# OCCUPATIONALhealth

## SOUTHERN AFRICA

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# SPECIAL ISSUE

Incorporating Festschrift for

## DAVID REES

**Official Journal of SASOM, SAIOH, SASOHN and MMPA**

- The South African Society of Occupational Medicine
- Southern African Institute for Occupational Hygiene
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SOUTHERN AFRICA

***Front cover photograph***

*Professor Emeritus David Rees.*

*Photograph: Sue Goldstein*

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# From the Editor . . .

**Gill Nelson,**
**Editor-in-chief**

Welcome to this Special Issue of *Occupational Health Southern Africa* which includes a Festschrift in honour of Professor Emeritus David Rees. David Rees has been a loyal supporter of the Journal, and has published 27 papers in 26 issues since its inception in 1995. His contribution to occupational health over the last three and a half decades is reflected in the tributes submitted by those whose lives he has touched, not only professionally but also personally. Some of the words commonly and accurately used to describe David in this Festschrift are inspiring, intelligent, knowledgeable, humble, honest, kind, quiet and funny. Essentially, he's a great person! Some of you will recognise yourselves in one or more of the many photographs that were taken in the 1980s and 1990s, and more recently. I hope that you enjoy the compilation.

> *Festschrift: a book honouring a respected person, especially an academic, and presented during his or her lifetime*

It would be unusual for a current issue of any health or medical journal not to include something about COVID-19. The research opportunities seem endless. You can read two COVID-19-related articles in this issue – one that describes the development of a screening tool, written primarily by researchers from the University of Pretoria, and the other about COVID-19 statistics in the mining industry, from the Minerals Council South Africa. It is fortuitous that David Rees has worked closely with authors of both these papers, but not surprising as he has worked with almost everyone in South Africa who has an interest in occupational health, particularly in occupational respiratory medicine – researcher, health professional or student.

The third paper comes from an unusual source – the Wits School of Business Sciences – but tackles a very important issue: that of compensation for occupational disease. Mushai and Crossley suggest that South Africa's penchant for using trusts to recompense diseased workers, or to supplement existing legislative mechanisms, may have several limitations. In the last two decades, four large trusts have been set up to compensate victims of asbestos-related diseases (from both occupational and environmental exposure), and silicosis and tuberculosis in mine workers. Trusts are widely considered, in South Africa, to be the potential answer to the lack of reform of the Occupational Diseases in Mines and Works Act (ODMWA), a topic that David Rees, together with Rodney Ehrlich, wrote about in 2015[1] – a paper that, together with the literature that is referenced, is a 'must read' for anyone interested in compensation for mine workers in South Africa. I would be interested to receive comments from others on the deliberation of trusts versus current legislation, so please write an opinion piece or a letter to the editor, sharing your views.

A successful scientific writing workshop was held in September, and I am pleased to see that some of you have signed up for the next one in November. For those of you who wish to participate, the application forms are available through your Societies. Alternatively, you can contact me directly at gill.nelson@wits.ac.za for more information.

On a final note, we wish Prof. Daan Kocks, president of SASOM and *Occupational Health Southern Africa* editorial board member, a speedy recovery – he has been seriously ill with COVID-19 for several weeks. Prof. Kocks' wisdom, experience and support is highly valued by the *Occupational Health Southern Africa* team. He has been actively and positively involved with the Journal since 1997, and is a constant source of encouragement. Get well soon, Daan!


**REFERENCES**

1. Ehrlich R, Rees D. Reforming miners' lung disease compensation in South Africa – long overdue but what are the options? New Solut. 2016; 25(4):451-468. DOI: 10.1177/1048291115610434.


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# Recommendations for screening tools used as part of COVID-19 health surveillance for health workers

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**Keywords:** decision support tool, electronic screening, symptom questions, numerical score

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Prof Daan Kocks and Dr Carmen Whyte are SASOM members

**Keywords:** decision support tool, electronic screening, symptom questions, numerical score, hazardous biological agent

## ABSTRACT

***Background:*** The coronavirus disease 2019 (COVID-19) pandemic has created the need for electronic screening tools for occupational health surveillance in South Africa. This is to ensure that the surveillance systems pick up symptomatic COVID-19 suspected cases early so that testing can be carried out, and cases isolated expeditiously, to facilitate control of transmission. Electronic screening tools are being used as part of the decision-making process to support referral for testing. The screening tools consist of a brief history and questions about selected signs and symptoms.

***Objective:*** To make recommendations on the choice of signs and symptoms and the numerical score that should be attached to each, in a screening tool.

***Methods:*** A rapid review of open source COVID-19 literature was undertaken to identify commonly reported presenting signs and symptoms of COVID-19 in healthcare workers.

***Results:*** The literature reviewed supported the recommendation that each of the six symptoms of cough, fever, sore throat, shortness of breath, fatigue and myalgia be prioritised in a screening tool, and provided a basis for assigning a predictive numerical score. A numerical score can be allocated to each sign or symptom based on its frequency of occurrence in cases diagnosed with COVID-19, and used in conjunction with personal and occupational risk ratings. The higher the cumulative score, the more likely that a healthcare worker has COVID-19 and requires urgent follow-up for appropriate evaluation and testing.

***Conclusion:*** A screening tool using a scoring system for COVID-19 health surveillance could support persons working in the field of occupational health with decision making on whether to test an employee for COVID-19.

## INTRODUCTION

The number of coronavirus disease (COVID-19) cases continues to rise despite most countries, including South Africa, having reached a peak; some are now experiencing a second wave of the pandemic.[1] As the lockdown regulations are being lifted and the economy is gradually opening, employers need to assess employees daily for symptoms of COVID-19. This is an essential part of addressing the public health crisis of the pandemic under the National State of Disaster.[2] According to the definition of the International Labour Organization (ILO), occupational health surveillance is "the ongoing systematic collection, analysis, interpretation and dissemination of data for the purpose of prevention".[3] Screening of health workers, defined as high-risk workers, as part of surveillance, enables occupational medical practitioners to detect and reduce transmission of disease at an early stage. We know that health workers are a vulnerable group because they work closely with COVID-19 positive patients for long hours at a time, in sometimes poorly resourced settings.[4] In such circumstances, a screening scoring system could assist in the clinical decision-making of non-COVID-19-related symptomology.

Clinical applications have been shown, in other countries, to help in setting up an epidemic prevention system and preventing widespread panic.[5] Some South African workplaces have, as part of their health surveillance for COVID-19, developed electronic or web-based surveillance applications to ensure daily employee self-assessment and reporting of COVID-19 symptoms.[6-8] The main purpose of the application is to identify employees who develop respiratory symptoms to be referred for appropriate evaluation and testing, and to link them up to the occupational health services that have recorded individuals' personal and occupational risks. Employees register on the application and then complete a 'screening' questionnaire daily regarding clinical symptoms such as fever, chills, cough, sore throat, shortness of breath, myalgia/body pains, anosmia, dysgeusia and diarrhoea.

In some workplaces, if an employee reports one or more symptoms, he/she is followed up telephonically by an occupational health practitioner (OHP) or, in prescribed cases such as those with comorbidities, by an occupational medicine practitioner (OMP), for further clinical assessment and verification of symptoms. Once assessed and verified, additional symptoms are recorded and each symptom can be allocated a score; the total screening score is then calculated. The score would generally not be shown to the employee but be used to support follow-up decisions in conjunction with the history and personal risk factors for each individual.

The scoring system applied to health workers aids in deciding who could be advised to seek medical care, who requires follow-up by the OHP/OMP, and who should get tested in view of the limited availability of testing.

Healthcare workers are constantly at risk for COVID-19 because

of their daily exposure to infected patients. They are, however, also exposed to other infectious agents that may cause similar signs and symptoms to those associated with SARS-CoV-2, and it is important that these diseases are differentiated and managed appropriately. If healthcare workers repeatedly present with symptoms that are not COVID-19 related, they may be subjected to multiple unnecessary tests in an already strained testing system. As a rule, an employee with an exposure history or a symptom score above a predetermined value, in conjunction with telephonic clinical assessment, is referred for COVID-19 testing. Those sent for testing receive treatment recommendations and quarantine instructions in line with the latest national guidelines from the National Institute for Communicable Diseases (NICD) of South Africa.[9] Those with a score below the predetermined value are monitored via the COVID-19 application for worsening or resolution of symptoms, and receive relevant advice, if needed, from the OHP or the OMP.

Decision support tools are commonly underpinned by clinical prediction models.[10] Ideally, if a model is used to facilitate decisions, such as whether an employee should be tested for COVID-19 or not, it should be robustly developed and be as accurate as possible. However, in the current urgent context of COVID-19, one can argue that the development of a tool in conjunction with some form of clinical assessment can be made rapidly available to support decision-making. Nevertheless, this should be done on condition that the tools are updated as new evidence arises. In order to evaluate and make recommendations on the choice of signs and symptoms for an application and the numerical score that should be attached to each, evidence needs to be garnered from proven cases of COVID-19.

## METHODS

A rapid review of open source COVID-19 literature, published from 1 December 2019 to 22 April 2020, was undertaken to identify commonly reported presenting signs and symptoms of COVID-19. For ease of access to COVID-19 articles, Google Scholar has provided links to a collection of journals with open access to the COVID-19 literature produced to date. Studies that described the presenting symptoms of confirmed COVID-19 cases were reviewed. Using the links on Google Scholar, the following were searched: The New England Journal of Medicine, the Journal of the American Medical Association, The Lancet, the British Medical Journal, Nature Coronavirus Collection; Elsevier

**Table 1. Summary of signs and symptoms reported in reviewed studies**

| | Study (first author, year) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Guan, 2020[11] | Bhatraju, 2020[12] | Zhou, 2020[13] | Chang, 2020[14] | Wang, 2020[15] | Arentz, 2020[16] | Spellberg, 2020[17] | Wu, 2020[18] | Chow, 2020[19] | Xu, 2020[20] | Chen, 2020[21] | Burrer, 2020[22] | |
| Sample size | 1 099 | 24 | 191 | 18 | 138 | 21 | 7 | 38 | 48 | 62 | 274 | 4 707 | |
| Weight (%) | 16.6 | 0.40 | 2.9 | 0.3 | 2.1 | 0.3 | 0.1 | 0.6 | 0.7 | 0.9 | 4.1 | 71.0 | |
| Setting | Hospital | ICU | Hospital | Hospital | Hospital | ICU | Community | Hospital | Community | Hospital | Hospital | Hospital and community | |
| Country | China | USA | China | Singapore | China | USA | USA | China | USA | China | China | USA | |
| Symptom (%) | | | | | | | | | | | | | Weighted average |
| Cough | 67.8 | 88.0 | 79.0 | 83.0 | 59.4 | 47.6 | 14.3 | 0.0 | 50.0 | 81.0 | 68.0 | 78.0 | 74.9 |
| Fever | 88.7 | 50.0 | 94.0 | 72.0 | 98.6 | 52.4 | 85.7 | 0.0 | 41.7 | 77.0 | 91.0 | 68.0 | 73.2 |
| Fatigue | 0.0 | 0.0 | 23.0 | 0.0 | 69.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 50.0 | 68.0 | 52.5 |
| Headache | 0.0 | 0.0 | 0.0 | 0.0 | 6.5 | 0.0 | 0.0 | 0.0 | 16.7 | 34.0 | 11.0 | 65.0 | 47.2 |
| Shortness of breath | 0.0 | 0.0 | 0.0 | 11.0 | 31.2 | 76.0 | 0.0 | 0.0 | 10.4 | 3.0 | 44.0 | 41.0 | 32.0 |
| Sore throat | 0.0 | 0.0 | 0.0 | 11.0 | 17.4 | 0.0 | 0.0 | 0.0 | 14.6 | 0.0 | 12.0 | 38.0 | 28.0 |
| Diarrhoea | 3.8 | 0.0 | 5.0 | 3.0 | 10.1 | 0.0 | 0.0 | 0.0 | 6.3 | 8.0 | 28.0 | 32.0 | 25.0 |
| Nausea and vomiting | 5.0 | 0.0 | 5.0 | 0.0 | 10.1 | 0.0 | 0.0 | 0.0 | 2.1 | 0.0 | 9.0 | 20.0 | 15.8 |
| Loss of smell or taste | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.0 | 11.4 |
| Abdominal pain | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 7.0 | 13.0 | 9.5 |
| Rhinorrhoea | 0.0 | 0.0 | 0.0 | 0.0 | 9.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 12.0 | 8.7 |
| Myalgia | 0.0 | 0.0 | 15.0 | 0.0 | 34.8 | 0.0 | 71.4 | 0.0 | 35.0 | 52.0 | 22.0 | 0.0 | 2.9 |
| Anorexia | 0.0 | 0.0 | 0.0 | 0.0 | 39.9 | 0.0 | 0.0 | 0.0 | 2.1 | 0.0 | 24.0 | 0.0 | 1.8 |
| Dizziness | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 8.0 | 0.0 | 0.3 |
| Conjunctivitis | 0.0 | 0.0 | 0.0 | 6.0 | 0.0 | 0.0 | 0.0 | 31.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 |
| Haemoptysis | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 0.0 | 0.1 |
| Chills | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 14.6 | 0.0 | 0.0 | 0.0 | 0.1 |
| Nasal congestion | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 12.5 | 0.0 | 0.0 | 0.0 | 0.1 |
| Hoarseness | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.2 | 0.0 | 0.0 | 0.0 | 0.03 |

Novel Coronavirus Information Center, and Oxford University Press. We included both published articles and research letters in our review, but only included those articles that reported on presenting signs and symptoms of COVID-19 in their results.

The sample sizes used in the studies that we included varied greatly. To determine the most common symptoms, we calculated the weighted average of each symptom from the different studies. First, the weight of each study was calculated by dividing the sample size by the sum of the sample sizes in all the studies. The weighted average for each symptom was then calculated by multiplying the percentage of participants in each study with that symptom by the weight of the study, then adding up all these products and dividing the sum of the products by the sum of the weights of all the studies. The formula used was: weighted average $\sum_{i=1}^{n} X_i W_i / \sum_{i=1}^{n} W_i$, where $X_i$ represents the symptom (%) and $W_i$ represents the weight (%).

## RESULTS

More than 300 articles and research letters were evaluated; 12 articles and research letters where included in the final review. The limitations of most of these studies included small sample sizes, inconsistent signs and symptoms, and short study timeframes.

Table 1 summarises the findings from the publications that were reviewed. The different studies reported a range of one to 16 presenting symptoms; 22 different symptoms were identified.[11-22] Only 19 of the symptoms are included in the table. The omitted symptoms were dry cough, sputum production or expectoration, which can be considered as a variation of cough, and tightness of chest, which can be viewed as shortness of breath.

