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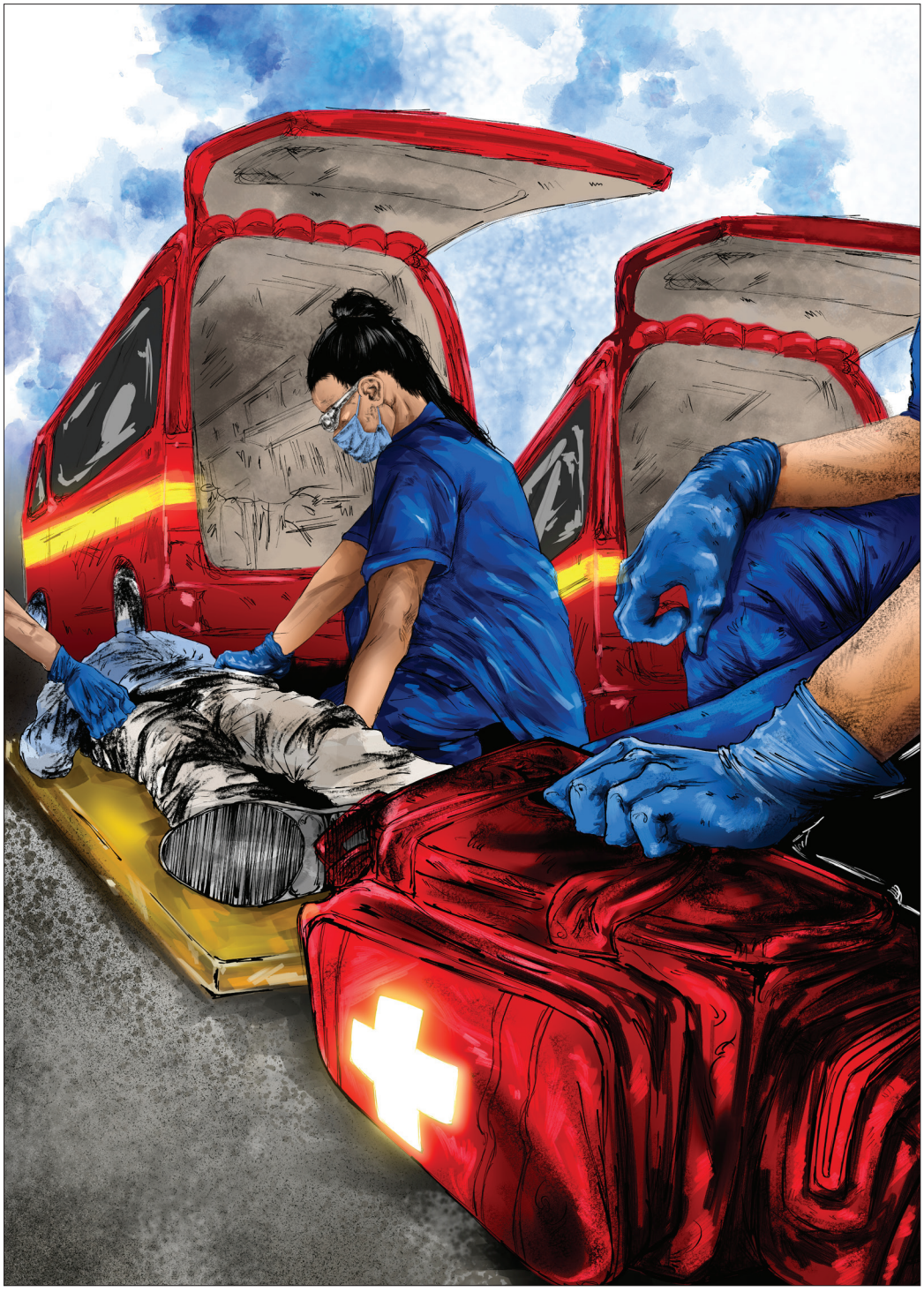

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Mine Medical Professionals Association (MMPA)

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From the Editor . . .

Gill Nelson,
Editor-in-Chief

It would be remiss of me not to write about the Trump administration's recent directives to withdraw the life-saving President's Emergency Plan for AIDS Relief (PEPFAR) and the United States Agency for International Development (USAID) funding from South Africa (and many other countries). PEPFAR had been instrumental in supporting HIV/AIDS prevention and treatment initiatives in South Africa since 2003. The consequences are dire for the hundreds of thousands of HIV-positive people, those with TB, and others who rely on US funds for survival. The cuts have affected more than 40 USAID-funded health projects in South Africa, including non-profit organisations like the Anova Health Institute. The consequences are that an estimated 500 000 South Africans will die and a similar number will become infected in the next 10 years.

Research programmes and researchers have not been spared from the fallout. During the past Human Rights weekend in South Africa (ironically), letters were received from the US, ending billions of Rands of funding, with immediate effect, to university HIV and TB grants. Institutions affected by the cut in funding include the Centre for the Aids Programme of Research in South Africa (CAPRISA) and the Wits Reproductive Health and HIV Institute (WRHI). In addition to the general population, HIV has been the cause of morbidity and mortality for many thousands of workers in South Africa since the 1990s, while TB has affected mine and other workers for more than 100 years. Both diseases are, therefore, often included in other aspects of occupational health research.

These funding cuts have severe consequences, globally. On 20 March, the World Health Organization (WHO) released a press statement, calling for *"urgent action to address worldwide disruptions in tuberculosis services putting millions of lives at risk"*.

The statement in the aforementioned letters that *"they … ultimately do not enhance health, lengthen life, or reduce illness"* is short-sighted as South Africa is a world leader in this field and both diseases, which also affect Americans, albeit at lower rates than in our country. In 2024, more than 10 000 cases of TB were provisionally reported in the US (3 cases per 100 000 population), an increase from 2023, while the rate of HIV was 11.3% in 2022. Ironically again, Monday, 24 March was World TB Day, with the theme, *Yes! We Can End TB: Commit, Invest, Deliver*.

This latest development will add to the already massive job losses. Many academics and research administrators, field workers, data capturers, and others have found themselves suddenly and unexpectedly jobless – only a few are 'lucky' enough to have been retrenched with at least some means of supporting themselves in the short term. It is not a simple matter of finding a job at another research institute. Even those with decades of experience are not being spared and have joined the large pool of job seekers. Incidentally, unemployment amongst graduates in South Africa was reported to be almost 10% at the end of 2024. Postgraduate students and postdoctoral researchers are among those who have already lost funding, leaving their academic careers hanging in the balance.

Meanwhile, the University of KwaZulu-Natal (UKZN) presented the results of a small HIV cure trial, using combination immunotherapy, at a conference in San Francisco in early March. Twenty percent of participants *"remain off ART and are virally suppressed after one-and-a-half years"*. This provides hope that there might not be a need for lifelong medication in the near future. The trial was led by Prof. Thumbi Ndung'u, who stated that *"… it proves that complex HIV cure research can be successfully conducted in resource-limited settings where the need is greatest, and highlights the importance of including African populations in global scientific advancements."* This development could potentially save lives in America too.

It is not only USAID funding that has ended. A $2.5 million grant from the National Institutes of Health (NIH) National Institute for Allergies and Infectious Diseases was cancelled on Human Rights Day, two-and-a-half years before it was due to end. An article published in *Science* on 14 March 2025 alerts researchers that the NIH *"could terminate all grants that fund work in that country* [South Africa] *within days"*.

It is, indeed, a dark time for health research in South Africa.

ANNOUNCEMENT

Late last year, SASOM conducted a survey amongst its 458 members about their perceived value of the questionnaire prepared for each issue of *Occupational Health Southern Africa*, which could earn them Continuing Education Units (CEUs) if answered correctly. Unfortunately, only 44 members responded. While 75% and 79% responded positively to questions about the value of the Journal, and 52% said that the topics covered in the Journal were relevant to their fields of practice, only 47% said that the CEU points offered were valuable. For this reason, SASOM has made the decision to discontinue the CEU questionnaire in the Journal.

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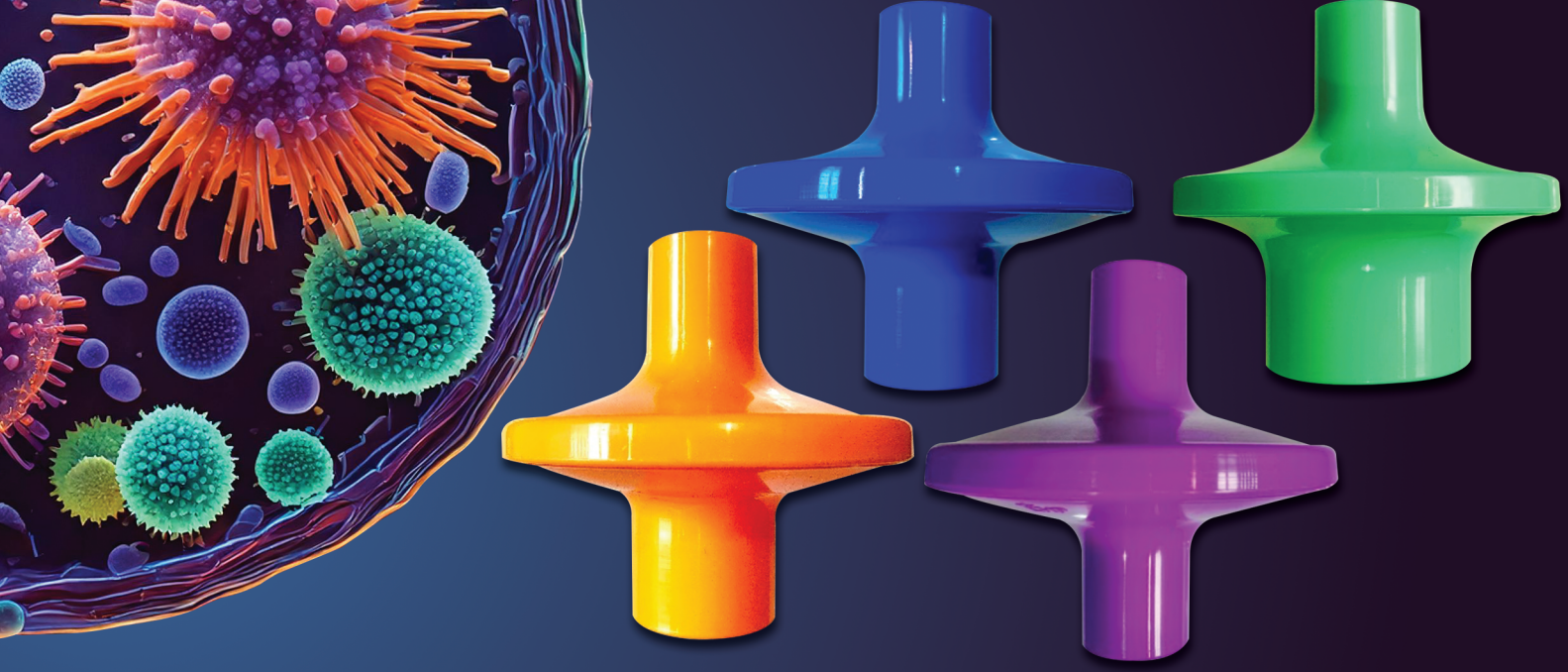

Product Code	Spirometer	Model
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		Easy on-PC
		EasyOne Pro
		EasyOne Pro LAB
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		SPIROVIT SP-1 G2

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	Vitalograph	ALPHA Touch
		ALPHA 6000
		In2itive
	Micro Medical	All models
	Schiller	SP-260
	MH	LA303
	COSMED	microQuark
		Quark Spiro
		Pony FX
	CONTEC	All models

Product Code	Spirometer	Model
PFT-2033 (Small) PFT-2533 (Standard) PFT-2233 (Oval)	Schiller	SP260
		Flowscreen Pro
	Jaeger	MasterScope
		MasterScreen
		Flowmate
		Spiro Pro
	Vyaire	Vyntus SPIRO PC
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Dingani Moyo

Dingani Moyo is an associate professor at the National University of Science and Technology in Zimbabwe, and an honorary senior lecturer at the University of the Witwatersrand in South Africa. He stands as an ambassador for occupational medicine in east, central, and southern Africa, and the world at large, where he has contributed immensely to the development of the discipline. He was born in Gweru, in the Midlands Province of Zimbabwe, and he hails from a rural village in Zhombe, outside the town of Kwe Kwe.

Prof. Moyo qualified as a medical doctor in 1994 from the University of Zimbabwe, and did his internship at Mpilo Central Hospital and United Bulawayo Hospitals in Bulawayo – 'The City of Kings' – in Zimbabwe. After his housemanship, he worked at Gweru Provincial Hospital before joining the Zimbabwe Mining and Smelting Company (Zimasco) Pvt Ltd, the biggest chrome mining company in the country at the time. Joining Zimasco was the genesis of his journey of a thousand miles into occupational health. After Zimasco, he joined Debswana Diamond Mining Company at Orapa Mine Hospital in Botswana, and later moved to head the Occupational Health Services at Norilsk Nickel's Tati Nickel Mining Company in Francistown, Botswana. Thereafter, he rejoined Zimasco as the Group Health Services Manager, overseeing the company's hospital and its five occupational health clinics across the country.

Prof. Moyo was driven by his insatiable appetite to reach the highest echelons of occupational health. He obtained several qualifications in a bid to improve his skills, including:

1. Fellow of the Royal College of Physicians of Ireland (FRCP)
2. Fellow of the Faculty of Occupational Medicine of Ireland (FFOM)
3. Member of the Faculty of Occupational Medicine of Ireland (MFOM)
4. Master (Hons) of Occupational Health and Safety (MOHS), University of Newcastle, Australia
5. Master of Applied Health Services Management, University of Newcastle, Australia
6. Bachelor of Medicine and Bachelor of Surgery degrees, University of Zimbabwe

In 2012, while attending the International Commission on Occupational Health (ICOH) congress, Prof. Moyo advocated for occupational health professionals in Zimbabwe to become ICOH members; he served as the first ICOH National Secretary for Zimbabwe (2012–2015). He has served on the ICOH Board for two triennia, 2015–2018 and 2022–2024, during which times he contributed to the global development of occupational health. In 2024, Prof. Moyo was elected as a Fellow of the prestigious Collegium Ramazzini, a select group of no more than 180 fellows from more than 40 different countries, each of clear personal and professional integrity, distinguished by their contributions to occupational and environmental health. In 2024, in recognition of his contribution to occupational health, he received two awards from the Society of Occupational Medicine (SOM) in the United Kingdom: 1) Outstanding contribution to the global development of occupational health, and 2) Outstanding contribution to occupational health research. He has published more than 50 research papers and more than 60 technical reports.

Professor Dingani Moyo

Prof. Moyo serves on the ICOH Working Group on Modernisation of ICOH Processes and Practices. He also serves on the Board of Trustees of OSHAfrica and heads the Education and Competency Improvement Scientific Committee. He also serves on the Education Committee of the Faculty of Occupational Medicine (FOM), Ireland.

Prof. Moyo has led several regional projects in southern Africa. Under the Global Fund Project, TB in the Mining Sector, he was the technical lead for the establishment and operationalisation of 11 occupational health service centres in seven southern African countries. He was involved in the training of healthcare personnel on spirometry, audiometry, and diagnostics for TB and occupational lung diseases (OLDs). Under the East, Central and Southern Africa Health Community (ECSA-HC), Prof. Moyo developed four generic mine health and safety standard operating procedures (MHS SOPs) for TB, HIV, and OLDs, and four country-specific MHS SOPs on the same for each of nine countries in the ECSA-HC. Under the African Union Development Agency (AUDA-NEPAD), Prof. Moyo developed a regional strategic framework for occupational safety, health, and environment for artisanal and small-scale miners (ASMs), and an occupational health services framework for Malawi and the Kingdom of Lesotho. Prof. Moyo assisted the Kingdom of Lesotho in developing the following documents for ASMs: 1) Occupational health, wellness, safety, and environment (OHSE) policy, 2) Handbook for OHSE, 3) Information, education and communication (IEC) strategic plan and communication advocacy on OHSE, and 4) Medical surveillance guidelines for ASMs.

As Prof. Moyo consolidates his contribution to occupational health, he is currently focusing on establishing a Master of Medicine degree in Occupational Medicine at the National University of Science and Technology in Bulawayo, Zimbabwe. He is very keen on mentoring upcoming specialists and practitioners in the field.

Assessing pulmonary tuberculosis in South Africa's mining industry: a trend analysis, 2015–2022

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Keywords
occupational lung diseases, mining industry, mine workers, occupational health services, SAMI

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ABSTRACT

Background: The South African mining industry (SAMI) has long faced a high burden of tuberculosis (TB). Recognising the need to strengthen employer interventions, the Masoyise iTB project was launched in 2015 to focus on reducing the impact of TB, and was expanded in 2019 into the Masoyise Health Programme (MHP) to include human immunodeficiency virus (HIV), occupational lung diseases, and non-communicable diseases in the SAMI.

Objectives: To assess the impact of the MHP, by describing trends in TB notification rates in the SAMI from 2015 to 2022.

Methods: We conducted an ecological study to analyse trends in TB case notifications from the MHP, Mine Health Safety Inspectorate (MHSI), Medical Bureau for Occupational Diseases (MBOD), and the general South African population. Data were plotted and tabulated, focusing on rates before and since the implementation of the MHP. Poisson regression analysis was used to calculate the average annual rates of change in TB case notifications.

Results: At the inception of the MHP, TB rates were 1 225 and 523 per 100 000 population in the SAMI and general population, respectively. From 2015 to 2022, the annual rate of decline in TB case notifications in the SAMI outpaced that of the general population, at 16.1% and 6.7%, respectively. The gold mines had a higher rate of decline in TB cases (17.5%; 95% CI 16.6–18.5). In 2022, the TB incidence rate was higher for gold (631 per 100 000 population) than for other commodities in the SAMI, and for the general population (354 per 100 000). The rate reductions in the MHP database were similar to those shown in the other SAMI-related databases (annual rate reductions were 17.1%, 95% CI 16.6–17.7 and 16.3%, 95% CI 15.5–17.0 for the MHSI and MBOD, respectively).

Conclusion: Industry initiatives play a crucial role in multi-sectoral strategies to tackle public health challenges in the SAMI. The trends in TB notification rates support ongoing collaboration amongst SAMI-related organisations and programmes to protect workers' health, with an emphasis on gold miners in which TB rates remain highest.

INTRODUCTION

South Africa experienced alarming rates of tuberculosis (TB) in the general population in the first decade of the 21st century: rates were even higher in the country's gold-mining industry.[1] While actions taken to address the "*urgent need to escalate the public health response*" [2] contributed to the prevention and control of TB transmission on a national scale,[3] and attention by the mining industry to this crisis is noted,[3] there is limited documentation of TB trends in the South African mining industry (SAMI).

The high prevalence of HIV, silicosis, and migrant labour in the mining environment contributed significantly to the TB burden in southern Africa.[4-5] Miners are particularly vulnerable to TB due to prolonged exposure to inhalable dust, which also increases their susceptibility to occupational lung diseases such as silicosis.[6-7] The immune-toxicity of silica dust and HIV, together with humid working conditions, poor ventilation in enclosed spaces, and cramped dormitories, transport, and recreational facilities, intensifies the transmission of TB.[8] In the early 2000s, the pulmonary TB rate among gold miners was estimated to be two-to-three times higher than that in the general population.[9] In 2022, the World Health Organization (WHO) estimated the TB incidence in South Africa to be 468 per 100 000 population.[10] Despite efforts to reduce dust exposure, persons with silicosis are at least 2.5 times more likely to develop TB.[11]

In low- and middle-income countries (LMICs), workers often have limited access to comprehensive occupational health services (OHS); where they exist, they tend to be less inclusive than those in higher-income countries.[12] In the SAMI, most workers have access to OHS and there is enforcement of OHS laws and regulations.[13] However, there is a history of occupational health challenges in the SAMI, particularly regarding occupational lung diseases (OLDs) such as silicosis and TB. In addition, ex-miners often face difficulties in accessing health services.[14] Current and ex-miners alike have faced barriers in receiving compensation for occupational diseases.[15] Responding to sustained pressure from civil society and government to address the TB epidemic in the mining industry,[15-16] the SAMI implemented several interventions (Table 1).[17-22]

To supplement and galvanise employer interventions, the Masoyise iTB (isiXhosa for 'Stop TB') project was launched in 2015 by the Minerals Council South Africa, in a collaborative effort with various mining industry stakeholders. The Masoyise iTB project was expanded into the Masoyise Health Programme (MHP) in 2019, the aim of which is to reduce the incidence of TB, human immunodeficiency virus (HIV), OLDs, and non-communicable diseases (NCDs) as occupational health threats in the SAMI.[23] Specifically, the Masoyise iTB project aimed to reduce TB incidence in the SAMI through 1) offering TB screening and HIV counselling and testing (HCT) to all permanent SAMI employees and contractors, at least annually, 2) providing TB contact tracing for employees and their contacts, 3) analysis and monitoring of TB treatment outcomes, 4) improving access to diagnosis and treatment, and 5) supporting small mines with TB management and control from 2016 to 2018.[23-24]

Both programmes united representatives from trade unions, government entities, and other organisations to work towards achieving the programme's objectives.[23,25] The MHP applies a comprehensive wellness approach, encompassing not only TB and HIV, but also NCDs such as diabetes, hypertension, and mental health issues, alongside OLDs such as the pneumoconiosis.

The objective of this study was to assess the impact of the MHP, by describing TB notification trends in the SAMI since the implementation of the Masoyise iTB project in 2015, to 2022, focusing on 1) comparing these trends between the SAMI and the general South African population; 2) describing trends by commodity, focusing on the gold-mining industry; 3) comparing TB trends calculated from MHP, Department of Mineral and Petroleum Resources' Mine Health Safety Inspectorate (MHSI), and Department of Health's Medical Bureau for Occupational Diseases (MBOD) databases.

METHODS

We used an ecological study design in our analysis of SAMI TB data from the Minerals Council South Africa (MHP), MHSI, and MBOD. The study was conducted in the SAMI, using records of mineworkers (permanent and those on short-term contracts) under the Minerals Council South Africa, which represents 90% of South African mineral production by value, in all mining commodities.[26] Comparison records were those of all miners and ex-miners in the SAMI, represented by the MHSI and the MBOD.

Table 1. Some TB interventions in the South African Mining Industry, 2013–2023

Year(s)	Item	Lead agency	Aim
Since 2000	NSP on HIV, TB, and STIs	NDoH	Serves as a roadmap for the journey towards a future where HIV, TB, and STIs are no longer public health problems in South Africa
2002, revised 2018	Guideline for the compilation of a mandatory CoP for an occupational health programme on personal exposure to airborne pollutants	MHSC	Developed to enable the employer at every mine to compile a CoP, which, if correctly implemented and complied with, would protect and improve miners' health by monitoring and reducing exposure to airborne pollutants
2002, amended 2013	Reporting and surveillance of TB in the SAMI	SAMI	• Allow mining industry healthcare workers access to the DoH electronic TB and manual register • Report occupational TB to the DMPR's MHSI
2003	Guidance note about TB in the SAMI	DMPR	TB control on the mines to minimise the burden of disease due to TB, through the proper management of those with TB, prevention of new cases, and identification of employees at high risk
2003	Adoption of IPT policy	DMPR/SAMI	Prevent at-risk miners from developing TB
2003–2004	Research and adoption of research findings	MHSC/SAMI	• Adoption of digital X-ray readings for medical surveillance • Identification, selection, and promotion of TB leading practices in the SAMI
2011	Provision of leadership and stewardship	DMPR collaborates with trade unions and employers through MHSC to establish the MITHAC	The Chief Inspector of Mines is responsible for leading the tripartite structures established by the Mine Health and Safety Act (No. 29 of 1996) as amended. Representatives of government, employees, and employers serve on these structures, including MITHAC, which advises the DMPR minister on TB and HIV/AIDS policies to improve performance of the mining industry
2013	DMR 164 HIV and TB reporting form	DMPR	• Understanding of HIV and TB disease distribution within the SAMI • Gathering reliable and current data on HIV and TB in the SAMI • Utilising data collected to guide policy and legislative review framework, in terms of HIV and TB management
2013	Prospecting and mining license renewals to include strategic and operational plans on HIV/AIDS and TB	DMPR	Increase commitment of the SAMI in managing HIV and TB, using best practices
2014	National tuberculosis management guidelines	NDoH	Guide healthcare workers on the management of people with TB and those co-infected with HIV
2014	10th Mine Occupational Health and Safety Summit 2014 milestones	MHSC	• By December 2024, the TB incidence rate should be at, or below, the national TB rate • 100% of employees should be offered HCT annually, with all eligible employees linked to an ART programme as per the NSP

ART: antiretroviral therapy, CoP: code of practice, DMPR: Department of Mineral and Petroleum Resources, DoH: Department of Health, HCT: HIV counselling and testing, HIV: human immunodeficiency virus, IPT: isoniazid preventive therapy, MHSC: Mine Health and Safety Council, MHSI: Mine Health and Safety Inspectorate, MITHAC: Mining Industry TB and HIV Advisory Committee, NDoH: National Department of Health, NSP: National Strategic Plan, SAMI: South African mining industry, STI: sexually transmitted infections, TB: tuberculosis

Data sources

1. Masoyise Health Programme database

On a quarterly basis, Minerals Council South Africa-affiliated mining companies submit data, such as the number of mineworkers employed and occupational health indicators (HIV and TB notifications, etc.), to the MHP. This dataset, which contains data from 2015 to 2022, is disaggregated by mining commodity and can be used to calculate annual TB case notification rates.

