NATIONAL INSTITUTE FOR OCCUPATIONAL HEALTH
Division of the National Health Laboratory Service

OccuZone

Stay safe during the holiday season

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Zinhle Mapumulo

MESSAGE FROM THE EDITOR

It's unbelievable how quickly the year has gone by. Just a few months ago, we were battling the cold, fighting the flu, and other respiratory illnesses. Now, we're soaking up the sun and getting ready for a well-deserved holiday break. That means long drives, outdoor adventures, and plenty of time under the South African sun.

As we enter the festive season, it's important to take care of ourselves - mind, body, and soul. That involves resting as much as possible, protecting ourselves from the scorching sun, and disconnecting from everyday work if you're on leave.

December is Skin Cancer Awareness Month, and in this issue, we highlight occupational skin cancer, a topic that has not been widely researched in South Africa. Professor Nisha Naicker unpacks the urgent need for local research to understand the extent and prevalence of this disease, identify industry-specific risk profiles, and strengthen the evidence linking ultraviolet (UV) exposure to occupational skin cancers.

South Africa experiences some of the highest levels of UV radiation globally due to its geographic location and long hours of sunshine, factors that heighten the risk of skin cancer. Dr Kerry Wilson expands on this topic, explaining that UV exposure is not the only occupational risk. She explores other work-related exposures linked to skin cancer, including ionising radiation, arsenic and inorganic arsenic compounds, pesticides, and mineral oils. Her article underscores the need for increased surveillance and research in this field.

We also feature an insightful piece by Thato Malesa and Bonolo Masoka, who take us through the evolution of ergonomics in South Africa. They reflect on the discipline's 40-year journey, shaped by early advocacy and ongoing development. In conversations with leading voices ranging from the Department of Employment and Labour to the International Ergonomics Association and Air Traffic and Navigation Services, they highlight current realities and future directions. Their article presents three thought-provoking perspectives on the state of ergonomics in South Africa from regulatory, international, and industry viewpoints.

In addition, we shine a spotlight on disability inclusion in the workplace. Goitsimang Buffel reminds us that people living with disabilities are an integral part of the workforce and are entitled to safe, supportive working environments. She outlines key legislation that protects their rights, a worthwhile read for all employers and employees.

This edition also highlights our latest scientific publications, which continue to deepen our understanding of occupational health risks in South Africa. One study examines the impact of long-term lead exposure on cognitive performance among elderly residents living near mining areas in Gauteng. Read more on our other scientific publications in this issue.

Wishing you safe and happy holidays.
Till next time!

Prof. Nisha Naicker

RESEARCH FOCUS

Globally, occupational UV exposure is classified as a Group 1 carcinogen by the International Agency for Research on Cancer (IARC).1 South Africa is one of the countries with high (UV) radiation levels, largely due to its geographic location and extended sunshine hours. Occupational skin cancer disproportionately affects rural agricultural workers, informal sector labourers, and workers with limited access to healthcare. These workers experience prolonged UV exposure, significantly increasing their risk of developing skin cancers such as squamous cell carcinoma, basal cell carcinoma, and melanoma.

Occupational skin cancer is often diagnosed late and rarely reported as an occupational disease.[2] Thus, the burden of occupational skin cancer may often be underestimated, preventing investments into prevention programmes, worker protection, and compensation claims.

The costs of late diagnosis and treatment are generally far higher than those associated with early detection and prevention measures, such as providing sunscreen, promoting awareness and knowledge, and installing shade structures.

Research into occupational skin cancer is critically important in South Africa to highlight the extent and prevalence of the disease, identify industry-specific risk profiles, and establish clear links between (UV) exposure and occupational skin cancers. Quantifying the economic impact of occupational skin cancer strengthens the argument for employers to invest in preventive measures and supports the development of evidence-based compensation policies. Such research also facilitates the implementation of equity-focused workplace interventions that address and reduce preventable health disparities among workers.

The Pathology Section published the latest research on this topic at NIOH.

Manenzhe R, McCusker Powell C, Mhlongo L N. Clinicopathological profile of basal cell carcinoma: a retrospective study from Limpopo province, South Africa. Clinical and Experimental Medicine (2025) 25:276.

https://doi.org/10.1007/s10238-025-01822-9

The NIOH is continuing its research on Occupational Skin Cancers with further studies planned in the near future.

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RESEARCH PUBLICATIONS

Dr Utembe, W

Indoor radon exposure and health risks in a community proximal to gold mine tailings in Gauteng Province, South Africa: a cross-sectional study

Author(s): Mphaga, K.V.; **Utembe, W.**; Mbonane, T.P.; Rathebe, P.C.

Source: https://doi.org/10.1007/s10653-025-02677-5

Summary: Exposure to indoor radon presents a significant risk for lung cancer and is also suspected to be associated with other health issues such as chronic obstructive pulmonary diseases (COPD) and leukemia (blood cancer). This study examined the association between indoor radon exposure and self-reported cases of lung cancer, COPD, and leukemia among individuals living in close proximity to gold mine tailings (solid waste), a known source of high radon levels. A cross-sectional study was carried out among residents living near or further away from gold mine tailings in Gauteng, South Africa. A total of 331 residents took part in an interviewer-administered questionnaire survey on socio-demographic characteristics (such as age and gender), smoking habits, occupational exposures, adverse health problems, and other factors related to lung cancer, COPD, and leukemia. Subsequently, their homes were tested for indoor radon concentration on the lowest livable floor over a two-hour period from June to July 2023 using AlphaE radon monitors. Logistic regression was employed to calculate odds ratios (OR) for lung cancer, COPD, and leukemia based on indoor radon exposure, dwelling location, smoking habits, and occupational exposures. The study found significantly higher indoor radon levels in the exposed group (103.30 ± 94.91 Bq/m3) compared to the control group (65.19 ± 47.83 Bq/m3). The results indicated an association between lung cancer and residing near gold mine tailings, while indoor radon exposure was linked to leukemia. However, no association was found between indoor radon exposure and COPD. In regions impacted by gold mine tailings, it is crucial to implement efficient indoor radon mitigation measures and promote public consciousness about the health hazards linked to indoor radon exposure. There is a need to motivate affected residents to adopt proactive steps to lower indoor radon concentrations, including enhancing ventilation practices.

Prof Naicker, N

Cumulative lead exposure and cognitive performance among the elderly in Johannesburg, South Africa.

Author(s): Kootbodien, T., **Naicker, N.**, Street, R., & Mathee, A.