The sample sizes in the studies ranged from six to 4 707; the largest study was conducted in the USA.[17,22] Cough (74.9%) was the most common symptom, followed by fever (73.2%), fatigue (52.5%), headache, (47.2%), shortness of breath (32.0%), and sore throat (28.0%). Loss of taste and/or smell occurred in 11.4% of the participants but it is important to consider as it is more specific for upper respiratory symptoms than are headache, diarrhoea, and nausea and vomiting, although all these symptoms were found to occur more frequently.

An interesting symptom that was reported in only one of the 12 studies was conjunctivitis.[18] In that study, one-third (12 of 38) of patients with COVID-19 had ocular manifestations consistent with conjunctivitis or increased secretions, which frequently occurred in patients with more severe COVID-19.[18]

## DISCUSSION

According to the South African Occupational Health and Safety Act, 1993, Regulations for Hazardous Biological Agents,[23] SARS-CoV-2 can be classified as a group 4 hazardous biological agent (HBA), thus necessitating rapid, innovative approaches to health surveillance. From the largest study reviewed, which included reports of symptoms from 4 707 cases, 92% of those who tested positive for COVID-19 had fever, cough, or shortness of breath.[22] The remaining 8% did not report any of these symptoms and, if not tested because they did not present with the three most common symptoms, they could have unknowingly spread the virus in their workplaces.[22] Important to note is that four of the six studies from China [11,13,15,21] consistently reported fever as the most common symptom, compared to two of five from the USA.[16,17] The prominence of fever as a symptom in China might be because self-temperature monitoring was more widespread in the Chinese community and therefore more commonly reported. The less frequent symptoms should not be ignored. The significance of the report that a third of patients with COVID-19 had conjunctivitis is to avoid overlooking conjunctivitis as a symptom.[18] Furthermore, although only two patients (5.2%) tested positive for COVID-19 from a conjunctival swab in the study, it shows that it is possible to transmit the virus via ocular secretions.[11,18] The limitations of most of the studies included in the review encompassed small sample sizes, inconsistent signs and symptoms, and short study timeframes. Consequently, symptoms may be underestimated as being atypical since, for this report, the calculations for the most common symptoms were based on a weighted average of each study.

This rapid review suggests that it is important for anyone developing a screening tool scoring system to consider giving a high score for each of the six most common symptoms that necessitate testing. In other words, any employee who presents with one of the six symptoms of cough, fever, sore throat, shortness of breath, fatigue or myalgia should be sent for testing. This is especially important for 'frontline workers' who are at a much higher occupational risk for COVID-19 than the general public, particularly if they have personal risk factors e.g. comorbidities. By including a wider range of signs and symptoms in the scoring system, fewer cases would be missed.

A scoring system was developed from the findings of the rapid review, as shown in Table 2. This scoring system will ensure that the surveillance screening tool is sufficiently sensitive. Since South African health workers have an ongoing likelihood of exposure to patients with COVID-19, it would be prudent to monitor and test as many symptomatic workers as possible.

The need for a highly sensitive screening tool was well demonstrated in the USA study from King County, Washington, in which they assessed a screening tool that included only fever and respiratory symptoms (cough, shortness of breath, or sore throat), with clinical discretion for evaluation for other symptoms (e.g. myalgia).[19] If the worker had any of the respiratory symptoms or fever, he/she qualified for testing. Screening for only fever, cough, shortness of breath, or sore throat might have resulted in 17% of symptomatic workers not being identified at the time of illness onset. Expanding the criteria for symptom screening to include myalgia and chills may still have missed 10%.[19]

There is sufficient evidence that increasing age and comorbidity are associated with a higher prevalence of severe outcomes.[22] Therefore it will be important, in addition to the scoring system, to consider the age and presence of comorbid conditions of the employee, as well as

**Table 2. Suggested scoring system**

| Symptom | Score |
|---|---|
| Cough | 5 |
| Fever | 5 |
| Fatigue | 5 |
| Shortness of breath | 5 |
| Sore throat | 5 |
| Loss of smell or taste | 5 |
| Headache* | 3 |
| Diarrhoea | 2 |
| Nausea and Vomiting | 2 |
| Abdominal pain | 2 |
| Rhinorrhoea | 2 |
| Conjunctivitis | 2 |
| Any other upper respiratory symptoms | 5 |

** A score of 5 or more requires referral for clinical evaluation*

the degree of occupational risk and exposure history to aid the decision of whether or not to prioritise testing.

Most electronic screening questionnaires are yes or no answers and do not quantify the likelihood of infection. The proposed tool provides a numerical value in the form of a score that highlights, to the practitioner, the urgency to respond and prioritise screening. Infected health workers present a hazard to their colleagues and patients; thus, screening is carried out to protect others, as well as to identify the support needed for medical diagnostic follow-up and employee fitness definition. Workplace screening for health workers offers better access to testing than non-health workplaces because tests from health workers are prioritised at all laboratories throughout the country. The screening tool should be evaluated by using it concurrently with a strategy of testing all symptomatic health workers to validate and estimate the sensitivity of the tool, so that the tool could be considered for use later to decide who should be tested or not.

Ultimately, the most effective screening tool for testing is one that promotes a healthy, COVID-19-free workforce and reduces transmission, as every worker is an asset to the prolonged response to the COVID-19 crisis.[24]

## CONCLUSION

A screening tool scoring system for COVID-19 disease surveillance needs to ensure that an employee presenting with any one of the six symptoms of cough, fever, sore throat, shortness of breath, fatigue or myalgia is referred for evaluation and testing for COVID-19. At the least, the scoring system for testing should be in line with the most current South African person under investigation (PUI) definition, and should be updated as new evidence comes to light. Although a screening tool with a scoring system is important in view of the limited access to testing, for some workplaces, such as the healthcare industry, universal testing for all healthcare workers might be the ideal but is not always possible. With COVID-19, a remaining problem both for occupational and public health is the asymptomatic cases which symptom screening cannot currently identify.

## 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: EBM, DJK, CW
Data acquisition: EBM
Data analysis: EBM
Interpretation of the data: EBM, DJK, CW
Drafting of the paper: EBM
Critical revision of the paper: DJK, CW

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# An analysis of COVID-19 cases and deaths in the South African mining industry

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## INTRODUCTION

On 31 December 2019, the World Health Organization (WHO) China Country Office was informed of cases of pneumonia of unknown etiology (unknown cause) detected in Wuhan City, Hubei province of China.[1] The WHO would later choose the official name of COVID-19 (coronavirus disease 2019) for the disease, and the term SARS–CoV-2 (severe acute respiratory syndrome coronavirus 2) for the virus.[2] The WHO declared COVID-19 as a global pandemic on 11 March and Dr Tedros Adhanom Ghebreyesus, WHO director-general, was quoted as saying, "This is not just a public health crisis, it is a crisis that will touch every sector… so every sector and every individual must be involved in the fight."[3]

The first case of the disease was detected in South Africa on 5 March 2020. By then, the Minerals Council South Africa had proactively distributed material for utilisation by companies, for the prevention, managment and mitigation of COVID-19. Following the national lockdown declared in South Africa on 26 March 2020, the Disaster Regulations were amended on 16 April 2020 to allow most of the mining industry to function at 50% capacity. The industry thus recalled employees that had been sent home ahead of the national lockdown.[4] The Minerals Council identified research as an important activity to understand this novel disease and its impact on the mining industry. The research was conducted by The Aurum Institute and was an analysis of COVID-19 cases reported in the industry until 31 July 2020. A summary of the findings is presented in this article.

## METHODS

Daily statistics on screening and testing, as well as basic demographic, test results and outcome data on all COVID-19 cases identified, were captured in the Minerals Council's Occupational Health Reporting System, hosted on Healthsource. Mining companies were required to report cases and deaths due to SARS-CoV-2 on a daily basis. Data from the first reported case on 21 March to 31 July 2020 were analysed. Summary statistics of indicators for mine employees were calculated. The denominator for statistics presented was the total number of workers called back to work. Cumulative incidence was calculated for employees who tested positive among all employees who returned.

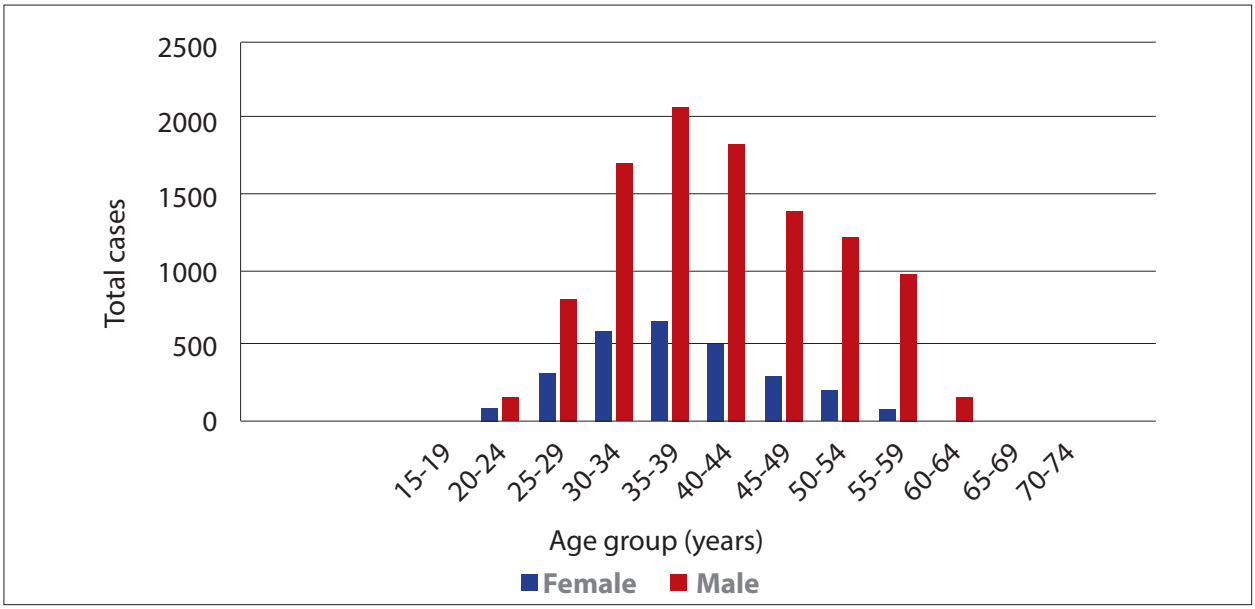


**Figure 1. COVID-19 cases by age and sex in mining companies, 21 March to 31 July 2020**

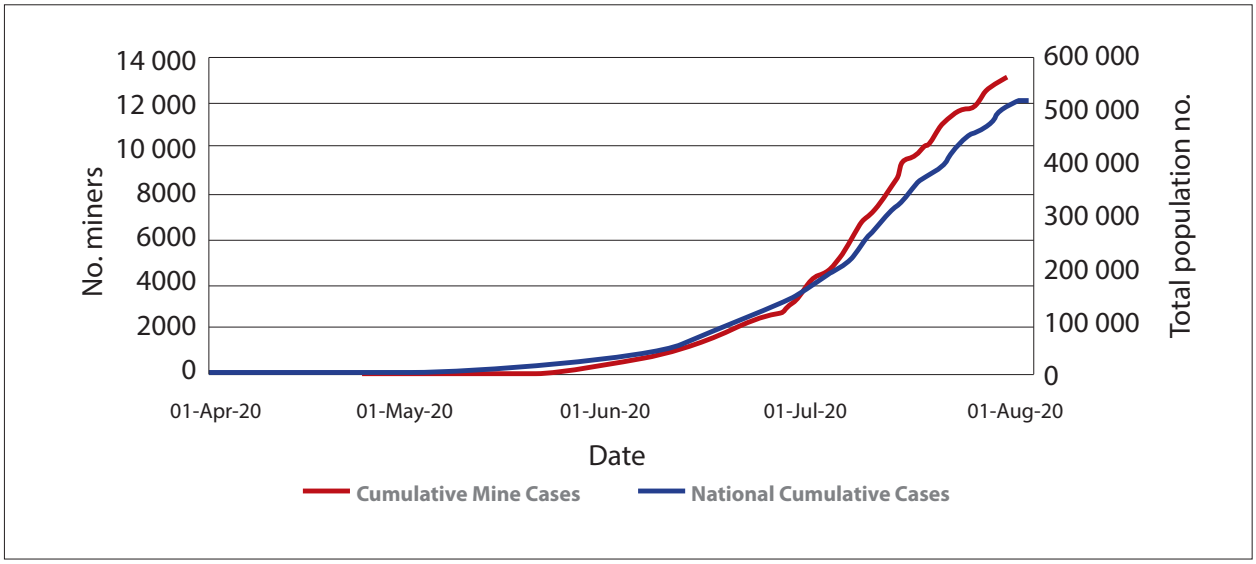


**Figure 2. National and mine COVID-19 daily cumulative trends**

Case fatality rates were calculated among confirmed cases and those with outcomes. We compared the mining testing rates, cumulative incidence and case fatality rates with the total population rates (which included mine employees) presented per province as per the National Institute of Communicable Diseases (NICD) weekly report of 1 August 2020.[5] Cumulative incidence for each sex was calculated, using 2019 estimates of sex breakdown for the Minerals Council-associated mining companies. We calculated the death rate among those with a known outcome, and compared that with the death rate of the South African population.

## RESULTS

Table 1 shows the summary of the key statistics. By July 2020, 75.1% of all employees were back at work and 98.8% had been screened for COVID-19. There had been 36 032 tests (11.2% of the workforce). Of those tested, 10 425 had tested positive (28.9%) and 9 226 (88.5%) had an outcome. The testing rate in the mining sector was approximately 40 times higher than that in the South African general population; cumulative incidence was almost four times higher.

Figure 1 shows the breakdown of cases by age and sex. Most cases occurred in the 30-44 years age groups, in both males and females.

Trends in the numbers of miners who tested positive, on a daily basis, were similar to the national trends (Figure 2).

The number of deaths accumulated steadily from June (Figure 3). As of 31 July 2020, a total of 111 deaths out of 9 226 cases with a known outcome were reported by the mines as being related to COVID-19; a case fatality ratio of 1.2%. In comparison, during the same period, South Africa reported 511 484 cases and 8 366 deaths; a case fatality ratio of 1.6%.