2. Mine Health and Safety Inspectorate database

By law, all mining companies in South Africa (including those that are not members of the Minerals Council South Africa) are required to submit similar data on TB and HIV to the MHSI, which reports these in its annual reports.[22] Thus, we were able to calculate commodity-specific TB incidence rates from the data published in the 2014–2022 annual reports.

3. Medical Bureau for Occupational Diseases database

The MBOD, which records mineworkers' compensation claims, was established under the Occupational Diseases in Mines and Works Act No. 78 of 1973.[27] Claims include compensation for both work-time loss during TB treatment, and permanent lung disability due to occupational TB. The MBOD database spans 2003 to 2023, and contains the number of TB claims per month, by commodity. Employment status (active or former mineworker) is also recorded.

4. World Health Organization database/Statistics South Africa

The annual TB case notification rates, which includes people of all ages in South Africa, is calculated from the WHO Global Tuberculosis Report database as the total number of new and relapsed cases, and cases with unknown previous TB treatment history, divided by the population of South Africa as reported by Statistics South Africa. We used the TB case notification rates from the WHO as the South African overall rate, as it is more analogous to the data collected by the MHP and the MHSI.

The case notification rates include only reported cases of TB (notifications) for all databases we used, and are, therefore, probably underestimates of the true TB incidence rates.

The data analysed related to active miners, and those who developed active TB within a year of leaving the mines and were, therefore, eligible for compensation. In all cases (all databases), pulmonary TB was diagnosed at the mine clinic for active mineworkers, and in any public or private health facility for ex-miners. Diagnosis was based on clinical history, examination, and laboratory confirmation (GeneXpert, AFB smear, or TB culture) of TB bacilli; and/or clinical signs and symptoms suggestive of TB and radiological evidence with, or without, bacteriological confirmation, in line with the National TB Management Guidelines.[21] For comparison across all years, subsets of each database from 2015 to 2022 were selected for analysis.

Data analysis

The annual rates of change in TB case notifications from each of the databases were compared for the years for which the data were available. We stratified the data by mining commodity (gold, platinum, coal, diamonds, and other) to describe commodity-specific trends.

As the MBOD database does not include the size of the mining workforce, the numbers of mineworkers in the MHSI database were used as the annual denominators in the calculations of the TB notification rates.

Poisson regression models were used to calculate the average annual rates of change in TB case notification rates over the study period, and included commodity as a covariate. The denominator populations in each database were used as the offset terms, and relative risks (RRs) were calculated for all commodities, and for each commodity, using platinum as the reference. The annual rates of reduction in TB case notifications were calculated as (1 – RR) x 100, and compared between the three databases and with the South African general population rates. For the model using the WHO TB case notifications in the general population, the Poisson regression model excluded mining commodity as

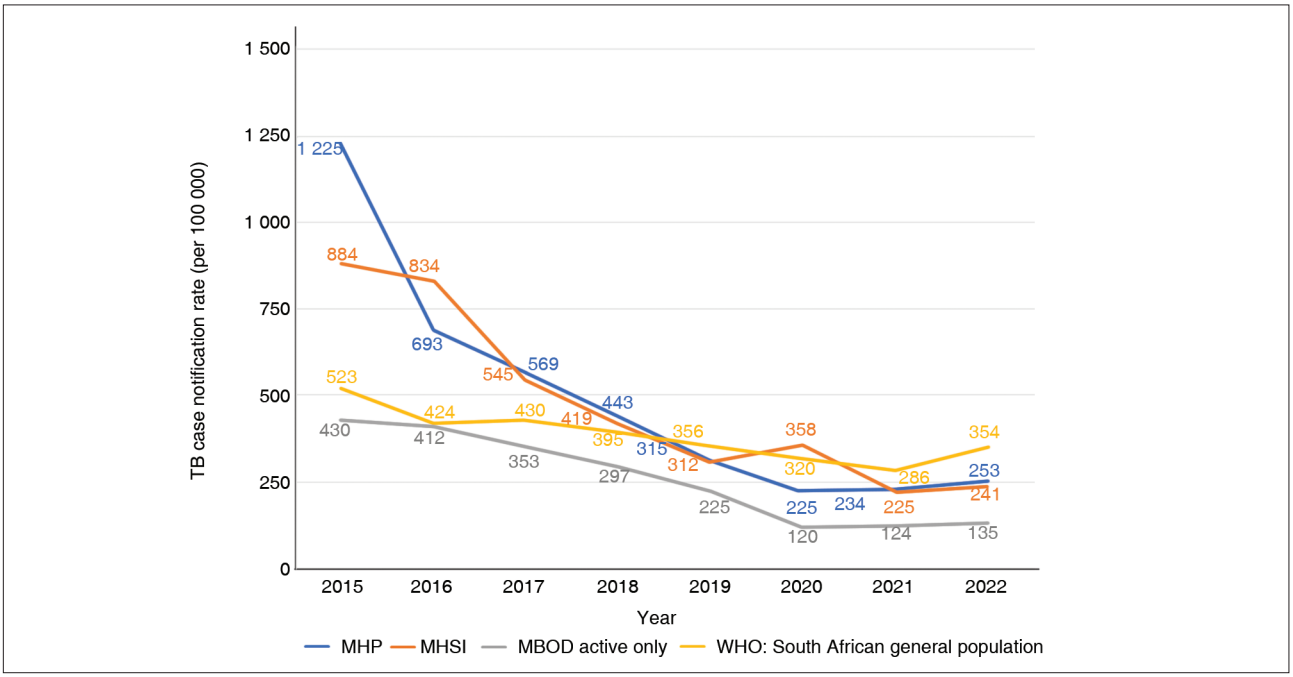

Figure 1. TB case notification rates for mineworkers from all commodities, from different sources, 2015–2022

MBOD: Medical Bureau for Occupational Diseases, MHP: Masoyise Health Programme, MHSI: Mine Health and Safety Inspectorate, TB: tuberculosis, WHO: World Health Organization

this variable is not in the database. The analysis was repeated for gold mines alone, as gold miners are at the highest risk of developing TB.

The study was approved by the University of Pretoria's Faculty of Health Sciences Research Ethics Committee (certificate number 411/2024); and the Behavioural Ethics Review Board of the University of British Columbia (certificate number H24-01375).

RESULTS

Trends in TB notification rates

TB notification rates decreased in South Africa, generally, and in the mining industry, from 2015 to 2022 (Table 2 and Figure 1).

The MBOD TB claim rate, for both active miners and those who filed a claim within one year of leaving the mines, showed a similar downward trend as the case notification rate calculated from the

Table 2. Tuberculosis notification (incidence) rates in the South African mining industry

		Population size, by data source			TB case notification rate (per 100 000), by data source			
Commodity	**Year**	**MHP**	**MHSI, MBOD**	**Stats SA**	**MHP**	**MHSI**	**MBOD**	**WHO/ Stats SA**
Gold	2015	55 187	127 521	55 876 504	1 857	1 615	881	523
	2016	111 883	124 953	56 422 274	1 334	1 476	819	424
	2017	104 390	102 953	56 641 209	1 096	1 018	822	430
	2018	84 943	107 768	57 339 635	929	811	595	395
	2019	115 075	105 844	58 087 055	519	575	387	356
	2020	104 644	88 595	58 801 927	487	1 172	287	320
	2021	106 460	81 572	59 392 255	535	559	380	286
	2022	99 764	93 960	59 893 885	631	614	357	354
Not gold	2015	80 577	349 104	55 876 504	792	616	265	523
	2016	257 564	330 728	56 422 274	415	591	258	424
	2017	308 647	371 019	56 641 209	391	413	223	430
	2018	327 627	385 287	57 339 635	317	309	214	395
	2019	359 154	343 402	58 087 055	250	231	175	356
	2020	360 850	393 473	58 801 927	149	175	82	320
	2021	379 588	399 170	59 392 255	149	157	69	286
	2022	400 939	404 805	59 893 885	159	154	81	354
All	2015	135 764	476 625	55 876 504	1 225	884	430	523
	2016	369 447	455 681	56 422 274	693	834	412	424
	2017	413 037	473 972	56 641 209	569	545	353	430
	2018	412 570	493 055	57 339 635	443	419	297	395
	2019	474 229	449 246	58 087 055	315	312	225	356
	2020	465 494	482 068	58 801 927	225	358	120	320
	2021	486 048	480 742	59 392 255	234	225	124	286
	2022	500 703	498 765	59 893 885	253	241	135	354

MBOD: Medical Bureau for Occupational Diseases, MHP: Masoyise Health Programme, MHSI: Mine Health and Safety Inspectorate, Stats SA: Statistics South Africa, WHO: World Health Organization
Note: South African general population data do not include mining commodity; the same figures are applied to all three commodity categories.

Table 3. Mean relative risk estimates for trends and annual reductions in TB notification rates, 2015–2022

	Data source							
	MHP		**MHSI**		**MBOD***		**WHO/Stats SA†**	
Commodity	**RR**	**95% CI**	**RR**	**95% CI**	**RR**	**95% CI**	**RR**	**95% CI**
All	0.839	0.832–0.847	0.829	0.823–0.834	0.837	0.830–0.845	0.933	0.933–0.934
Platinum	Reference		Reference		Reference		–	
Gold	2.115	2.039–2.195	2.038	1.973–2.105	2.903	2.768–3.045	–	
Coal	0.400	0.375–0.428	0.416	0.393–0.441	0.266	0.238–0.296	–	
Diamonds	0.245	0.199–0.302	0.291	0.249–0.339	0.141	0.097–0.205	–	
Other	0.430	0.394–0.469	0.468	0.443–0.494	1.351	1.274–1.433	–	
	Annual reduction in TB notification rate (%)							
	Mean	**95% CI**	**Mean**	**95% CI**	**Mean**	**95% CI**	**Mean**	**95% CI**
	16.1	15.3–16.8	17.1	16.6–17.7	16.3	15.5–17.0	6.7	6.6–6.7

CI: confidence interval, MBOD: Medical Bureau for Occupational Diseases, MHP: Masoyise Health Programme, MHSI: Mine Health and Safety Inspectorate, RR: relative risk, Stats SA: Statistics South Africa, WHO: World Health Organization
*active miners and those who submitted claims within one year of leaving employment; using MHSI denominators
†South African general population

MHP and MHSI data, although at lower absolute rates (Table 2 and Figure 1). When considering TB claims from active miners only, a similar trend was observed, but at even lower absolute rates (Supplementary Figure 1).

Table 3 provides relative risk estimates for trends in TB case notification rates across the four databases from 2015 to 2022, with a focus on different commodities. The Poisson regression analysis showed that, using the MHP data, the annual reduction in the TB notification rate was significantly higher in the SAMI than in the general population (16.1%, 95% CI 15.3–16.8% and 6.7%, 95% CI 6.6–6.7%, respectively) (Table 3).

The average annual reduction in TB claims submitted to the MBOD by active miners, and those who left employment within one year, was 16.3% (95% CI 15.5–17.0) – similar to that calculated from the MHP data. When TB claims submitted by active miners only were considered, the average rate reduction was slightly higher than for both groups, viz.18.4% (95% CI 17.5–19.2) (data not shown).

While the absolute TB claim rate calculated from the MBOD data (from 430 to 135 per 100 000) was lower than that calculated from the MHP data (from 1 225 to 253 per 100 000), the average annual reductions in rates were similar (16.3% and 16.1%, respectively). The rate calculated from the MHSI data was slightly higher, at 17.1% (95% CI 16.6–17.7).

TB in gold miners

The TB case notification rate for gold miners was much higher than that for other commodities (Table 2 and Fig 2). The gold-mining workforce, comprising approximately 23% of the total mining workforce as reported to the MHP (Table 2), had a relative risk of TB case notification of 2.1 (95% CI 2.0–2.2) compared to platinum miners – much lower than that of the other commodities (Table 3).

Using the MPH data, the average annual reduction in the TB notification rate for gold miners was 17.5% (95% CI 16.6–18.5) (Table 4) – slightly higher than that for all miners (16.1%, 95% CI 15.3–16.8) (Table 3). Although the relative risks of TB notification were higher for gold miners than for all miners (Table 4), the decreases in TB case notification rates were similar (Table 3).

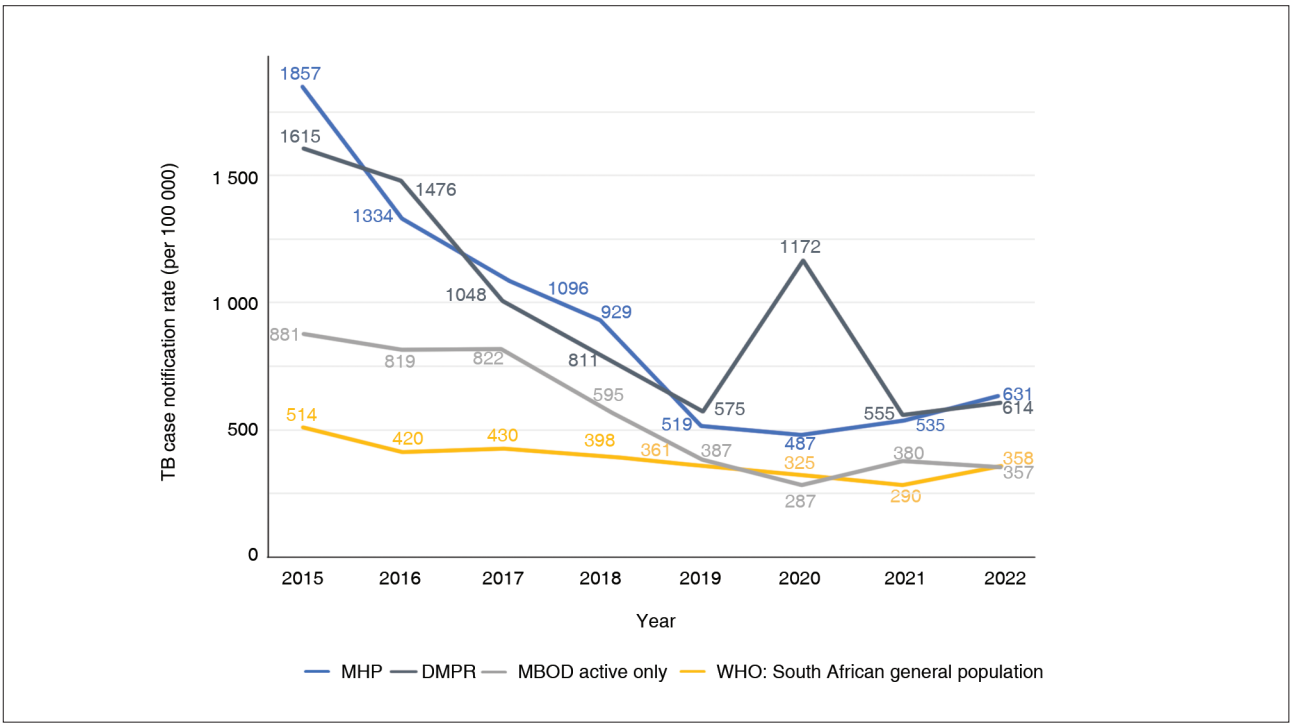

Figure 2. TB case notification rates for gold mineworkers, from different sources, 2015–2022

DMPR: Department of Mineral and Petroleum Resources, MBOD: Medical Bureau for Occupational Diseases, MHP: Masoyise Health Programme, TB: tuberculosis, WHO: World Health Organization

Table 4. Mean relative risk estimates for trends and annual reductions in TB notification rates for gold miners, 2015–2022

Data source							
MHP		MHSI		MBOD*		WHO/Stats SA†	
RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
0.825	0.815–0.834	0.864	0.855–0.872	0.848	0.837–0.859	0.933	0.933–0.934
Annual reduction in TB notification rate (%)							
Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
17.5	16.6–18.5	13.6	12.8–14.5	15.2	14.1–16.3	6.66	6.60–6.72

Year is the only covariate in the Poisson regression model from the WHO Global TB Report database for comparison.
Values are reported as the relative risk with a 95% confidence interval, with the average annual reduction calculated from the relative risk per year.
CI: confidence interval, MBOD: Medical Bureau for Occupational Diseases, MHP: Masoyise Health Programme, MHSI: Mine Health and Safety Inspectorate, RR: relative risk, Stats SA: Statistics South Africa, WHO: World Health Organization
*active miners and those who submitted claims within one year of leaving employment; using MHSI denominators
†South African general population

DISCUSSION

Although *"strides in the fight against TB since 2010"* have resulted in a slow, but steady, decline in incidence and mortality in the South African population,[28] an analysis of TB trends in the mining industry has been lacking.[29-30] Mbuya et al. (2023)[29] found TB prevalence was 7% in miners in Mererani, northern Tanzania – 24 times higher than the national average.[29] In a review of the literature on TB in miners in Zambia, Chanda-Kapata and colleagues reported the weighted average of the incidence rate of TB among current miners 1994–2014 as 658 per 100 000 population.[31] In 2022, the Minerals Council South Africa reported a TB incidence of 278 per 100 000 in the mining industry, close to half that in the general population (537 per 100 000 population).[32] The National Institute for Occupational Health (NIOH) has reported a decrease in active pulmonary TB in black miners at autopsy; in 2021 the rate found was 155 per 1 000, the lowest since 1997.[33]

Our analysis of TB notification rates showed that, despite the 'healthy worker effect', where sick workers leave employment, resulting in a healthier workforce compared to the rest of the population,[34] TB rates among miners at the start of the MHP were higher than those in the general population, aligning with findings from previous studies.[29-30] TB rates declined more rapidly in the mining industry than in the general population over the study period. While absolute rate comparisons were not feasible – primarily because age adjustment analysis was not possible – the faster reduction of TB in the mining industry suggests that the SAMI's efforts, including the MHP, have been effective in helping to reduce TB rates among miners.

This reduction in TB rates underlines the important roles of not only government and other public industry and civil society interventions in combatting TB, but also the mining industry itself. This realisation is not new. More than 30 years ago, Klitzman and Kellner (1994), in their article entitled 'Control of tuberculosis in the workplace: toward an integration of occupational health and public health', outlined the obstacles to linking public health and workplace-based efforts to control TB, and called for a comprehensive approach.[35] Guidelines have been developed, such as the WHO's 2003 guideline, 'The Contribution of Workplace TB Control Activities to TB Control in the Community', which outlines principles for workplace TB control.[36] One of these principles, as Podewils et al. (2022) stressed with respect to TB control programmes in Zambia,[37] is the importance of respecting mineworker rights. A 2018 report on 'Managing tuberculosis and occupational health in the mining sector in southern Africa', conducted in South Africa, called for cross-border responses to TB, with effective coordination of the various policy, programmatic, and service delivery considerations that bridge mines, communities, and countries. It also stressed the importance of including housing, labour, health and mining sectors, civil society, labour unions, and mineworkers.[38]

In our analysis of differences in TB trends by mining commodity, we identified higher TB notification rates among gold miners than those in other commodities, although the difference was not statistically significant. This has been documented by others[14,39] and underlines the need for attention to be directed towards workers in the gold-mining sector. Working and housing conditions, exposure to silica dust, HIV, and socioeconomic factors play a part in the high TB rates in this workforce.[38]

Future research should examine the specific factors driving TB notifications in the gold mines, with efforts focused on targeted interventions to address the unique challenges faced by these miners.

Historically, it was extremely difficult for gold miners to receive compensation for TB time loss or lung impairment, as required by law.[27] A 2004 study found that out of 28 161 claims accepted by the MBOD over a 21-month period, the Compensation Commissioner for Occupational Diseases (CCOD) approved only 400.[40] This proportion has increased in recent years through active case-finding efforts by the MBOD/CCOD.[15] Nevertheless, compensation for TB is still subject to many rules, including that only TB cases diagnosed during employment or within a year of leaving the mines are compensable, although silica dust exposure confers lifetime increased risk.[38,41]

The decrease in TB among South African miners over the study period demonstrates the efficacy of 'escalating a public health response' to challenges in workplace settings, where employers are accountable for the health and safety of workers.[42,43] In addition to the much-needed ongoing focus on prevention measures, with respect to working and living conditions in peri-mining communities, the surveillance provided by occupational health programmes can draw early attention to concerns and provide a baseline for tracking progress through rigorous data collection and analysis. Recognising the achievements in reducing the rate of TB in South African mines over the past decade, attention to the experience and needs of workers in labour-sending areas beyond the scope of the MHP is warranted. Multi-stakeholder initiatives should be encouraged so that the mining industry can carry out its responsibility to care for the health of workers, regardless of where they reside after leaving the mines.

Finally, we note that when we compared TB trends using the MHP data with those using the MHSI and MBOD data, we saw that they are comparable and, therefore, provide a reliability check.

Our analysis had some limitations. Although the MHP data are provided by mines that represent 90% of South Africa's mineral production by value,[26] the data are self-reported, which may lead to under-reporting, especially as the many contract workers may not be included in reports. Second, TB may be unreported if a worker seeks treatment outside of the mine's occupational health system, resulting in underestimations of rates. Third, the denominators used comprise all mine employees, including those who are not at increased risk of TB, e.g. office workers. Fourth, cases of TB in miners would only appear in the MBOD data if the disease was deemed to have been diagnosed while serving as an active miner, or within one year of leaving the mines. Nevertheless, even if the absolute number of TB cases is under-reported in the MHP data, the annual rates in the mining sector appear to be decreasing more rapidly than in the South African general population.

The overarching goal of the MHP is to contribute to mitigating the impact of TB, HIV, OLDs, and NCDs as significant threats to the health of miners. While the downward trends in TB rates are encouraging, NCDs, including cardiovascular disease, cancer, chronic respiratory conditions, and diabetes, are leading causes of both mortality and disability, globally. Further research is, therefore, warranted to assess the effectiveness of the MHP as part of a comprehensive approach to addressing these interconnected health challenges.

CONCLUSION

Our analyses showed that TB notification rates among miners in South Africa have decreased at a higher rate than those in the general population. These findings support the crucial role of industry initiatives as part of multisectoral strategies to tackle occupational health in the SAMI. The potential impact of the MHP in reducing TB rates highlights the need for ongoing collaboration to protect workers' health, with an emphasis on gold miners in which TB rates remain the highest.

KEY MESSAGES

1. At the start of the MHP, TB rates in the SAMI were higher than those in the general population.
2. The TB incidence rate in gold miners remains significantly higher than that in miners of other commodities.
3. After the implementation of the MHP, the rate of decline in TB case notifications in the SAMI outpaced that in the general population, suggesting that the programme plays an important role in reducing TB rates in the SAMI.
4. The MHP's success in reducing TB rates underscores the critical role of sustained collaboration among stakeholders to address occupational health challenges in the SAMI, and to ensure long-term health protections for workers, even after they leave the industry.