Source: Environmental Advances, 21, 100652. https://doi.org/10.1016/J.ENVADV.2025.100652

Summary: This study investigated the relationship between cumulative lead (Pb) exposure and cognitive performance in older adults living near mining areas in Gauteng Province, South Africa. A total of 139 individuals aged 60–80 years from state-assisted care facilities participated. Researchers measured bone lead levels using K-X-ray fluorescence (KXRF) and assessed cognitive function with the Early Dementia Questionnaire (EDQ) and the Cambridge Neuropsychological Test Automated Battery (CANTAB), focusing on memory, executive function, attention, and psychomotor speed. The average age of participants was 69.9 years, with 30% reporting occupational exposure. The average bone lead level was 8.1 µg/g, and over half of the participants showed signs of mild cognitive impairment. Higher bone lead levels were significantly associated with poorer cognitive performance, particularly slower reaction times and increased memory-related errors. A notable sex difference was found, with stronger associations in women than in men. Additionally, the relationship between lead exposure and spatial working memory errors was nonlinear, with cognitive impairments worsening more rapidly at higher lead levels. The findings suggest that even low-level, chronic lead exposure may negatively impact cognitive function in the elderly, especially among women. The study highlights the need for further research to confirm these associations and to explore potential interventions in similar vulnerable populations.

Mr Ramatsoma, H

Prevalence and Frequency of Non-Fatal Workplace Injuries Among Waste Recyclers at Buy-Back Centres in Johannesburg, South Africa: A Cross-Sectional Study

Author(s): Ramatsoma, H.; Motlhale, M.; Moiane, T.; Wilson, K.; Naicker, N.

Source: Int. J. Environ. Res. Public Health 2025, 22, 1348. https://doi.org/10.3390/ijerph22091348

Summary: Physical hazards are a common cause of health problems among waste recyclers, often resulting in workplace injuries. In South Africa, formal buy-back centres (BBCs) play an important role in the recycling system, but little is known about non-fatal injuries among workers at these sites. This study aimed to describe the prevalence and risk factors of workplace injuries among BBC recyclers in Johannesburg. A cross-sectional survey at ten BBCs, including 160 participants (median age 32 years; 55.6% female) was conducted. Using a structured questionnaire, information on worker characteristics and self-reported injuries over the past six months was collected. Overall, 69.4% of recyclers reported at least one injury, with cuts or lacerations (67.6%) and sprains or muscle strains (39.6%) being the most common. Risk of frequent injury increased with age (1% per year), longer work hours (22% increase per additional hour), and sensory problems like hearing or vision issues (45% higher risk). These findings highlight the urgent need for targeted measures to protect this vulnerable group. Suggested interventions include limiting work hours, accommodating workers with sensory impairments, and providing properly fitting personal protective equipment (PPE). Improving safety at BBCs can help reduce injuries and support the health of waste recyclers.

Dr Manganyi, J

Head and face dimensions of Black South African respirator users

Author(s): Manganyi, J.; Rees, D.; Brosseau, L.M.; Wilson, K.

Source: https://doi.org/10.1093/annweh/wxaf053

Summary: Many South African workers rely on respirators for protection from airborne hazards. To our knowledge, there is no public head and face anthropometric database for Black South African respirator users to inform the design of respirators. Our study determined the facial dimensions of Black South African respirator users, following the methodology employed in a 2005 study by the United States National Institute for Occupational Safety and Health (NIOSH). Traditional measurement tools, including calipers and a pupillometer, were used to conduct the measurements. A Student's t-test was used to analyze the data.

The study found that the mean values of Black South African facial dimensions differed significantly from those of the American and the Chinese populations. It was concluded that respirators designed and tested using the 2007 NIOSH and the 2009 Chinese fit test panels do not include dimensions representative of Black South African respirator users. Therefore, currently supplied respirators are likely to leave some Black South Africans unprotected due to poor fit. The study suggested a need to use the collected data to develop a dedicated respirator fit test panel for Black South African respirator users.

Mr Radzilani, M

Clinicopathological profile of basal cell carcinoma: a retrospective study from Limpopo province, South Africa

Author(s): Radzilani, M.: McCusker, P.C.J.; and Mhlongo, L.N.N.

Source: Int. J. Environ. Res. Public Health 2025, 22, 1348. https://doi.org/10.3390/ijerph22091348

Summary: Basal cell carcinoma is (BCC) a non-melanoma skin cancer arising from basal epidermal keratinocytes. Its incidence is on the rise in the African continent and has been reported as the common skin cancer worldwide, more common in males. This study aimed to describe the demographic and clinicopathological characteristics of basal cell carcinoma cases from a predominantly native African population.

The study found a higher frequency of BCC in females compared to males. Diagnosed patients were black Africans in their sixth decade of life and older. The head and neck region is where lesions commonly present, and nodular BCC was the most frequent histological subtype.

This study demonstrated that BCC is prevalent in the African native population of the Limpopo province. The clinicopathological characteristics observed in this population are similar to those observed in other local and international studies, except for the gender distribution. Excision with adequate margins is necessary for the infiltrating subtypes to minimise recurrence.

Occupational Risk Factors for Skin Cancer – UV exposure is not the only occupational exposure linked to skin cancer

By Dr Kerry Wilson

A recent publication, "Occupational Risk Factors for Skin Cancer: A Comprehensive Review" by Lee YS et al., 2024, suggests sufficient evidence for a relationship between skin cancer and certain occupational exposures [1].

Skin cancer can originate from various types of skin cells, and it presents with different characteristics depending on the type. Skin cancer is often grouped into two types: non-melanoma skin cancer (NMSC) and malignant melanoma (MM). Many skin cancers are treatable, but can cause ill health if diagnosed late. Work-related factors may occur in higher concentrations than outside work, and work-related exposures are considered modifiable; thus, they are important to consider and control [1].

The summary of evidence presented in the recent paper:

UV radiation – Short-term intense UV exposure is a cause of melanoma and basal cell carcinoma (BCC). While long-term continuous exposure is associated with squamous cell carcinoma (SCC). Ultraviolet radiation from the sun and artificial sources has been classified as carcinogenic to humans by the International Agency for Research on Cancer (IARC). A systematic review on occupational sun exposure and keratinocyte cancers found that 95% of studies reported higher risks in outdoor workers, and statistically significant results were found in 50% of studies [2]. The studies mainly included pale-skinned ethnicities, and there is a noted gap in research on non-Caucasian ethnicities [1]. Occupational exposure to solar UV radiation has limited evidence for harmfulness in melanoma, but can increase the risk [3].