**Table 1. Key COVID-19 statistics as on 31 July 2020**

| Indicator | n | % |
|---|---|---|
| Total employees* | 435 474 | |
| Employees back at work | 327 100 | 75.1 |
| Employees screened | 323 058 | 98.8 |
| Employees tested | 36 032 | 11.2 |
| Employees COVID-19 positive | 10 425 | 28.9 |
| COVID-19 positive employees with outcome | 9 226 | 88.5 |
| **Testing rate (per 100 000 population)** | | |
| Mining industry | 11 015 | |
| SA general population** | 273.5 | |
| **Cumulative incidence (per 1 000 population)** | | |
| Mining industry | 32.3 | |
| SA general population** | 8.7 | |
| **Total number of deaths** | | |
| Mining industry | 111 | |
| SA general population** | 8 366 | |

**Minerals Council South Africa-associated mining companies **NICD Report, 1 August 20205*

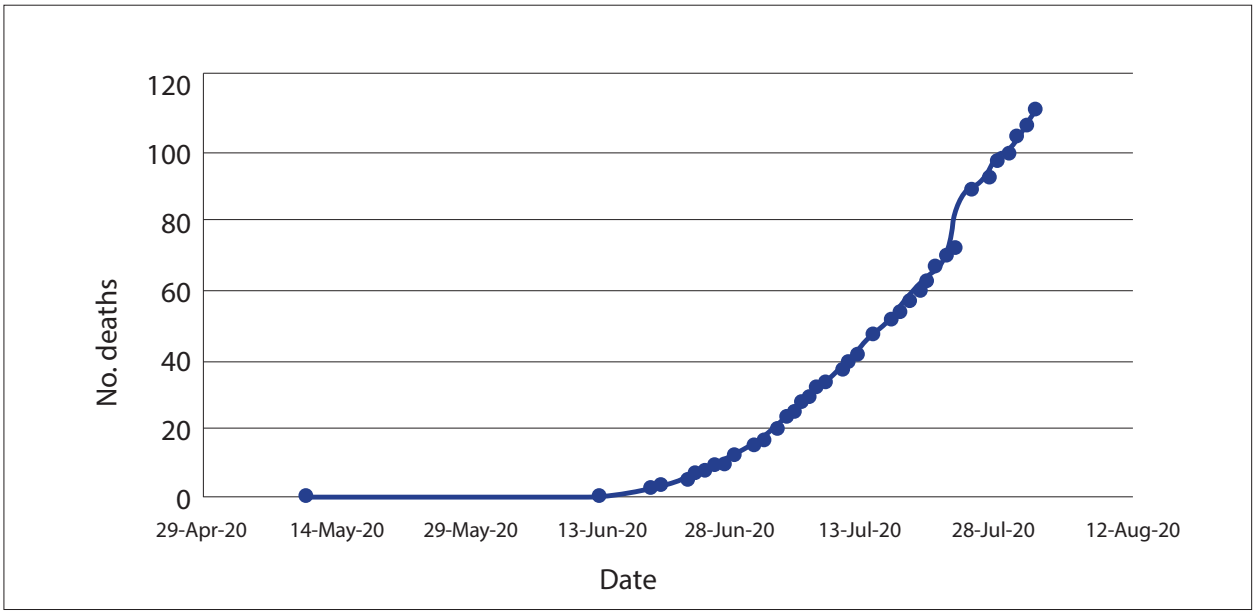


**Figure 3. Cumulative deaths related to COVID-19 in South African mines**

## CONCLUSION

The testing rate in the mining sector was approximately 40 times higher than that in the South African general population from 5 March to 31 July 2020, while cumulative incidence was almost four times higher by 31 July 2020. It is possible that this was driven by the higher testing rates. The case fatality rate appeared lower among miners than the general population, but this is probably driven by low numbers in the > 60-year age category as this is a working population. Continued and more in-depth surveillance, with knowledge of background population and risk factors, will enable a more robust understanding of the situation.

## 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.

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# Critical perspectives on trusts as a compensation option for occupational diseases in South Africa

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## ABSTRACT

The purpose of this article is to argue that trusts are not a panacea for the problem of funding compensation for diseases, contrary to the popular view that these institutions represent justice for victims of disease. Drawing from local and American experience, we argue that, in addition to the inability to internalise social costs or externalities that occupational disease generates, trusts are vulnerable to other internal and external problems, ranging from lack of a clear deterrence framework to political interference. Furthermore, we argue that trusts offer no new insights in the provision of compensation to victims of long-latency diseases beyond the workers' compensation system. Consequently, we conclude that the growing faith placed in trusts in South Africa lacks empirical support from other regions of the world. On the contrary, there are persuasive reasons to question their desirability as a compensation mechanism for diseases.

## INTRODUCTION

Trusts are fast becoming a method of choice for settling claims for occupational diseases in the South African mining industry. Since the early 2000s, four trusts have emerged for this purpose, namely: the Asbestos Relief Trust (2003), the Kgalagadi Relief Trust (2006), the Q(h)ubeka Trust (2016), and the Tshiamiso Trust (2019). The Asbestos Relief and Kgalagadi Relief Trusts provide compensation for asbestos-related claims, while the Q(h)ubeka and Tshiamiso Trusts cater for claims related to silicosis and tuberculosis. In terms of capital amounts available, the Tshiamiso Trust is by far the largest, with an amount of R5 billion, followed by the Q(h)ubeka Trust with R464 million. These trusts operate alongside the workers' compensation system for diseases in mines that was established in 1894.[1]

The introduction of trusts in the mining industry attracted positive reviews from various commentators. Some have described the development as a culmination of justice for mine workers, while others see trusts as an efficient way to handle occupational disease claims.[2] In this article, we challenge some of these perspectives. There are reasons to suggest that trusts for settling occupational disease claims suffer from deficiencies of their own. Apart from the United States of America (US), it is difficult to find any other country that relies on trusts to compensate victims of occupational disease. This is an important signal about the lack of global appeal of these institutions. Diseases have a long history in the South African mines, spanning over a century, yet trusts did not feature as a compensation option until the early 2000s.

In this article, we highlight five problem areas of trusts as a compensation option for occupational diseases. Using evidence from South Africa and the US, we question the desirability of trusts in respect of their ability to: i) internalise social costs or externalities, ii) eliminate uncertainty, iii) minimise the problem of outside interference, including political interference, iv) promote transparency, and v) create incentives for disease prevention (deterrence). We conclude that, despite its administrative challenges, the workers' compensation system should remain the main pillar for occupational disease compensation in South Africa.

## BRIEF HISTORY OF BODILY INJURY TRUSTS IN SOUTH AFRICA AND THE USA

Trusts for settling claims for mining-related diseases first appeared in the South African compensation system in the early 2000s, following a complex asbestos lawsuit against Cape Plc in London that began in 1997.[3] About 7 500 ex-miners from South Africa sued Cape Plc for illness arising from exposure to asbestos. It soon became clear that Cape Plc was in a bad financial state, bringing into question its ability to satisfy the judgement if found liable. In 2002, the London High Court agreed to the inclusion in the litigation of Gencor Limited,[3] a South African company. A year later, Cape Plc and Gencor Limited agreed to two separate settlements, leading to the creation of two trusts, the main one being the R400 million Asbestos Relief Trust.[2] In 2006, the Swiss Eternit Group agreed to another asbestos claim settlement, leading to the establishment of the Kgalagadi Relief Trust with a capital amount of R136 million. March 2016 saw the formation of the Q(h)ubeka Trust to compensate silicosis and other lung disease claimants from South Africa, Lesotho and Swaziland. This trust has two financiers – AngloGold Ashanti Limited and Anglo American South Africa. Between them, they paid R464 million without admitting liability.[4] Finally, in July 2019, the High Court approved a R5 billion settlement, leading to the establishment the Tshiamiso Trust – by far the largest trust to date in capital terms. Its purpose is to compensate silicosis and pulmonary tuberculosis claimants employed in the mining industry from March 1965 onwards.[5] Tshiamiso has six financiers, all from the gold mining sector,

namely: African Rainbow Minerals, AngloGold Ashanti Limited, Anglo American South Africa, Gold Fields, Harmony Gold, and Sibanye Stillwater.[5]

In the USA, bodily injury trusts date back to 1968 when the first asbestos-disease lawsuit against Manville Corporation began.[6] Thousands of claimants sued the corporation for exposure to asbestos. At the time, Manville was a world leader in the supply of asbestos products.[7,8] Confronted by future asbestos claims in excess of its net worth, Manville filed for bankruptcy under Chapter 11 of the Bankruptcy Reform Act of 1978.[8] This resulted in the formation of a US$ 2.5 billion trust fund to compensate claimants. Another leading US asbestos firm forced into a bankruptcy filing and the formation of a trust was Keene Corporation. Litigation against the company started in the 1970s with a solution emerging only in 1996, through the establishment of the Keene Creditors' Trust.[7] Subsequent to these developments, asbestos trusts increased dramatically across the USA. Their main advocates are plaintiff lawyers who, in most cases, also run the trusts. There are many trusts in the USA with billions of dollars in assets – a majority of which were formed by companies that filed for bankruptcy.[8] However, many studies point to their numerous shortcomings and the need for reform.[6,7,9,10] Among these US studies, success stories associated with trusts are virtually non-existent.

There are three important similarities between US asbestos trusts and those emerging in South Africa, making the USA a useful point of reference. First, both cover diseases with long latencies. In the USA, trusts cover various medical conditions arising from primary and secondary asbestos exposure while, in South Africa, trusts seek to pay compensation primarily for mesothelioma, silicosis, and pulmonary tuberculosis. Close to 50% of asbestos claims filed in the US since the early 2000s were from people with little or no physical impairment, the so-called 'unimpaired lives'.[10,11] Second, both US and South African trusts cover mass claims. In the USA, it is estimated that at least 27 million people were exposed to asbestos.[8] In South Africa, the number of people with silicosis is unknown. However, researchers agree that the number is high since potential claimants are from the entire southern African region because of the migrant labour system.[12] Silicosis and tuberculosis rates in South African gold mines rank among the highest in the world.[13] Finally, both US and local trusts have litigation or threats thereof as a precursor. Asbestos trusts across the US are products of the asbestos litigation floodgates that opened in the 1970s. In South Africa, the Cape Plc/Gencor litigation, and the class action suits certified after the 2011 Constitutional Court judgment in the Mankayi[14] litigation, led to the establishment of the trusts seen today.

## CRITICAL APPRAISAL OF TRUSTS AS A COMPENSATION MECHANISM

For almost 100 years, since the early 1900s, South Africa has relied on workers' compensation as the sole and exclusive remedy for victims of occupational diseases. However, since 2000, trusts have emerged as the main option for the same purpose. There is a dearth of local literature on this development. Nevertheless, those who have written on this subject to date, whether from an academic, media or social activist standpoint, applaud the development as positive.[2] Words such as 'justice' and 'victory' often feature in the media, with reference to the Q(h)ubeka and Tshiamiso Trusts.[15] However, there are important aspects about trusts that cast doubt on these perspectives. Those aspects have significant implications for policy and practice when designing a compensation system.

Commercial activities impose externalities or social costs on third parties outside the voluntary mechanism of the market place.[16] In the mining industry, diseases like silicosis and pulmonary tuberculosis are a prime example of such social costs. Apart from affecting the stricken workers, these diseases also affect family members, co-workers and the healthcare system in ways that are impossible to measure.[17] An effective way to handle these social costs is to internalise them, thereby ensuring that the party responsible for generating the cost pays for it. Experience-rated workers' compensation schemes attempt to achieve this objective by ensuring that levies that each employer pays reflect the incidence of disease that they generate. By trying to link levies to claims, workers' compensation converts (or internalises) compensation for diseases into a cost of production. Trusts fall short on this theoretical but fundamental economic principle. All the trusts formed to pay sick miners came into being because the companies funding them had no interest in pursuing protracted litigation. There is no basis for linking what each company pays into the trust to its degree of culpability because that aspect remains unknown. Furthermore, trusts seek to pay compensation for diseases for which causal factors date back to the 1960s. The shareholding structures of most of the defendant companies have changed significantly over the years, implying that shareholders bearing the burden of this liability today may not be the ones that created the risk in the first place.

Economic agents value certainty and predictability of their operating environments. Apart from complicating decision-making, uncertainty affects businesses in ways that are difficult to quantify. This partly explains why workers' compensation replaced common law liability of employers in the early 1900s. Common law liability creates uncertainty for employers and injured employees alike. Employers are uncertain about how many lawsuits they may face, and their cost. Likewise, employees are uncertain about their prospects of getting compensation. Workers' compensation eliminates uncertainty for both parties. Trusts, on the other hand, rely on incomplete information to quantify claims and estimate the amount of money required. It is impossible to know *ex ante* the exact number of claimants. In the case of an underestimation, future claimants risk missing out completely.[11] Overestimation of claims brings problems of a different kind. Either way, it is debatable if this constitutes an efficient application of resources. Efficiency denotes the application or utilisation of resources in the best way possible.[18]

Trusts are also vulnerable to political interference. The Asbestos Relief Trust provides illustrative insights. On at least two occasions in 2012, officials from the Department of Mineral Resources requested trustees of the Asbestos Relief Trust to pay R30 million *ex gratia* to people who were not sick and therefore did not qualify for compensation (ART annual report 2013).[18] This request had the support of the premier of the Northern Cape. The reason for the request was that the people concerned had supported the class action that led to the creation of the trust. To their credit, trustees declined to accede to the request. On 5 August 2013, the chief master of the High Court appointed two additional trustees to the board, presumably to pacify community activists. In the event, the payment of the R30 million to people who did not qualify did not materialise. That notwithstanding, the developments are disturbing. Trusts are supposed to enjoy autonomy. Even more worrisome is the effect of such interference on

the prospects of future claimants to get compensation, if the request to pay the R30 million had succeeded.

Trusts also raise concerns with regard to transparency. On this point, developments on asbestos trusts in the USA are insightful. Two issues are noteworthy. First is the issue of inaccurate information placed before courts to justify the creation of large trust funds. Second is the issue of monitoring and supervising trusts. In January 2014, plaintiff lawyers in North Carolina argued in court that a defendant company, Garlock Sealing Technologies, should pay US$ 1.4 billion into a trust for compensating victims of asbestos.[20] Judge George Hodges of the Western District found the claims to be grossly overstated, aided by suppression of evidence favouring the defendant company. The judge observed that the higher amounts "are infected with the impropriety of some law firms and inflated by the cost of defense".[20] He found that plaintiff lawyers had hidden evidence and not disclosed other claims filed on behalf of the same claimants in other cases. Accordingly, the judge reduced the amount from US$ 1.4 billion to US$ 125 million.[20]

Refusal by asbestos trusts to share information has been a concern in the USA for a long time. In November 2013, the House of Representatives passed the Furthering Asbestos Claim Transparency (FACT) Bill.[21] It requires asbestos trusts to lodge comprehensive quarterly reports with the Executive Office of US Trusts on claims, from receipt to resolution. The Bill was renamed Fairness in Class Action Litigation and Furthering Asbestos Claim Transparency Act in 2016.[21] Among other things, the law seeks to protect asbestos trusts against fraudulent claims by ensuring that only deserving people receive compensation. Therefore, trusts require adequate supervision to ensure transparency.