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DECLARATION

The authors declare that this is their own work; all the sources used in this work have been duly acknowledged, and there are no conflicts of interest in relation to the conduct of this study. MZ and MM are employed by the NIOH, and have received funding from the Minerals Council South Africa for research conducted on behalf of their employer, the NHLS. BK is employed by the NDoH, which has received support from the Minerals Council South Africa for programmes aimed at former mineworkers under the NDoH. AY, JS, KL, and SB are employed by the University of British Columbia (UBC). The Minerals Council South Africa has contributed funds for collaborative research with UBC. TB is employed by the Minerals Council South Africa, but participated in this research in her personal capacity.

AUTHOR CONTRIBUTIONS

Conception and design of the study: MZ, AY, KL, JS, SB
Data acquisition: MZ, AY
Data analysis: SB, KL
Interpretation of the data: MZ, SB, KL, AY, JS, MM, BK, TB
Drafting of the paper: MZ, SB, KL, AY
Critical revision of the paper: MZ, TB, SB, JS, KL, BK, MM, AY

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Exposure dose metrics, instrumentation, and operating procedures for occupational exposure assessment for nanomaterials and nanoparticles: a scoping review

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ABSTRACT

Introduction: The rapid emergence of nanotechnology has resulted in the potential for workplace exposure to airborne particles in the nano-range, but consensus on exposure dose metrics hinders measurement strategies and evaluation. Thus, the association between exposure and adverse health outcomes is challenging to establish.

Aim: The aim of this scoping review was to describe current exposure dose metrics, instrumentation, and strategies for quantifying occupational exposure to nanomaterials and nanoparticles.

Methods: Peer-reviewed manuscripts and articles published from January 2008 to November 2024 about exposure dose metrics, instrumentation, and standard operating procedures for quantifying nanomaterials and nanoparticles in occupational settings were identified, using Google Scholar, PubMed, and ScienceDirect. Search phrases were (*"direct reading instruments"* OR *"exposure dose metric"* OR *"human risk assessment"*) AND (*"nanoparticles manufacturing"* OR *"occupational exposure assessment"* OR *"standard operating procedures for exposure assessments"*) AND *"sampling techniques"*.

Results: Five hundred peer-reviewed papers were identified,118 of which were included in the review. Most of the literature reviewed focused on inhalation as an exposure route. Mass concentration was the most commonly used exposure dose metric. The chosen exposure dose metric appeared to be influenced by the availability of the data collection instrument. Six real-time monitoring instruments were widely used: four particle sizers and two particle counters. Only one particle counter that was used measured three exposure dose metrics (concentration, mass, and size); the others measured only one exposure dose metric. The filter-based method was widely preferred for sampling. Various analytical methods were used to characterise nanomaterials and nanoparticles.

Conclusion: There is no consensus on exposure assessment methodology in the nanotechnology field, hindering the ability to compare exposure scenarios and to draw conclusions about associations between exposures and adverse health outcomes. Africa lags behind other continents in the use of exposure dose metrics other than particle mass concentration. A combination of real-time instrumentation, analytical methods, and exposure models is needed to provide an integrated exposure assessment methodology, and to standardise exposure quantification in the rapidly growing nanotechnology field.

INTRODUCTION

With the rapid emergence of nanotechnology, nanomaterials (NMs) are in high demand for applications to improve product strength and/or durability in cosmetics, food processing, pharmaceuticals, medical applications, etc. The International Organisation for Standardisation (ISO) and Organisation for Economic Co-operation and Development (OECD) refer to NMs as *"materials with any external dimension in the nanoscale or having an internal structure or surface structure in the nanoscale range"*.[1] Nanoparticles (NPs) are *"nano-objects with all external dimensions in the nanoscale range where the lengths of the longest and the shortest axes of the nano-objects do not differ significantly"*.[2]

Several studies have highlighted that the wide use of NMs and NPs could result in human exposure through dermal, inhalation, and/or ingestion, leading to toxic endpoints such as lung inflammation, permanent cell damage, organ injury, and oxidative stress.[3–5] Some NPs can cause infertility by reducing sperm counts and causing ovaries to undergo apoptosis.[6] Studies have highlighted that exposure to NMs and NPs has the potential to induce cyto-and-genotoxic effects, inflammation, and even cancer.[7,8]

There is a lack of consensus regarding the most appropriate single exposure dose metric for assessing exposure to NMs and NPs, which creates uncertainty about the type of instrumentation

and measurement strategies to use.[9,10] There is a need to investigate the use and value of all available exposure dose metrics.[11]

The objective of this scoping review was to describe dose metrics and instrumentation used in NM and NP exposure assessment, and standard operating procedures used to quantify NMs and NPs in occupational settings.

METHODS

A scoping review was conducted to acquire peer-reviewed literature addressing exposure dose metrics, instrumentation used in exposure assessment, and standard operating procedures on how to quantify exposure to NMs and NPs in occupational settings. Terms used in this paper are defined in Table 1.

The review was conducted within a larger study that received ethical approval from the University of the Witwatersrand Human Research Ethics Committee (ethics clearance certificate number HRECNMW23/02/04).

Search strategy

Three scholarly databases were searched, viz. Google Scholar, PubMed, and ScienceDirect, for scientific papers published from January 2008 to November 2024. The keywords/phrases that were used were *("direct reading instruments"* OR *"exposure dose metric"* OR *"human risk assessment"*) AND (*"nanoparticles manufacturing"* OR *"occupational exposure assessment"* OR *"standard operating procedures for exposure assessments"*) AND *"sampling techniques"*. Papers were included in the review based on the information in terms of the metrics, measurement strategies, and different instruments used as well as the data analysis.

Inclusion criteria

Only peer-reviewed papers published in English between January 2008 and November 2024 were included in this review. A team of four reviewed the papers in this scoping review. Although there was some research on this topic before 2008, studies on the potential health effects of exposure to NMs and NPs began to be published in 2008 (Figure 1).

Table 1. Definitions of key terms

Key term	Definition
Exposure assessment	The process of estimating or measuring the magnitude, frequency, and duration of exposure to an agent, along with the number and characteristics of the population exposed[12]
Exposure dose metric	A concentration at a specific time point or total concentration integrated over time, e.g. particle mass, number, and surface area[13]
Particle mass concentration	The total mass of particles per unit volume of air (μg/m^3)[14]
Particle number concentration	The number of nanoparticles per unit of volume or mass[2]
Surface area	The total particle surface area per unit volume of media[15]
Particle size	The size of a particle in micrometres (μm) or nanometres (nm)[2]

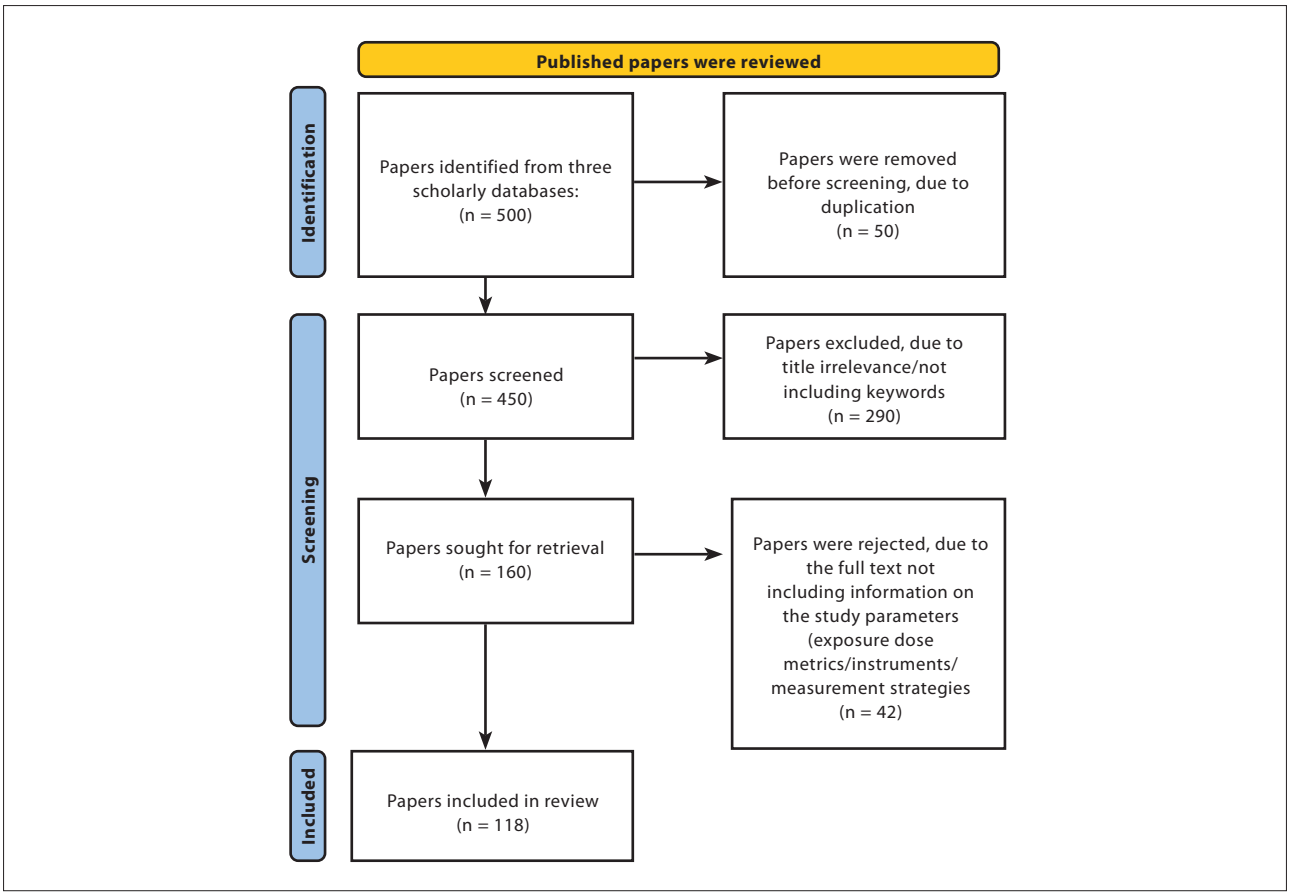

Figure 1. Selection of papers for scoping review

Data analysis

The criteria used to assess the quality of the information from the 118 published papers sourced were modified from the method published by Balshem et al. (2011),[16] as shown in Table 2.

RESULTS AND DISCUSSION

One hundred and eighteen English-language peer-reviewed papers that described studies on exposure assessment in occupational settings, and addressed inhalation as the exposure route for NMs and NPs, were selected for review.

Concentration metrics in exposure assessments (external dose)

External dose/environmental concentration refers to the concentration of the emissions of NMs/NPs in the microenvironment in which personnel conduct their activities. In 26 of the 118 papers reviewed (22.0%), a single exposure dose metric was described (see Supplementary Table S1). Fourteen of the 26 papers (53.8%) used particle mass concentration to quantify exposure and toxicity of NPs.[17–30] However, several authors showed that, given the negligible mass of NPs, this exposure dose metric is impractical.[31–39] Particle number concentration, volume, and surface area were the suggested exposure dose metrics to use.[26,38,40–49] Thirty-three (28.0%) of the articles reviewed reported the simultaneous use of two exposure dose metrics (particle number concentration, particle mass, or particle size) as exposure dose metrics for NMs and/or NPs during exposure assessments.[35,39,50–80] More than two metrics (particle number concentration, particle mass, surface area, and/or particle size) were used as exposure dose metrics in nine (7.6%) of the papers reviewed.[81–89]

Consensus on the most appropriate exposure dose metric to use for NP exposure assessment is necessary, as there is insufficient and inconsistent information regarding the correlation between particle number concentration, mass concentration, and surface area.[32,35,37]

Particle number concentration

Particle number concentration was reported to be the most informative metric to describe the exposure dose of NPs.[34,37,60,90,91] Some authors stated that although particle number concentration was a better exposure dose metric than particle mass concentration, size, and surface area, it may not be useful in the post-synthesis of NPs where particles are agglomerated. Particle number concentration was the commonly used metric used in studies in laboratory settings.

Only six of the 118 papers (5.1%) described using only particle number concentration as the exposure dose metric.[4,90,92–95] It has been reported that instrumentation that focuses solely on particle number concentration is relatively insensitive for NP exposure assessments.[4,91] Particle number concentration and surface area may present challenges, due to the heterogeneity and different shapes of particles.[34] In one paper, it was stated that it is difficult to separate ultrafine particles from background NMs or NPs using particle number concentration and size distribution measurements.[7]

Particle mass concentration

It is recommended that mass concentration be used as an exposure dose metric for exposure assessment of engineered nanomaterials (ENMs).[48,60,96–98] Fourteen of the 118 papers (11.9%) described using only particle mass concentration to quantify exposure to NMs and NPs.[17-30] Some researchers argued that, due to the physiochemical characteristics of NPs, the use of mass concentration does not accurately show the toxicological effects induced by exposure to NPs, making it difficult to characterise the exposure.[32,96] Thus, mass and chemical composition alone may not adequately describe the dose, because particles with the same chemical compositions can have different toxic mass doses dependent on properties such as particle size.[40] Nanoparticles account for a small percentage of the total mass concentration of particles, due to their size, so often the mass is negligible, but they account for a high percentage of the particle number concentration.[32,46] While it has been argued that mass concentration is unlikely to be the best exposure dose metric to assess exposure, it can be used while more accurate exposure dose metrics are being developed.[38]

Surface area

Several studies concluded that surface area is likely to be a better exposure dose metric than particle mass concentration to quantify exposure to NMs and NPs;[35,36,38,43,48,97] however, in only three was surface area alone used as an exposure dose metric.[43,99–101] This conclusion was based on the fact that surface area accounts for NPs with the same chemical composition, but of different sizes.[102] However, surface area changes with the shape of the particles, while particle number and mass concentration do not.[46] It has been argued that, due to the differences in particle composition and morphology of NPs, further research on surface area is needed before it is considered to be a reliable exposure dose metric.[103] It has also been argued that particle number concentration and surface area may be better exposure dose metrics than mass concentration when classifying exposure to NPs.[32] Other researchers have argued that surface area is potentially a better metric than particle number concentration concerning toxicity assessment, as the exposure dose is more important than the ambient air concentration.[35,46,104,105] The consensus is that, toxicologically, the surface area is likely to be the most appropriate exposure dose metric for inhaled, spherical NPs.[43]

Table 2. Assessment criteria used in the review

	Rating		
Assessment criterion	**High**	**Moderate**	**Low**
Number of metrics	Three or more (mass, particle number concentration, and surface area)	Two (mass and particle number concentration, OR particle number concentration and surface area, OR mass concentration and surface area)	One (mass, or particle number concentration, or surface area)
Instruments	Real-time measurements, sampling and offline analysis	Real-time measurements	Sampling and offline analysis
Measurement strategy	Adopted from known scientific body/programmes, e.g. OECD, ECHA	Adopted from other published papers	Authors' own strategy

ECHA: European Chemicals Agency, OECD: Organisation for Economic Co-operation and Development

Comparison of exposure dose metrics (external dose)

To improve the quantification of exposure to NPs, it is necessary to use a multi-metric approach, where all exposure dose metrics can be used, depending on the exposure scenario.[96] This approach is necessary to assess if NPs are released from different work activities and should form the basis of exposure assessment strategies.[32] It has been stated that particle number concentration and surface area provide biological information associated with exposure to NPs.[96,101] Of concern, is the lack of multi-metric use on the African continent, where only mass concentration is usually used to quantify exposure to ultrafine and respirable dust fractions, and then compared against mass concentration-derived occupational exposure limits.

Several papers reported that surface area and particle number concentration were useful to identify exposure, while mass was needed for risk characterisation as the instruments tend to be extremely sensitive to NPs emissions.[61,96,103,106] However, none of these exposure dose metrics can be used to measure dose in the lungs; they can only be used for external exposure.[46] Particle number concentration is not a commonly used parameter due to agglomeration, while mass concentration is dominated by the largest particles.[107] To date, no limitations have been identified regarding the multi-metric approach. It reduces measurement errors during exposure assessments, while ensuring that the associations between exposure and health outcome are discernible.

As recommended in all the papers, a combination of exposure dose metrics should be used for the exposure assessment of NPs. The European Chemical Agency (ECHA), under the European Union (EU), has recommended using more than a single metric.[33,60] As all exposure dose metrics are dependent on particle size, instruments used for exposure assessments must be sensitive in terms of the size-dependent response function per particle.[46] In one paper, it was emphasised that the best metric in terms of accuracy in representing exposure has not yet been identified, primarily due to the lack of comparability. A harmonised approach for data evaluation concerning metric, size range, etc. is missing, which hinders the ability to reach scientifically sound conclusions.[91]

A single metric may not be sufficient to characterise and quantify NP exposure for all types of ENMs adequately, due to poor correlation between the particle number and mass concentration, and insufficient data about surface areas related to NP exposure.[32,54]

From the scoping review, the preferred type of exposure dose metric was categorised according to geographical region. Most of the research on exposure dose metrics was conducted in Europe (58.4% of papers), followed by North America (28.7%), as shown in Figure 2. In Africa, only one study, by Masekameni et al. (2022),[108] investigated airborne exposure to silver and gold NPs in South Africa, using mass and particle number concentration as exposure dose metrics, which were then converted to particle mass concentration for comparison with occupational exposure limits.

Real-time monitoring instruments

Area measurements predominated in the papers reviewed. There was limited information regarding measuring exposures to NMs, especially personal exposures,[13] which is primarily due to the lack of availability of suitable instruments. Real-time instruments, which are practical and portable, aid in the ability to identify particle exposure in workplaces.[32,39] In 23 of the 118 papers reviewed (19.5%), it was stated that real-time instruments were used to assess exposure to NMs or NPs;[46,51,85,90,94,107–121] most of the studies (> 50%) were conducted in Europe. One study in Africa made use of real-time instrumentation, viz. the NanoScan Scanning Mobility Particle Sizer (SMPS), which was used to assess exposure to gold and silver NPs during synthesis activities in a South African research laboratory.[108]

Particle sizers

Scanning mobility particle sizer

The scanning mobility particle sizer (SMPS) measures particles of 2.5 to 1 000 nm and is often referred to as a reference instrument for measurements within the nano-range.[114,122,123] The instrument considers the number size distribution based on the electrical mobility diameter.[62,69] However, the instrument requires operating personnel

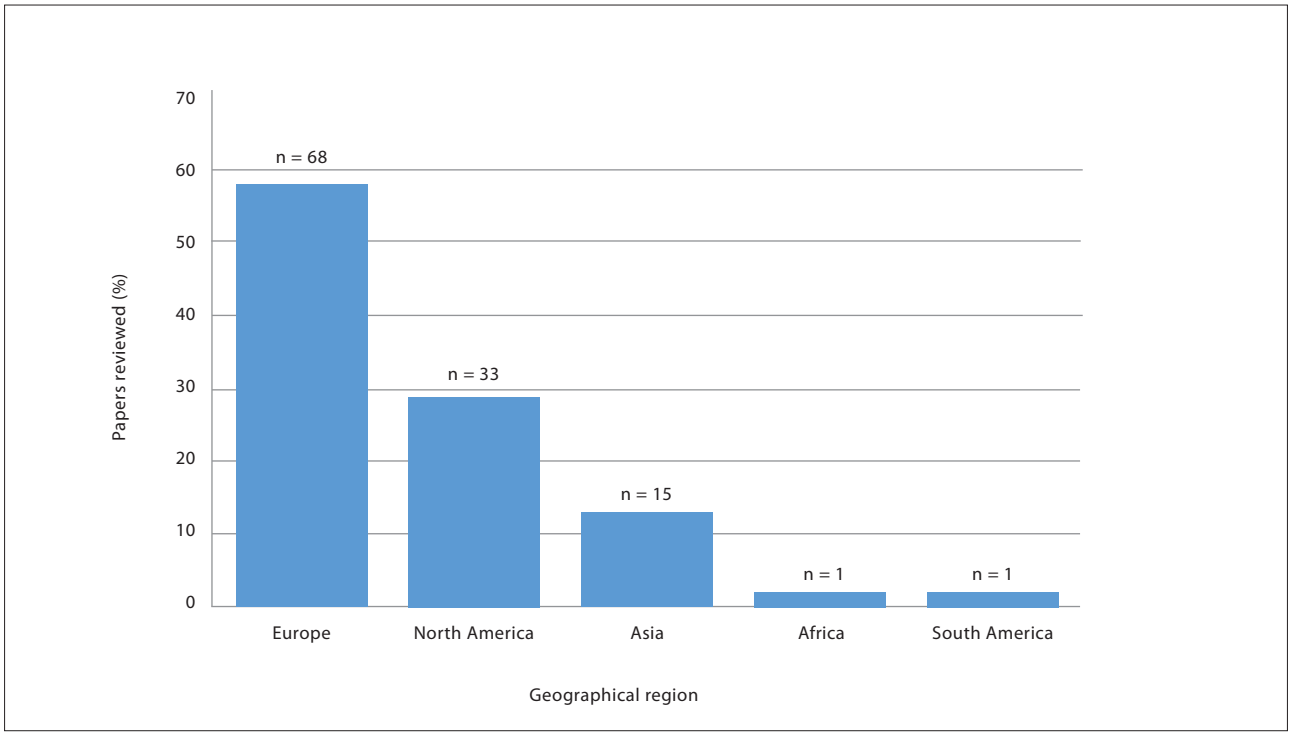

Figure 2. Papers included in the review, by geographical region

to be trained in aerosol measurement techniques.[107] Several variables need to be considered (scan time, airflow, impactor used, type of differential mobility analyser), and the size of the instrument makes it difficult to carry and operate in the workplace.[114] Nevertheless, SMPS data are considered to most accurately represent particle size concentration.[111]

Smaller, portable versions of the SMPS, such as the NanoScan SMPS, are used to measure particle number concentrations of 10 to 420 nm, in 13-size bins.[122,124,125] Its portability and the use of a non-radioactive charger make it suitable for workplace monitoring.[118,120] However, the 13 size fractions are an indication of the low sizing resolution, which translates into an overestimation of measured particle number concentration, due to particle size misclassification.[111,118,120] This misclassification makes SMPS unsuitable for occupational exposure assessments.[111] Another disadvantage is the complexity of the raw data from a NanoScan SMPS in comparison to that obtained from other types of SMPSs, especially since the multiple charge and diffusion loss corrections are already inherently included in the empirical data.[111]

The NanoScan SMPS is suitable for tier 2 studies, i.e. studies that focus on a basic exposure or release assessment, using a straightforward approach to determine if releases of, or exposure to, engineered nano-objects may occur. This requires a basic background exposure assessment to measure the concentration of NM or NP emissions for at least 45 minutes to determine if there is exposure (or not), using, for example, personal samplers to obtain real-time measurements throughout the entire work shift.[13,125] The NanoScan SMPS is discouraged for tier 3 studies, i.e. those that focus on obtaining as much information as possible about airborne nano-objects in the workplace, to a) determine if exposure to engineered nano-objects has the potential to occur, b) identify the level of exposure, and c) assess the need for additional risk management steps, which involve real-time instruments in addition to those used in tier 2 studies.[125] Real-time instruments are discouraged for tier 3 studies, because complex instruments and analytical methods are used in these studies to characterise both particle exposure and emission in terms of agglomeration, aggregation, morphology, and chemical composition.[13]

Aerodynamic particle sizer

Aerodynamic particle sizers (APSs) cover a broad range of aerosol sizes, as they measure the aerodynamic size distribution in the 0.52–20 µm range.[80,126]

Optical particle sizer

Optical particle sizers (OPSs) measure the particle number concentration for particles of 300–1 000 nm and comprise 16-size bins.[4]

Fast mobility particle sizer

The fast mobility particle sizer (FMPS) measures much smaller particles (5.6–560 nm in 32-size bins) and higher concentrations than the SMPS, providing better time resolution.[114] The disadvantage of the FMPS is that it cannot measure distributions of spherical particles with a geometric mean diameter > 200 nm.[64] One study highlighted that the FMPS tends to overestimate the total particle number concentration, by about three-fold, when particles are agglomerated.[120]

Particle counters

Optical particle counter

Particle counters are used to measure the particle number concentration of NPs.[122] The optical particle counter (OPC) is used to supplement filter-based sampling. It can measure emissions, but not characterise particle size distribution or measure the number of particles sized 10–100 nm.[31,113] For example, the optical aerosol Nanozen DustCount 9000 is used to measure real-time mass concentration, particle number concentration, and size distribution, and has 20 particle size channels.[127–129] It has a removable cassette that allows the collection of the aerosol on a 25-mm diameter particulate filter.[127,129]

Condensation particle counter

P-Trak is a condensation particle counter (CPC) used to measure the particle number concentration of 200–1 000 nm-sized particles.[129] The instrument is portable, easy to use, and less expensive than the SMPS.[120] Disadvantages are the lack of a comparable size distribution[120] and that it cannot be used in high-temperature environments, such as welding, smelting etc., because this can result in coincidence errors (where multiple particles are detected as a single larger particle).[32]

Comparison of real-time monitoring instruments

Real-time monitoring instruments are effective in assessing the efficacy of control measures and are the best instruments to measure exposure to NPs by inhalation.[46,130] The instruments are useful for studying variations in exposure by identifying peak emissions which, in turn, will indicate the activities/phases that are associated with peak emissions.[33,84,131] Exposure assessments can be conducted at any moment using real-time monitoring instruments, which assists in early warning systems.[112] Some researchers have stated that SMPSs provide size distribution information with better time resolution.[55]

The major limitation of the real-time monitoring instruments is their inability to differentiate NPs from background particles.[33] They are not capable of differentiating the physio-chemical properties of particles collected on filters. There are also differences in the sensitivities of the various instruments, e.g. the CPC can measure size particles of 1–3 µm, but those larger than 1 µm are easily lost due to inertial impaction (this does not affect NPs). The NanoScan SMPS tends to underestimate size distributions of particles > 100 nm.[132]

Another limitation of real-time monitoring instruments is the uncertainty related to the 30% deviation during the calibration of the instruments.[33,133] According to some authors, research should be conducted on both the uncertainties and the instruments' detection limits, to ensure reliable measurement data and enable comparison of results from different studies.[91] Most of the instruments are not suitable for non-spherical particles and tend to measure major deviations for agglomerated particles.[4] Environmental conditions can influence the results, e.g. in high-humidity environments, water droplets in the air may be counted by the OPC instrument.[119] Caution should be taken when using direct-reading results to derive mass-related values for exposure dose assessments.[33] Some authors indicated that the instruments often cannot be used for a wide spectrum of NPs.[45] Additionally, the relative performance of these instruments is limited to single exposure dose metrics.[134]

In summary, from the papers reviewed, it is clear that the comparability and variability of real-time monitoring instruments are not consistent, even when using instruments of the same model. Deviation errors, sensitivity, and detection limits of the same instruments varied between instruments made by different manufacturers. Real-time instruments that can provide data on particle number concentration, mass concentration, and particle size distribution would be valuable for conducting exposure assessments for NPs.