Ionising radiation – the relationship with skin cancer has been demonstrated in head and neck radiation therapy, X-ray treatment of ringworm, and the atomic bombs. A study of workers in a Russian nuclear production facility found an increased risk of carcinoma (BCC), and radiology technologists exposed before 1950 or before 1960s also had an increased risk of BCC. There was insufficient evidence for melanoma [1].

Arsenic and inorganic arsenic compounds – these have been classified as group 1 carcinogens by IARC with sufficient evidence for non-melanoma skin cancer. An occupational case-control study of non-melanoma skin cancer did not show a significant association between airborne arsenic exposure and NMSC. Still, they did find an increased risk with co-exposure to sunlight [4]. This indicates a synergistic effect between arsenic and UV radiation. A cross-sectional study suggests an association between arsenical pesticide exposure and melanoma.

Pesticides – IARC has classified occupational exposure to arsenic and polychlorinated biphenyls (PCB), found in pesticides, as a definite carcinogen for skin cancer. Limited research is available on occupational pesticide exposure and NMSC. Contrary to this, research on melanoma and occupational pesticide exposure has shown significantly increased odds and relative risks for melanoma for specific pesticides such as mancozeb, parathion and carbaryl [5].

Organic solvents - some organic solvents are associated with other cancers, and the mechanisms suggest they could be associated with skin cancer. One study has found an association between trichloroethylene and NMSC. Polychlorinated biphenyl solvent exposure has been associated with melanoma in studies, but recent work shows controversial results. Studies conducted in the chemical industry have shown an increased incidence of melanoma in workers exposed to polyvinyl chloride and vinyl chloride monomers used as solvents or intermediates.

Mineral oils – IARC classified untreated and mildly treated mineral oils as group 1 carcinogens based on evidence of Squamous Cell Carcinoma (SCC). However, since the 1950s, polycyclic aromatic hydrocarbons (PAHs) have been removed from oils, reducing their carcinogenic potential. Two more recent studies found significantly raised rates and hazard ratios for melanoma in the aviation and automotive industries, particularly for exposure to straight mineral oils [1].

Petroleum refining – this industry contributes to the production of various chemicals, and work there has been classified as a group 1 carcinogen. Workers with exposure to crude paraffin wax have been shown to suffer from SCC in case reports and series. Again, more studies have been conducted on petroleum refinement and melanoma, with an increased risk of melanoma associated with working in the oil and petroleum industry [6]. Several chemicals have been listed as contributing to melanoma in oil-refining workers, from benzene to PCBs and PAHs.

Firefighting - in the process of fighting fires, firefighters are exposed to numerous group 1 carcinogens. Statistically significant associations between firefighters and NMSC have been found in Australia, New Zealand, Sweden and Korea. The relationship between firefighting and melanoma was shown in incidence risk estimate studies [7], but a decrease in incidence has been demonstrated over time, perhaps linked to improved protective controls.

Sufficient evidence for various occupational exposures and skin cancer has been presented, but in some exposures, the number and design of studies are limited, particularly around the healthy worker effect. More surveillance and research is needed.

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Disability awareness in the workplace

By Sister Goitsimang Buffel

According to the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD), disability is an evolving concept and disability results from the interaction between persons with impairments and attitudinal and environmental barriers. It recognises persons with disabilities as those persons who have long-term physical, mental, intellectual or sensory impairments which, in interaction with various barriers, may hinder their full and effective participation in society on an equal basis with others.1

In the South African context, disability is defined as the loss or elimination of opportunities to take part in the life of the community, equitably with others, that is encountered by persons having physical, sensory, psychological, developmental, learning, neurological or other impairments that may be permanent, temporary or episodic in nature, thereby causing activity limitations and participation restriction with the mainstream of society. [2]

This definition is referred to as the "social model". The South African Human Rights Commission endorses the UNCRPD approach and encourages all employer groups to incorporate this application and understanding of disability into their policies and practices.[3]

People living with disabilities in the workplace are protected under the following legal provisions:

» The Constitution of the Republic of South Africa (1996)

» The United Nations Convention on the Rights of Persons with Disabilities (Article 27)

» The Employment Equity Act 55 of 1998

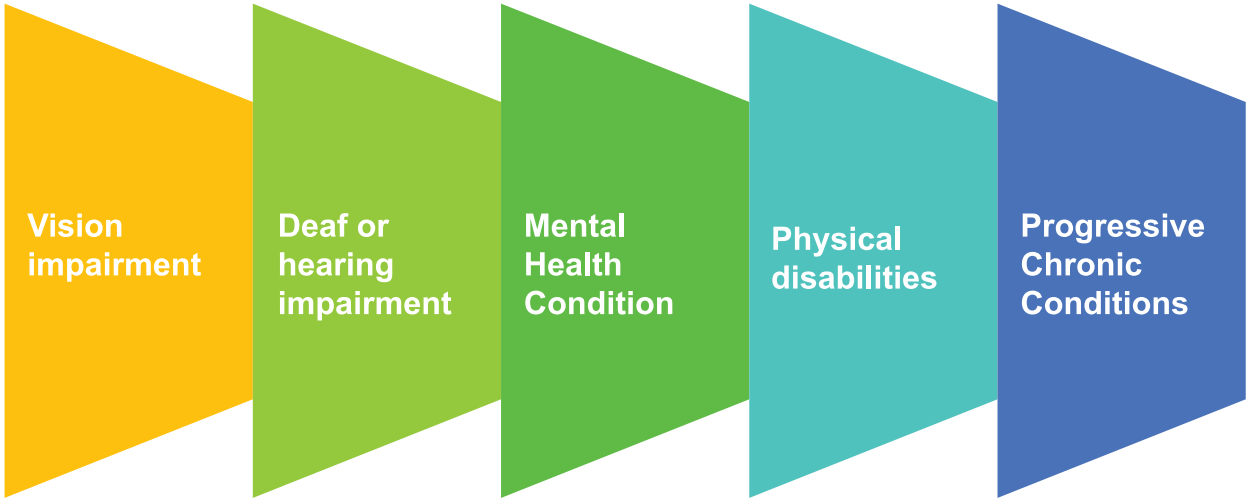
» The Labour Relations Act 66 of 1995

» The Occupational Health and Safety Act 85 of 1993

Occupational health and safety regulations

People living with disabilities form part of employment, therefore they are entitled to a safe working environment, and employers are required to ensure the safety of all in the workplace. The Employment Equity Act (EE Act) provides details on the inclusivity of people living with disabilities in the workplace and provides guidance on environmental accommodation. The Labour Relations Act (LRA) regulates working conditions of all employees with inclusion of employees with disabilities.[4,5,6]

Examples of categories of disabilities which may be found in the workplace



Need for a proactive approach by employer on personal emergency evacuation plan (PEEP)

Employers' emergency evacuation plans must always include accommodations and special measures as may be required for people living with disabilities to prepare for emergencies. As guided by the Occupational Health and Safety (OHS) Act, employers must display safety signage, including the ones for people living with disabilities, at the workplace for a better and safer emergency evacuation process.