Finally, an efficient compensation system seeks to achieve two main objectives. The first objective is to determine who should pay compensation. The second is to create incentives for disease-prevention (deterrence).[22,23] A balance between effective incentives for disease prevention (*ex ante* efficiency) and providing compensation that is realistic (*ex post* efficiency) is therefore important.[22] Incentives are critical in shaping how economic agents behave in the market. Experience or risk rating the compensation system are common methods suggested in literature to achieve deterrence.[19,24] However, evidence on the effectiveness of these measures is mixed. In 1998, The Netherlands reformed its disability insurance system to make levies that employers pay dependent on the accident rates. After this reform, accident rates dropped.[24] South African workers' compensation legislation also acknowledges the role of employer-targeted incentives in the reduction of occupational injuries and diseases.[25,26] However, other studies have found that experience rating in compensation systems has a limited or moderate effect on deterrence.[26] South African trusts for disease compensation are products of litigation or threats thereof. None of the companies funding them admitted liability for any disease, and disease prevention does not feature in the settlement framework for trusts. Even under the admission that deterrence under workers' compensation is moderate, trusts fare much worse in that respect. Their focus is payment of claims.

Notwithstanding the foregoing, it is important to note two additional points. We argue that workers' compensation should remain the cornerstone of the South African compensation system because of its strong theoretical appeal compared to trusts. However, it is important to acknowledge that there are problems in both the workers' compensation for general industry as well as that for the mining industry.[26,28] The problems are both administrative and structural. Most of the administrative problems require nothing more than political will to address them. Even some of the structural ones, such as fragmentation of the entire compensation system, also point towards political will for solutions. A second point worth noting is the dearth of empirical evidence on the performance of South African occupational disease trusts. This is not surprising given the recent origin of these institutions in South Africa. The two biggest trusts, Q(h)ubeka and Tshiamiso, date back to 2016 and 2019, respectively. In addition, most occupational diseases in mining such as asbestosis, silicosis and mesothelioma have long latency periods, some spanning decades.[29] Therefore, it will take time for empirical patterns to emerge regarding the performance of these trusts. Accordingly, 10 years after its formation, the Asbestos Relief Trust, which is by far the oldest, still had R305 443 879 available for distribution or 76% of the amount paid into the trust at its formation.[18]

## CONCLUSION

Trusts as a compensation option for diseases in South African mines are gaining popularity. Amidst this rise in popularity is growing optimism that they represent justice, improved access to compensation, and improved efficiency. We provide a contrary perspective to these notions by highlighting the theoretical and practical shortcomings of trusts. From an economic theory perspective, trusts do not spread the cost of disease optimally. In addition, they provide no framework for building incentives for employers to invest in disease prevention. Despite the mixed evidence on the effectiveness of deterrence in workers' compensation systems, trusts fare even worse in that respect. From a practical standpoint, trusts are also problematic. They are vulnerable to the principal-agent problem and to manipulation by public officials. Additionally, trusts require a well-functioning monitoring system as evidence from the US suggests. Not surprisingly, not many countries use trusts as a model for compensating victims of long-latency occupational disease. That must count for something.

## 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.

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# A regional response to tuberculosis amid COVID-19 in southern Africa: Towards eliminating silicosis and ending tuberculosis by 2030

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## BACKGROUND

Tuberculosis (TB), caused by *Mycobacterium tuberculosis* (MTB), is one of the oldest known communicable diseases, dating back more than three million years.[1] It has always been associated with high morbidity and mortality rates and is one of the top 10 causes of deaths, and the leading cause of death from a single infectious agent, currently ranked above HIV/AIDS.[1] TB is responsible for 1.5 million deaths globally per year, including 251 000 in people with HIV.[2] Approximately 24% of the global cases of TB in 2018 were from the World Health Organization (WHO) Africa region – ranked second after south-east Asia at 44%.[2] Over the centuries, TB was known by many different names, such as *phthisis* in Greece, *schachepheth* in biblical times, the king's evil in England and France, and white plague in the 18th century. Later, TB was called 'captain of all these men of death' because of its epidemic proportions in Europe and North America, being the cause of one in four deaths.[1] Hippocrates described *phthisis* as a fatal disease, especially for young adults.

Currently, of the 10 million new cases in a year, about 5.7 million are men, 3.2 million are women, and 1.1 million are children.[2] Many studies provide evidence that TB mostly affects adults in their most productive years.[1,2] Tuberculosis does not respect age, race, nationality, borders, or health status; the key qualifying criterion for a person to contract TB is breathing, the route of transmission.

Exposure to silica-containing dust can result in silicosis which is a risk factor for tuberculosis.[3] Despite compelling evidence that silicosis increases the risk of contracting TB, little effort has been made to curb exposure to silica-containing dust in most workplaces. Unlike coronavirus disease 2019 (COVID-19), there are effective TB prevention, treatment and vaccination programmes for children. Bacillus Calmette-Guérin (BCG) vaccine that protects against the severe form of TB in children is also suspected to contribute to the protection of children against COVID-19.[2,4]

COVID-19 is a highly infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). As of 21 September 2020, there were 31 243 024 confirmed cases in the world, 965 097 deaths and 22 835 563 recoveries.[5] In Africa, the number of confirmed cases stood at 1 405 783; there were 33 917 reported deaths and 1 152 155 recoveries.[5] The global and Africa region COVID-19 death rates were 4% and 2.4%, respectively.[6] Africa has reported a higher recovery rate than other countries, although the southern African region is a hub for both COVID-19 and TB.

## IMPACT OF COVID-19 PANDEMIC ON TB INTERVENTIONS IN THE WORKPLACE

The overwhelming response to COVID-19 led to TB care interventions being sidelined in most countries. There were huge COVID-19 awareness interventions, research, development of guidelines on quarantine and isolation, and provisions of personal protective equipment (PPE). Many governments activated their disaster management laws, resulting in massive screening and closures of borders. Consequently, many countries' resources for addressing TB and occupational lung diseases were diverted to COVID-19.

The Stop TB Partnership estimated that, as of 28 August 2020, the percentages of TB cases and deaths in all the Global Fund TB-, malaria-, and HIV-eligible countries in the Africa region were higher than that of COVID-19 (Table 1). Chopra et al. (2020)[7] noted that any interventions that focus on COVID-19 while overlooking TB challenges will be detrimental in the future. A three-month lockdown can lead to a 25% decline in TB detection, which can result in a 13% global increase in TB death rates.[8] Preliminary reports from countries severely affected by COVID-19 show a sharp decline in TB notifications, interruptions in services, and diminished quality of service provision.[9] This will be a catastrophe for TB interventions and progress, and the TB mortality rate will regress. The world could register an additional 1.4 million deaths, at least, as a result of the COVID-19 pandemic and then we could be back to the TB death rate experienced in 2012.[8,10] This estimated number will be worse if the silica dust reduction interventions aimed at curbing silicosis in the workplace are disrupted as a result of the pandemic. This will indeed waste all the investments that member states have made towards ending TB.

## REGIONAL RESPONSE TO TB

In response to global and regional targets, the Southern Africa Development Community (SADC) member states are intensifying their fights against TB, although the momentum has been decelerated by the COVID-19 pandemic. The efforts are in response to targets set in the African Union (AU) Catalytic Framework to end AIDS, TB and Malaria by 2030,[13] the SADC protocol on health,[14] the SADC protocol on employment and labour,[15] and the SADC Declaration on TB in the Mining Sector.[16] The interventions further contribute to the achievement of Goal 3 of the Sustainable Development Goals on good health and wellbeing;[17] the ILO/WHO Global Programme for the Elimination of Silicosis (GPES) by 2030; the United Nations High-Level Meeting declaration to end TB, through implementing primary prevention

**Table 1. TB and COVID-19 cases and deaths from Global Fund-eligible countries,[11] as of 28 August 2020[12]**

| | Disease | Cases (n) | Deaths (n) | Death rate (%) |
|---|---|---|---|---|
| **Globally** | COVID-19 | 7 438 464 | 171 791 | 2.3 |
| | Tuberculosis | 5 762 987 | 934 306 | 16.2 |
| **WHO Africa region** | COVID-19 | 1 028 374 | 21 236 | 2.1 |
| | Tuberculosis | 1 618 596 | 401 921 | 24.8 |

in high-risk occupations, by reducing silica dust exposure in mining, construction and other dusty workplaces;[18] and the WHO's End TB Strategy.[19] There are concerted efforts geared towards tackling TB and COVID-19 in the region by the SADC member states, the World Bank (WB), the Global Fund (GF), the African Union Development Agency-New Partnership for Africa's Development (AUDA-NEPAD), the East, Central and Southern Africa Health Community (ECSA-HC), and other partners.

The collaborations are implementing a network of major regional projects, such as the Southern African TB and Health Systems Support (SATBHSS) project, and the TB in the Mining Sector (TIMS) project. These projects are linked with other regional and in-country projects under the SADC. The projects have been implemented by means of a regional multi-sectoral approach, involving ministries responsible for health, mines and labour; the private sector; civil society organisations; organised labour; and academic institutions. The initiative will collaborate with the Global Fund Regional Laboratory Strengthening TB project to strengthen occupational hygiene analysis laboratories, thereby leveraging on economies of scales while guaranteeing international quality management systems of the newly established laboratories.

To maintain momentum on the progress made in the fight against TB amidst the COVID-19 pandemic, the SATBHSS project has been expanded to support COVID-19 response activities.[20] The Regional Advisory Mechanism (RCM) for TB in the mining sector has also recently finalised the development of phase III of the project for the period 2021–2023. The third phase of the project will focus on the regional coordination of TB in the mining sector.

## RESOURCES FOR UPDATES ON PROJECT ACTIVITIES

**Website:** http://www.satbhss.org/
**Twitter:** https://twitter.com/SATBHSS_Project
**Facebook:** https://www.facebook.com/SATBHSS/
**YouTube:** https://www.youtube.com/channel/UCpfa6BVEg8WhTDIgYDLwfAg

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# Connection between patient and healthcare worker health and safety

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As we join the rest of the world in marking World Patient Safety Day 2020 (adopted at the 72nd World Health Assembly Resolution – WHA 72.6 "Global Action on Patient Safety" in May 2019), it is important to highlight the need to protect the health and safety of both healthcare workers and patients. The impact of COVID-19 on the welfare of healthcare workers emphasises the need to integrate health and safety in global discussions. The World Health Organization's (WHO's) theme for this year's event is *Healthcare workers safety: a priority for patient safety.*

Over 160 years ago, Florence Nightingale said, "The very first requirement in a hospital is that it should do the sick no harm".[1] This principle is as pertinent today as it was then. The question is – do we apply this rule in health facilities? Are we comfortable when we send our loved ones to healthcare facilities for treatment? Do healthcare workers feel safe in these facilities? These and many more questions beg for answers.

As much as we advocate for the safety of patients, we also need to remember that healthcare facilities are workplaces first, before being places where patients receive care. The health and safety of healthcare workers should be a very important item in conversations about patient safety. If we cannot guarantee the health and safety of healthcare workers, patient health and safety could be jeopardised. The multidisciplinary nature and complexity of health systems means that patient health and safety depend on many variables, making it difficult to give credit to any single profession within the system. Patient outcomes are the results of joint efforts of all employees. This is one of the reasons that we advocate that safety must spread from the boardroom to the bedside, to the household yard gate, and beyond.

According to the WHO, healthcare facilities employ more than 59 million workers, globally.[2] These workers are exposed to a complex variety of health and safety hazards, daily. Lately, the issue of psychosocial hazards in the healthcare sector has grown exponentially, indicating the increasing risk of patient harm. In addition, there are increasing rates of workplace violence against healthcare workers by patients and patients' family members. Healthcare workers are at risk of violence across the world: between 8% and 38% of healthcare workers suffer physical violence at some point in their careers.[3] According to a 2014 report from the US Bureau for Labor Statistics, 52% of reported workplace violence occurred in healthcare.[3] The Emergency Nurses Association Survey of November 2011 found that one in 10 emergency room nurses had suffered some form of physical violence in a period of one week.[4,5] This is the enormity of the concern.

According to Dr Teryl Nuckols, an internist and assistant professor at David Geffen School of Medicine, University of California, in Los Angeles, "Residents are working more than 30 hours at a single stretch and often times forgo sleep entirely".[6] In many healthcare systems across the world, there seems to be a prohibition on 'mandatory' healthcare worker overtime but nothing is mentioned about 'voluntary' healthcare worker overtime.[7-9]

The poor infrastructural design in most healthcare facilities also poses certain levels of risks to healthcare workers. For example, a number of multiple floors facilities have no elevators or ramps. Healthcare workers are made to lift patients or, in some instances, support patients to climb stairs, resulting in slips, trips and falls, harming both healthcare workers and patients. The 2017 US Bureau of Labor Statistics report stated that slips, trips and falls are the second most common cause of lost work-day injuries in hospitals.[10] Advocacy for safety planning at the design stage of healthcare facilities is a new conversation.

We appeal to all employers within the healthcare sector, the government, and regulatory agencies to look closely into the issues of healthcare workers' safety and protection. The healthcare work environment is highly infectious and what is needed, most of the time, is mitigation in the form of safe process designs, improved hygiene practices, use of personal protective equipment, and vaccination of healthcare workers against infectious diseases. In many cases, there is an absence of duty of care from the employers. During the 2014 Ebola outbreak in west Africa, 401 healthcare workers were infected, and 232 healthcare worker deaths were recorded.[11]

In Africa, healthcare workers have been hit hard by the COVID-19 pandemic, with more than 10 000 of them having been infected.[12,13] Dr Moeti (WHO regional director for Africa) highlighted that the protection and care of healthcare workers is our collective responsibility: "Doctors, nurses and other health professionals are our mothers, brothers and sisters. They are helping to save lives endangered by COVID-19."[13]

The world is already experiencing a high shortage in healthcare workers. The increasing rate of harm, poor welfare and absence of social safety nets and protection will further increase healthcare worker shortages by making the sector an unattractive employment option. Our recommendations, as we mark this year's World Patient Safety Day, is for advocacy for the right kind of leadership, and for empathy to be an integral part of the healthcare system globally. The existing defensive culture should be replaced with a just and transparent culture, without the blame-game that is played when things go wrong.

In light of this, existing health legislation should be reviewed, and policymakers need to stand up for change. Healthcare technology companies can contribute to change by designing safe equipment, using safe new technologies. Healthcare workers themselves can bring about change through competency improvement and by giving due consideration to patient health and safety. Patient wellbeing must be at the center of their care, and be involved in treatment decisions.