Instrumentation used for characterisation of nanomaterials/nanoparticles

The use of analytical methods for the characterisation of NMs/NPs is still preferred over the use of real-time instrumentation. In 29 of the 118 reviewed papers (24.6%), analytical methods and instrumentation for the characterisation of NM/NP were used.[17–30,43,44,93,100,131,135–140]

Filter-based sampling

A single-particle inductively coupled plasma mass spectrometer (ICP-MS) is used to quantify the number, concentration, and size of NPs, and it has been stated that this technique has high sensitivity and selectivity for elemental analysis.[19,20] Inductively coupled plasma optical emission spectrometry (ICP-OES) is the most common method used to identify the elemental composition of particles.[33,129]

Gravimetric analysis is used to measure the mass of particles; filters are weighed on a microbalance scale.[68,129] This sampling technique is not used to assess exposure to a single NP, but caters to large micro agglomerates and/or aggregates of NPs.[26,68] Gravimetric analysis can only be applied to NMs/NPs when used in conjunction with a size-selective sampler, designed to measure particles in the nano-range size.

Electron microscopy

Scanning electron microscopy (SEM) is used to detect size, shape, dimensions, elemental composition, and degree of agglomeration of NPs.[32,141] Compared to transmission electron microscopy (TEM), SEM provides sufficient data about a single particle and provides statistical analysis of the NPs, including physical and elemental composition data.[31,84,124,131,133] However, for elemental composition data, the SEM is coupled with energy-dispersive X-ray spectroscopy (EDS). Transmission electron microscopy uses image analysis software to obtain data on the NPs per volume of air, as well as morphological characteristics such as size, shape, and degree of agglomeration.[68,124] Similar to SEM, for elemental composition data, TEM is coupled with EDS. Additionally, TEM requires a small amount of sample – an advantage over SEM.[100]

Analytical inter-comparison of methods/techniques used for characterisation of nanomaterials/nanoparticles

The efficiency of the sampling is dependent on the filter's sufficient particle load.[31] Additionally, filter-based sampling allows for the analysis of the morphology and chemical content of the particles.[124] The method provides information about the characteristics that affect the toxicity of NPs.[142,143] Studies have highlighted that SEM and TEM techniques are accurate in identifying particle size distributions; however, statistically reliable results can only be obtained by counting the number of particles.[142,143]

One limitation of filter-based sampling is that the data are not readily available, as the filters need to be analysed in a laboratory.[144] Analytical methods to obtain statistically robust data about the shape, composition, and size distribution of NPs are time-consuming.[22,131] Another disadvantage is that gravimetric samplers cannot be used to detect small mass concentrations of NPs.[120,124] Gravimetric sampling is not ideal for obtaining information about changes in emissions of NPs throughout the work shift.[120] Overloaded filters will compromise TEM and SEM analysis.[31] While TEM and SEM provide information about the surface of a sample, they cannot be used to identify NPs embedded in a matrix, e.g. polymer fragments with carbon nanotubes.[33]

In conclusion, considering real-time monitoring instruments as well as analytical techniques used for the characterisation of NMs/NPs, it is evident that a single instrument cannot be used to measure all exposure dose metrics simultaneously; multiple instruments are required for exposure assessments. Instrumentation for the characterisation of NMs/NPs requires care when handling, and extensive training and experience in their use, and retrieval and analysis of the data.[26,31]

Internal dose and dose-response for exposure modelling

Ambient concentrations of NMs and NPs do not necessarily equate to the concentrations humans are exposed to, hence internal dose should also be considered.[145] In exposure models, the particle mass concentration as an input value is necessary to mimic exposure and provide the internal dose output. However, due to the negligible mass of NMs/NPs, it is necessary to convert particle number concentration to particle mass concentration. Dose exposure assessment is based on two methods: single- and multiple-path. Such methods are used for tracking the airflow and particle deposition in the lungs, providing output values in terms of lung surface area.[146] Understanding human exposure enables the improvement of experimental designs within exposure models, which predict not only exposure due to emissions, but also how exposure to NMs and NPs may translocate to different organs in the human body.[147]

Multiple-path particle dosimetry

Multiple-path particle dosimetry (MPPD) is used to model particle deposition ranging from nano-sized to coarse, and the clearance thereof from the lungs.[108,148,149] A paper describing a study on silver nanoparticles reported that (according to the model) the fraction of NPs that reaches the alveoli is about 5.5 times higher for 15-nm NPs than for 410-nm particles.[150] It has been suggested that the MPPD model can be used to relate human lung cytotoxicity and pulmonary inflammation to risk profiling.[151]

Single-path particle dosimetry (International Commission on Radiological Protection dosimetry model)

The International Commission on Radiological Protection (ICRP) dosimetry model is a single-method path model used to describe the deposition and retention of particles.[124,149] The model tends to predict the penetration of fewer particles into the respiratory regions than the MPPD model,[152] attributed to the single-path model using semi-empirical expressions based on experimental data, while the MPPD model is based on lung morphology.[18]

Comparison of exposure dose models

The MPPD model allows for the quantification of deposited particles within the different lung segments for both spherical and non-spherical NPs, and accounts for their uptake into the alveolar macrophages.[18,153] The MPPD model is readily available online and the particle dosimetry calculations are easy to apply.[146] Multiple-path particle dosimetry tends to overestimate exposure to NPs by not accounting for NP dissolution (interaction of NPs with the lung lining fluid), lung clearance, and ventilation changes that occur during exposure.[148] Accurate simulations require accurate estimates in terms of systemic absorption, clearance, and disposition, following the dissolution of NPs.[148]

Another limitation of exposure models is that they are dependent on the inhaled lung volume and the exposure concentration, and not the size of the particles inhaled.[146] Although MPPD and ICRP are both lung deposition models, the outcomes of the simulations

of the deposited particle concentrations vary significantly, e.g. the ICRP deposition curve was reported to have the highest deposition values for particles close to 10 nm, whereas the MPPD curve showed the highest values for particles larger than 60 nm.[46] Because the MPPD and ICRP are deposition models, they often report only on the deposition of the NMs/NPs, and not on any possible translocation (transport of the particles from the lungs to other regions of the human body) that may occur. The main differences between the MPPD and ICRP models are the breathing frequency and lung volume estimates used, which can lead to differences in outputs.[46] Despite the availability of the exposure models, the interpretation of the models is limited in the absence of actual human exposure data, and the estimation of exposure in work environments should take precedence.[147]

In summary, there are only a few studies on exposure dose of human absorption, which are not comparable.[145] The internal dose of NMs and/or NPs in the human body has been estimated using a variety of techniques and exposure models, which has led to variation in estimations.

Frameworks for occupational exposure assessments

To conduct reliable and robust exposure assessments, guidelines regarding the different measurement strategies are necessary, including how to implement those strategies and how to interpret and draw conclusions from the findings. This will also enable the reproducibility of exposure assessments, thus creating harmonisation and standardisation. The methods and guidelines form the basis for the efficient collection of NMs according to their size, composition, and shape, which is crucial in exposure assessments.[34,39] Currently, there is no single best method for measuring NMs/NPs, and the recommendation is to use a combination of methods/strategies.[154]

Measurement strategies

Measurement strategies for chemicals, which include easy-to-measure mass-based metrics suitable for exposure assessment, are well documented.[33] However, there are no globally established standard measurement strategies for NPs, other than those from country-specific harmonisation initiatives or those proposed by various international organisations.[83,145] Most of the published NP measurement strategies described similar exposure dose metrics but differences in the instrumentation used,[83] and omitted one aspect of the work activity.[83] Work activity accounts not only for the concentration of the contaminants in the environment, but also the length of time and type of tasks that expose employees to potential hazards. Thus, work activity represents work done by the worker and the possible exposure during work tasks.[83]

Recently, a tiered approach developed by bodies such as the OECD, the European Committee for Standardization (CEN), and the ECHA was recommended for exposure assessments relating to NPs.[3,83] The tiered approach is a risk-based approach to conducting an exposure assessment to determine whether exposure to NMs/NPs may occur, and if there is a need for risk management steps.[125] The approach involves tailoring the exposure assessment to the materials used, and work-based scenarios, to reduce uncertainty in the assessment of exposure while creating a balance regarding costs and effectiveness.[7,33,155] The tiered approach comprises three steps, viz. information gathering (literature search and review), basic exposure assessment (spot check measurements, using real-time monitoring instruments), and expert exposure assessment (labour-intensive, expensive tier).[45,51,108]

Currently, there is no harmonisation regarding the best analytical method for characterising exposure to NPs emitted from ENMs. The National Institute for Occupational Safety and Health (NIOSH) and the ISO have acknowledged that there are no established analytical methods to assess exposure to NPs using any exposure dose metric other than mass concentration.[33,115] The identification of emission sources of NPs, using quantitative assessments, is well-documented in the literature, e.g. comparing particle concentrations at the emission source with background concentrations to enable the implementation of measures for exposure mitigation.[31] One study highlighted that the ISO 2007 guidelines provide information about methods of characterisation, but not about analysis or interpretation of measurement results, considering differentiation between ENMs and other nano-sized particles emitted in the workplace environment. [33]

It is evident that no 'one-size-fits-all' approach can be followed in exposure assessments, especially as aspects of exposure dose metrics, measurement strategies, and measurement instruments are influenced by the exposure scenario. The use of a single exposure dose metric creates uncertainty about whether there is exposure or not. Due to some regulatory frameworks, dose is expressed in mg/m^3 (mass), but most of the instruments available for monitoring NPs (that measure particle number concentration) require conversion of particle number to particle mass concentration. Some studies have highlighted that the correlation between the particle number and mass concentration is not always consistent, and that there are insufficient data regarding the particle surface area related to NP exposure. This is because each exposure dose metric serves a unique purpose in an exposure assessment, and provides unique information, e.g. surface area provides information about lung deposition, whereas particle number concentration provides information about the number of particles in a specific volume. The multi-metric approach is recommended to provide an holistic overview. Such information can be used in various exposure assessment models that mimic human exposure, such as MPPD. These dose models can provide information regarding the deposition and retention of NPs, particularly those that are bio-accumulative (non-biodegradable).

Real-time monitoring is preferable over the use of analytical methods only, as it provides real-time information. However, considering background particles, the use of offline analyses, such as gravimetric analysis and ICP-MS, can assist in differentiating emissions associated with specific activities (exposure scenario) from those not associated with the exposure scenario. The use of offline analysis can provide information about the physiochemical characteristics and the possible toxicological effects of the NPs, which is essential in determining the potential health outcomes associated with exposure.

Last, considering that there is no harmonisation on the standard measurement strategies, we recommend the use of the tiered approach as cited by the OECD, CEN, and ECHA. The starting point of this approach is understanding the exposure scenario to inform the measurement strategy, and the instruments to use with the exposure dose metric of interest. This information is essential in the exposure assessment toolkit of quantifying exposure by characterising the exposure, rather than merely using the risk rating approach (e.g. low to high risk), which is often subjective and increases the level of uncertainty.

CONCLUSION AND RECOMMENDATIONS

In this paper, we have highlighted aspects of exposure assessment that influence the quantification of exposure, considering the exposure assessment toolkit, and showed that consensus about

exposure dose metrics, types of instruments, analytical methods, and measurement strategies remains unresolved within the nanotechnology fraternity. This hinders the ability to quantify exposures, as well as to draw conclusions about associations between exposure and adverse health outcomes.

The use of real-time instrumentation, in conjunction with offline analysis, can provide information on emitted NM/NP concentration fluctuations throughout the associated activities. This will decrease many uncertainties regarding the data recorded by instruments during exposure assessments. Exposure models such as MPPD mimic lung deposition and provide information on particle deposition and retention; however, they lack information on translocation. This information is important, given that NPs can translocate from the lungs during gaseous exchange to other organs of the body, due to their small size and non-biodegradability.

We compared the strengths and limitations of each NP measuring instrument, which should be considered when selecting an instrument for NP exposure assessments. There is a wealth of literature on standardised measurement techniques for particles outside of the nano-range size, but limited knowledge regarding measurement strategies and approaches for determining exposure to NMs/NPs. Quantification of exposure to NPs remains comparatively difficult. In the absence of a standardised strategy, we recommended that the measurement strategies proposed by the OECD, CEN, ECHA, and others be applied with caution. A multi-metric approach should be incorporated into a standardised measurement strategy that will be used in exposure assessments to protect human health.

Overall, we explored the use of different exposure dose metrics simultaneously during exposure assessments, considering that particle mass concentration is often negligible when referring to NMs/NPs. The use of real-time instrumentation, in conjunction with the methods of characterisation to assess exposure, provides a more integrated approach. There is an urgency to standardise methods/strategies to quantify exposure to NMs/NPs, considering the rapid growth of the nanotechnology field.

KEY MESSAGES

1. There is no consensus about appropriate exposure dose metrics to use for quantifying exposure to nanomaterials/nanoparticles (NMs/NPs).
2. The type of instrumentation used to assess exposure to NMs/NPs is dependent on the exposure dose metric of interest.
3. Exposure models allow for mimicking particle deposition and penetration in the human respiratory tract, which is essential for predicting deposition, retention, and clearance of NPs in the various regions of the respiratory tract.
4. Although there is literature describing standardised measurement approaches for particle sizes beyond the nano-range, measurement strategies/approaches for quantifying exposure to NMs/NPs remain underdeveloped.
5. There is a need for more exposure assessment studies on NMs and NPs on the African continent.

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: MSL, MDM, CA
Data acquisition: MSL
Data analysis: MSL
Interpretation of the data: MSL
Drafting of the paper: MSL
Critical revision of the paper: MSL, MDM, CA, MG

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Psychosocial support services for emergency medical services personnel in the City of Tshwane, South Africa: availability and accessibility

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ABSTRACT

Background: Emergency medical services (EMS) personnel are exposed to dangerous, challenging, and emotionally draining work situations as they reach out to survivors of emergencies to provide physical and emotional support. Attending to life-threatening incidents while being directly exposed to personal safety threats is common.

Objective: We described the availability and accessibility of psychosocial support services for EMS personnel in the City of Tshwane, South Africa in 2022.

Methods: A descriptive qualitative research design was used. Twelve EMS personnel were purposively sampled from one of the seven regions in the City of Tshwane, and data were collected using semi-structured interviews. Data were analysed using qualitative content analysis.

Results: Despite the available services for EMS personnel, which they acknowledged, the utilisation thereof was poor. This was due to the limited numbers of service providers and inadequate referral procedures. Peer and self-support were alternative strategies used, and private professional services were consulted. While there is a need for psychosocial support for EMS personnel, barriers such as concerns about stigmatisation, referral difficulties, and resource limitations prevent access to, and use of, services.

Conclusion: There is a dire need for preventive and supportive psychosocial interventions for EMS personnel. Strengthening psychosocial support for these healthcare professionals can prevent burnout and increase resilience. Support services should address psychosocial hazards in the workplace and psychosocial health literacy, and be supported by management.

INTRODUCTION

Emergency medical services (EMS) personnel are first responders to medical emergencies and disasters in communities. They *"interact with people and the forces of nature in extreme circumstances"*.[1] They provide acute care for urgent and critical conditions on the scene, prehospital care, and patient transportation to relevant hospitals.[2] The burden of disease as a consequence of trauma in South Africa is increasing. Minnie et al. (2015) reported that prehospital trauma in South Africa was significantly higher than the global average,[3] impacting the workload and exposure to critical incidents of EMS personnel.[4]

Emergency medical services personnel are exposed to many critical incidents (also referred to as traumatic events).[5-8] According to the 2022 *Diagnostic and Statistical Manual of Mental Disorders* (DSM5-TR),[9] a traumatic event includes exposure to actual or threatened death, injury or sexual violence, witnessing the event, learning that the trauma happened to a close relative or friend, or repeated exposure to aversive details of a traumatic event, usually in the course of professional duties.[6,10] They are sometimes threatened and assaulted by community members, and theft and verbal abuse of EMS personnel are common.[10] Vincent-Lambert and Westwood (2019) estimated that 66% of South African EMS personnel reported being assaulted while on duty.[11]

Dealing with critical incidents is emotionally demanding and EMS personnel need to remain calm and professional in all situations.[1,12] They are also often exposed to long working hours, shift work, financial stressors, conflict, and lack of support in the work environment, all of which affect their physical and psychosocial health.[4,13,14] Physical consequences include digestive problems, headaches, backache, sleep deprivation, and fatigue.[4] After exposure to critical incidents, many EMS personnel experience psychological distress, which can affect their work performance.[15]

Several studies have suggested that, due to the nature of their work, EMS personnel are at greater risk of adverse psychological outcomes than is the general population.[8,16,17] In a meta-analysis of 18 studies, Petrie et al. (2018) estimated that 11% of EMS personnel suffered from post-traumatic stress disorder (PTSD), 15% had depression, 15% experienced anxiety, and 27% experienced general psychological distress.[18]

The work of EMS personnel also has social consequences, impacting family life and structures.[18] Shift work disrupts marital and parental responsibilities, leisure, participation in social events, and household schedules.[4,8]

However, not all EMS personnel are negatively impacted if support systems, including support from management, are in place.[8,19] Psychosocial support is essential for improving the overall mental wellbeing of EMS personnel.[16, 20] Early intervention after a critical incident can improve the team's cohesion, reduce adverse responses, reduce sick leave, and increase performance.[21]

The aim of this study was to describe the availability and accessibility of psychosocial support services for EMS personnel in the City of Tshwane, Gauteng province, South Africa.

METHODS

This was a descriptive qualitative study. The study population comprised 120 EMS personnel from five stations in the City of Tshwane, with a minimum of one year of experience. Purposive sampling was used to select EMS personnel who were considered likely to be the most informed about the the psychosocial support services available and their accessibility.

After permission was obtained from the EMS managers of the five stations, potential participants were approached while on duty, but waiting to be called out to medical emergencies, and the study was explained to them.

Data were collected using semi-structured individual interviews from December 2021 to February 2022. The interviews were conducted in English at the station in a private room and were audio-recorded. The interview questions were: "*What are your experiences with the use of psychosocial support services for EMS personnel in your work environment?", "Which psychosocial support services are available for EMS personnel working in public health services in the City of Tshwane?",* and *"How do you get access to these psychosocial support services?"* The interviews took 40–60 minutes. Field notes were included with the interview transcripts in the data analysis.

Table 1. Demographic characteristics of study participants (N = 12)

Characteristic	n	%
Sex		
Male	5	41.6
Female	7	58.4
Age (years)		
≤ 30	2	16.7
31–40	6	50.0
41–50	4	33.3
Emergency medical services experience (years)		
6–10	5	41.7
11–15	6	50.0
> 15	1	8.3
Job title		
Basic ambulance assistant	11	91.7
Emergency care technician	1	8.3

Data collection and analysis were done in parallel to identify themes and determine the point of data saturation. If an emergency callout interrupted the interview, then it was terminated and rescheduled at a more convenient time.

The interview schedule was piloted on two participants. Since no changes were made to the interview schedule after pilot testing, these two participants were included in the analysis.

The study was approved by the Tshwane University of Technology's Research Ethics Committee [# FCRE 2021/05/009 (SCI) FCPS 2].

Data analysis

The audio-recorded interviews were transcribed verbatim; no transcription software was used. Data were analysed using qualitative content analysis, repetitive statements were identified, and relevant meanings were formulated. Thereafter, themes were identified with consensus among the researchers.

Trustworthiness

The framework described by Lincoln and Guba, cited by Polit and Beck (2021), was used to ensure the study's trustworthiness.[22] This framework identifies five criteria for trustworthiness: credibility, dependability, confirmability, transferability, and authenticity. Credibility was enhanced through multiple interviews lasting up to one hour. Dependability was enhanced by an audit trail of the approved proposal, audio-recorded interviews, transcriptions, consent letters, and field notes. The senior researchers enhanced confirmability and co-analysed the data; consensus was reached on themes, categories, and sub-categories. Transferability was enhanced by purposively sampling EMS personnel with sufficient information about the topic. Authenticity was enhanced by audio-recording the interviews and quoting participants verbatim.

RESULTS

Twelve EMS personnel were interviewed before data saturation was reached. As shown in Table 1, most of the study participants were female (n = 7, 58.4%). Half (n = 6, 50.0%) were aged 31–40 years. Six of the study participants (50.0%) had 11–15 years of experience; only one (8.3%) had more than 15 years of experience. Most were basic ambulance assistants (n = 11, 91.7%).