To determine whether the impairment constitutes a disability, the relevant criteria must be evaluated. The Department of Labour's Technical Assistance Guideline (TAG) outlines three basic qualifying criteria to determine if a person has a disability – and provides guidelines to assist in the application and understanding of these criteria (**there must be an impairment**).[7]

Three basic qualifying criteria to determine if a person has a disability (Department of Labour's Technical Assistance Guideline)

An impairment may either be physical or mental or a combination of both. A physical impairment means "a partial or total loss of a bodily function or part of the body. It includes sensory impairments such as being deaf, hearing impaired or visually impaired". A mental impairment is a clinically recognised condition or illness that affects a person's thought processes, judgement or emotions. This includes conditions such as intellectual, emotional and learning disabilities. For reasons of public policy, certain conditions or impairments may not be considered as disabilities.

The impairment must be long-term or recurring Long-term means the impairment has lasted for, or is likely to persist for at least twelve months. Recurring means the impairment in one that is likely to happen again and when it does, it is substantially limiting. The condition can go away for a period of time and return again but it is never cured. It includes a constant chronic condition, even if its effects on a person fluctuate, such as is the case in some forms of multiple sclerosis

The impairment must be substantially limiting an impairment is substantially limiting if its nature, duration or effects substantially limit a person's ability to perform essential functions of the job for which he/she is being considered. If the effects of the impairment are not substantially limiting, even if they are physical and/or mental, are long-term or recurring, then the person is not covered under the EE Act. Employers are encouraged to seek the assistance and advice of technical experts to determine whether a particular impairment is substantially limiting, or an applicant or employee may be able to provide information that is deemed sufficient to document this.

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3. SouthAfricanHumanRightsCommission, Act No 54 of 1994(as amended).

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6. South African Labour Relations Act, No. 66 of 1995 (as amended).

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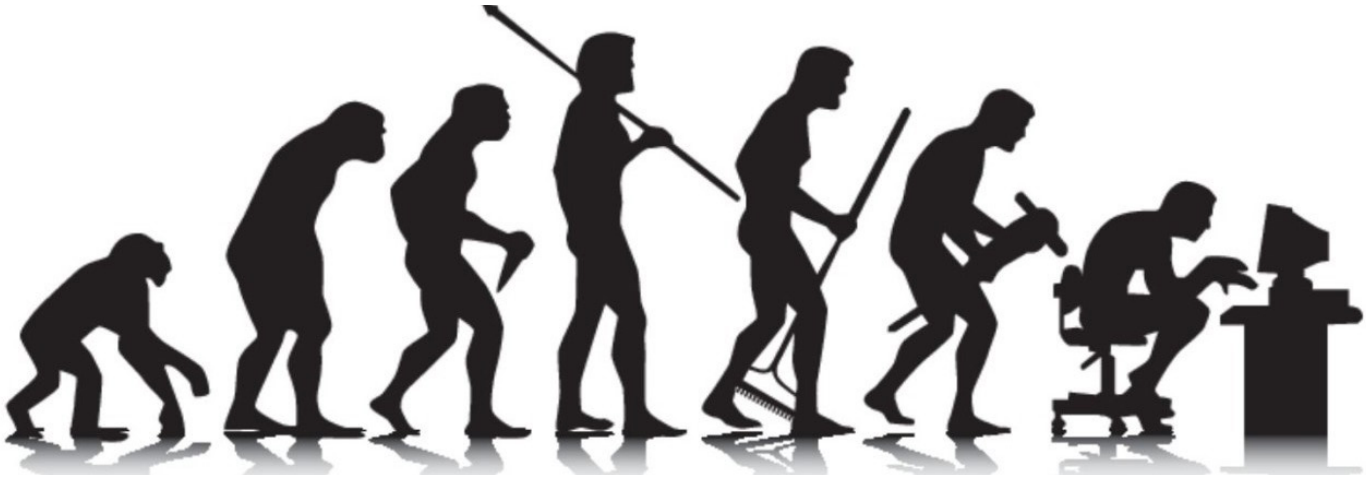
The Evolution of the Ergonomics Discipline in South Africa

By Ms Thato Malesa and Ms Bonolo Masoka



As South Africa marks nearly four decades of progress in the Human Factors and Ergonomics (HFE) discipline, the National Institute for Occupational Health (NIOH) reflects on the discipline's transformative journey that began with early advocacy in 1985. From its modest origins to its current status, HFE has evolved into a cornerstone of workplace health and safety, shaping how South African's work and stay protected on the job. The Ergonomics Unit at the NIOH convened a series of discussions with leading voices in the field, including representatives from the Department of Employment and Labour, the International Ergonomics Association (IEA) president, and representatives from the Air Traffic and Navigation Services (ATNS). These collaborations aimed to foster a dialogue and share insights on the current status and future direction of ergonomics in South Africa. In the following section, we present three insightful contributions that capture the state of the Ergonomics discipline in South Africa, from a regulatory, international, and industry perspectives.

1. Insights from the Department of Employment and Labour – Mr Warren Mallon

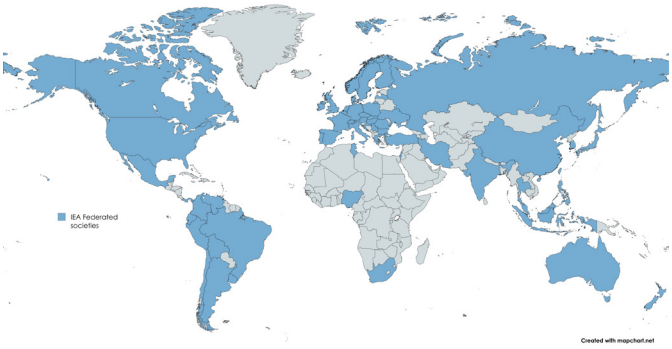
The Ergonomics Regulations were promulgated on 6 December 2019 and apply to all workplaces, as defined in the Occupational Health and Safety Act, No. 85 of 1993, as amended. The Regulations require an employer to develop and implement an ergonomics programme, which should be integrated into existing occupational health and safety programmes. Ergonomics in the workplace should not be viewed in isolation, but rather as part of a comprehensive approach to ensure the workplace is safe, free from health risks, and conducive to improved productivity. Since the promulgation of the Ergonomics Regulations, the Department of Employment and Labour has embarked on two data collection activities. These involved inspectors collecting data on the implementation of the regulations during inspections. Data were collected from a total of 745 employers during the two data

collection activities, across various sectors. The bulk of the employers came from the following sectors: iron and steel, agriculture, chemical manufacturing, health care, construction, and food and beverage manufacturing. The employers were also spread between those that employ 10 or fewer employees to those who employ more than 500 employees. The most extensive spread was among employers who employed between 11 and 99 employees.