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# American Industrial Hygiene Association (AIHA) expands sector-specific guidelines for business re-opening

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**9 SEPTEMBER 2020, FALLS CHURCH, VA, USA**

As businesses, schools, retailers and manufacturers manage reopening due to the pandemic, the American Industrial Hygiene Association (AIHA) continues to expand its library of comprehensive Back to Work Safely guidelines, white papers, and resources, aimed at 26 different business and community sectors. The latest guidelines include recommendations on engineering controls (ventilation, enhanced filtration and physical barriers), germicidal ultraviolet radiation, enhanced cleaning and disinfection, and personal hygiene and physical distancing:

- Reducing the Risk of COVID-19 Using Engineering Controls
- Employers Guide to COVID-19 Cleaning and Disinfection in Non-Healthcare Workplaces
- Effective and Safe Practices, Guidance for Custodians, Cleaning and Maintenance Staff
- Occupational Safety and Health Guide for Surface Disinfection Practices Using Germicidal Ultraviolet Radiation
- Infographic: Considerations on the Safe use of UVC Radiation for Surface and Air Disinfection

"While many solutions rely primarily on PPE, AIHA scientists and health professionals have developed more comprehensive guidelines which are specific and written with small to mid-sized businesses in mind. The guidelines include practical checklists that point out ways the employer, employees, customers and visitors can minimize their risk", said Lindsay Cook, AIHA president.

"The AIHA Back to Work Safely guidelines include engineering and work practice solutions that complement the effective utilization of masks. They offer a detailed view of how ventilation can be an effective control in non-healthcare and non-industrial workplaces, and how employers can develop specific cleaning and disinfection programs."

The AIHA and its volunteer committees of industrial hygienists urge employers to implement engineering controls in all indoor workplaces, even those outside of the healthcare industry, to reduce the spread of COVID-19. The broad categories of engineering controls that may be effective against the SARS-CoV-2 virus include:

- Physical barriers, enclosures, and guards
- Automatic door openers and sensors
- Local exhaust ventilation
- Enhanced filtration to capture infectious aerosols
- Devices that inactivate or 'kill' infectious organisms
- Dilution ventilation and increasing outside air delivery

"Using a combination of available technologies, equipment, and time-tested methods to control infectious aerosols is the most reliable way to reduce the risk of disease spread", said Cook.

Guidelines are freely available in English and Spanish for the following industries:

- Amateur sports
- At-home service providers
- Bars
- Business services
- Childcare providers
- Construction sites
- Dental office settings
- General office settings
- Gyms and workout facilities
- Hair and nail salons
- Houses of worship
- Institutions of higher education
- Libraries
- Museums and collecting institutions
- Physical and occupational therapy, massage therapy
- Retail
- Restaurants
- Rideshare, taxi, limo and other passenger driver-for-hire services
- Schools K-12
- Small manufacturing and maintenance shops
- Small entertainment venues (e.g. mini golf and arcades)
- Small and medium sports facilities
- Small lodging establishments
- Street vendors and farmers' markets
- Transit systems
- Warehousing/transportation

All resources are available for download from www.backtoworksafely.org. The Centers for Disease Control and Prevention (CDC) includes a link to these guidance documents on its website. Additionally, COVID-19 resources on personal protective equipment (PPE) and re-entry into the workplace hazards can be found at the AIHA Media Outreach Center.

The AIHA Back to Work Safely task force is comprised of more than a dozen highly-trained and experienced occupational and environmental health and safety (OEHS) scientists and professionals, representing various business sectors: government, industry, higher education and consulting.

# European platform for Professionals in Occupational Hygiene – current status and recent advances

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As early as 2016, there was discussion of a European platform for Professionals in Occupational Hygiene (EPOH). Currently there are eight professional organisations in the loosely joined consortium:

- AEHI, Spain
- AIDII, Italy
- BOHS, United Kingdom
- BSOH, Belgium
- DGAH, Germany
- NVvA, The Netherlands
- SOFHYT, France
- SSHT, Switzerland


The objectives of the EPOH platform are:

- To promote the harmonisation of occupational hygiene (OH)-related methods, standards and guidelines,
- To serve as a contact point and discussion partner for European Union (EU) staff/institutions,
- To contribute to schemes of training, qualification or certification in OH in the context of a common EU regulation,
- To exchange OH knowledge and practical field experiences,
- To strengthen the communication and collaboration between the different European associations, and
- To create more visibility of OH as a profession at the European level.

The current priorities for the platform are focused on chemical hazards, in the context of the "Healthy Workplaces Manage Dangerous Substances" campaign driven by the EU occupational safety and health (OSH) Agency, for 2018–2020. In association with those priorities, the EPOH platform identified three technical topics and one strategic topic to be focused on for further development:

- Hazard and control banding strategies,
- Carcinogenic and mutagenic agents, and skin exposure control,
- Interaction between registration, evaluation, authorisation and restriction of chemicals (REACH) and OSH regulations, and
- Harmonisation of OH education and training.

The EPOH is set up as a working group of representative members from each organisation. They meet, virtually, approximately every second month, and try to have annual face-to-face meetings. A coordinator, designated every two years from among the platform's members, takes care of organising and conducting meetings, and representing the platform.

Members of the EPOH are currently working on the drafts of two position papers. One is on skin exposure of carcinogenic and mutagenic agents in the workplace, and the other is on the REACH programme and OH.

The EPOH is currently working with IOHA to see how best the organisations can collaborate in the future. At this time, all of the EPOH participants are also IOHA members but, in the future, there may be other professional organisations in EPOH with members who are not members of IOHA. For now, a memorandum of understanding to foster support and engagement between IOHA and the EPOH is being developed. In addition, IOHA is making space on its webpage for information on the EPOH, and its projects and activities.

# SASOM steps up support to members in the era of COVID-19

**Claudina Nogueira**, Occupational health consultant/Project manager, University of Pretoria, South Africa
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The South African Society of Occupational Medicine (SASOM) national office in Pretoria has relocated to new premises in Montana, after being based in Meyerspark for many years. The new contact details are as follows:

- **Physical address:** Plot 59, Dr van der Merwe Avenue, Montana, Pretoria *(new)*
- **Postal address**: PO Box 32, Silverton, 0127 *(unchanged)*
- **Telephone number:** +27 (0) 87 288 0893 *(new)*

Since July, SASOM has been offering its members webinars dedicated to various aspects of COVID-19, aligned with the topics of interest that have been requested by its members. This online programme came about because SASOM's annual congress for 2020 was cancelled due to the global pandemic. The webinars are accredited by the South African Medical Association (SAMA) for Continuing Professional Development (CPD points/CEUnits) for all participants, and the presentations are available on the SASOM website, for members to access.

COVID-19-related guidance documents and scientific publications from various sources, including SASOM and the national Departments of Health, and Employment and Labour, have been shared with members. Examples of topics covered to date are (i) Clinical manifestations, risk factors, and maternal and perinatal outcomes of coronavirus disease 2019 in pregnancy: Living systematic review and meta-analysis;

**Reminiscing on the 'good old days' of real-time-real-place meetings that created opportunities for face-to-face professional and social networking – SASOM-MEDICHEM Joint Congress 2019, Johannesburg, South Africa**
*Photograph: Laria Botha*

(ii) Occupational medical examinations during the COVID-19 pandemic; (iii) Survey on mental health in healthcare workers during COVID-19; (iv) Co-morbidity factors associated with COVID-19 death in a global study of 17 million patients; (v) COID directive on compensation for workplace-acquired COVID-19; and (vi) SAMA guide to doctors for issuing medical certificates and letters for COVID-19-related employer and employee requests.

For the benefit of its members, SASOM continues to share information and invitations for online events related to COVID-19, organised by both national and international organisations.

The National Institute for Occupational Health (NIOH) has established a COVID-19 Task Team whose members organise and present an ongoing training programme, consisting of a series of webinars on a diversity of pandemic-related topics; all events are accredited for CPD points and the presentations are available on the NIOH website. As of mid-September 2020, the NIOH has presented 48 webinars (organised solely or in partnership with other organisations) to close to 31 000 participants – a phenomenal amount of work and reach that deserves congratulations. At a recent NIOH webinar (10 September 2020), titled 'Ethical considerations of health and safety personnel in the workplace around COVID-19', two SASOM members were invited to present, viz. Dr Frank Fox who presented 'COVID-19-related ethical issues specific to occupational health practice: Practical implications', and Dr Murray Coombs who presented 'An overview of ethics in occupational health practice and outbreaks'. Following this well-attended webinar, the NIOH has uploaded ethics guidance documents on its website for all interested parties. Among these documents is 'SASOM Guideline 17 – Ethical and professional conduct for occupational medical practitioners'. Although the suite of SASOM guidelines is available freely to only SASOM members as a society benefit, SASOM has taken the decision to make the ethics guideline publically available at this time, free of charge, for inclusion in the NIOH compilation of ethics guidance materials that include ethics guidance from various organisations, viz. the International Commission on Occupational Health (ICOH), the Health Professions Council of South Africa (HPCSA), the Southern African Institute for Occupational Hygiene (SAIOH), the South African Institute of Occupational Safety and Health (Saiosh), SAMA, and SASOM (https://sasom.org/wp-content/uploads/2018/09/17-Guideline-on-Ethics-in-occupational-health-2016.pdf).

To date, seven webinars have been organised and offered by SASOM (Table 1). SAIOH, a sister organisation of SASOM, has also presented a series of online events related to COVID-19, as has Saiosh. At a recent SAIOH webinar (4 September 2020) titled 'The use of ventilation to control the spread of COVID-19', SASOM ExCo member, Dr Greg Kew, was invited to co-present and be a panellist with Garth Hunter, SAIOH member and SAIOH representative on the board of the International Occupational Hygiene Association (IOHA).

**Table 1. Webinars organised and offered by SASOM, July to September 2020**

| Date | Webinar title | Presenter | Affiliation | No. participants |
|---|---|---|---|---|
| 14 Jul 2020 | Standardisation of spirometry: 2020 update | Sr Lindsay Zurba | Director and training manager, Education for Health Africa | 87 |
| 28 Jul 2020 | Cardio-metabolic risk factors for COVID-19 infection | Prof. Veronica Ueckermann | Adjunct Professor, Department of Internal Medicine, University of Pretoria and Steve Biko Academic Hospital | 69 |
| 11 Aug 2020 | Workplace chronic lung complications of COVID-19 | Prof. Veronica Ueckermann | Adjunct Professor, Department of Internal Medicine, University of Pretoria and Steve Biko Academic Hospital | 94 |
| 18 Aug 2020 | Part 1 of 3: Statutory legal impact of COVID-19 on practice of occupational medicine practitioners (OMPs) | Dr Jan NR Lapere | SASOM ExCo member, occupational health, safety and medicine consultant, and OHS law consultant | 136 |
| 20 Aug 2020 | Part 2 of 3: Ethical impacts of COVID-19 on practice of OMPs | Dr Jan NR Lapere | SASOM ExCo member, occupational health, safety and medicine consultant, and OHS law consultant | 116 |
| 26 Aug 2020 | Part 3 of 3: COVID-19 and 'new normal' legal and ethical constraints, queries and solutions in the practice of occupational medicine | Dr Jan NR Lapere | SASOM ExCo member, occupational health, safety and medicine consultant, and OHS law consultant | 98 |
| 3 Sep 2020 | Mental health and COVID-19: An OMP approach | Ms Tanya van de Water<br>Dr Nick van de Water | Clinical psychologist<br>OMP and SASOM ExCo member | 68 |

Some of the webinars organised and presented by the Wits Health Consortium, the Health and Welfare Sector Educational and Training Authority (HWSETA), the Foundation for Professional Development (FPD), and Business Enterprises at University of Pretoria (Pty) Ltd among others, are:

- Addressing psychosocial challenges during the COVID-19 pandemic
- An update on COVID-19 in South Africa
- COVID-19: Unpacking co-morbidities
- Fitness for duty and workplace adaptation: Short and long-term health of workers, risks related to working hours, workload and fatigue
- COVID-19 and tuberculosis
- Management and prevention of recurring COVID-19 infections at work: Employee leave, disinfection/cleaning and incident investigations
- Keeping workers safe with masks and respirators
- COVID-19 infection control
- Return to work post-COVID-19 illness and lockdown
- The impact of COVID-19 on the body
- COVID-19 online courses for the healthcare and other essential services sectors and the public in South Africa (offered by FPD)
- Virtual workshop to review the current occupational exposure limits (OELs) as listed in Schedule 22.9(A) of the Mine Health and Safety Act

Webinars and other virtual training opportunities offered by regional and international organisations that have been shared with SASOM members include:

- *Occupational Health Southern Africa* journal – CPD-accredited 'Online scientific writing workshop 2020' – a programme designed specifically for members of the four occupational health societies who would like to improve their scientific writing skills
- World Health Organization (WHO) – Health worker focus: Free online course titled 'Occupational health and safety for health workers in the context of COVID-19' and webinar in preparation for World Patient Safety Day (WPSD) 2020
- American College of Occupational and Environmental Medicine (ACOEM) in collaboration with the International Occupational Medicine Society Collaborative (IOMSC) – 'IOMSC Global Insights Webinar: Addressing how healthcare worker safety impacts patient safety during the pandemic era'
- ACOEM – 'Incorporating occupational data into infectious disease case reports and employee health records'
- IOMSC – 'Mental and emotional health in the healthcare workforce during the COVID-19 pandemic era: A global perspective', and 'Fresh air and sunshine: Indoors! – Expert guidance and key steps on how clean indoor air can help contain the spread of COVID-19'
- IOMSC and Western Australian Regional Committee of the Australian Faculty of Occupational and Environmental Medicine – 'Supporting the State in the recovery phase: Coping with COVID-19'
- The 'Global action on TB initiative/TB Civil Society Group' coordinated by ICOH (managed by Dr Marilyn Fingerhut, USA, past ICOH vice president) shares resources, webinar invitations, funding opportunities and world health 'hot topic' updates on a regular basis. Recent examples are: (i) 'Virtual launch – The impact of COVID-19 on the TB epidemic: A community perspective' (results of a global civil society-led survey); (ii) 'Treatment Action Group (TAG) policy brief: TB research investments provide returns in combating both TB and COVID-19'; (iii) 'Demanding a higher standard of TB care: New tools, new challenges, new approaches to improving TB diagnosis and treatment'; (iv) 'Providing prevention, care, and treatment for TB in low-resource non-US settings during the COVID-19 pandemic' (a CDC-US resource); (v) link to *WHO Bulletin*, a monthly peer-reviewed journal of public health that is fully open-access with no article-processing charges; (vi) a review of the third edition of 'WHO/UNICEF WASH and waste management guidance for SARS-CoV-2'; (vii) invitation to a high-level seminar on 15 October 2020 – 'Fighting the unrecognised pandemic: Re-prioritising TB, HIV and non-communicable diseases in the era of COVID-19' (organised by the Masoyise Health Programme of Minerals Council South Africa); and (viii) link to the bi-monthly TB E-Newsletter (a Global Health Strategies resource)

# Nursing scopes of practice: Legal certainty required despite practising in uncertain times

**Justin Malherbe**, Senior associate attorney, Webber Wentzel, e-mail: Justin.Malherbe@webberwentzel.com

Nursing, like most fields of healthcare endeavour, is a dynamic profession. Ongoing technological advancements in health, together with a concomitant increase and expansion in scientific knowledge, demand that professionals operating in this sphere adapt to new levels of understanding and ways of doing things. Given the wide-reaching changes in our society in the past few decades, as well as healthcare economics, South Africa has experienced changes to the methods and means of healthcare service delivery and financing. It can thus be reasonably expected of the Law to keep pace with these developments.