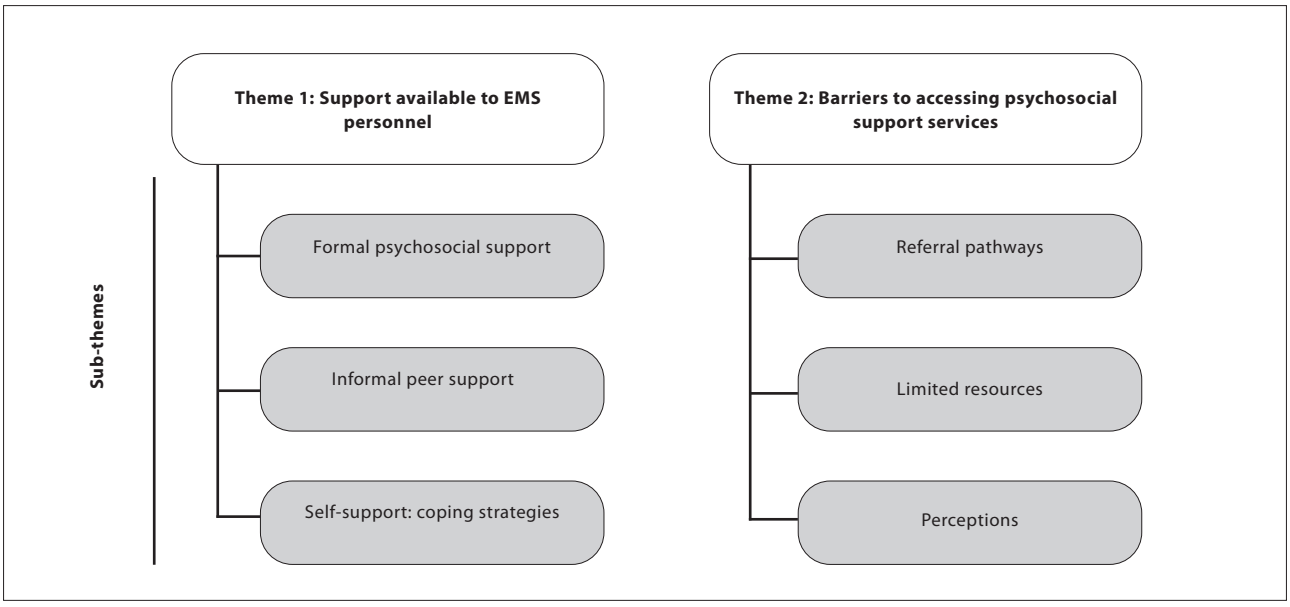

Figure 1. Themes and sub-themes identified from interviews with study participants

Themes

Two main themes emerged: 1) support available to EMS personnel and, 2) barriers to accessing psychosocial support services (Figure 1).

Theme 1: Support available to EMS personnel

Three sub-themes were identified within this theme, viz. formal psychosocial support services, peer support, and self-support and coping strategies.

Formal psychosocial support

The formal support services that the EMS personnel were aware of, and had used, included both public and private health services and occupational health services. Public health services were used when they were physically ill or had suffered a physical injury, such as an accidental needle stick injury. These services included the chaplain's services, which usually provided support immediately after someone had attended a traumatic incident and needed debriefing.

> *There is a municipality clinic where, when you have pricked yourself with a needle, they will take you there and test you; they must counsel you and give you emergency whatever.*
>
> *P3*

> *We were hijacked the time we were working at the clinics; they came and took the vehicle at the station at gunpoint, then that day and at the end of it, they called the chaplain.*
>
> *P2*

One of the available services known by the participants was occupational health and safety (OHS), offered at the wellness clinics in the City of Tshwane. The participants explained that the wellness clinic services were under-resourced, as one professional was responsible for all personnel working in the area.

> *We have wellness support, but we have one person; the problem is one person deals with the stations…, but all departments, not only from EMS. It is a problem for us because she is unavailable at any time. It will take time to see her because you have to make an appointment.*
>
> *P7*

The participants explained that, due to the limited support services in their work environment, they used private health services such as psychologists, psychiatrists, and other medical practitioners.

> *I think we are not coping because we are human beings. I resorted to a personal psychologist; I believe we all have medical aid. They also have to resort to that, so I advise them to see a therapist, a counsellor or psychiatrist, psychologist, or anything to help you.*
>
> *P11*

Informal peer support

The participants explained that they faced many challenges in the 12 hours of their shifts and attended to all calls, including motor vehicle accidents, suicides, and assaults. They shared that they were often not counselled at work, but supported each other as a team or discussed the incident with colleagues working on that shift.

> *The support so far is with the colleagues, especially after an incident or call. We just come together, speak about it, or we work together we speak what we went through.*
>
> *P9*

> *Discuss with colleagues; it becomes better and better every day. When you arrive home, you do not stress; you do not think of what is happening at work. You can focus on your family and partner.*
>
> *P7*

Self-support: coping strategies

When asked how they coped with exposure to trauma, the participants stated that they used different self-coping strategies, such as suppression, normalisation, humour, avoidance (absenteeism), substance misuse, and recreational activities.

They explained that, even if they tried to forget the incidents they had attended, those incidents presented as trauma symptoms later because they were suppressed. Some participants said that they suppressed thoughts about the trauma they had experienced, in order to cope with the next call to which they needed to attend.

> *No, none* [trauma counselling]*, you sit alone, think about it, make sure you get rid of it from your mind and make sure that you are not going to live with it for the rest of your life.*
>
> *P6*

> *You are coming from a train accident; somebody has been smashed by a train, then you come here at the station, you clean the ambulance, and they give you another call. You must behave as if nothing has happened at the previous call and then be a new person when you go for another call. You just have to react as if everything is ok.*
>
> *P12*

The participants stated that the regular exposure to trauma in the working environment has made these incidents appear normal, and that this normalisation enabled them to have the strength to cope.

> *We just take the day as it is; there is nothing new or different. As long as you come to work, you console yourself that the current job that I have applied for and the situation where I am going to work are normal.*
>
> *P12*

Humour was common after attending traumatic calls.

> *At some point, you think it is a joke. Sometimes, you laugh about it, even when it is traumatising. At the end of the day, you will be relieved and feel much better. Speaking about it makes things easier. It does not completely remove the trauma, but talking about it makes it easier; this is how I cope with it.*
>
> *P9*

> *The only thing is to talk to colleagues, make jokes about that incident, and get rid of it.*
>
> *P2*

Some participants explained that they sometimes absented themselves from work to avoid traumatic exposures, especially on weekends. Others felt tired due to their long working hours, wanted to rest, and so absented themselves from work.

> *I think it affects us the same; there is much absenteeism. You see, the people are tired.*
>
> *P7*

> *The only time you will see that this person is not coping is when he takes a lot of leave and sick leave.*
>
> *P8*

Some were unable to forget the scenes to which they were exposed, and started using alcohol and other substances as a coping strategy.

> *Let us say you have a problem with these scenes of accidents at work; you start shouting at kids at home, you start taking drugs, drinking, and even absenting yourself from work.*
>
> *P3*

Others used exercise as a distraction, and to relieve stress.

> *I am quiet, so I like to exercise most of the time. If I am stressed, I go to the gym, and exercise is another way to relieve stress, concentrate on other things, and not stay on my mind.*
>
> *P10*

Theme 2: Barriers to accessing psychosocial support services

The participants indicated that they intended to use the available support services, but were prevented from doing so by factors beyond their control. The barriers to using support services were referral pathways, limited resources, and perceptions.

Referral pathways

Participants stated that they had to be referred by their supervisors to any EMS department support service. Both the EMS personnel and their supervisors had to follow a procedure, during a crisis or emergency, to consult with a professional. The participants described these referral pathways as barriers.

> *For every problem you encounter at the station, you pass through the officer, who will arrange everything for you. It is not easy because if the officer is not available, you are going to struggle to get the service.*
>
> *P12*

> *You feel that you need that private session. Sometimes, you want to keep the department from knowing about us. It could be like going to the counsellor's office without the supervisor's knowledge. When I have troubles at home, I tell the supervisor that it is no longer confidential.*
>
> *P6*

There were long waiting times to consult the wellness services, and some chose private psychological services because of the limited support resources available in the work environment.

> *It is not easy for them because it takes time to get assistance. Like for example on my shift there is this lady who was pointed with a gun even today, she is still afraid and has not got assistance from the city, from the wellness, and they have been sending email, email, emails.*
>
> *P9*

Limited resources

The participants provided reasons for their limited utilisation of support services and explained the conditions under which it was compulsory to access them. The available support services comprised a wellness service (a councellor), occupational health services, and services of a chaplain. Often, the supervisors referred the EMS personnel to the relevant support services in the City of Tshwane, but these services were under-resourced. Furthermore, the appointment system was based on a first-come-first-served basis, making it difficult to get support during a crisis. When asked how often they utilised the support services, the participants stated that it was limited.

> *If I am not fine emotionally and I feel I need counselling, I instead pop out the money and go to a private institution where they can help me.*
>
> *P6*

> *If we were using that service as we are supposed to, she would not have coped; that is why she is using appointments. If she was not busy, we could go there and find her, or find her anywhere. She is one person; if you say, I want to see you tomorrow, she will say not tomorrow, maybe after three days. That happens if something serious happens and is referred to by the supervisor.*
>
> *P8*

Perceptions

Some participants believed that the wellness clinic staff could not assist them because they did not understand the trauma they experienced, and were not knowledgeable about the EMS jobs.

> *I am not making any confession. I am sitting on the problem, walking with the problem; I am having a problem. So, I do not think the chaplain can help me because it is not a religious problem I am having; it is a medical problem. So, in most cases, if you do not get the wellness people, you are referred to the chaplain.*
>
> *P11*

DISCUSSION

The study particpants comprised predominantly mid-career professionals with substantial experience in EMS and were, therefore, in a position to respond accurately and appropriately to the interview questions. We investigated the availability and accessibility of psychosocial support services for EMS personnel in the City of Tshwane. Two themes emerged from the interviews, viz. the available psychosocial support and barriers to utilising that support. It became evident that EMS personnel were aware of the formal psychosocial support services, which are introduced during the induction period or when they are referred to them after a critical incident. Peer support was an important coping mechanism, but the participants also used self-support strategies.

Formal psychosocial support services

Having access to formal support services for EMS personnel, such as early post-trauma intervention, can improve social cohesion, coping skills, and work performance, and reduce harmful responses, such as PTSD, depression and anxiety, and absenteeism.[16,21] Formal or professional support services in other countries include support from psychologists, employee assistance programmes, and chaplain services that work together and independently.[10,23] Studies by Tunks

Leach et al. (2022, 2023) confirm the value of chaplain services for EMS personnel in reducing barriers to help-seeking behaviour, enabling referrals to psychological support, and providing relational support rather than diagnostic and managerial support.[23,24]

Informal peer support

The EMS personnel valued informal peer support when dealing with critical incidents and stress. Austin et al. (2018) reported similar findings amongst paramedics in the USA, who relied more on peer networks than formal support to deal with everyday pressure.[25] Peer support provides an opportunity to exchange personal experiences, as shown in several other studies.[3,5,19] Peer support can also improve resilience through camaraderie[4,13] and reduce post-traumatic stress.[21,26] Clompus and Albarran (2016) showed that family support increased the resilience of EMS personnel, although they rarely shared work experiences with their family members,[13] similar to reports from the participants in this study.

Self-support: coping strategies

Alshahrani et al. (2022) found that the EMS personnel in their study who used passive coping, such as suppression or avoidance, were more likely to have higher levels of post-traumatic stress.[26] Avoidance through absenteeism, as described in this study, is a coping mechanism for high levels of stress.[13]

While detachment is a short-term coping mechanism after experiencing distressing incidents,[13] studies have found that the use of suppression by EMS personnel can exacerbate psychological challenges, such as post-traumatic, depressive, and somatic symptoms.[27] In a study by Gärtner et al. (2019), avoidance was predicted to cause less work-related stress but correlated with more severe post-traumatic, depressive, and somatic symptoms.[27] As in our study, alcohol misuse as a coping mechanism and a form of 'self-medication' has been reported by others.[8,14,28,29] The EMS personnel used adaptive coping strategies in this study, such as humour and exercise. The latter can improve resilience and coping,[30] and humour has been reported to serve as a distraction and diffuse tense work-related situations.[13]

Barriers to utilisation

While formal support services were available to our study participants, access was compromised due to the referral pathways, the already overburdened professional services, and the EMS personnel's views that professionals offering psychosocial services did not understand their experiences. Findings from other studies suggest that managerial factors affect access to professional services, such as the failure of managers to acknowledge the psychosocial effects of witnessing traumatic events, and lack of confidentiality.[4,13] Consequently, the EMS personnel in our study often used private professional services outside the workplace. Similarly, Mackinnon et al. (2020) found that more than a third of participants in their study in New Zealand and Australia accessed psychosocial services external to the workplace.[16] Early organisational support is beneficial as it enables managers to refer employees for assistance, assess work-related outcomes, and allocate appropriate resources within a supportive and inclusive work environment.[8,21]

Several studies have reported reduced help-seeking behaviour in EMS personnel due to fears of being seen as weak, career and confidentiality concerns, work pressures, or denial that they needed support.[16,19,31] Perceptions can also be barriers to access. Being suspicious of occupational health professionals and senior management's intentions compromises access to professional psychosocial services.[21] Participants in our study believed that professionals offering psychosocial support, such as chaplains, did not understand the reality of their work environment. Similarly, Mackinnon et al. (2020) found that counselling by professionals without experience of working with EMS personnel led to the psychosocial support being unspecific and generally unhelpful.[16] Lawn et al. (2020) showed that inappropriate therapies contributed to under-utilisation of psychosocial services.[4] To address these barriers, counselling staff need to be well trained in dealing with EMS personnel's exposure to traumatic incidents, as well as their day-to-day work.[14]

Recommendations

The World Health Organization (WHO) guidelines on mental health at work outline evidence-based recommendations to protect, promote, and support the EMS personnel's mental health.[32] These interventions are at organisational, managerial, and individual levels for EMS personnel.[4,32]

Organisational interventions

Policies, systems, and processes should be designed to assess and manage the psychosocial risk factors that affect EMS personnel, such as work design, workload, schedules, work control, equipment, organisational culture, interpersonal relationships at work, roles in the organisation, career development, and the work-home interface. Possible interventions include workload management, schedule and shift changes, improved communication and teamwork, enforced leave, and rest periods.[4,30,32] In the City of Tshwane, policies and procedures should be tailored for specific challenges, such as the high incidence of violence and trauma in certain areas, and cultural and resource constraints. Organisations should advocate for the allocation of funding to strengthen under-resourced psychosocial support services, to reduce waiting times, and improve accessibility. Partnering with provincial health authorities could support referral processes for EMS personnel to address long waiting times.

Training of managers and EMS personnel

Managers and supervisors of EMS personnel should be trained on psychosocial risk management and methods to support and protect their mental health. Training should improve the managers' knowledge, attitudes, and behaviour towards mental health, which would positively impact the help-seeking behaviour of EMS personnel, and enable managers to make appropriate and timely referrals for psychosocial support.[31,32] Similarly, EMS personnel should be trained to provide peer support and self-support, and to identify when professional psychosocial support services are required.[32] Training to increase the psychosocial health literacy of EMS personnel and their managers can further assist to reduce stigma, through increasing awareness of available psychosocial support services.[4,32] This training should start with preparing EMS students and new employees in pre-incident psychosocial and resiliency preparation.[4,6]

Individual interventions

Psychosocial interventions should be implemented in the workplace for all employees. Such interventions include stress management, mindfulness training, cognitive behavioural therapy, self-care training, communication skills training, critical incident stress management, psychological first aid, support groups, and employee assistance programmes.[20,32-34] The processes that need to be followed to access psychosocial support services should be revisited; clear and uncomplicated processes should be introduced to promote help-seeking behaviour by EMS personnel. Furthermore,

leisure-based physical activities should be part of the workplace culture and processes.[32] Due to resource constraints, alternative methods of providing support and interventions should be implemented, e.g. partnering with support groups such as the South African Depression and Anxiety Group (SADAG) and providing workplace-based online or telephonic crisis intervention and support services.[32] Manager support and referral systems should improve linkages to care through clear and confidential referral systems. Introducing confidential, direct-access systems to psychosocial support services – bypassing hierarchical referral pathways that discourage help-seeking – could support psychosocial support utilisation for EMS personnel in public health services in the City of Tshwane.

Limitations

The purposive sampling method, small sample size, and setting of our study limits its generalisability to EMS personnel in other cities in South Africa, or globally. The use of interviews to collect data could have led to social desirability bias. In addition, the interviews were conducted in English, which was not the first language of all participants, and which could have limited their ability to fully express themselves.

CONCLUSION

Emergency medical services personnel are, by the nature of their work, disproportionately affected by psychosocial disorders. Our findings highlight the need to improve their access to psychosocial support services. Systemic challenges such as psychosocial resource constraints, referral pathways, and stigmatisation in the public health sector are barriers to accessing formal support services. However, alternative professional services are used, and EMS personnel support each other. Preventive and targeted psychosocial support interventions are needed to reduce psychosocial risks and foster a culture of support in the EMS. Interventions must take the unique workplace culture into account, be supported by the organisation and senior management, and utilise existing social cohesion and peer support systems. Prioritising the psychosocial health of EMS personnel will foster a more resilient and capable workforce, assist in retaining EMS personnel, reduce burnout, and improve the much-needed emergency service delivery in South Africa.

KEY MESSAGES

1. Access to structured support services, such as early post-trauma interventions, improves coping, reduces stress-related disorders, and enhances work performance.
2. Complex referral processes, overburdened professional services, confidentiality issues, and a lack of trust in professionals are barriers to using formal support services.
3. Informal peer support is a key coping mechanism, fostering resilience and camaraderie among EMS personnel.

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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: RMDM, YH, MdV
Data acquisition: RMDM
Data analysis: RMDM
Interpretation of the data: RMDM, YH, MdV
Drafting of the paper: RMDM, YH, MdV
Critical revision of the paper: RMDM, YH

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Breaking barriers: women's impact on occupational hygiene in South Africa

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ABSTRACT

The field of occupational hygiene was founded by, and historically dominated by, men. However, as more women entered the workplace, they also entered the field of occupational hygiene. This paper highlights the contributions of women to the field of occupational hygiene, globally, and provides a brief overview of the history of women in occupational hygiene in South Africa. It also highlights the impact of women in the Southern African Institute for Occupational Hygiene (SAIOH), the National Institute for Occupational Health (NIOH), the mining industry, academia, and government – specifically, the South African Department of Employment and Labour. The emphasis of this paper is largely focused on the field of occupational hygiene, but the connection to occupational health should not be overlooked. As an all-female authorship, we wish to encourage young women interested in science to enter the fields of occupational health and occupational hygiene, by showcasing the impressive progress that has been made by women.

INTRODUCTION

In South Africa, women have been historically under-represented in the fields of science, technology, engineering, and mathematics (STEM) due to societal attitudes and traditional gender roles, which have limited their access to education and career opportunities. However, the active promotion of gender equality and inclusivity has changed this. Mentorship, female role models, and supportive networks in STEM are inspiring more women to obtain tertiary qualifications and to enter the workforce in these fields.[1]

In 2023, only 23% of STEM professionals working in South Africa were women, of which only 17% held leadership positions.[2] This gender imbalance reflects trends within the scientific community, where women's contributions have often been overlooked or received less attention than those of men.[3-5] According to the World Economic Forum's global gender gap reports, women make up one half of the world's human capital,[6-8] but this is not reflected in workforces across the world.

Women are increasingly making their marks in occupational health and hygiene, contributing significantly to its development and implementation across various sectors, nationally and internationally.[9,10] Recently there has been an increased focus on women's health needs in the workplace, including reproductive health and personal protective equipment (PPE) designed specifically for women.[11,12]

This paper explores the historical and current contributions of women to occupational hygiene, with a particular focus on South Africa. As female authors, we recognise and celebrate the role of women in occupational health and hygiene, and hope to inspire women and foster gender inclusivity in scientific research and practice. The women mentioned in this paper are representative of female contributions to occupational health and hygiene, but there are many other women who have played major roles in the discipline. We acknowledge and celebrate the contributions of all.

HISTORY OF OCCUPATIONAL HYGIENE

Hippocrates was probably the first to identify occupational disease when he documented lead toxicity in mining in the 4th century BC.[13] Bernardino Ramazzini is known as the father of occupational hygiene (or industrial medicine as it was then known), as he linked disease with occupation in 1700 by asking *"What is your trade?"*.[13]

Occupational hygiene was founded by men, and the global development has been primarily driven by men. Dr Alice Hamilton broke through the barriers as the first female expert in occupational health. She was a pioneer in toxicology and her research focused on the effects of metals, specifically lead, on the human body. In 1908, she published her first paper about occupational diseases in the USA. In 1919, she was the first woman to be appointed to the faculty at Harvard Medical School, as an assistant professor in the Department

of Industrial Medicine. As a woman, she was excluded from social activities and the graduation processions. Dr Hamilton was the only female member of the League of Nations Health Committee from 1924 to 1930.[14] She described an epidemic of phossy jaw caused by exposure to phosphorus in workers tasked with making matches.[15] Dr Hamilton's research created awareness about the dangerous effects of various chemicals amongst government and industry workers. She is regarded as the matriarch of occupational medicine in the USA.

Other women have historically impacted the field of occupational hygiene. In 1894, Adelaide Anderson was the first female factory inspector in the UK; her most noticeable contribution was the improvement of women's working conditions in the textile industry. She also authored a book, *Women in the Factory: An Administrative Adventure, 1893 to 1921*.[17,18] Molly Newhouse, a South African-born occupational physician in Britain, researched asbestos dust exposure and the development of mesothelioma in 1965. Her work was instrumental to the banning of asbestos by many countries.[19,20] Even the name, 'occupational hygiene', is derived from the female Greek goddess, Hygeia, who represented the preservation of good health and prevention of disease.[21]

SOUTH AFRICAN PERSPECTIVE

Gender-based discrimination is prohibited in South Africa under the Employment Equity Act No. 55 of 1998 (EEA). The EEA stipulates that no individual may unfairly discriminate against an employee, either directly or indirectly, based on grounds such as race, gender, pregnancy, marital status, ethnic or social origin, colour, sexual orientation, and age, amongst others.[22] However, women still face unfair treatment in terms of remuneration, promotion, and opportunities for advancement in many workplaces. Stereotyping and cultural norms can also contribute to gender-based discrimination in the workplace. Nevertheless, efforts are being made to address these issues through initiatives aimed at promoting gender equality and enforcing anti-discrimination laws.

Figure 1. Dr Alice Hamilton, first female Faculty member at Harvard University

Source: Harvard University, 2024[16]

Women are under-represented in leadership and academia in South Africa, with only six of 26 academic institutions led by women in 2024.[23,24] Women have often been underestimated or overlooked for leadership roles, despite their qualifications and capabilities.[25] Even when they secure employment, women often struggle to attain decision-making positions in specific sectors. According to the Quarterly Labour Force Survey of the 2nd quarter of 2023, men in the South African labour market are more likely than women to be employed in paid positions, regardless of race.[26]

The historical under-representation of women in occupational hygiene is underpinned by numerous barriers, including limited access to education and training opportunities, and entry into, and advancement in, this field. However, in South Africa, women are increasingly taking leadership roles and making significant contributions to the field.[27]

WOMEN IN THE SOUTHERN AFRICAN INSTITUTE FOR OCCUPATIONAL HYGIENE

The Southern African Institute for Occupational Hygiene (SAIOH) has made major strides in promoting gender equality and increasing women's participation in the field of occupational hygiene. As of February 2025, SAIOH had 566 registered female members; 53% of members were women, compared to 27% in 2005 (personal communication, SAIOH administrative team). Over the past 10 years, almost 50% of branch chairs have been women.

SAIOH provides mentorship programmes and support networks designed to help women advance their careers in occupational hygiene, offering guidance, professional development, and networking opportunities. The Institute promotes inclusive policies and practices that ensure equal opportunities for all members, regardless of sex.

Annually, SAIOH recognises the exceptional professional conduct and achievements of an occupational hygienist during the previous year. According to available records, in the last 15 years, six out of 15 (40%) of the Occupational Hygienist of the Year awards were awarded to female members of SAIOH (personal communication, SAIOH administrative team). These include Miranda Melk, Tatjana Radojevic Rogowski, Corli Venter, Keneilwe Matjola, Jeanneth Manganyi, and Melinda Venter.