The data collected indicated that less than half of the workplaces had not conducted ergonomics risk assessments. Furthermore, the data showed that awareness among employers and employees regarding the Ergonomics Regulations is also low, as well as the fact that employers are not conducting medical surveillance on exposed employees. In order to continuously advocate the requirements of the Ergonomics Regulations, the Department has drafted a number of supporting documents. This includes the Competent Person Guideline Document and the Ergonomics Programme Approach Guideline Document. Employers and employees should read these documents together with the Occupational Health and Safety Act, Ergonomics Regulations and the explanatory notes.

2. Global Perspectives: Reflection from the International Ergonomics and Human Factors Association (IEA) – current state and future directions – Professor Andrew Thatcher

Professor Thatcher highlights that "as the current President of the International Ergonomics and Human Factors Association (IEA), he gets a fantastic international view on the state of human factors and ergonomics (HFE). Globally, HFE is in a fairly good and stable place at the moment." The IEA has 57 federated societies, and some of those federated societies (e.g., the Nordic Ergonomics Society and the French-speaking Ergonomics Society – SELF) have a presence in multiple countries. The IEA has a presence in approximately 70 countries worldwide. At the recent IEA Council meeting in Beijing that took place on the 28 and 29 October 2025, the IEA welcomed Bolivia as the 58th federated society, but unfortunately, it was unable to welcome Algeria because its government would not allow it join an international organisation. The figure below shows where the IEA (and therefore HFE) has an official presence (those countries coloured in blue). It is easy to see that there are enormous gaps across the African continent. There are only three IEA federated societies in Africa: **South Africa**, Nigeria, and Tunisia. There is, however, still considerable HFE activity across the African continent, with IEA and IEA federated society projects in Angola, Mozambique, Tanzania, Ghana, Côte d'Ivoire, Algeria, Morocco, Namibia, Botswana, and Zimbabwe. With concerted effort and some creative organisation, there are enormous opportunities for growth across this region. In particular, there is much that we in Africa can learn from the Latin American HFE network (ULAERGO) and the Asian HFE Network (ACED), which have demonstrated some innovative ways to assist the development of HFE in new countries and regions.



Membership in HFE societies in the Global South is still growing, with the Chinese Ergonomics Society now being the largest HFE society in the world, overtaking the HFES society of the USA. Membership growth continues in HFE societies in Latin America and across Asia. Even South Africa has seen a slight increase in ESSA society membership, which is encouraging to see under its relatively new and youthful leadership. The IEA will do what it can to promote and support this growth. The next IEA Congress (IEA2027) will be in London (from 23-25 August 2027, at the Excel Centre on the Eastern edge of London. For more updates on the IEA Congress, scan the IEA2027 QR code to be added to the "early bird" list.

3. Industry Reflections: Human Factors and Ergonomics Specialist and General Manager at Air Traffic and Navigation Services (ATNS): Lesedi Milanzi

Ms Lesedi Milanzi presents an industry-focused viewpoint on how the HFE discipline is transforming modern workplaces. She discusses the discipline's strategic role in enhancing safety, productivity, and employee well-being. Ms Milanzi highlights that workplaces today are becoming increasingly complex. The proliferation of digital interfaces, the expansion of remote work arrangements in specific sectors, the prevalence of shift work, and an intensified focus on employee cognitive and physical performance have collectively transformed HFE from a "nice to have" convenience into a strategic business imperative. Rather than being viewed as a peripheral safety exercise, HFE now underpins organizational efficiency, risk mitigation, employee well-being, and, ultimately, sustainable profitability.

In South Africa, the HFE discipline is gaining considerable traction, especially within high risk, and labour intensive sectors. Across industries such as military, railway, transport industry, mining, informal economy, and aviation industry, HFE has consistently demonstrated its capacity to mitigate sector-specific hazards, deliver measurable cost-benefit outcomes, and foster a culture of health and safety. By virtue of the promulgated Ergonomics Regulation, South Africa possesses a solid foundation of regulatory intent for HFE. The legislation signals a clear governmental commitment to embedding ergonomic principles within the statutory framework of workplace safety. However, the mere existence of regulation is insufficient to drive meaningful change; it requires concerted, collaborative effort from academia, industry bodies, and the workforce itself to translate that intent into practice.

One of the most noteworthy achievements in the evolution of HFE in South Africa, has been the remarkable increase in the number of qualified and certified HFE specialists entering the workforce. About 17 years ago, the discipline was a rarity, only a tiny handful of Ergonomists and Human Factors professionals operated. Today, however, the landscape has undergone a dramatic shift. A decent influx of HFE professionals is now observable across a diverse range of sectors, as well as traditional high risk industries. This expansion of qualified specialists is enabling a more systematic and comprehensive application of HFE principles, thereby broadening the services that HFE practitioners can offer to industry. If this trend continues, organisations will be better positioned to integrate HFE into their occupational health and safety frameworks, supporting the nation's broader objectives of safer, healthier, and more productive workplaces.

SERVICE DELIVERY

By Ms Karen du Preez

Profiling the NIOH Toxicology and Biochemistry Section

In alignment with the National Institute for Occupational Health (NIOH)'s core mission, the Toxicology and Biochemistry Section plays a pivotal role in advancing occupational health. The Section fosters collaborative research with national and international institutions, delivers specialised services, builds capacity through teaching and training for undergraduate and postgraduate students, and provides expert consultations to government departments and industry stakeholders. The Section operates through five specialised units, each equipped with state-of-the-art technology and expertise:

1. **Toxicity Assessment Unit**
2. **Genotoxicity Unit**
3. **Molecular Biology Unit**
4. **Ambient Particle Assessment Unit**
5. **Toxicological and Chemical Risk Assessment Unit**

These resources support diverse applications across biomedical research, microbiology, environmental science, food safety, pharmaceutical development, medical diagnostics, genetic research, agriculture, forensics, and biotechnology. The Section also contributes to education by supervising MSc and PhD students from various national institutions and professional development courses in areas related to toxicology. The comprehensive training programmes include workshops on core subjects, such as the Globally Harmonized System (GHS) of Classification and Labelling of Chemicals, and individualised sessions focusing on specialised methods like CytoViva Hyperspectral Imaging, xCELLigence Real-Time Cell Analysis, cell culture techniques, and health risk assessments.