That is not always the case. When it comes to healthcare regulation in South Africa, and particularly the regulation of nursing, a deficit often exists between changes in the laws regulating the health professions, and their implementation in practice. This phenomenon is not unique to South Africa. However, in the South African context, where there is a myriad of developmental challenges, this brings into sharp relief, at times, just how important it is to maintain and improve on legal certainty in the professions – especially during periods of accelerated change.

A recent example of this is the publication for comment of new regulations pertaining to the scopes of practice for nurses and midwives. These (proposed) regulations were first introduced in May 2020 (Government Notice 521, published in Government Gazette No. 43305 of 12 May 2020). This was subsequently followed by the publication of a different set of proposed regulations in July 2020 (Government Notice R744, published in Government Gazette No. 43496 of 3 July 2020). An announcement made by the South African Nursing Council (SANC), on 27 May 2020, clarified that an incorrect version of the proposed regulations had been published by the Department of Health in May 2020.

What is of interest in the context of this discussion is the extent to which the two sets of proposed regulations differ in their scope and application. While both sets are directed towards amending (and, in certain respects, possibly overhauling) the current scope of practice regulations which still reside under the now repealed Nursing Act 1978 ('Regulations pertaining to the scope of practice of persons who are registered or enrolled under the Nursing Act, 1978' published in Government Notice R2598, in Government Gazette No. 9513 of 30 November 1984, as amended), it would appear that their individual effects – were they to be implemented in either of their respective formats – would be materially different, depending on which set of proposed regulations is ultimately preferred.

The regulations published in May 2020 sought to amend chapters 1, 2 and 3 of the current scope of practice regulations, whereas the proposed regulations published in July 2020 seek to amend only chapters 3 and 6 of the current regulations. Different terminology is used and new defined terms introduced in each set of proposed regulations. (See, for example, the distinctions drawn in the May 2020 version with regards to 'basic', 'general' and 'comprehensive' nursing care which do not appear in the July 2020 version, as well as defined terms for 'competence/competencies'). Ultimately, neither deals with all categories of nursing professionals as created in terms of the current Nursing Act, 2005 (Section 31(1) and (2)). The presumption therefore exists that the current regulations will remain in force and effect for those categories of nurses who are not affected by the proposed regulations. For example, enrolled nurses (which designation was confirmed as a category of registration most recently by way of Government Notice 9393, in Government Gazette of 28 June 2019) are not mentioned in either set of proposed regulations, although the May 2020 version does contain revisions to the scope of practice for a staff nurse (as defined in Section 31(1)(c)).

A noteworthy proposal is the introduction of a scope of practice for the registration category to be known as a general nurse. Although this was also recently introduced (in Government Notice 9393, in Government Gazette of 28 June 2019) by the minister of health, it was still necessary to provide content to the role and professional responsibilities of this new category of registered person. That content is as proposed in the July 2020 regulations.

The delineation between the scope of practice of a general nurse and that of an enrolled nurse is not clear. The former is notionally based on the new competency framework aligned to the current Higher Education Qualifications Sub-Framework (HEQSF) governing nursing education, whereas the latter is not (having been based on legacy qualifications that have been phased out). Valid concern arises about the interrelationship between these two categories of registered persons, particularly with regards to their equivalency of scope or otherwise, taking into account the presence of a further category (that of a staff nurse) which also needs to be catered for in providing a scope of practice in terms of the Nursing Act, 2005.

Similar concerns could be expressed regarding the categorisation of midwifery professionals (which encompasses midwives and enrolled midwives per the current regulations), in differentiation from the proposed regulations. In addition, currently under development are the nurse/midwife specialist-qualified practitioners in respect of whom no additional legislative guidance is currently available. Regulations relating to the minimum education requirements for specialisation in certain categories of nursing practice (such as occupational health) were published for comment in 2019 but have yet to be promulgated (published in Government Notice 1322, in Government Gazette 42770 of 16 October 2019).

From a legal risk standpoint, the difficulty recreated by the current proposals (in any of their forms) is one of legislative certainty. The scope of practice of a registered person in terms of

any legislation governing the conduct of a profession is a crucial term of reference insofar as adjudicating professional conduct matters is concerned, as well as civil, criminal, and quasi-judicial inquiries involving members of a profession. For example, one of the standards that South African courts routinely apply to determine whether there is professional negligence on the part of a professional person, is whether their conduct in a given situation falls short of the standard reasonably required of persons belonging to that profession (or branch of the profession) in similar circumstances (Van Wyk v Lewis 1924 AD 438 at 444). To determine this, the courts use various sources of information that serve as evidence as to the standard required. Where scopes of practice are available and published in terms of applicable legislation for a profession, this serves as prima facie evidence of the level or standard of skill and expertise required. Failure to meet the required standard would demonstrate negligence on the part of the professional concerned (Goliath v Member of the Executive Council for Health, Eastern Cape (085/2014) [2014] ZASCA 182 at para 8).

Over many years, our courts have considered aspects relating to wrongfulness and negligence of a professional person's conduct with reference to, inter alia, healthcare. In some of the leading cases, the courts have highlighted the fact that the conduct of a practitioner – whether in a civil or criminal context – can be evaluated and determined according to the reasonable standard comprised of a body of professional opinion of members of the same profession (see discussion in Michael and Another v Linksfield Park Clinic (Pty) Ltd 2001 (3) SA 1188 (SCA) at 34 to 40). Accordingly, unequivocal expressions as to the scope of professional practice are necessary and useful, even in a legal context.

On an individual level, the absence of certainty surrounding current and future scopes of practice applicable to various categories of professionals, such as those envisaged by the Nursing Act, 2005, has the potential to create unwanted anxiety – not only for professionals who seek to know and comprehend the regulated boundaries of their professional activities, but also to collective groups of professionals with common interests, goals or skills sets (e.g. professional societies and voluntary associations) that seek to guide, interpret and direct their members towards meeting their legal and ethical obligations towards the profession.

Often, in judicial proceedings involving nurses, the inquiry turns to considering the level of competence, independence and delegation permitted or required of a nurse in a particular registration category. Without a clear statement of what is legislatively permitted or required in distinction from other categories of professional, a court is hampered in its ability to render a fair verdict or outcome. The dearth in interpretation is often made up using expert evidence. This, in itself, can lead to further challenges, especially in dealing with professions (such as nursing) where professional standards and educational outcomes have changed and are yet changing over time. What is certain is that the additional time and expense of leading evidence in substantiation of the 'reasonable person' standard in each legal setting can be minimised (and perhaps avoided) if greater legislative certainty could be achieved. The introduction of new or revised scopes of practice for nurses is one such opportunity to improve on legal understanding and outcomes.

It must also be mentioned that a lack of appreciation for what constitutes one's scope of practice as a registered person can, of itself, attract sanction. In terms of the professional conduct regulations promulgated under the Nursing Act, 2005 (published under Government Notice R767, in Government Gazette No. 38047 of 1 October 2014), the acts or omissions in respect of which SANC can take disciplinary steps against a practitioner registered in terms of the Act include the performance of professional acts that are beyond the scope of practice for the practitioner concerned (Rule 7). Failing to observe the provisions of any law, rule or regulation that applies to a particular registered practitioner can also be grounds for disciplinary action by SANC (Rule 25). These provide additional reasons why clear, distinct scopes of practice are necessary to ensure a proper understanding and consistent application of professional standards of conduct across the nursing profession.

Thus, while an explanation has been offered by the regulator as to the publication of the different sets of proposed regulations, what is not immediately apparent is whether either of the proposed regulations are capable of delivering the levels of legal certainty that are urgently required in order for nurses of all registration categories (past and present) to fulfil their roles and execute their professional responsibilities as registered persons. The role of nursing is increasingly important given South Africa's slow transition to universal healthcare coverage, the backbone of which is expected to be built from a foundation of a strong nursing profession. As with legislative developments linked to national health insurance (National Health Insurance Bill 11 of 2019 was introduced by the minister of health in 2019 and is currently before parliament), there is a clear need for consultative dialogue surrounding scopes of practice in nursing to achieve consensus prior to transitioning to a new regulatory environment. It is hoped that the processes currently underway to transform and modernise the regulatory regime for nursing will achieve that and more, for the benefit of the profession and the public alike.

**Norman Khoza, 2020 SAIOH president**

# SAIOH president's message

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## In this newsletter



### SAIOH: SERVING OUR MEMBERS

- We continue to bring information to our membership database via e-mail, on topical issues, technical developments, jobs and more.
- We facilitate and collaborate with other organisations to bring training, information sessions, workshops, and case studies – webinars in this time of social distancing.
- We innovate, explore and implement novel ways of conducting certification assessments in these trying times, to ensure the growth of the Instutute and continued development of our members.

As I write this message, news has come through that we have entered lockdown level 1, and I am sure you join me in rejoicing. Our economy is nearly back to normal and spring has sprung after an exceptionally long, dark winter. What a journey, during which I believe and hope, valuable lessons have been learnt. If there is one thing that I have observed, it is that countries around the globe came to realise that there is no development without health. Having said that, I hope that the occupational health and safety fraternity will take up the challenge and assume their roles and responsibilities to achieve healthy workplaces, and thus contribute to the broader public health spheres.

Importantly, COVID-19 is not the only current workplace hazard. Governments in the United Nations General Assembly committed to ending tuberculosis through implementing primary prevention in high-risk occupations, by reducing silica dust exposure in mining, construction and other dusty workplaces.[1] This specific commitment is perfectly positioned for occupational hygienists, in collaboration with other engineering, environmental, health and safety professionals. We need to understand the importance of collaborations, as there is no difference between workplace and public interventions. The same worker is the same person in the public.

On 24 September 2020, South Africa celebrated Heritage Day – a day when we celebrate the cultural wealth of our nation; a day that was more special this year since the gathering restrictions have been relaxed. Finally, the president of our country has announced the Jerusalema dance challenge. I cannot wait for the SAIOH Council to partake in this! Please share with us your own office Jerusalema dance challenge.

### CELEBRATED INTERNATIONAL DAYS AND THEIR LINK TO THE CURRENT GLOBAL CRISIS

In this time of COVID-19, with its impact on our health, and physical and mental wellbeing, we would like to highlight two celebrated International Days: World Suicide Prevention Day (10 September) and World Patient Safety Day (17 September). We salute our health workers who continue to compassionately fight the pandemic on the frontline. We wish strength and solidarity to all those affected by COVID-19.

#### World Patient Safety Day

This year, the objective of World Patient Safety Day is to raise global awareness about the importance of health worker safety and the need for a holistic approach to patient safety. *Health worker safety: A priority for patient safety* is the theme for 2020. It emphasises the need for a safe working environment for health workers, as a pre-requisite for ensuring patient safety. It has never been truer than during this pandemic. Are we, as employers, occupational hygiene professionals, and health workers, doing enough to ensure a safe working environment?

#### World Suicide Prevention Day

The theme for 2020 is *Working together to prevent suicide.* Suicide is the result of a convergence of genetic, psychological, social, cultural and other risk factors, sometimes combined with experiences of trauma and loss. The COVID-19 pandemic brings anxiety, social disconnectedness, and suffering (economic and health), which add to the burden already borne by people, and might just be the tipping point for someone. It takes work to prevent suicide, and all of us have a role to play, whether at work or at home. There are a few questions that we need to ask ourselves: am I tuned in to those around me and do I act on behaviour changes; am I staying socially connected with those close to me in this time of social distancing; and do I realise that it is okay to not be okay, and that there are helplines and support services available?

#### International Days: A workplace perspective

Employers must consider all risks associated with COVID-19. These include the risks presented to health workers and other workers in the

firing line, the physical health and mental wellbeing of employees who have COVID-19, as well as the additional workload, stress and anxiety that COVID-19 places on colleagues who remain at work. Ultimately, these affect an organisation's operations and increase health and safety risks (e.g. from absentmindedness). Showing compassion towards employees and providing support and assistance to all those affected (directly or indirectly), will go a long way in these uncertain times.

## SAIOH IN A NUTSHELL: 2020 THUS FAR

The year 2020 will be marked as an unprecedented year across the globe – the year that forced everyone to find new and innovative ways of going about many of their activities. It had profound impacts on people and economies, and has brought pandemics and their controls to the forefront. SAIOH is no different – we have had a busy year thus far!

### COVID-19

SAIOH sent a motivation to the Department of Employment and Labour at the start of the pandemic in South Africa and, with their support, was listed as an essential service during level 4 of the COVID-19 lock-down. SAIOH was extremely active during the COVID-19 pandemic, ensuring dissemination of scientific and accurate COVID-19 matters through marketing, collaboration and participation in webinars with the National Institute for Occupational Health (NIOH), Wits Health Consortium, the South African Institute of Occupational Safety and Health (Saiosh), Workplace Health Without Borders (WHWB), the Department of Employment and Labour, the Department of Health, the American Industrial Hygiene Association (AIHA), and the American Conference of Governmental Industrial Hygienists (ACGIH). SAIOH is currently collaborating with NIOH on a webinar addressing the efficacy and risks of cloth masks, and masks with or without inlet valves.

Two SAIOH-specific webinars related to COVID-19 were conducted. The first one was by Cas Badenhorst and his team (Deon Swanepoel, Sean Chester and other members of SAIOH) on the work done by the occupational hygiene practitioner (OHP) team that conducted COVID-19 risk assessments (RAs) for the Department of Health. This included developing a template for these RAs and setting related occupational hygiene (OH) standards. These invaluable recommendations were incorporated by the Department of Health into the COVID-19 Health Regulations, and by the Department of Employment and Labour into the COVID-19 Health Directives.