Some of the extraordinary women in the field of occupational hygiene are Jo-Anne Bradley, who served as the Occupational Hygiene Association of South Africa (OHASA) President from 1989 to 1990, and Melinda Venter, who, in 2010, 10 years after the launch of SAIOH, became the first woman to serve as its President. Not only did Melinda open doors for other women to serve on the SAIOH Council, but she was also instrumental in the development of the SAIOH Quality System.

Since 2017, the key leadership roles within SAIOH have predominately been held by women (Table 1).

The Professional Certification Committee (PCC) of SAIOH has historically had the largest representation of women in SAIOH, with five female PCC Chairs to date, demonstrating women's growing influence in the development of occupational hygiene professionals in South Africa. Elsabe Steyn served as the first female SAIOH PCC Chair during 2004–2005, followed by Melinda Venter, Julie Hills, Karen du Preez, and Corlia Peens (personal communication, Deon Jansen van Vuuren).

Julie Hills served as PCC Chief Examiner from 2014 to 2015 and PCC Chair from 2015 to 2016. During this tenure, she guided the development of the SAIOH self-assessment system and was integral in introducing the Occupational Hygiene Training Association (OHTA) training modules into South Africa. After stepping down as Chair of the PCC, she became SAIOH Vice-President in 2017, and President in 2018. She remained an active Council member in 2019/2020, guiding the development and launch of the Occupational Hygiene Skills Forum to pull all aspects of education and qualifications, training, and modular learning under a single umbrella. In 2019, Julie was the first woman to be awarded an honorary SAIOH fellowship, one of only seven ever awarded.

The position of PCC Chair was held by Karen du Preez from 2020 to 2021, followed by Corlia Peens who continues to oversee professional development projects, ensuring continuous improvement of the necessary certification systems and international registration standards. Within the PCC, the role of Chief Examiner has also been held by women, with Maryke van der Walt serving from 2022 to 2024.

Non-occupational hygiene professionals have also played important roles in SAIOH. Claudina Nogueira's contribution as a SAIOH Council member, from 2012 to 2018, enabled the Institute to develop and strengthen relationships with other workplace health-related organisations, locally and internationally. She continues to serve on the South African Society of Occupational Medicine (SASOM) Council and the International Commission on Occupational Health (ICOH) Council, highlighting the ongoing impact of women in occupational health in South Africa. She remains a member of SAIOH. She is the current President of Workplace Health Without Borders (WHWB), an international non-profit volunteer organisation of occupational health and safety professionals founded in 2011 by occupational hygienists, whose founding president was a woman, Marianne Levitsky. Other women who currently contribute to SAIOH are Kate Smart and Tracy Mphaphuli, who oversee administrative matters related to the SAIOH Head Office, and Lee Doolan and Rebecca Dick, who handle the SAIOH PCC administration.

Table 1. Female representatives on SAIOH Council, 2009 to 2026

Role	Name	Year(s)
President	Karen du Preez	2025–2026
	Naadiya Mundy	2023–2024
	Celia Keet	2019
	Julie Hills	2018
	Melinda Venter	2010–2012
SAIOH Immediate Past President	Naadiya Mundy	2025–2026
	Celia Keet	2020
	Julie Hills	2019
	Melinda Venter	2012–2013
SAIOH Vice President	Karen du Preez	2023–2024
	Naadiya Mundy	2021–2022
	Celia Keet	2018
	Julie Hills	2017
	Melinda Venter	2008–2009
Council member	Lizette Greef	2024–2025
	Goitsemang Keretetse	2024–2025
	Naadiya Mundy	2019–2020
	Claudina Nogueira	2012–2018
	Elize Lourens	2012–2015
	Milly Ruiters	2009
	Corlia Peens	2009
Secretary	Delmarie Kruger	2010–2011

Although the focus of this paper is on South African women, it is important to mention Keneilwe Matjola, the 2016 Occupational Hygienist of the Year winner. She not only holds the position of Senior Occupational Hygiene Manager at the Debswana Corporate Centre in Botswana, but she was also pivotal in the launch and development of the Botswana branch of SAIOH, which was formally registered as the Botswana Association for Occupational Hygiene (BAOH) in 2017. Keneilwe served as its first Chair from 2017 to 2022. She continues to work closely with the University of Botswana, the Botswana Chamber of Mines, and the Ministry of Labour and Home Affairs to establish a formal occupational hygiene programme in Botswana.

WOMEN IN THE SOUTH AFRICAN MINING INDUSTRY

Two centuries ago, the mining sector boasted a significantly larger female workforce than in contemporary times, possibly even outnumbering men by a factor of 10.[28] The demographic shift was a result of the enactment of the British Mines and Collieries Act of 1842, allegedly introduced out of concern for women's safety.[29] However, rather than addressing the inherent dangers and exploitative practices in mining, authorities opted for an expedient solution: the exclusion of women from underground labour.

The dawn of democracy in South Africa heralded a paradigm shift, epitomised by the appointment of Phumzile Mlambo-Ngcuka as Minister of Minerals and Energy in 1999. Her tenure catalysed the establishment of organisations championing women's participation in the mining sector, alongside legislative reforms aimed at fostering inclusivity and gender parity.[28,30]

The repeal of the Minerals Act in 2004 reaffirmed South Africa's commitment to expanding opportunities for historically marginalised groups within the mineral and petroleum industries, including women.[31] In the following years, there was a notable increase in the representation of women in the mining sector, from 3% in 2002 to 15% in 2018.[32] This period coincided with the emergence of women in the ventilation and occupational hygiene disciplines. The increase in the number of women in mining is a testament to the transformative power of inclusivity and equal opportunity.

While obtaining a degree in mining engineering was never explicitly prohibited for women, the practicality of such a degree was called into question. After all, what good/use is a degree if one is barred from utilising it in the field? The prohibition on women entering underground mining environments rendered their academic qualifications seemingly redundant – a mere 'worthless piece of paper'.[28] Yet, amidst these challenges, trailblazers emerged. Dale Pearson etched her name in the annals of history as the first woman in South Africa to obtain a mining engineering degree, from Wits in 1994. Her groundbreaking achievement paved the way for future generations of women to defy convention and pursue careers in the male-dominated mining industry. Nearly a decade later, in 2005, Celiwe Mosoane shattered another barrier by becoming the first black woman to follow in Pearson's footsteps in mining engineering, further expanding the horizons of possibility for women in the field.[28,33]

The Mine Ventilation Society of South Africa (MVSSA) emerged from a recognition among industry stakeholders of the importance of ventilation challenges in the mining sector. Established in November 1944, the Society attained official registration as a Section 21 company in 2003, but elected its first female president, Julize van Niekerk, only in 2023.

While the timeline may appear lengthy, particularly considering the Society's predominantly male leadership over 78 years, it is crucial to acknowledge the swift strides taken by the MVSSA in integrating women once they were permitted to work underground from 1996. Examination of the MVSSA Constitution reveals that the pathway to the presidency entails a substantial commitment of 15 to 20 years of active participation and contribution to the Society. The election of a female President underscores the visions of Past Presidents and Council members to foster an environment conducive to female participation and leadership.

The registration of the first female member in 1990, despite incomplete record-keeping until 2000, marked the beginning of a shift towards greater gender diversity within the MVSSA. This was evident in a steady increase of female membership – a total of 277 female members – with Lebo Molefe as the first black female member in 2003, highlighting the Society's drive towards inclusivity. Membership is based on qualifications, while Fellow grading depends on active participation at a managerial level. Unfortunately, only 11 of the almost 300 registered women are Fellows. There is, thus, a need to increase the role of women in the Society (personal communication, Liezl Slabbert: Administrative Assistant MVSSA).

The Minerals Council South Africa has taken a proactive stance to address the gender disparity, with a target of 30% of women in the industry by 2025 through targeted initiatives. Furthermore, they strive to have women in 50% of management positions by 2035.[34]

WOMEN IN THE SOUTH AFRICAN GOVERNMENT

There have been 18 Ministers of Labour in the South African Government since 1924. The only woman in this position was Mildred Oliphant, who served from 2010 to 2019. Although qualified in macroeconomics, she empathised with the ordinary worker in South Africa[35] and, during her tenure, recognised the value of occupational hygiene to safeguard workers.

The late Siyanda Pearl Nxawe was Deputy Director General for the Inspection and Enforcement Branch of the then Department of Labour from 2009 to 2013, where she led the Branch through a turbulent time of public service strikes.[36] She was part of the Department for her entire career, from 1982 until her death at the age of 50 years in 2013. In 1995, she obtained a Bachelor's Degree in Law, which, along with her other qualifications, enabled her to move up the ranks, becoming Chief of Staff to the former Labour Minister, Membathisi Mdladlana, in 2005.[37] In conversation, Jabulile Mhlophe (19 April 2024) recalled her as a decisive leader who operated with an 'open-door policy', leading the drive to ensure the professionalisation of the labour inspectorate, amongst others in the field of occupational hygiene, and establishing a comprehensive case-management system.

In 2023, Millicent Ruiters was appointed as Chief Inspector of Occupational Health and Safety at the Department of Employment and Labour – only the second woman to fill this position; the first was Faiza Salie, who served from 1995 to 2002. Ruiters was appointed as the Director for Occupational Health and Hygiene from 2009 to 2017. Her career led her to a three-year stint at the Compensation Fund, before returning to take up the position of Chief Inspector of Occupational Health and Safety. During her years of employment in the field, she managed occupational hygienists, occupational health nurses, radiographers, occupational medical practitioners, medical doctors, and labour inspectors.[38]

Regulations under the Occupational Health and Safety Act No. 85 of 1993, as amended, which deal with occupational hygiene and enforce the involvement of occupational hygienists in the workplace, include: Regulations of Hazardous Biological Agents, 2022; Lead Regulations, 2001; Noise-induced Hearing Loss Regulations, 2003; Asbestos Abatement Regulations, 2022; and Regulations for Hazardous Chemical Agents, 2021.[39] Four of these regulations are currently (February 2025) under review, with the Technical Committees being chaired by women. The strong presence of women in the Department of Employment and Labour, responsible for occupational health and hygiene, resulted in the inclusion of vulnerable workers into legislation, including reproductively able, pregnant, and lactating women. The Ergonomics Regulations of 2019, under the Act, were one of the first pieces of legislation, internationally, to regulate ergonomic risk in the workplace; the Technical Committee working on this was established by a woman, Bulelwa D Huna.

The Department of Employment and Labour currently has three SAIOH-registered occupational hygienists in its employ, two of whom are women.

OCCUPATIONAL HYGIENE PRACTITIONERS IN ACADEMIA

Academia has historically been male-dominated, but many institutions have amended their policies and strategies to increase the number of women in leadership roles.[40] A study by Mouton et al. (2022) reported the gender gap in research outputs from universities in 2022, although the contributions of women have increased since 2005.[40] This is also reflected in the field of occupational hygiene, where women have increasingly taken on key roles in research and education, with the aim of mentoring the next generation of occupational hygienists.

There are many female academics currently active in the field of occupational hygiene in South Africa. At North-West University (NWU), 50% of the staff in the Occupational Health and Hygiene Research Initiative (OHHRI) are female. Prof. Anja Franken, Prof. Sonette du Preez, and Dr Cynthia Ramotsehoa are three of the five female academics who are actively involved in teaching undergraduate students and supervising postgraduate students in OHHRI within the NWU. Prof. Franken studies occupational skin exposure to metals, and in vitro skin permeation of platinum group metals. Prof. du Preez is a trailblazer in studying occupational exposures during additive manufacturing (3D printing). Dr Ramotsehoa's research focuses on opencast mine workers' occupational exposure to solar ultraviolet radiation. At the University of the Witwatersrand, Dr Goitsemang Keretetse, an occupational hygienist, is a lecturer in occupational hygiene and exposure science, and studies the assessment and control of exposure to volatile organic compounds (VOCs). At the University of Limpopo, Dr Karlien Linde's research focuses on occupational solar ultraviolet radiation exposure, where she is a lecturer in the Department of Physiology and Environmental Health. Zanele Zulu is a senior lecturer in occupational health and safety at the Mangosuthu University of Technology. She is currently pursuing her PhD, focusing on occupational heat exposure among female workers, with a particular focus on pregnancy outcomes.

NATIONAL INSTITUTE FOR OCCUPATIONAL HEALTH

The National Institute for Occupational Health (NIOH) has a history of female leadership, starting with Prof. Mary Ross as Executive Director from 2004 to 2007, followed by Dr Sophia Kisting-Cairncross from 2014 to 2018. The current Executive Director, Prof. Spo Kgalamono, is the first black leader of the Institute and was also the first female Head of the NIOH Occupational Medical Section. The Occupational Hygiene Section at the NIOH was led by male occupational hygiene professionals until 2016, when Dr Jeanneth Manganyi was appointed as the first female Head of Section.

The role of women in scientific disciplines that contribute towards occupational health is evidenced by the large number of female scientists involved in occupational health research and training.[41] With a research history of more than 60 years, the NIOH has trained many extraordinary female scientists. During the worldwide COVID-19 pandemic, women from various disciplines led initiatives that guided workplaces and government. The NIOH Occupational Health Outbreak Response Team (OHORT) consisted mostly of women and was instrumental in the development of COVID-19 guidelines and procedures, infographics, and providing online training and education. Four of the women in leadership positions who participated in this team were Prof. Spo Kgalamono, Prof. Tanusha Singh, Dr Odette Volmink, and Dr Jeanneth Manganyi.[42]

CONCLUSION

Women play a major role in occupational hygiene in South Africa and globally, from research to policy development, while others are heading occupational hygiene associations or organisations, such as SAIOH or government departments. While women have been under-represented in STEM historically, the promotion of gender equality has enabled more women to participate in occupational health- and occupational hygiene-related fields. As more women continue to contribute to STEM, they provide diversity and a unique perspective for more inclusive solutions. As female authors of this paper, we wish to encourage young women interested in science to enter the field of occupational health and hygiene. We hope that the acknowledgement of women's contributions in occupational hygiene will strengthen the discipline, dismantle barriers, and foster a diverse and representative workplace.

KEY MESSAGES

1. The relevance and contributions of women are increasingly recognised in the formerly male-dominated field of occupational hygiene.
2. The exceptional women working in occupational hygiene should inspire young women to enter the occupational hygiene- or occupational health-related fields, where they can make an impact on the health of workers.
3. Women are in leadership roles, heading relevant committees, institutions and organisations, and government departments.

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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: AF
Data acquisition: AF, KdP, SdP, JH, GK, EL, JM, NM, ZS-D, JvN
Drafting of the paper: AF, KdP, SdP, JH, GK, EL, JM, NM, ZS-D, JvN
Critical revision of the paper: AF, KdP, SdP, JH, GK, EL, JM, NM, ZS-D, JvN

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Major Hazard Installation Regulations, 2022: Reminder of key dates for compliance by duty holders

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The Major Hazard Installation (MHI) Regulations were published in January 2023, repealing the 2001 MHI Regulations. Webber Wentzel previously published an article outlining key timelines for compliance with the amended MHI Regulations. The MHI Regulations should be read together with the published Explanatory Note, which provides guidance to duty holders on interpreting the MHI Regulations and ensuring compliance.

The implementation of the MHI Regulations follows a staged approach over 36 months, with duty holders expected to have already complied with several obligations, while others take effect by January 2026. Duty holders should be carefully tracking their progress to ensure that any actions requiring time for implementation are properly planned.

Obligations already in force and which duty holders can be assessed against

By now, the following steps should have been completed by duty holders and embedded into safety management systems:

1. Designation of a competent, responsible person or persons (with the appropriate qualifications in high-hazard establishments) in full-time capacity to monitor compliance with the Occupational Health and Safety Act (OHSA) and MHI Regulations;
2. Reviewing and updating emergency plans for existing establishments to ensure alignment with SANS 1514;
3. Training on the MHI Regulations and general good practice for employees involved in the processing, handling, and storage of hazardous substances. There are three types of training provided for in the Explanatory Note, (i) general awareness/familiarisation training, (ii) induction training, and (iii) function-specific training. The training must be periodically reviewed and supplemented with refresher training being carried out periodically and at least every 12 months. Training must also be provided when there is a change in the establishment or when the MHI risk assessment has been revised; and
4. Submission of the updated notifications of existing establishments to the relevant Chief Director and local government by 31 January 2025. This submission should have included the various required documents, such as the permission on land use, letter of appointment of the competent person, inventory lists, most recent risk assessment, site maps, and information regarding neighbours within the impact zone. Once registered, the duty holder must conspicuously display the certificate of registration.

The MHI Regulations prescribe that failure by a duty holder to comply with the MHI Regulations, including obligations that were required to be met by the end of January 2025, constitutes an offence. Upon conviction, penalties may include fines ranging from 500 000–5 000 000 ZAR or imprisonment for a period not exceeding 24 months.

Future compliance obligations

Looking ahead, the MHI Regulations require high-hazard establishments to meet certain obligations by 31 January 2026. The following compliance obligations should remain a priority for high-hazard establishments (Table 1).

Scope of application and exemptions

Establishments that were previously classified as MHIs under the repealed 2001 MHI Regulations, but no longer meet the definition under the amended MHI Regulations, must take steps for reclassification, as outlined in the Transition Strategy detailed in the Explanatory Note. The Transition Strategy, a new concept introduced in the Explanatory Note, is not referenced in the MHI Regulations themselves. It seeks to address specific transitional arrangements for establishments that require re-evaluation in light of the amendments.

For declassification and deregistration, duty holders must submit an exit report generated by an approved inspection authority (AIA), the prescribed Form A, various additional documents as specified in the Transition Strategy, and local government support documentation. These must be submitted to the Provincial Operations for approval.

The Explanatory Note specifies that certain establishments may fall outside of the scope of the MHI Regulations, including those excluded under Regulation 2(6), which precludes nuclear installations governed by the Nuclear Energy Act No. 131 of 1993. These are characterised by hazards created by ionising radiation,

Table 1. Compliance obligations for high-hazard establishments

Regulation	Deadline	Compliance requirement
Regulation 11	31 January 2026	Major incident prevention policies for high-hazard establishments must be finalised and recorded in the format prescribed in Regulation 11 and Annexure C of the MHI Regulations. (After 31 January 2026, this requirement will apply to all establishments.)
Regulation 12	31 January 2026	Comprehensive safety reports for high-hazard establishments, including the contents of Annexure D of the MHI Regulations, must be submitted to the Chief Inspector.
Regulation 13	31 January 2026	Existing high-hazard establishments must apply for a licence to operate with the Chief Inspector.

or where ionising radiation is present in a nuclear establishment. However, the enforceability of these exclusions is in question, as the Explanatory Note is not legally binding. Other establishments that fall outside the scope of application of the MHI Regulations are offshore establishments; mining establishments; transport of dangerous substances in transit and outside establishments (governed by separate legislation); and establishments operated within military, civil, and aviation sectors.

While the MHI Regulations generally apply to all MHIs, low- and medium-hazard establishments are not required to prepare safety reports or apply for a licence to operate. Additionally, low-hazard establishments are exempt from developing a major hazard prevention policy.

Duty holders must track key compliance deadlines and ensure ongoing compliance, as contravention of the MHI Regulations may result in fines or imprisonment. Furthermore, an inspector may determine that a duty holder's non-compliance exposes employees to a health or safety risk, and may prohibit the use of the plant, workplace, or machinery until compliance is achieved. There are significant operational and legal risks associated with non-compliance with the MHI Regulations.

UPCOMING EVENTS

SOUTH AFRICA

SAIOH Annual Scientific Conference
Radisson Blu Hotel, Umhlanga, South Africa
20-23 October 2025
Website: https://www.saioh.co.za/page/SAIOHConference2025

INTERNATIONAL

9th World Conference on Research Integrity (WCRI)
The Westin Bayshore Hotel. Vancouver, Canada
3-6 May 2025
Register: https://wcri2026.org/?utm_campaign=website&utm_medium=email&utm_source=sendgrid.com

Asbestonomy 2025
Berlin, Germany
24-25 June 2025
Register: https://asbestonomy.com/

Go to
www.occhealth.co.za
'Upcoming Events'
to see upcoming local and international OH events

A-OSH EXPO 2025 – workplace safety is more than a checklist

Workplace safety, while driven by compliance with Occupational Health and Safety Act regulations, should be more than just a checklist. Because it directly impacts on employee wellbeing, business continuity, and productivity, it should be considered a critical, non-negotiable part of all stakeholders' working lives. The management of organisations needs to play a proactive role in ensuring buy-in from employees by implementing a pre-emptive safety strategy.

"The cost of inadequate or ineffective workplace safety practices is immense, and can include increased workplace injuries, legal and financial implications, decreased employee morale and productivity, and damage to an organisation's reputation", says Mark Anderson, Portfolio Director at Specialised Exhibitions – a division of Montgomery Group.

Anderson says that finding the right solutions to match a specific workplace environment should be a top priority for organisations serious about occupational safety and health (OSH) compliance. *"This starts with risk assessments, which will identify areas of strength and weakness in the organisation's OSH profile. It also includes appropriate training, and the adoption and implementation of high-quality safety products and technology. A visit to A-OSH EXPO 2025 is the best starting point for risk and safety managers, as each of these modalities is covered extensively by the exhibitors."*

Co-located with Securex South Africa, Facilities Management Expo, and Firexpo – at Gallagher Convention Centre in Midrand from 3–5 June 2025 – A-OSH EXPO is Africa's largest and most comprehensive one-stop source of OSH solutions. *"This means that not only do organisations save a substantial amount of time and effort in finding what they need, but their interactions with the knowledgeable and highly experienced exhibitors means that they are given sterling advice on their OSH requirements",* says Anderson.

Anderson points out that the free-to-attend Saiosh Seminar Theatre and the Working at Height and Safety Seminar Theatre are currently being populated with highly informative seminar sessions, guaranteed to provide the latest and most topical information on current trends and OSH regulations. *"To find out more about companies exhibiting at A-OSH EXPO, the seminar sessions, and other important expo information, visit our show website at www.aosh.co.za."*

See some of the A-OSH EXPO 2024 highlights here: https://youtu.be/SBIJRHVUxZM?si=3G6BUoPEgPGo-MQq

Attendance at A-OSH EXPO and the co-located Securex South Africa, Facilities Management Expo, and Firexpo is free. Visit www.aosh.co.za to register.

Organisations wishing to exhibit at A-OSH EXPO 2025 can contact the A-OSH EXPO team on zelda.jordaan@montgomerygroup.com or johan.vanheerden@montgomerygroup.com to book a space, or capitalise on a sponsorship opportunity.

The widest array of OSH solutions, all under one roof, make a visit to A-OSH EXPO 2025 a must

Photograph: Montgomery Group

SASOM news

Claudina Nogueira: Occupational health consultant; SASOM ExCo member; ICOH National Secretary for South Africa (2024–2027); WHWB President (2024–2025)
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Claudia Frost: SASOM National Office Coordinator
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SASOM ANNUAL CONFERENCE 2024

The South African Society of Occupational Medicine (SASOM) hosted its annual conference on Saturday, 9 November 2024, in association with the SASOM Annual General Meeting (AGM). The last SASOM ExCo meeting of the year was held on Friday, 8 November 2024. The three events, hosted by the SASOM Western Cape Chapter, were held in hybrid format, at the Vineyard Hotel, Newlands, Cape Town, using the SASOM Zoom platform. SASOM takes this opportunity to thank the organisation that provided the exhibition and sponsorship for the conference: Tealio – Occupational Health Software for Workplaces and Educational Institutions (www.tealio.ai), represented by Benjamin Amoils and his team.

The conference was themed *Occupational health in the digital age: navigating the challenges,* and was accredited by the South African Medical Association (SAMA) for seven Continuing Professional Development (CPD) points/units for full attendance (one ethics and six clinical points). The conference was opened by the SASOM Chair, Prof. Daan Kocks, who welcomed the 37 onsite and 91 online delegates.