1. Toxicity Assessment Unit: Real-Time Insights into Cellular Health

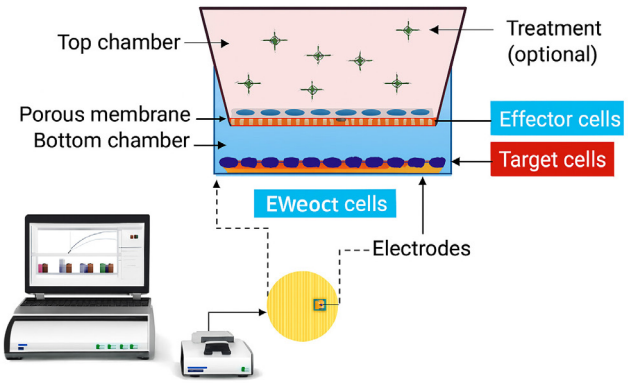
This unit evaluates the potential toxicity of pharmaceuticals, chemicals, environmental contaminants, nanomaterials, and micro-particles. The unit uses advanced in vitro (cell-based) research using a wide range of human cell lines. The Toxicity Assessment Unit is equipped with two state-of-the-art specialised instruments:

xCELLigence Real Time Cell Analyser (RTCA)
The xCELLigence RTCA is a label-free, electronic system that continuously monitors cell health, attachment, growth, and behaviour in real-time via electrical impedance. It uses electrical impedance to measure changes in cell attachment and growth over time.

xCELLigence Real Time Cell Analyser (RTCA)

The xCELLigence RTCA has a wide variety of applications including:

- Real-time cytotoxicity/apoptosis profiling for chemicals, nanoparticles, and environmental contaminants both in mono-culture and co-culture settings (see figure below).
- High-throughput drug screening to identify optimal dosing windows and mechanisms.
- Cell adhesion and spreading may be monitored as a consequence of hormones, extracellular matrices or target molecules
- Antiviral drug efficacy and virus-mediated cytotoxicity.
- Immune cell-mediated killing (NK cells, CAR-T, T-cells; real-time kinetics of target cell lysis).



xCELLigence E-plate inserts

CytoViva Hyperspectral Imaging (HSI) System with 3D module

In addition to toxicity, the section can assess whether compounds enter cells, potentially increasing their harmful effects. The Section utilises the patented illumination technology of CytoViva, which integrates with a standard microscope to provide high-resolution, darkfield images. This allows for rapid observation of a wide range of compounds within unlabelled cells and tissues. A dual fluorescence module also allows for observations of fluorescently-labelled cells and tissues. This system is further enhanced by the CytoViva HSI, which analyses spectral data from images to identify specific materials. The HSI operates in the visible and near-infrared range and has been specifically designed for nanoscale studies. This instrument is also fitted with a 3D system, enabling the creation of three-dimensional representations of compounds, allowing us to pinpoint their location within cells and even organelles.

CytoViva Hyperspectral Imaging system with dual fluorescence and 3D modules.

Additional assays utilised in the department include the following but are not limited to:

- **Cellular Toxicity Assays: These standard tests screen compounds for their impact on cell growth or viability. Common assays include:**
  - Tetrazolium reduction assays (MTT, MTS, XTT, WST-1): These assays measure viable cells using tetrazolium compounds.
  - Neutral Red and Alamar Blue: These assays assess cell health based on dye uptake or cellular energy levels (ATP).
  - LDH (lactate dehydrogenase) assay: This assay detects cell membrane damage by measuring the presence of intracellular substances leaking into the surrounding medium.
- **Oxidative Stress Assays: These assays measure markers of cellular damage caused by free radicals:**
  - 8-hydroxy-2-deoxyguanosine (8-OHdG): Marker of DNA damage

- 8-isoprostane assay: Measures levels of a free radical by-product in urine

The toxicity assessments can be conducted in vitro utilising a wide variety of human cell lines readily available within the section. Additionally, biomarker evaluation can be performed in vivo (in living organisms) by analysing blood or urine samples.

2. Genotoxicity unit

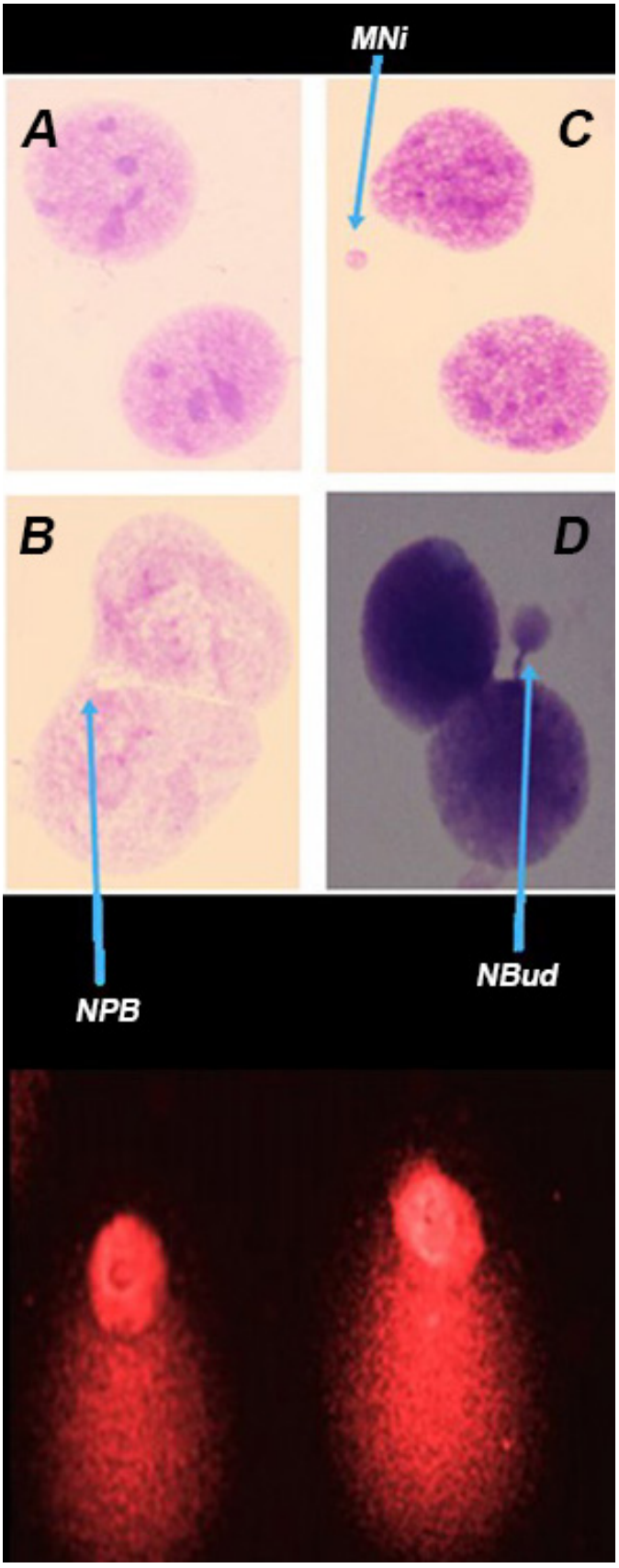
This unit screens for genetic alterations induced by chemicals and nanomaterials in mammalian cells and biological samples. Genotoxicity refers to the ability of chemical agents to cause genetic alterations in somatic and/or germ cells. The genotoxic effects of chemicals are examined by measuring the extent of DNA damage in cells exposed to chemicals. Genetic alterations in somatic cells may cause cancer if they occur in genes such as proto-oncogenes, tumour suppressor genes and/or DNA damage response genes and may be responsible for a variety of other (non-cancer) genetic diseases. On the other hand, genetic alterations of DNA in germ cells can result in reproductive effects and transmissible changes that may be passed to progeny. The unit uses various tests for assessing the genotoxicity of chemicals and they include:

