

DISCUSSION

It is evident that the SAMI remained resilient with regard to the TB and HIV response amidst the COVID-19 pandemic. In 2020, the sector improved on TB and HIV reporting and the allocation of budgets to TB and HIV programmes, however, the implementation of the integrated policy, programme, and monitoring regressed slightly during the Pandemic. The industry improved in 2021, to the 2019 figures, while other mines improved beyond their 2019 performances. TB screening and treatment remained above 90%, while HIV counselling regressed from 2020 to 2021. HIV testing, on the other hand, improved in 2021.

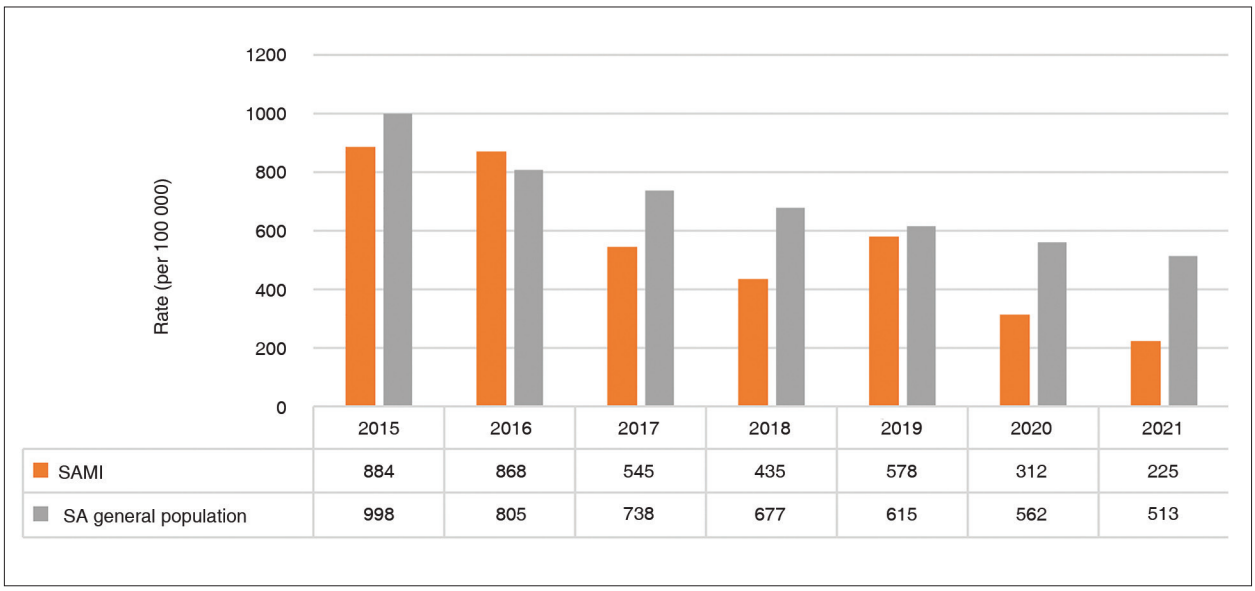
Several initiatives contributed to the sector remaining resilient while fighting SARS-CoV-2, which had claimed the lives of approximately 750 mine employees by July 2022.[10]

- Through the MHSC, the guiding principles and guidelines on the prevention, mitigation, and management of COVID-19 were developed to guide the industry.
- Measures were put in place to protect mine employees against COVID-19 and, through mines' risk assessments, key populations (including vulnerable groups) were prioritised.
- In 2020, when the Minerals Council observed a decline in reporting and performance on the 2014 MHSC and Masoyise milestone indicators by its members, a study was commissioned to identify companies that were performing well amidst the Pandemic.[11]



Source: DMRE MHSI Annual Reports, 2019–2021[6-8]

Figure 1. Compliance with DMRE 164 TB and HIV indicators by South African mines (2019–2021)



Sources: DMRE Annual Reports, 2015–2021, World Health Organization[9]

Figure 2. Trends in TB incidence (SAMI vs SA general population)

Case studies were documented, together with critical success factors (CSFs) from the selected mine companies, for knowledge transfer and adoption by other mines. From the study, five mining companies were identified and, in all of them, the following CSFs were found to be common in maintaining good performance: leadership, financial and human resourcing, electronic health information systems, stakeholder engagement, and communication. The study outcomes have been widely disseminated.

- Agility to respond to emerging risks has been evident in the sector.
- Education, awareness, and communication – these continue to take place at mine level and industry level through platforms such as the Occupational Health Dialogue, the World AIDS Day and TB Day campaigns, DMRE interaction with the mines, and at international conferences where the mining industry continues to learn from others.

A comprehensive response to TB, HIV, and AIDS by the industry will be discussed in detail at the SAMI's parallel session on *Sustainable responses to HIV and AIDS in the world of work*, on 22 June 2023, at the SA AIDS Conference, including the NSP 2023–2028 and proposals on how the SAMI should implement relevant indicators. Stakeholders are encouraged to register and attend the conference via the link: https://saaids.co.za/register/

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