The second webinar was coordinated by Garth Hunter and Sean Chester, both of whom are SAIOH registered occupational hygienists (ROHs) who are involved with SAIOH's Professional Certification Committee (PCC), and Dr Greg Kew (occupational medical specialist). The theme of the webinar was the use of ventilation to control the transmission of SARS-CoV-2. In this, indoor air quality was detailed as a barrier to COVID-19, not only now but also after the pandemic. Unfortunately OHPs do not always give the necessary attention to indoor air quality, e.g. in using and recommending effective ventilation for indoor workplaces. This, together with more focus on RAs, is indeed a key focus point in the future of occupational hygiene.

The SAIOH technical team is diligently developing a technical paper on the aforesaid ventilation requirements. We are, likewise, planning to write a technical paper on hazardous biological agent (HBA) RAs, followed by a position paper. A second technical paper, on the importance of effective RA for OH, which will assist in the prevention of future pandemics and occupational health risks, is planned. In a similar vein, SAIOH recently released a press statement on its role in, and the importance of, OH during this pandemic, and thereafter, as well as a position paper on the transmission of the COVID-19 virus being much further than 2 m.

### SAIOH members in the media

SAIOH organised radio interviews for members: Deon Swanepoel spoke about the transmission paper, and Koos Roets spoke about asbestos and the evidence that he gave at the Zondo Commission for State Capture, regarding the asbestos roof audit fraud in the Free State province. Recordings of these are on the SAIOH website and have been circulated to our members and stakeholders.

### SAIOH operational activities

SAIOH recently signed a memorandum of understanding (MoU) with the Occupational Hygiene Approved Inspection Authority (OH AIA) Association, and is currently finalising an MoU with the Ergonomics Society of South Africa (ESSA).

The SAIOH administrative team is engaging with website developers and is waiting for proposals to overhaul the SAIOH website. Watch this space (and the website)!

### SAIOH branch activities

All SAIOH branches and discussion groups are maintaining contact with their members by holding virtual meetings. In the last month alone, the Gauteng North, Gauteng South, and KwaZulu-Natal (KZN) branches, and the Richards Bay discussion group, met this way. The North West (Potchefstroom), North West (Rustenburg) and Western Cape branches are also organising virtual meetings.

SAIOH is lifting the bar, with international OH specialists presenting at our branch committee virtual meetings, e.g. Adrian Sims (a ventilation consultant from the UK) held a workshop with the KZN branch early in September.

Another innovation from the KZN branch, initiated and coordinated by Lloyd Askham (a SAIOH ROH), is a pilot project on continuous development. He is sending two questions, based on real-life OH case studies, via a SAIOH Mailchimp, to the KZN branch members who are expected to research and answer the questions within one week. The following week, he will send a further two questions with a link to the answers (including a detailed explanation for each of the correct answers). The answers will be published on the SAIOH website. This is an excellent initiative to ensure that participating OHPs can maintain their continuous development. If this project is successful it will be rolled out to all SAIOH members, nationally.

## FROM THE PCC

Information on the PCC's activities and assessment statistics are provided below. The PCC continues to impress with its use of digital tools and innovative ways of fulfilling its mandate during the pandemic.

### PCC operational activities

The PCC executive committee (Exco) had several monthly virtual catch-up calls during the pandemic, and full PCC Exco meetings in March and July, followed by a full virtual PCC meeting (and a SAIOH induction session before the meeting) on Friday 31 July 2020. The PCC team is meeting biweekly via MS Teams to work on the new oral assessment format. This project aims to ensure that the oral assessments and questions asked are fair, equally weighted, cover all OH fields, meet the same quality criteria, and are scored correctly. At the end of this

**Table 1. Final written and oral assessment results (2020 year to date)**

| Certification Category | Assessed | Result | | |
|---|---|---|---|---|
| | | Passed | Failed | Pass rate (%) |
| OH assistants (W201 Course) | 39 | 30 | 9 | 76.9 |
| OH technologists | 31 | 20 | 11 | 64.5 |
| Occupational hygienists | 6 | 4 | 2 | 66.7 |
| Total | 76 | 54 | 22 | 71.1 |

exercise (anticpated to be late 2020), the team will conduct round-robin training for all the PCC assessors on the new system. The new oral assessment format will be rolled out during 2021.

### Assessments – Q1 and Q2

The PCC facilitated electronic written assessments throughout South Africa and in Botswana in quarters one and two, with great success. The written results were good: in Q1, 14 out of 23 candidates (technologist and hygiene candidates) passed; in Q2, 30 out of 39 candidates passed. Assistants sat for the W201 exams across the two quarters. From the start of the pandemic, candidates who passed the written assessment in Q1 took their oral assessments on virtual platforms, facilitated by the PCC assessors country-wide. The PCC Exco thanks both the assessors and the assessed for adapting to, and ensuring, an effortless assessment for all participants, in line with COVID-19 control measures.

### Assessments – Q3

Seventy-one certification applications were evaluated in the third quarter's written assessments in September: 35 OH assistants, 18 OH technologists, and 18 occupational hygienists. This is a large number of applications, for which we are ready and also very grateful.

The PCC Exco met with the ICT company that is developing the electronic assessments, to iron out some glitches experienced in the pilot phase last year. This is going well. The ICT service supplier also started the task of loading all the questions into the electronic question database. Automatic generation of papers is now within our reach.

For the next assessment round (Sept 2020), all three categories' written assessments will take place on the electronic platform. The papers have been loaded and tested, and applicants have been advised of the electronic assessment system to be used.

### Assessment statistics

Table 1 summarises the final certification assessment results, as at August 2020. We congratulate all our members who passed their assessments and wish them the best in their professional development journey. All the candidates who passed will be certified and registered at the respective levels, as per the rules. We encourage those who did not pass not to give up, and to seek a mentor through SAIOH's mentorship programme to assist them in their development. Lee Doolan, PCC administrative officer, can be contacted in this regard.

## HAVE YOUR SAY

The SAIOH Council invites and welcomes your feedback on how this communication is helping you as a SAIOH member, and how we can improve. If you have any suggestions, inputs, or contributions, please e-mail them to our president at president@saioh.co.za.

## REFERENCE

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# Unpacking Section 20 of the Mine Health and Safety Act

**Dipalesa Mokoboto**, MMPA vice president, Medical inspector, Department of Mineral Resources and Energy, South Africa
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## INTRODUCTION

The mining sector is mainly regulated through the Mine Health and Safety Act (MHSA), Act No. 29 of 1996, which addresses health and safety requirements in the mining industry. Unlike the Occupational Health and Safety Act (OHSA), the MHSA offers employees an opportunity to dispute findings of an occupational medical practitioner (OMP) through Section 20. Accordingly, an employee may dispute a finding of unfitness to perform work by lodging an appeal to the medical inspector in case the decision was not made in a fair manner.

In terms of Section 49(1)(b) of the MHSA, the chief inspector of mines must appoint an officer, with prescribed qualifications and experience, as the medical inspector – a medical doctor with a postgraduate qualification in occupational health. The medical inspector serves as an ombudsman by investigating and adjudicating medical appeals in line with Section 20 of the MHSA. Unfortunately, Section 20 is limited to medically related disputes and excludes labour-related disputes. However, many people misinterpret the requirements of Section 20 of the MHSA, which are explained in this article.

## UNPACKING THE SUBSECTIONS

### 1. Section 20(1) provides that:

"An employee may appeal to the Medical Inspector against –

a) a decision that the employee is unfit to perform any particular category of work; or
b) any finding of an occupational medical practitioner contained in an exit certificate prepared in terms of Section 17."

Basically, this implies that there are only two conditions under which an employee may lodge a Section 20 medical appeal. First, the employee has to have been declared permanently unfit to perform work. Temporarily unfit employees need not lodge a medical appeal as their medical conditions would still be under review. The second condition relates to the exit certificate, which is unrelated to fitness to work. This implies that an employee may not appeal a decision of unfitness, after exiting the mine. The exit certificate can also not be used as a supporting document for disputing unfitness, as the certificate does not contain information about the fitness status of an employee.

### 2) Section 20(2) provides that:

"An appeal under subsection (1) must –

a) be lodged with the Medical Inspector within 30 days of the relevant decision or finding, or such period as may be prescribed; and
b) state the grounds of the appeal."

When an OMP declares an employee permanently unfit for work, it is prudent for the OMP to assist the employee in line with Section 13(5)(b) of the MHSA. The OMP will need to advise the employee of his/her right to lodge a Section 20 appeal, and that the appeal must be lodged within 30 days of the employee being declared unfit for work. To assist the process, the OMP should provide the employee with a certificate of fitness, indicating his/her fitness status, and contact details for ease of communication with the medical inspector when clarity is sought, and for feedback to the OMP. The OMP should also submit a report to the medical inspector, when requested, indicating factors that were considered when making the decision about fitness to work.

### Section 20(3) provides that:

"When the Medical Inspector receives an appeal under subsection (1), the Medical Inspector must choose a medical practitioner who is not employed by the employer of the employee…"

The problem with this subsection is that the requirements are outdated and not in sync with medical developments. First, in the occupational health sphere, employees get referred to other professionals such as audiologists, occupational therapists, physiotherapists, etc., who are not necessarily regarded as medical practitioners. Medical practitioners without an occupational medicine qualification might not be able to determine the fitness to work of an employee. However, an OMP can assess the fitness to work status of an employee, taking into consideration the working environment of the employee and the occupational hazards to which the employee is exposed.

Second, if an employee has just undergone a battery of investigations at a private facility, which may include MRI scans, CT scans and chest X-rays, it will not be necessary to repeat the same tests when the employee lodges an appeal. The results from the investigations conducted will still be relevant and should be considered by the medical inspector, without requesting repeat tests.

### Section 20(4):

"The medical practitioner referred to in subsection (3), must report to the Medical Inspector, who must then consider the appeal and –

a) Confirm, set aside or vary the decision or finding of the occupational medical practitioner, or…"

The health practitioner to whom the employee is referred needs to submit a report of the findings to the medical inspector. This report, together with other factors and other reports, are interrogated to ascertain if the decision pertaining to the fitness to work status of the employee was fair and ethical. Section 20(4) gives the medical inspector the right to confirm, set aside, or vary the decision or finding of the OMP, after the appeal has been holistically interrogated. OMPs often resort to blanket decisions, avoiding individualisation and without considering the merits of each case. Both OMPs and employees have expectations that the medical inspector will take their side, forgetting that the decision to either confirm or set aside the OMP's findings is based on the facts presented.

### Section 20(5):

"Nothing in this section precludes an employee from –

a) Obtaining and paying for a medical opinion from any other practitioner; or…"

This subsection implies that an employee may lodge an appeal and opt to self-refer to his/her own practitioner. This does not mean that the practitioner can make a ruling on the fitness to work status of the employee. The chosen practitioner needs to submit a report of the findings to the medical inspector so that the appeal can be finalised, considering the report and other factors. This option is offered to employees who are prepared to pay for a practitioner's services rather than having the medical inspector choose a practitioner paid for by the Department of Mineral Resources and Energy. This is disadvantageous to the employee as his/her chosen practitioner might not be able to perform the necessary investigations. The medical inspector might refer employees for a third opinion only if the report from the employee's chosen practitioner is inconclusive.

## CONCLUSION

Section 20 of the MHSA was drafted with good intentions, to assist employees who might have been unfairly declared unfit for work, and to provide access to a second medical opinion for employees who cannot afford to consult a private practitioner. There are, however, challenges, which include misinterpretation of the Section, and some subsections not being in sync with medical developments. There is also confusion between Section 20 disputes and those related to the incapacity process. These need to be addressed in line with the Labour Relations Act. Unfortunately, employees disputing unfair labour processes and compensation matters tend to lodge Section 20 medical appeals, which are valid only under the two conditions mentioned. Awareness campaigns by the medical inspector are ongoing to clarify the requirements and interpretations of Section 20 of the MHSA.

# Festschrift

# Professor Emeritus David Rees

## an exceptional academic and individual


## Contents



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# Honouring the lifelong contribution by Professor Emeritus David Rees to South Africa as he retires

After a lifelong and meaningful contribution to occupational health in South Africa, Professor David Rees, head of the Occupational Medicine and Epidemiology Division at the National Institute for Occupational Health (NIOH) – a division of the National Health Laboratory Service (NHLS) – is retiring. Prof. Rees has also held the chair in Occupational Health in the School of Public Health, University of the Witwatersrand, Johannesburg, since 1998.

With more than 35 years of experience, and regarded as a pioneer of occupational medicine in South Africa, Prof. Rees played an instrumental role in more than 130 research papers. During his career, he received numerous awards, including the Joan and Ian Webster gold medal in Occupational Health, the Harding le Riche gold medal in Epidemiology, and recognition for his dedication and achievement in research from the Faculty of Health Sciences at Wits University.

He has been an effective contributor to policy development and a great support to the Department of Health where he also acted as a chief director from 1996 to 1997, until he heeded a call to become the National Centre for Occupational Health (NCOH) executive director. At this time, he was also a member of several committees under the Department of Health, to establish new models for rendering occupational health services in the country in the new dispensation, producing the Abdullah Report that sought to overcome fragmentation and coordinate government activities.

It is at this time that the NCOH was restructured, and Prof. Rees managed its transition from the Department of Health to the National Health Laboratory Service where it emerged as a more modern institute – now known as the NIOH – with expanded responsibilities for surveillance programmes; more attention to occupational toxicology; the establishment of new units (ergonomics and bioaerosols); an expanded education and training programme, and extensive international collaboration. Prof. Rees continued to serve on numerous national and international commissions and has extensive experience with multilateral and bilateral agencies – notably, NIOSH, the Health and Safety Executive, the International Labour Organization (ILO), and the World Health Organization (WHO).

Since entering the occupational health sector in 1984, and over the subsequent decades, he has contributed immensely to capacity-building of occupational health professionals. He established the Master in Public Health (MPH) programme in the field of occupational hygiene at the Wits School of Public Health in 2001, in response to a shortage of trained occupational hygienists in the country. This was the only occupational hygiene programme in Africa and he managed to obtain scholarships to support students from SADC countries. Prof. Rees has also taught occupational health to various professional groups at several universities and continues to be the occupational medicine specialist for the Wits Postgraduate Diploma in Occupational Health course. At the NIOH, he has been the head of the Division of Occupational Medicine and Epidemiology since 2004, where he had oversight on a staff complement of about 30 medical practitioners, scientists and support staff.

The magnitude of his work has positively impacted millions of South African workers, and he has played a pivotal role in policy development and the creation of clinical guidelines. We are extremely proud of what he has accomplished for South Africa and our people; he continues to inspire occupational health professionals and workers alike. It has been an honour and a privilege working with him and tapping into and learning from his vast experiences, skills and knowledge.

Prof. Rees has a rich social life and is a friend to everyone. He is quietly casual in his approach to life yet has an excellent work ethic. He hardly missed deadlines and would always volunteer to take on work or start projects. His students enjoyed his full commitment to research projects.