Comet assay

The comet assay, also known as the single-cell gel electrophoresis, is a rapid and sensitive procedure for quantifying DNA damage in mammalian cells and is widely used to test the genotoxicity of chemicals including nanomaterials. Applications of the comet assay include genotoxicity testing in ecological studies, human biomonitoring and clinical studies.

Micronucleus (MN) assay

The MN assay detects small sub-nuclear bodies known as micronuclei and quantifies the chromosome breakage and changes in chromosome number (clastogenesis) in cells that have gone through cell division during or after chemical exposure. Applications of the MN assay include toxicological screening for potential genotoxic pharmaceutical chemicals, cosmetics, agricultural and industrial chemicals and food additives.



3. Molecular Biology Unit

The Molecular Biology Unit is supported by a fully equipped laboratory, enabling efficient isolation and purification of RNA, DNA, and proteins from various sample types.

The unit makes use of the CFX96 Touch Real-Time polymerase chain reaction (PCR) Detection System that specifically offers precise temperature control and fluorescence detection capabilities making it valuable for amplifying and analysing DNA samples with high accuracy and reproducibility. The equipment has a wide range of applications including:

- Quantitative PCR (qPCR): for accurate quantification of nucleic acid targets such as viral load quantification and microbial quantification.
- Digital PCR (dPCR): For absolute quantification of nucleic acids without the need for standard curves, useful for rare mutation detection, copy number variation analysis.
- Gene Expressional analysis: for studying the expression levels of genes under different experimental conditions or in different tissues, providing insights into biological processes and disease mechanism
- Pathogen detection: for identifying and quantifying pathogens such as bacteria, viruses, and fungi in clinical samples, food, water and environmental samples
- Environmental testing: For analysing environmental samples for the presence of contaminants, pollutants, chemicals, and, microbial communities, aiding in environmental monitoring and assessment.

Real-time PCR thermocycler in the Molecular Biology laboratory

4. Ambient Particle Assessment Unit

The Ambient Particle Assessment Unit provides a multi-modal approach to characterizing indoor and outdoor airborne particulate matter and nanomaterials, enabling real-time analysis and in-depth physical/chemical characterisation. This dedicated unit features a range of instruments for both online and offline assessments, including particle number, size, and surface area. This data is critical for environmental quality monitoring and informing health risk assessments. These instruments include:

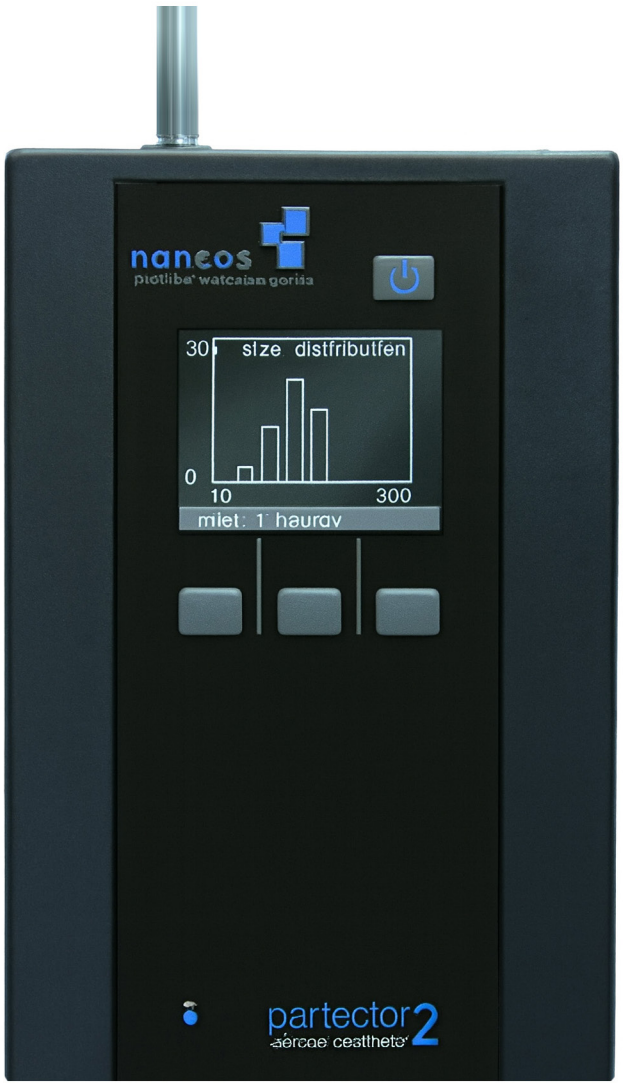
- Real-time particle counters and sizers (NanoScan SMPS, OPS, Electrostatic Classifier, APS)
- Nano-ID Select: Collects particles of various sizes on filters and glass slides for further analysis.
- Partector: A miniature personal sampler that measures the lung-deposited surface area of respirable nanoparticles.
- AS200 Air Jet Sieve: Separates bulk dust samples into different size fractions for further analysis.