Two chairs are better than one
Dr Itumeleng Ntatamala, SASOM Western Cape Chapter and UCT (L) and Dr Geoffrey Tafaune, SASOM Treasurer, Gauteng Department of Health and Wellness, and University of Pretoria (R), co-chaired the sessions of the SASOM Annual Conference 2024
Photograph: Claudina Nogueira (South Africa)

The morning session was chaired by Dr Itumeleng Mtatamala, occupational medicine specialist and senior lecturer from the University of Cape Town (UCT). Four presentations were delivered:

- Dr William Kleynhans (Cipla South Africa, and Ocule Health) presented 'Data-driven workplace health: using AI and big data to predict and prevent workplace injuries and diseases'.
- Prof. Rodney Ehrlich (UCT) presented 'Understanding the challenges of using computer-aided detection for occupational tuberculosis and silicosis'.
- Prof. Shahieda Adams (UCT) presented 'Mental health in the digital age: navigating the challenges of the hyperconnected workplace and 24/7 work cycle'.
- Dr Zahida Sonday (Western Cape Government Health and Wellness (WCGHW)) presented 'Case studies: Occupational Health and Safety Information System (OHASIS) – reflections on introducing digital health technologies into an existing occupational health programme'.

The afternoon session was chaired by Dr Geoffrey Tafaune (Gauteng Department of Health and Wellness, and the University of Pretoria). Two presentations were delivered, followed by a panel discussion:

- Dr Nomonde Buyiswe Mabuya-Moloele (Qalo Digihealth (Pty) Ltd) presented 'Delivery of workplace health and wellness in the digital age: integrating 4IR technology and wearables in the workplace'.
- Dr Jan Lapere (Private practitioner – occupational medicine, medico-legal and social labour law, Gqeberha, and SASOM ExCo member) presented 'Ethical and legal considerations for using wearables and other worker monitoring digital technologies in the workplace'.
- Dr Casper Joubert (Tygerberg Hospital, Cape Town) chaired a panel discussion on 'The future of work in the digital age: what the next decade holds'. Panel members were Prof. Mohamed Jeebhay (UCT), Dr Shamila Fakie (Medscheme Holdings, South Africa), and Dr Marion Morkel (Sanlam, South Africa).

SASOM ANNUAL GENERAL MEETING 2024: A YEAR IN REVIEW

The AGM followed the conference. Prof. Daan Kocks (SASOM Chair) read the 2024 annual report prepared by the SASOM 2024 National Secretary, Dr Frank Fox, and highlighted the several activities and outcomes in 2024.

SASOM National Office

- The SASOM office bearers for 2025 are Prof. Daan Kocks (Chair), Dr André Kotzé (Vice Chair), Dr Frank Fox (Secretary), and Dr Geoffrey Tafaune (Treasurer).

- As of 31 October 2024, SASOM had 459 members, including nine honorary members. By mid-February 2025, following a membership marketing and renewal drive, 176 members (38%) had renewed their memberships, and 12 new members (1%) had joined the Society. SASOM members also reside in Botswana, Canada, Namibia, Zimbabwe, the United Kingdom, and other countries.

SASOM awards

- In recognition of their unwavering dedication and contributions to the fields of occupational medicine and occupational health, SASOM bestowed honorary membership awards on Dr Jan Lapere and Dr André Kotzé.
- Ludwick Lebaka (Sibanye Stillwater) was the winner of the SASOM Annual Author Prize for 2023. On behalf of *Occupational Health Southern Africa*, SASOM encourages researchers working in the field of occupational health to publish their research findings. SASOM provides a cash award to a novice author who is the first author of the best paper published in the Journal in a calendar year. Membership of SASOM is not a criterion.

SASOM Guidelines

SASOM Guidelines are provided to members in good standing, at no cost. Efforts to update and standardise the Guidelines continued throughout the year. Two Guidelines were updated during 2024, viz. 'Alcohol and drug abuse in the workplace' and 'Ethics and professional conduct for occupational medicine practitioners'. A third update is currently under review – 'Radiation and heat exposure'.

SASOM website

- From November 2023 to October 2024, unique visitors to the website totalled more than 6 000. This highlights the importance of a user-friendly and informative digital platform.
- SASOM expanded its online presence with the creation of Facebook and LinkedIn pages, with the intent of increasing member engagement, sharing industry updates, promoting events, and fostering professional networking within the occupational medicine community.

SASOM and *Occupational Health Southern Africa*

- Prof. Daan Kocks thanked SASOM ExCo members, Claudina Nogueira, for her facilitation of the publication of SASOM's pages in the Journal, and Prof. Mary Ross and Mrs Claudia Frost (SASOM National Office Coordinator), for drafting and facilitating the CPD questionnaires based on the published content of *Occupational Health Southern Africa*, respectively. Members were able to earn three CPD/CEU points per questionnaire, potentially earning 12 points per annum. Despite the time and effort spent developing the questionnaires, participation from SASOM members is disappointingly low; less than 10% of members submitted answers to the questionnaires in 2024. Hence, SASOM will no longer offer the questionnaire for SASOM members to obtain CPD points.
- Prof. Daan Kocks wrote a guest editorial for the third issue of the Journal (July–September 2024). He raised the issue of the complexity of a competent person's knowledge and cognitive need to function in the world of occupational health.

SASOM liaison

- Formal communication with organisations engaged in the enhancement of occupational medicine continued with SASOM ExCo members (co-opted) from the National Institute for Occupational Health (NIOH), the Compensation Commissioner (CC), the International Commission on Occupational Health (ICOH), the South African Society of Travel Medicine (SASTM), and the Mine Medical Professionals Association (MMPA).
- Liaison with other organisations continued, nationally and internationally, reinforcing SASOM's regional and global presence throughout 2024, and included the South African Department of Employment and Labour, the SAMA, the Council for Health Service Accreditation of Southern Africa (COHSASA), the International Occupational Medicine Society Collaborative (IOMSC), and the American College of Occupational and Environmental Medicine (ACOEM).
- SASOM continues to provide professional advice and support to members upon request, and is fortunate to have access to top occupational medicine practitioners (OMPs) and a qualified OMP with an MLB (Master of Laws) degree to offer comprehensive guidance.

SASOM outlook for 2025

- 2024 was marked by progress and strategic investments aligned with SASOM's vision and mission. While financial challenges were noted, the strong asset base and non-operational income provided stability. The ongoing dedication of the SASOM National Office, branch representatives, and members is integral to these successes.
- SASOM aims to increase membership, expand event participation, and continue updating Guidelines. The 6% increase in membership fees for 2025 will support these objectives and sustain SASOM's strategic initiatives.

SASOM and ICOH activities in 2024

The ICOH Scientific Committee on Biohazards and Occupational Health, chaired by Prof. Mary Ross (specialist in occupational medicine, public health, and travel medicine; professor at the University of the Witwatersrand; and SASOM ExCo member), organised a webinar on 27 March 2024, titled 'Occupational infections: reports from South Africa'. The three talks were:

- 'Working remotely: cautionary tales from Africa': Dr Albie de Frey (International Health Management Consultants, Geneva; WHO Expert Roster on Travel Health)
- 'Q fever as an occupational disease': Prof. John Frean (Editor-in-Chief of *Tropical Medicine and Infectious Disease*; National Health Laboratory Service; University of the Witwatersrand and University of Pretoria)
- 'COVID-19: strategies for healthier and safer workplaces in non-healthcare settings': Dr Itumeleng Ntatamala (UCT)

Several SASOM members participated in the planning and organisation of ICOH's 34th International Congress on Occupational Health (ICOH2024) in Marrakesh, Morocco, from 28 April to 3 May 2024. As an ICOH affiliate member, SASOM invited members in good standing, whose abstract submissions had been accepted for the ICOH2024 Congress, to apply for partial funding

to attend the congress; four members were sponsored. SASOM was instrumental in marketing the ICOH2024 Congress, by providing updates through the SASOM pages of *Occupational Health Southern Africa* during the two-year interval between the ICOH2022 Digital Congress and the ICOH2024 Congress, and a report on the congress. The first announcement of the 35th International Congress on Occupational Health (ICOH2027) in Mumbai, India, from 14 to 19 February 2027, was published on 4 March 2025 and can be accessed at: www.icohweb.org/site/multimedia/events/pdf/ICOH%202027%20FIRST%20ANNOUNCEMENT_hyperlinked.pdf

Claudina Nogueira (ICOH National Secretary (NS) for South Africa and SASOM ExCo member) collaborated with three other ICOH NSs from the 'global South' – Argentina, Colombia, and Peru – to offer a webinar titled, 'Occupational health and safety in mining: an overview of management, legislation, and current challenges in low- and middle-income countries (LMICs)'. Dr Diana Cuervo, NS for Colombia, is thanked for personally covering the costs of the recordings and the translations of the presentation transcripts.

Webinars hosted by SASOM in 2024

SASOM held a National Roadshow in three sessions, on 3 July (hybrid format in Gqeberha), 14 August (virtual format), and 16 October 2024 (hybrid format in Umhlanga, Durban). The broad theme was *Occupational medicine is a highly specific discipline in workers' health*. The three sessions had their own sub-themes, viz. *Occupational medicine as a peer-based discipline, Peer-review networking of OMPs,* and *Duties and responsibilities of OMPs.* The Roadshow, which was accredited for CPD points by the SAMA, was organised in response to the many concerns raised by OMPs regarding service provision by non-OMPs, convoluted and illegal business settings, and unethical occupational medicine.

The SASOM Western Cape Chapter remained active throughout 2024 and hosted several webinars:

- 26 March – SASOM/MEDICHEM session: tackling chemical hazards in the workplace
- 14 May – Neurodiversity in the workplace: addressing the shape-shifting needs of neurodiverse adults
- 18 June – Aviation and maritime medicine: recent developments
- 6 August – Fitness to work: an update
- 17 September – i) Groote Schuur Hospital occupational medicine clinic case reviews, and ii) Incapacity management within a large organisation
- 27 October – Occupational medicine in practice: reflections by industry experts

SASOM supported the first (virtual) South African National Symposium on Occupational Heat Exposure, organised by the Discipline of Occupational and Environmental Health, University of KwaZulu-Natal, Durban. The two days (25–26 November 2024) of stimulating discourse on occupational heat exposure convened international experts, senior government policymakers, researchers, and occupational health professionals to address a most pressing and emerging global issue in the workplace.

AROUND THE WORLD IN OCCUPATIONAL HEALTH

WHWB is the newest ICOH affiliate member

Workplace Health Without Borders (WHWB), an international non-profit volunteer organisation, became an ICOH affiliate member in February 2025. WHWB (International) is a registered Canadian charity with three independent branches in the United States (WHWB-US), United Kingdom (WHWB-UK), and Australia (WHWB-Australia); the WHWB-Africa branch is under development. WHWB's values and objectives are aligned with those of ICOH, and there are many synergies in terms of promoting and enabling good practices and expertise in global occupational health.

Founded by occupational hygienists in 2011, WHWB is a global network of concerned occupational health professionals who volunteer to advance WHWB's mission, viz. 'To prevent work-related disease and injury around the world through shared expertise, knowledge, and skills'. Membership is open to all those who share WHWB's goals and vision – 'Imagine a world where workers, their families and communities, do not get ill because of their work'. WHWB's primary focus is the health and safety of workers who have limited access to occupational health and hygiene expertise, whether in LMICs or richer nations.

To enable its mandates and activities, WHWB has various standing committees and working groups. The Healthcare and Heat Stress Working Groups are more recent additions to WHWB.

Examples of WHWB work include i) conducting occupational hygiene training sessions in collaboration with agencies and institutions in host countries, using training materials developed by the Occupational Hygiene Training Association (OHTA) and delivered by professional occupational hygienists and occupational health professionals (WHWB is an accredited OHTA training provider); ii) conducting research to evaluate worker exposures to hazardous agents such as silica, asbestos, and chemicals; iii) assessing the health hazards of workers involved in waste handling and recycling; iv) connecting occupational health professionals around the world with experienced professionals, through a mentoring programme; v) advocacy, professional, and public awareness; and vi) capacity-building in occupational health and hygiene.

WHWB members organise, sponsor, and speak at seminars and other professional events, present to universities and schools, and are available to the media to discuss global occupational health and safety. During the Pandemic, WHWB held 22 webinars on topics related to COVID-19 and infection control and offered a webinar series on asbestos and silica exposure, including that from engineered stone countertops. Other topics were the impact of climate change on workers, innovative strategies for reaching rural workers, control-banding tools, and lessons learned from epidemics. All webinar recordings are available on the WHWB YouTube channel. A recent initiative undertaken by WHWB is the coordination of the 'Global Occupational Safety and Health (GOSH) Coalition', which emerged from the ICOH2024 Congress. The driving force was the conviction that occupational health and safety do not receive the global focus they deserve, considering their impact on global health. This is demonstrated by the almost three million work-related fatalities each year, over and above the 374 million non-fatal workplace injuries and diseases reported worldwide. GOSH issued a 'Call to Action' for occupational health and safety to be elevated on the global agenda, including several specific measures. To date, 18 organisations have participated in GOSH (including WHWB and ICOH).

See the WHWB website for more information, and the 2024 WHWB Progress Report.

The 52nd Annual MEDICHEM Conference 2025

MEDICHEM, another ICOH affiliate member, is a global organisation dedicated to occupational and environmental health within the chemical industry. The 52nd Annual MEDICHEM Conference was held

at the Burjeel Hospital in Abu Dhabi, United Arab Emirates (UAE), on 17 and 18 February 2025. Themed *Sustainability and Environmental, Social and Governance (ESG) considerations in the chemical sector*, the conference convened industry experts and occupational and environmental health professionals to share knowledge, expertise, and advancements in chemical regulations, safety protocols, and best practices. Delegates and presenters joined to elevate industry standards, promote innovation, and contribute to the creation of a safer, more sustainable, and efficient industry.

Although the conference was held onsite in Abu Dhabi, several of the invited speakers presented virtually. Invited presentations are listed below:

- Bassel Elshaboury (Head of Marketing for Henkel Consumer Brands across the regions of Latin America, Middle East and North Africa, Central Asia, and Australia and New Zealand) presented 'Sustainability in the chemical industry'.
- Dr Tee Guidotti (consultant in health, safety, environment, sustainability, and occupational health and medicine, USA) presented (virtually) 'New challenges to sustainability in the chemical sector'.
- Dr Manijeh Berenji (Chief of Occupational Health at VA Long Beach Healthcare System and Lead of Academic and Community Partnerships at the University of California Center for Climate, Health and Equity, USA) presented (virtually) 'Innovations in chemical risk management: harnessing the power of health informatics'.
- Dr Ade Mutiara (occupational health and medicine specialist and Secretary of the ICOH Scientific Committee on Occupational Medicine, Indonesia) presented 'Occupational health, technology, and ESG in the chemical industry'.
- Dr Sunisa Chaiklieng (professor of occupational health and safety and Head of the Department of Occupational Safety and Environmental Health, Faculty of Public Health, Khon Kaen University, Thailand) presented 'Automotive gasoline: history and issues of chemical exposure and risk assessment for occupational health surveillance'.
- Dr Aida Lucia Fajardo Montiel (chemical engineer and research professor in engineering and technology, University of Guadalajara, Mexico) presented (virtually) 'Assisting small- and medium-sized enterprises (SMEs) by providing essential information on occupational health in the context of ESG: insights from Mexico and Latin America'.
- Nanisuria Aris (certified occupational hygienist and Lead of Industrial Hygiene in a major oil and gas company, Qatar) presented 'Occupational heat stress: reducing health risks through simple interventions in high-exposure environments using the ESG strategy of sustainability'.
- Prof. Janvier Gasana (professor of occupational and environmental medicine (OEM), Founder/Chair of Global Applied Prevention Center Inc. (GAPCI), USA, and current Chair of MEDICHEM's Education Development Training) presented 'Global lead exposure among children and the general population'.
- Prof. Marianne Cloeren (associate professor in the Division of Occupational and Environmental Medicine, Department of Medicine, University of Maryland School of Medicine, USA) presented (virtually) 'Leveraging OEM expertise to prepare organisations for the ESG challenges presented by climate change'.
- Dr Kaveri Rangappa (medical professional, public health and AI specialist advancing innovative solutions in digital modelling, India) presented (virtually) a documentary titled *The legacy of toxic waste unfolds: unveiling the chemical crisis in the Middle East*.
- Dr Sami Bég (physician executive with extensive expertise in healthcare, specialising in preventive medicine, population health, and digital health, USA) presented (virtually) 'Fostering lifestyle at work: a catalyst for occupational health and ESG in the chemical industry'.

52nd MEDICHEM Annual Conference, Abu Dhabi, presenters and organisers
L to R: Dr Ashish Mishra (Chief Health and Wellbeing Officer, Hindustan Unilever Limited (HUL), ICOH and MEDICHEM Board member, Vice President of the Indian Association of Occupational Health (IAOH), India); Dr Ade Mutiara (Secretary of the ICOH Scientific Committee on Occupational Medicine, Indonesia); Dr Alex Govender (SASOM member, South Africa); Prof. Ibrahim Bani (Yale University, USA, Sudan and UAE); Prof. Janvier Gasana (Founder/Chair of Global Applied Prevention Center Inc. (GAPCI), and Chair of MEDICHEM's Education Development Training, USA); Dr Nahyan Helal (consultant specialist in occupational medicine and occupational health, UAE); Dr Samah Nur (Sudanese American who manages a clinic in UAE); Prof. Sunisa Chaiklieng (Faculty of Public Health, Khon Kaen University, Thailand); and Fahad Al Saiqal (Abu Dhabi National Oil Company – ADNOC)
Photograph: Courtesy of Prof. Janvier Gasana (USA)

The Sheikh Zayed Grand Mosque
The largest place of worship in the UAE, a centre for learning about Islam and culture in Abu Dhabi, and one of the country's most important tourist attractions. L to R: Dr Basheer Ahamed Taj (Abu Dhabi National Oil Company – ADNOC); Dr Ade Mutiara (Secretary of the ICOH Scientific Committee on Occupational Medicine, Indonesia); Dr Alex Govender (SASOM member, South Africa); and Prof. Sunisa Chaiklieng (Faculty of Public Health, Khon Kaen University, Thailand)
Photograph: Dr Ade Mutiara (Indonesia)

- Dr Ashish Mishra (Chief Health and Wellbeing Officer, Hindustan Unilever Limited (HUL), ICOH and MEDICHEM Board member, Vice President of the Indian Association of Occupational Health (IAOH), India) presented 'MEDICHEM and the ICOH Scientific Committee on Occupational Health in the Chemical Industry', and moderated a panel titled 'Multidisciplinary approach to ESG in the chemical sector'.
- Claudina Nogueira (occupational health consultant and medical biochemist, ICOH National Secretary for South Africa, President of WHWB, and SASOM ExCo member, South Africa) presented (virtually) 'Occupational health in the global context of sustainability – ICOH's past and present role'.

ICOH SC AP and IOSH host a joint webinar on asbestos and silica hazards

The ICOH Scientific Committee on Accident Prevention (SC AP), chaired by Dr Karen Michell, and the Construction Group of the Institute of Occupational Safety and Health (IOSH, UK), vice-chaired by Dr Shaun Lundy, hosted a webinar on 30 January 2025, titled 'Tackling asbestos and silica hazards: lessons for occupational safety and health professionals'. The objectives of the webinar were i) to explore the health consequences of asbestos and silica exposure, including asbestosis, silicosis, and mesothelioma, ii) to gain insights into the UK asbestos ban, Australia's engineered stone ban, and their implications for workplace safety, iii) to recognise environments and practices that pose risks for high-silica and asbestos exposure, and iv) to discuss the critical role of occupational health and safety professionals in preventing exposure, managing risks, and protecting workers' health through practical measures and best practices. Dr Kevin Hedges (WHWB Board member and Occupational Health Clinics for Ontario Workers Inc. (OHCOW), Canada) was invited to provide a background to asbestos and silica use, to set the scene on global aspects of asbestos and silica, and to participate in a discussion panel with Dr Shaun Lundy, moderated by Dr Karen Michell. Close to 900 participants attended the webinar from around the globe, mostly from the UK (493), followed by South Africa (81), Ireland (37), the UAE (33), the USA (31), and Saudi Arabia (25). The recording of the webinar is available at: https://www.youtube.com/watch?v=c0q4XITUeF8.

IMPORTANT UPDATE FROM THE SASOM NATIONAL OFFICE: ADDRESSING RECENT TECHNICAL CHALLENGES AND SERVICE IMPROVEMENT

SASOM is appreciative of its members' patience and continued support as it navigates operational challenges that have recently impacted its response times. At the start of the year, SASOM experienced technical disruptions following multiple hacking attempts and a Microsoft upgrade, which affected e-mail systems. As part of the resolution, SASOM introduced a new correspondence e-mail address, office@sasom.org, which was communicated to members via e-mail, WhatsApp, and the website on 6 February 2025.

While the website remained fully operational – allowing members to sign up, log in to the member zone, renew their membership, print certificates, and access all SASOM resources – some members made direct bank payments without following the online renewal process. Since financial reconciliations are not conducted daily, this resulted in a delay in granting platform and resource access to said members. Coupled with the existing backlog, this caused concern among members.

SASOM is taking several measures to improve its service delivery and ensure a smoother experience for all members, including:

- Automation and process efficiency – members are encouraged to complete renewals via the online platform to ensure faster processing and minimise the administrative burden (www.sasom.org/membership)
- Enhanced communication – more effective interaction channels are being streamlined to provide faster updates on service disruptions
- Process optimisation – SASOM is refining its financial reconciliation and membership verification procedures to reduce delays
- Improved system stability – the recent e-mail system changes aim to enhance reliability and reduce technical disruptions

The online process maintains efficiency, ensures timely access to services, and minimises administrative costs and fees. Please note that an additional administrative fee of R75 will be charged for any manual renewals of SASOM membership.

SASOM deeply values its members' ongoing support and trust in the Society, and appreciates their patience and understanding as it continues to streamline and improve its operations.

SAIOH news

The Southern African Institute for Occupational Hygiene (SAIOH) is dedicated to its members and the advancement of the occupational hygiene profession. As part of our commitment, we regularly share updates and developments with our members. SAIOH thrives through your active involvement and ethical contributions in the field of occupational hygiene. To further strengthen our community, we encourage feedback and input on the matters discussed in this edition of the Journal.

SAIOH PRESIDENT'S ADDRESS

Karen du Preez: SAIOH President
e-mail: president@saioh.co.za

Karen du Preez
Photograph: courtesy of SAIOH

The legacy of SAIOH

The Southern African Institute for Occupational Hygiene is a professional body recognised by the South African Qualifications Authority (SAQA) and the International Occupational Hygiene Association (IOHA), with approximately 1 000 members. The management team and Council members who serve SAIOH volunteer their time and expertise to contribute to the vision and mission of SAIOH. What motivates someone with a demanding day job to take up a position that places another claim on their already limited time? The answer is 'legacy', which can be defined as the long-lasting impact of specific past events or actions. The actions and commitment of past and present leaders of SAIOH have contributed to the growth of SAIOH and paved the way for incoming members to excel. Standing at the beginning of my tenure as SAIOH President, I acknowledge these past actions and contributions. I know the road has been travelled by great names in occupational hygiene, and following in their footsteps is a privilege and an honour.

My commitment to SAIOH members is to build on the great example set by past presidents, who served the occupational hygiene profession and SAIOH's best interests with passion and dedication. Together with the Council and management team, my focus will be on identifying and implementing projects that align with SAIOH's strategic objectives, to enable our members to practise sound and ethical occupational hygiene that ensures safer and healthier workplaces. My invitation to our members is to utilise the opportunities that SAIOH provides you to grow professionally, and excel as occupational hygiene professionals in southern Africa and beyond.

NATIONAL COUNCIL FEEDBACK

Karen du Preez: SAIOH President
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Deon Jansen van Vuuren: SAIOH General Manager
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The SAIOH Management Board has retained the momentum of 2024 with various meetings and collaborative discussions. The first Management Board meeting took place on 3 February 2025, followed by the SAIOH strategic session and first Council meeting on 26 and 27 February 2025, respectively.