5. Toxicological and Chemical Risk Assessment Unit

The Toxicological and Chemical Risk Assessment Unit boasts extensive knowledge and experience in national and international

NanoScanSMPS

AS200 Air Jet Sieve



Partector

regulatory frameworks and processes, including the Organisation for Economic Co-operation and Development (OECD), United States Environmental Protection Agency (USEPA), the European Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), the World Health Organization (WHO) and others.

It consolidates and integrates results from the other units in the department as well as from toxicological dossiers and the literature to perform risk and safety assessments for workers and pharmaceutical, industrial, cosmetics, agricultural and other consumer products as well as risk assessments for hazard (toxic) installations and risk management of chemical events (incidents, accidents and disasters). The unit analyses and recommends worker and product safety standards and guidelines, including the development and review of the United Nations Globally Harmonized System of Classification and Labelling of Chemicals (GHS) Safety Data Sheets (SDSs) and labels.

For further information on the services offered by the Toxicology and Biochemistry Section, please contact the Section via email at Toxicology@nioh.ac.za or Dr Jitcy Joseph at jitcyj@nioh.ac.za, or telephonically at 011 712 6411/6483

NATIONAL INSTITUTE FOR OCCUPATIONAL HEALTH
Division of the National Health Laboratory Service

GHS Safety Data Sheets and Chemical Labels Webinar

This webinar is designed to equip laboratory personnel, with the essential skills to safely handle chemicals. It focuses on the Globally Harmonised System (GHS), a United Nations-developed standard for classifying and communicating chemical hazards.

CPD ACCREDITED

Key learning outcomes:

- Read and understand GHS Safety Data Sheets (SDSs).
- Correctly interpret GHS chemical labels.
- Master proper handling, storage, and disposal procedures for various chemicals.

Target Audience: Medical Scientists, Researchers, Health and Safety Representatives, Laboratory Technicians, Assistants and Analysts.
Cost: R1000
Date: 24-25 February 2026 (two days) | Time: 10:00 - 13:00 | Venue: Online (zoom)
Contact: Toxicology@nioh.ac.za | 011 712 6411
Click here to register

NIOH SERVICES

Section	Services	Contact person
Analytical Services	Analytical Services provides a broad range of users with analytical services expertise in occupational hygiene, biological monitoring, and some clinical laboratory tests.	Head of Section Dr Puleng Matatiele Tel: 011 712 6477 Email: PulengM@nioh.ac.za
Immunology & Microbiology	The Immunology and Microbiology section consists of three units: Occupational Allergy, Waterborne Pathogens and Bioaerosol. The Occupational Allergy Unit provides diagnostic tests to identify workplace agents that cause respiratory and skin diseases. The Occupational Skin Disease Clinic also offers consultations with a dermatologist. Waterborne Pathogens Unit (WBPU) conducts monthly microbiological testing of potable water from workplaces to ensure compliance with the SANS 241 drinking water standard. It also analyses non-potable water samples to ensure they meet microbiological safety standards for their designated occupational use. The Bioaerosol Unit identifies bacteria and fungi in environmental air samples taken from the workplace and performs efficacy testing on air disinfection devices, such as ultraviolet germicidal irradiation (UVGI). In addition, the unit performs risk assessments for Hazardous Biological Agents (HBA) in different workplaces.	Head of Section Ms Edith Ratshikhopha Tel: 011 712 6475 Email: EdithR@nioh.ac.za
Information Services and Training	**Archive** Documenting and preserving the institutional memory and create access points to the rare and unique information resources showcasing how the institute has evolved over time. These records stretch as far as 1912, they include personal papers, conference papers, registers, obsolete instruments, photographs etc.	Mr Simphiwe Yako Tel: 011 712 6518 Email: simphiwey@nioh.ac.za
Pathology Division	**Training laboratory technical staff:** The laboratory performs practical training of technical laboratory staff enrolled as medical laboratory scientists, and laboratory technologists in the histopathology disciple.	Ms Busisiwe Mkhonza Tel: 011 712 6519 Email: BusisiweM@nioh.ac.za

Section	Services	Contact person
Toxicology and Biochemistry	**United Nations Globally Harmonised System of Classification and Labelling of Chemicals (UNGHS)** The Toxicology Department facilitates the UNGHS workshop to train individuals who handle hazardous chemicals in their workplaces in the identification and management of chemical hazards according to GHS classification criteria.	Dr Wells Utembe Tel 0117126741 Email: wellsu@nioh.ac.za
Occupational Medicine	**Advisory services** Advisory services on the prevention and management of occupational diseases and disorders offered to organizations within the SADC region.	**Occupational Medicine Specialist referral clinic:** Mr Jacob Senamolela Tel: 011 712 6462 Email: JacobSe@nioh.ac.za
Occupational Hygiene	**Occupational Hygiene Training Association (OHTA) Modules** The Occupational Hygiene Section is an approved OHTA trainer, and provide training on the following modules: Foundation level: • OHTA201 Basic principles in Occupational Hygiene Intermediate level – core modules: • OHTA501 Measurement of Hazardous Substances • OHTA503 Noise – Measurement and its effects • OHTA505 Control of Hazardous Substances • OHTA507 Health effects of Hazardous Substances Intermediate level – optional modules: • OHTA502 Thermal Environment. • OHTA504 Asbestos and other fibres. • OHTA506 Ergonomics Essentials.	Dr Jeanneth Manganyi Tel: 011 712 6406 Email: JeannethM@nioh.ac.za
Epidemiology & Surveillance	**Trianing and services:** Epidemiology and Biostatistics Training: • Basic and Advanced courses. • How to use routine surveillance data to improve the health of workers. • How to use REDCap Protocol development for research on Occupational exposures and Health outcomes. • Development of REDCap tools and other data collection tools. • Research on work exposures and health outcomes in the workplace.	Asanda Jekwa Email: AsandaJ@nioh.ac.za

Section	Services	Contact person
	Services: • Analyses of routine medical surveillance data. • Developing analysis plans for surveillance data. • Literature Reviews on occupational health topics. • Evaluation of Surveillance systems. • Advice and guidance around developing a surveillance system or advice for selecting a service provider for surveillance tools. • Designing or conducting occupational health screening surveys along with staff satisfaction and mental health surveys in your workplace. • Evaluation of training programs in occupational hazards, health and safety.	

NATIONAL INSTITUTE FOR OCCUPATIONAL HEALTH

Division of the National Health Laboratory Service

Contact details

25 Hospital Street, Constitution Hill, Johannesburg, South Africa

PO Box 4788, Johannesburg, South Africa, 2000

Tel : +27 11 712 6400
Fax : +27 11 712 6545 / 6532
Email : info@nioh.ac.za
Web : www.nioh.ac.za