Other interactions include:

- September and October 2024: Impromptu Zoom and MS Teams meetings were held with the conference organising and planning committee.
- 16 October 2024: The Department of Employment and Labour held a successful Occupational Health and Safety (OHS) Strategy Conference and the signing of the OHS Accord at Emperors Palace.
- November 2024, January and February 2025: Information about several occupational hygiene-related webinars was circulated to SAIOH members.
- 21 November 2024: SAIOH Professional Certification Committee (PCC) Chief Examiner represented SAIOH at the South African Society of Occupational Health Nursing Practitioners (SASOHN) Annual Conference in White River, Mpumalanga.
- 25 and 26 November 2024: SAIOH participated in the Occupational Heat Exposure Symposium organised by the University of KwaZulu-Natal.
- 27 November 2024: SAIOH participated in the *Occupational Health Southern Africa* Editorial Board meeting.
- 29 November 2024: SAIOH participated in the Mine Health and Safety Council's heat tolerance screening workshop.
- 29 November 2024: SAIOH attended the Occupational Hygiene Approved Inspection Authority (OH AIA) Association's meetings.
- Naadiya Mundy, representing SAIOH management, attended ongoing meetings with Workplace Health Without Borders (WHWB), the International Occupational Hygiene Association (IOHA), and other occupational hygiene organisations to discuss and implement strategies to address global threats to occupational hygiene. These threats have been exacerbated by the US Congress' call to abolish their Occupational Safety and Health (OSH) Act.

SAIOH strategic plan

The current SAIOH strategic (5-year) plan is steered by Jaco Pieterse. This is discussed, and progress is evaluated at the monthly SAIOH Management Board and quarterly Council meetings.

Ethics

NGO Law is currently conducting a review of the SAIOH Ethics Policy and Procedures. We have received their initial feedback, along with additional questions for SAIOH regarding specific procedures. The

review of our procedures is urgent as it is important for the Ethics Committee to begin with implementation, and it is also a crucial item in the SAIOH strategy (#3).

Note: From 1 January 2023, all SAIOH-certified members are 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. Terry McDonald, of the British Occupational Hygiene Society (BOHS), presented Professional Development Courses (PDCs) during the 2021 and 2022 Annual Conferences and again on 25 July 2024. These online seminars are available to purchase.

SAIOH branch activities

The Western Cape and Gauteng branches each held successful meetings in November 2024. In Gauteng, the high turnout overwhelmed SAIOH's Zoom capacity, leading to technical difficulties. The Western Cape branch (in-person) held an innovative quiz on all things related to SAIOH. Both branches are preparing for their first meetings of 2025. Members are reminded to stay alert for our Mailchimp notifications.

Unfortunately, the Central (Free State), Northern Cape, and Mpumalanga branches remain inactive.

SAIOH 2025 Annual Scientific Conference

The conference dates have been confirmed as 20–23 October 2025. Members are requested to save the date and keep a lookout for abstract submission dates.

The 2025 SAIOH Conference will be held on 20–23 October 2025 at the Raddison Blu Hotel, Umhlanga, Durban and will be hosted by the KwaZulu-Natal branch of SAIOH.

Occupational Hygiene in Practice – Navigating New Workplace Challenges

International Occupational Hygiene Association Board, the National Accreditation Recognition Committee, and Occupational Hygiene Training Association feedback

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

The OHTA *Global Link* and IOHA *Global Exposure Manager* (GEM) newsletters are posted on the SAIOH website and sent to all members via Mailchimp as soon as they become available.

Deon Jansen van Vuuren's representation of SAIOH on the IOHA Board and the National Accreditation Recognition Committee (NARC) concluded on 31 December 2024. The PCC Exco has nominated Corlia Peens as the new IOHA Board Director and member of the NARC, effective 1 January 2025.

Several IOHA and NARC meetings took place in October, November, and December 2024, including an IOHA Governance Meeting on 19 October 2024, where the draft IOHA strategy document for 2026–2030 was considered.

Excellent news

SAIOH was informed by IOHA, just before the Botswana Conference in October 2024, that the NARC renewed the SAIOH PCC's system for another five years.

SAIOH Technical Committee feedback

The SAIOH Technical Committee's research on welding fumes, encompassing both measurement and analysis, was spearheaded by Dr Ivan Niranjan, the SAIOH Technical Portfolio Coordinator. A subcommittee, comprised of SAIOH and OH AIA Association members, has already convened to develop a technical and position paper on this topic. The final position paper is expected in 2025.

Our second Technical Committee has started developing technical procedures and a SAIOH position paper on heat stress management. Unfortunately, the death of Schu Schutte was a setback. We have since commenced co-ordination with the Council for Scientific and Industrial Research (CSIR) and Dr Johan Kielblock to conduct the necessary research. The deadline for this is mid-2025. The focus remains two-fold: to develop a technical paper, and to enable SAIOH to provide comprehensive and relevant proposals to strengthen the recently launched Physical Agents Regulations (PAR), formerly known as the Environmental Regulations for Workplaces.

Wessel van Wyk, the previous technical co-ordinator, is still involved in finalising a position paper on real-time monitoring. Once this document receives approval from the SAIOH PCC Exco's sub-committee and Technical Committee, it will be circulated to all SAIOH members and stakeholders.

Communications

SAIOH publishes its newsletter/Presidents' page in two electronic media formats, namely *Occupational Health Southern Africa*, and the *African OS&H magazine* (A-OS&H).

Numerous interactive communications were accomplished in the final months of 2024 and the first two months of 2025:

- November 2024: the then SAIOH Vice President, Karen du Preez, gave a presentation on SAIOH at the Tshwane University of Technology (TUT) for their 3rd-year students.
- February 2025: Deon Jansen van Vuuren, representing SAIOH, spoke about heat stress to the Diploma in Occupational Health students at the University of the Witwatersrand School of Public Health.
- SAIOH communicates daily with its stakeholders via e-mail, Mailchimp notifications, phone calls, and virtual meetings. These

communications cover important news, technical information, legislation changes, new standards, occupational hygiene job opportunities, occupational hygiene products and services, courses, and webinars on occupational hygiene, health, and occupational and environmental safety.
- Several communications were held with the American Industrial Hygiene Association (AIHA), regarding the threat to occupational health and safety in the USA.

Several e-mail notifications on occupational hygiene and health webinars and short courses were distributed towards the end of 2024 for IOHA, WHWB, South African Society of Occupational Medicine (SASOM) webinars, the SASOHN Annual Conference, and Safety-First's Fire Conference.

Several online events and webinars were recently hosted by our stakeholders and attended by SAIOH management, members, and staff, including:
- 30 January 2025: WHWB webinar on asbestos and silica risks
- 12 February 2025: University of Johannesburg Occupational Health Department's lecture on 'The impact of new technologies on occupational health'

FROM THE PROFESSIONAL CERTIFICATION COMMITTEE

Lee Doolan: SAIOH PCC administrator
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Ivan Niranjan: PCC Chairperson
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Professional Certification Committee (PCC) members are SAIOH-registered occupational hygienists (ROHs) with at least five years' experience at this level, volunteering their time to ensure that the certification processes are in line with South African requirements and international occupational hygiene practices. The PCC processes and procedures are documented in Chapter 2 of the SAIOH Quality Manual, and assessors undergo regular instruction and training through meetings and webinars.

The PCC is supported by highly skilled and dedicated administrative staff, who adhere to strict professional conduct to provide the best possible service to all members. The PCC administrators, in handling communication with members regarding the sensitive topic of assessment processes and outcomes, occasionally have challenging conversations with members. We urge all members to treat staff and volunteers with respect and dignity at all times. SAIOH regularly provides members with updates on rules, guides, ethics, compliance, and more. We value each member and strive to maintain a community where everyone feels respected and valued.

Certification assessments

A summary of results for the assessments that took place from mid-March to December 2024 is provided in Table 1.

PCC news

- The PCC Exco nominated a new Chief Examiner, Dr Goitsemang Keretetse.
- The PCC is developing an electronic written assessment on the MS Excel platform to replace the current learning management system (LMS) electronic assessment system. This task is proving to be more challenging than anticipated, especially as we aim to convert all certification assessments to multiple-choice format. This work is ongoing.
- The PCC's written assessments will continue to be conducted in hard copy format until a new system is finalised and implemented.

PCC activities

- The subcommittee responsible for revising the skill set/self-assessment tool meets biweekly. They have completed work on the 17 skill sets and are developing scenario questions aligned with the skill set module requirements for use in oral assessments. PCC members convened on 14 February 2025 for the first of a series of training workshops.
- The PCC ExCo held an official handover session on 24 January 2025, during which the previous Chair, Vice Chair, and Chief Examiner officially transferred their duties to the new PCC management team. The new team comprises Dr Ivan Niranjan as Chair, Andre van Rooyen as Vice Chair, and Dr Goitsemang Keretetse as Chief Examiner.

Table 1. SAIOH PCC certification assessment results for 2024

Certification category	Written assessments				Oral assessments			
	Assessed	Passed	Failed	Pass rate	Assessed	Passed	Failed	Pass rate
	n	n	n	%	n	n	n	%
OH assistant	245	240	5	98.0	0	0	0	-
OH technologist	84	70	14	83.3	101	58	43	57.4
Occupational hygienist	41	22	19	53.7	34	18	16	52.9
Total	**370**	**332**	**38**	**89.7**	**135**	**76**	**59**	**56.3**

Table 2. SAIOH PCC written and oral assessment dates and deadlines, 2025

Assessment type	Deadline for applications	Deadline for assessment evaluations and payment	Assessment date
Written	12 January	14 February	14 March
Oral	-	-	Week of 11 April
Written	25 April	30 May	27 June
Oral	-	-	Week of 25 July
Written	1 August	5 September	3 October
Oral	-	-	Week of 14 November

We thank the previous incumbents, Corlia Peens (Chair) and Maryke van der Walt (Chief Examiner), for their excellent service.

The PCC assessment dates for 2025 are in Table 2.

Occupational Hygiene Skills Forum

The SAIOH Occupational Hygiene Skills Forum (OHSF) was established to oversee all aspects related to the recognition of occupational hygiene training materials, such as asbestos training courses, and occupational hygiene training short course providers and institutions. The forum is also responsible for the development and management of assessment and examination systems.

The OHSF took part in the OHTA Approved Training Provider forum meetings in 2024/2025. The OHSF is making good, albeit slow, progress with the accreditation of tertiary institutions and is in the final stages of evaluating the Cape Peninsula University of Technology's (CPUT) occupational health qualification. Qualifications offered by North-West University (NWU) and the Tshwane University of Technology (TUT) are already recognised. Several universities, including those from Botswana and Uganda, are scheduled to meet in early 2025 to discuss their curricula. All tertiary institutions that offer occupational hygiene qualifications are encouraged to contact the PCC Administrator, Lee Doolan, for information regarding application for recognition: lee@saioh.co.za

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

Dr Hennie van der Westhuizen contributed to the OHSF by developing draft questions based on an article previously published in *Occupational Health Southern Africa*, to pilot an additional Continual Professional Development (CPD) activity. This initiative will allow members to earn CPD points and promote more active involvement in the Journal. SAIOH is preparing to launch this activity during the second quarter of 2025 and, thereafter, at least biannually, based on interest and participation of members.

Leading in a world of diversity, equity, and inclusion: creating a sense of belonging

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INTRODUCTION

Diversity, equity, and inclusion (DEI) is not only a matter of compliance, but is imperative for organisational success, good corporate governance, and sustainability of business. In the context of a dynamic and globalised world, organisations have come to embrace diversity and foster inclusive culture, not only as an ethical and moral essential, but also to yield tangible and significant benefits.[1] Employees who are engaged and feel valued are more likely to be committed, dedicated, and motivated to give their best at the workplace[2] (see Figure 1). In an attempt to empower historically disadvantaged persons, South Africa enacted legislation in the first decade of democracy, such as the Employment Equity Act No. 55 of 1998, the Skills Development Act No. 37 of 1998, and the Promotion of Equality and Prevention of Unfair Discrimination Act No. 4 of 2000, amongst others. The measurement of the efficacy of these pieces of legislations has proven to be complex.[3] Reflecting on the progress made, the figures make the task seem impossible. However, learning from previous successful projects, and celebrating small gains, could be the impetus that is required for organisations to pursue the noble idea of DEI. Extensive research and advocacy in the international context have underscored the pivotal role of DEI in the modern workplace.[4] Combining employees from diverse backgrounds, thereby creating an inclusive culture, allows the organisation to receive fresh perspectives about complex problem-solving, sparking creativity and driving needed innovation within the organisation.[5]

The purpose of this reflective article is to remind us of our context and reasons for believing that DEI is imperative for the success of organisations, and to share good stories.

INTER-GENERATIONAL WORKFORCE PROFILE IN A WORLD OF DIVERSITY, EQUITY, AND INCLUSION

For the first time in history, there are four generations in the workplace as people are living longer and working into their old age. The strategies used to manage different generational groups working in an organisation are expected to focus on reducing the differences between them, whilst maintaining their diversity. Choosing the most effective strategy starts with knowing and understanding the characteristics of each generation[7] (see Table 1).

The generational mix poses a major challenge to leaders in creating an inclusive culture and a sense of belonging for all workers. It is, therefore, important that organisations adopt nuanced and tailored strategies that acknowledge and accommodate intersecting identities of the workforce, to enhance psycho-safety within teams and aid employees to be authentic.[1] A one-size-fits-all approach should no longer be the order of the day in the workplace. Each generation, by and large, has its own unique world view and is motivated by different factors.

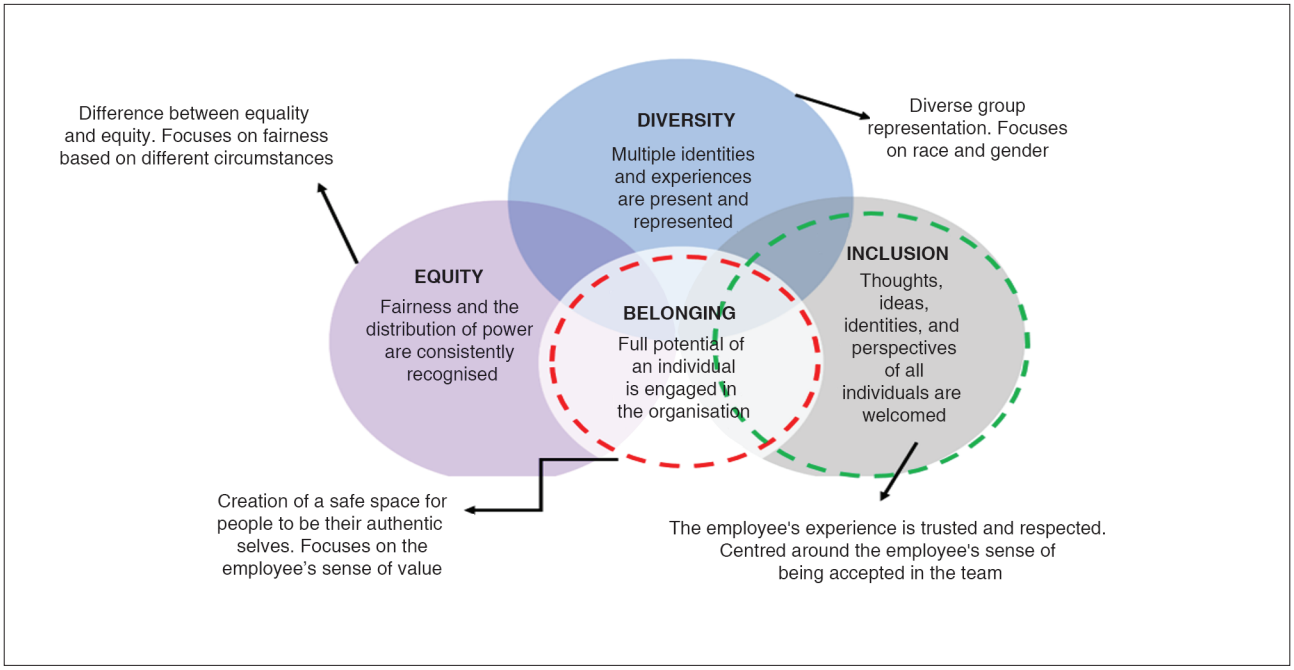

Figure 1. Diversity, equity, inclusion, and belonging
Adapted from Burnette, 2019 [6]

Table 1. Traits of different generations

Boomers
Motivated by: positive attitude, economic prosperity, navigating complex environment
Worldview: strong work ethic, resilience, no-nonsense attitude
Career: organisational career defined by the employee

Gen X
Motivated by: independence, clearly formulated expectations, career development, short-term results
Worldview: autonomous, pragmatic, lifelong learning, opportunities to enjoy life
Career: loyal to the profession, not the employer

Millennials
Motivated by: responsibility, the quality of their manager, unique work experiences
Worldview: seek challenge, development, growth, fun, work-life balance
Career: work with the organisation, not for them

Gen Z
Motivated by: diversity, personalisation, individuality, creativity, innovation
Worldview: self-identity, value independence and individuality, exploration, new technologies
Career: want to enjoy themselves in the workplace and prove themselves

It is, therefore, imperative for leaders to treat work team members as individuals, if they are to build high-performing teams and create sustainable organisations.

Source: Managing different generations in the workplace [7]

Table 2. Leadership and female representation at Harmony Gold Mining Company

	HDPs[1]			Female HDPs		
	Target %	Actual FY24	Actual FY23	Target %	Actual FY24	Actual FY23
Board[2]	50	**67**	67	20	**25**	25
Executive management	50	**57**	60	20	**24**	25
Senior management	60	**62**	58	25	**27**	27
Middle management	60	**63**	60	25	**29**	28
Junior management	70	**72**	70	30	**21**	21
Core and critical skills	60	**74**	73	n/a	**n/a**	n/a
People living with disabilities	1.5	**0.3**	0.3	n/a	**n/a**	n/a

[1] HDPs include women and exclude white males and foreign nationals
[2] Harmony's three executive directors are included as board members

FY: financial year, HDPs: historically disadvantaged persons

Source: ESG Report 2024 [8]

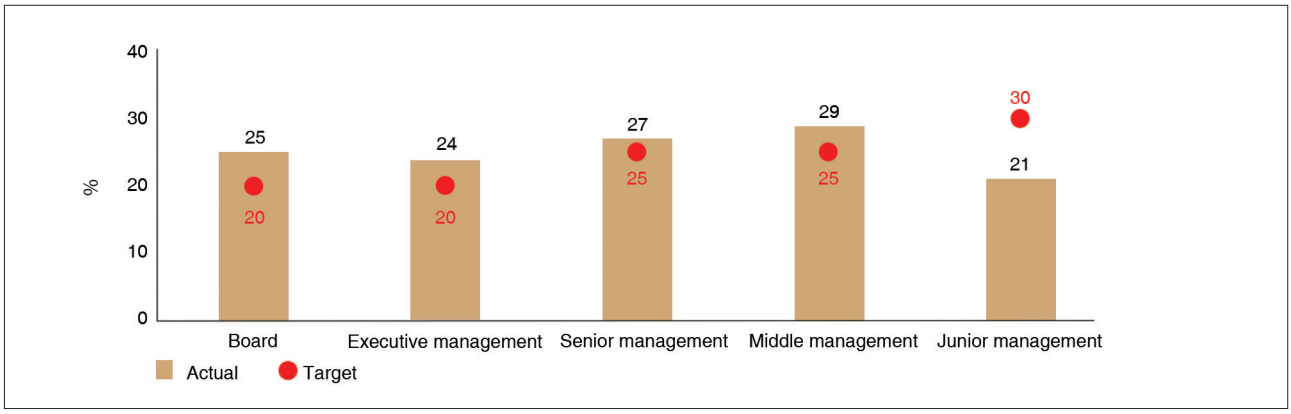

Figure 2. Women in the Harmony Gold Mining Company workforce

Source: ESG Report 2024 [8]

CELEBRATING SMALL GAINS

At Harmony Gold Mining Company, we firmly believe in mining with purpose, and building a sustainable future, where mining is not only about extracting resources but also about empowering communities, advancing environmental stewardship, and driving inclusive economic growth.

Harmony is intentional and strives to maintain and enhance DEI programmes across all its operations. We recognise that mining is still a predominately male industry, and we foster an inclusive culture through development of gender-sensitive policies. We aim to create a level playing field for all employees, with an equity eye on women with respect to skills development and representation

across all (including technical) levels (see Table 2 and Figure 2). We also focus on creating a conducive and safe environment for women, so that they want to work for Harmony. We are intentional about understanding gender issues across all our operations, with the aim of continuously improving the everyday working experiences of our employees, particularly women. To support this, we conducted a survey about gender-based bias and workplace bullying, including sexual harassment. The findings have been widely communicated to all our employees, stakeholders, and executives up to Board levels, where implementation plans are monitored.

Harmony has been recognised for its commitment to gender equality, as evidenced by its inclusion, for the fifth consecutive year, in the Bloomberg Gender Equality Index. The Index tracks the performance of public companies committed to supporting gender equality through policy development, representation, and transparency. In 2024, Harmony was honoured for its efforts in striving for DEI, and was awarded the overall winner in the Standard Bank Top Women Awards, in the category of Standard Bank Top Women Business in Construction, Infrastructure and Mining 2024.

The story of Khethiwe Mothobi, the managing director of Tailor Made Trading and Projects bears testament to this. The company, which was founded by Khethiwe in 2017, is based in Welkom, Matjhabeng Municipality. It is the only black women- and youth-owned company in South Africa that specialises in demolition, rehabilitation, and shaft filling.

Khethiwe, as the founder and managing director of Tailor Made, shared her success story with the Harmony family. She partnered with Harmony Enterprise and Supplier Development (ESD) for procurement readiness, gap analyses, and pre-technical assessment in a mentorship programme. In 2020, her company was awarded its first contract; in 2021, she received a three-year contract to supply bulk cement; in 2022, she was awarded a five-year contract to run the Harmony canteen at the company's mine worker hostels; and, in 2023, she was awarded additional rehabilitation contracts. In 2024, Khethiwe was featured in the 19th Edition of Standard Bank Top Women.[9]

Khethiwe was asked: "*How has Harmony's ESD and mentorship impacted you and your business?*" She responded: *"Harmony was a turning point to me. The mentorship sessions from ESD equipped me in ways no other school of life could have. I learned about managing finances, human resources practices, and importance of having systems, procedures, and policies in the workplace. My workforce grew by 50% just from the investment Harmony made and contributed to Tailor Made. My finance got a massive boost as well, but most importantly, we managed to grow our service offering not just vertically anymore; we are now horizontal as well. I can never thank Harmony enough for what they did and continue to do for me and Tailor Made."*

This is one of many beautiful stories of meaningful partnership that gives Harmony, as a company, a reason to continue to empower women in the interests of creating an inclusive economy.

IMPORTANCE OF DEI IN THE WORKPLACE

- Improves bias awareness – avoiding unconscious biases in decision-making
- Promotes a healthy and conducive working environment for all
- Increases the talent pool (attracting Millennials and Gen Z employees)
- Boosts employee engagement (creating successful teams)
- Improves decision-making (multiple perspectives)
- Improves performance (diverse companies were reported to have up to 36% more profitability) (Hunt et al., 2015)[10]

A Deloitte University study, published in 2020, found that DEI and belonging offers a company a 46% competitive advantage in the industry, 40% better and more accurate decision-making, 34% increase in financial performance, improved retention rates, and more cutting-edge innovation.[11]

CONCLUSION

There has been progress in promoting DEI, but challenges remain. With commitment from leadership, companies can employ various strategies to enhance DEI within the workplace. Companies that prioritise DEI will enjoy significant benefits, including an abundance of innovation and creativity, increase in employee engagement, improvement in retention rates, and improved financial performance. Implementation of gender-sensitive and anti-discriminatory policies improves organisational ability to promote DEI.

Organisations that show commitment to DEI are recognised and honoured by global societies/bodies that promote DEI. For the managers of today to manage intergenerational group differences effectively, whilst maintaining diversity, they need to understand and appreciate the characteristics of each generation.

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