We wish him well in his retirement and he will be greatly missed. This Festschrift is a tribute to a committed, dedicated and hard worker whose career is steeped in ethics, integrity and objectivity. It is a testament to the research he has undertaken during his working life and is a reflection of the connections and impact he has made to the profession – locally, nationally, and internationally.

Thank you, Prof. Rees. Now you can finally sit back and enjoy time with your family. We want you to know that your dedication and service to our nation has not gone unnoticed. You brought greatness with you into our midst, and made your mark here. You can rest assured in the knowledge that, whilst your presence will be missed, you leave behind many students whom you have taught well and who will advance worker health and safety across all sectors of society. You have laid the foundation for progressive occupational health in South Africa, not only for your peers but for future generations. We wish you everything of the best as you enter a new chapter of life.

On the following pages, you will read about Prof. Rees' reputation as a researcher, a teacher, a colleague, a friend, and a father, from more than 60 people whose lives he has touched. We have selected three of his research papers to republish in this Festschrift, and a list of his scientific journal publications. His book chapters, scientific reports and other contributions to occupational health would fill many more pages.

We thank everyone who contributed to this Festschrift, which was suggested at an *Occupational Health Southern Africa* editorial board meeting more than a year ago. Thanks are extended to all those who sent photographs, or wrote a few lines or much more. We also thank our sponsors without which this Festschrift would not have been possible to publish: Anglo American, the Kgalagadi Relief Trust, the Wits School of Public Health, Rand Mutual Assurance, the Minerals Council South Africa, and the South African Society for Occupational Medicine (SASOM). Prof. Rees contributed immensely to all these organisations. Special thanks go to Prof. Mary Ross (ex-director of the NIOH) for guidance on the Festschrift, Shanaz Hampson (NIOH) for finding sponsorship, arranging the event on 30 October, and much more; and the *Occupational Health Southern Africa* editorial and production teams, especially Gill Nelson (editor), Kevin Beaumont (publisher) and Bev Logan (designer).

**Spo Kgalamono,** Executive director (Acting),
National Institute for Occupational Health


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**Jim teWaterNaude**

*Public health medicine specialist: Diagnostic Medicine; Honorary senior lecturer: University of Cape Town, South Africa; Consultant: Asbestos and Kgalagadi Relief Trusts, and Q(h)ubeka Trust; Treasurer: International Mesothelioma Interest Group*

David has always made me feel welcome at the NIOH, and included me in the greater occupational health team. We share common interests in respiratory diseases – asbestos-related diseases, silicosis and tuberculosis. Each is a huge field in which he enhanced my understanding. As a frequent visitor to Johannesburg over the years, I often popped in for advice and comment, and knew that I would get a knowledgeable, experienced and reflective audience. He did not spare me scrutiny, nor difficult and searching questions, but it was done as a skilled educator – sparking interest, aligning me to a new viewpoint, or suggesting another would be a cul-de-sac. Thank you very much, David, for this. I believe there's still more to come, and thank you for your always warm and welcoming smile.

**Shan Naidoo**

*Chief specialist and head of department: Community Health, University of the Witwatersrand, South Africa*

I have known David since 1990 when I did my Diploma in Occupational Health under his guidance. He is a good human being, kind and generous, and always supportive of his students, colleagues and staff. He will be sorely missed by all of us. He has been the chair of Occupational Health in the School of Public Health for many years and is an inspiration to everyone on issues of workers' health. David carries his academic duties with true professionalism, and stamped his authority and expertise at the faculty level where he is well respected. He assisted with the registration of occupational medicine as a specialty with the HPCSA, and formed the Occupational Medicine Division of the College of Public Health Medicine, where Occupational Medicine is now a separate specialty. His lasting legacy will be for fighting for workers' rights to good health in South Africa!

**Nicola Christofides**
*Wits School of Public Health, University of the Witwatersrand, South Africa*

When I think of my interactions with David, there is a saying that pops into my mind, which he personifies: "A candle loses nothing by lighting another candle". David has given so much to strengthening the capacity of others and enabling them to become leading lights in occupational health and hygiene. Through his supervision and mentorship of others, they have been able to put in place measures to better protect the health and wellbeing of employees, their families and their communities, and to compensate people who have been affected by occupational exposures.

David was the pioneer of the field of study in the MPH in occupational hygiene. He was motivated by wanting to elevate the field and to strengthen the skills and advance research in occupational hygiene. Along the way, he supervised many students in occupational hygiene as well as those doing MMeds and PhDs. So many have gained through his kind and generous approach to supervision and mentoring.

I have learned many things from David; one of the lasting ones is his approach to assessing student protocols. He always expressed his view that the focus of assessment should be on the big conceptual issues rather than on the details. It is easy sometimes to get caught up in details so that we miss the bigger picture – David always reminded me of the bigger picture. He is a gentle giant in the field, a visionary, and a man of purpose.

**Lucille Blumberg**
*Deputy director: Epidemiology, and founding head: Division of Public Health Surveillance and Response, National Institute for Communicable Diseases (NICD), South Africa*

David, we first met in the 1980s when you arrived in the ICU at ' Bara' for a six-month stint, fresh-faced, energetic, full of the joys of life and, might I say, 'needing to be kept in line, a touch'. Our paths have crossed so many times over the years when you took on occupational health – you were always a mine (pun intended!) of information and a clear thinker around 'occ health' matters. I learnt the art of innovative and creative teaching from you when I studied for the DOH in 1990/1991and this really informed my own teaching style. Most recently, we shared a forum to prepare mines for COVID risks and 'return to work', and your clear thinking and experience shone through the politics and confusion. It's your time now to spend on things you enjoy, and with Sue and your family. I still plan to call on you, so don't cycle too far away.

**Gill Nelson**
*Wits School of Public Health, University of the Witwatersrand; Editor-in-chief,* Occupational Health Southern Africa

I met David in the mid-1980s when I was fresh out of university and didn't know the meaning of epidemiology. Tony Davies was instrumental in my joining the National Centre for Occupational Health, as it was then known, and I suspect that he also played a part in David joining the Centre. I loved working there and learning about occupational health (and even a little bit of medicine from the young doctors, including David). It was also a lot of fun. I remember doing field work with David and other colleagues in the 1990s, at a poultry farm in Delmas (I think) – my first real field work experience that involved collecting data from workers.

While many of the doctors and scientists from those 'early days' eventually left the NCOH to pursue careers at South African and other universities and research institutes, David remained – steadily teaching and learning about occupational medicine, and providing care to workers who came to the clinic for help. We both taught on the DOH programme in those years and continue to do so – David more than me.

David writes as if he was born with a pen in his hand. Most of us take months to write a paper for a journal; David takes a week. It comes so easily to him; his publication list is impressive! His extensive knowledge about occupational health is evident, not only in his writing, but also in his interactions with colleagues and students to whom he gives thoughtful guidance and advice, stimulating lectures, and supportive research supervision.

As many have noted, David is humble, and softly spoken. But he is also quick to crack a joke (his subtle humour is often missed), and to laugh at himself. Perhaps a sense of humour has saved him from despair in the many times that he has missed flights (returning home from Barcelona being only one example), lost laptops and cell phones, lost his way in foreign cities (his 'Japan' – was it Tokyo? – story is particularly funny), and injured himself quite by accident (the most recent involving a hotel room and a broken collar bone). Many years ago, I shared a taxi with David in Cairo. While I don't remember exactly what caused us to laugh hysterically on that journey, I do recall that it involved drinking beer and needing a bathroom.

It feels as if I have known David forever – certainly, 35 years is a lifetime. He has been a superb role model to many, including me, and his quiet presence at Wits will be missed. Having said that, he knows that he is going to continue to be harassed to give the odd lecture, share some of his infinite wisdom, and sometimes just join us for a cup of coffee or a beer.

**L-R: Frans Coetzee, Kevin Renton, Lea Roodt, Vali Yousefi, David Rees, Danuta Kielkowski, Rudi du Toit, Rosalie Lowe, Gill Nelson** *Photograph: Courtesy of Gill Nelson*

**Thuthula Balfour**
*Head: Health Department, Minerals Council South Africa*

I first met David in 1997 when he lectured me in the Diploma in Occupational Health (DOH). I never imagined that I would work so closely with him – and I did when I joined the mining industry in 2008. From then on, David was the go-to person for all things related to occupational health in mining, especially occupational lung diseases. I particularly appreciated the balanced way in which he viewed the evolution of these diseases, always firm on why and how more should be done to spare more people from the devastation of pneumoconiosis.

Though retired, David, I hope that you will continue to contribute to the body of knowledge in our industry and occupational health in general. We also wish you some well-deserved rest and more time with your wife and family. All of the best.

**André Rose**
*National Cancer Institute, Bethesda, Maryland, USA*

I value the influence you have had in my life, David. Thank you for being a mentor during my studies. Your passion for occupational health and social justice have aided in fanning the fires for the discipline in my life. You have helped forge an enthusiasm in me for research and I value the guidance you have given me. You have challenged me to think broadly about life and the perspectives one holds regarding matters, and I cling dearly to these lessons learnt. I enjoyed the broad spectrum that our conversations have spanned and it's always a pleasure for me to engage with you. Your legacy in occupational health is iconic. More than your professional prowess and influence, I value you as a person. You are principled, caring, contemplative, thoughtful and considerate. You are zealous and add flavour to life with your dry and unique sense of humour. Your holistic view of life is refreshing and encouraging. I pray that, as you enter this next season of your life, you will continue to embrace life, that you will have joy and contentment, and that you will have many opportunities to infuse yourself into the lives of the people around you.

**NIOH year-end celebration 2019. L-R: Odette Volmink, Karen du Preez, Jeanneth Manganyi, David Rees**
*Photograph: Shanaz Hampson*

**Odette Volmink**
*Occupational medicine specialist: National Institute for Occupational Health (NIOH), South Africa*

From my very first encounter with Prof in 2010, I have witnessed, first-hand, the extreme level of excellence that he strives for. At the start of my career in occupational health, while completing the Diploma in Occupational Health at the University of the Witwatersrand, I would religiously ensure that I attended all Prof's lectures. These would often be succinct and so simplified that a novice in the field of occupational health would be able to easily grasp the content. In true Prof-style, at the end of the lecture, all the important take-home messages would be highlighted on the flip chart, making it largely unnecessary to revisit those lectures before the exam. His insightful teaching points were invaluable when a patient with the medical condition lectured on required an assessment at the occupational medicine clinic.

Prof. Rees' excellence spilled over to all areas of his practise of occupational medicine. I was always humbled by his love for patient interaction, and this was very much reciprocated. His patients were often visibly disappointed if they had to consult with any of the other doctors in the clinic. Usually, on presenting at the reception area, you would very clearly hear his patients say: "Hi, I'm Prof Rees's patient…". Prof would meticulously care for his patients, listening attentively to their detailed histories, and always going the extra mile; filling out every form, and discussing the implications of the clinical findings so that the patient was very involved in the decision-making process, particularly where it may have financial implications for workplace management. He honestly strived to make working life better for all workers – for individual patients who consulted him, but also those workers whom he indirectly assisted through the research that he was involved in during his career.

While completing the research component for my specialisation, I gained a great appreciation of Prof's selfless dedication to his students. Although I was concerned about not completing my research in time, the ever-patient Prof provided such excellent academic mentorship that I was able to complete this well within the allocated time limit.

Although many of Prof's attributes have impressed me over the years, one that deserves to be mentioned is his kindness. To date, I have not heard a harsh word addressed to any of his subordinates; instead, he is always willing to support, to speak to an expert on your behalf if needs be, to direct you towards the best articles/books written on the subject that you are enquiring about, and always willing to give you a recommendation or introduction if needed. He always treated his staff like his own children, stressing like a parent as we went through our fellowship exams, and giving advice to ensure that we are always progressing and have avenues to follow our interests.

Prof has been a great mentor to me over the last decade and I count myself truly blessed to have worked under his guidance. He epitomises the wonderful combination of professional brilliance and humility, and lives up to the commonly used quotation about success:

> *"To laugh often and love much; to win the respect of intelligent persons and the affection of children; to earn the approbation of honest citizens and endure the betrayal of false friends; to appreciate beauty; to find the best in others; to give of one's self; to leave the world a bit better, whether by a healthy child, a garden patch or a redeemed social condition; to have played and laughed with enthusiasm and sung with exultation; to know even one life has breathed easier because you have lived – this is to have succeeded"*.
>
> Ralph Waldo Emerson

And Prof, you certainly have.

**Vanessa Govender**

*Lecturer/Academic coordinator: Occupational Health Division, Wits School of Public Health, University of the Witwatersrand, South Africa*

What is occupational medicine without a passionate teacher like Prof. Rees? Even now, as a teacher of occupational medicine myself, I am still learning from this giant in occupational health.

In 1998 I started my studies in the Diploma of Occupational Health (DOH) at Wits – inspired by mine workers on the gold mines, and motivated by great leaders at the National Centre for Occupational Health (NCOH), as it was known then, and Wits University. Prof. Rees imparted great wisdom and supremely insightful learnings in a speciality that was almost unheard of at the time. He took us on a journey that was filled with questions (and answers) and which made one enquire deeply why workers had to be exposed in the first place. Examining those exposure-outcome relationships with deep clinical insight, science-based evidence and with sheer humility, he taught me how to apply science, art and heart into decision-making, from the coal face to the board room. For him, workers' health within a decent work agenda was always top of mind.

As my career meandered over the years, it didn't matter which crossroad I was at – preparing for a corporate board presentation; setting the DOH course week; assignments and exams; navigating from face-to-face to online lectures during the onslaught of the COVID-19 epidemic; deciphering nodules on a chest X-ray that were p1 or p2; or writing standards for compensation for occupational lung diseases. Neither did it matter who I was dealing with – be it the CEO, an irate client, a patient whose lungs were wrecked by TB/silicosis, a frustrated labour representative, an impatient lawyer, a bereaved wife of an ex-mine worker wanting justice, or an anxious student – Prof. Rees was always a phone call away.

Even now, in this COVID-19 pandemic, Prof. Rees' teachings resound as we contribute by applying those fundamental principles of occupational medicine in a tough new world order where businesses are more dependent on us occupational health professionals.

Prof. Rees, as you enter this exciting phase with great fortitude and a sense of sheer restfulness, know that your indelible legacy of occupational health (both medicine and hygiene), placing this noble speciality rightfully on the academic, business, social and humanitarian agendas, where it belongs, not just on the continent but globally, lives on. We, in the Wits School of Public Health, and the many occupational health and safety professionals and specialists who had the honour of being taught by you, are eternally grateful to you.

**Organisers and some participants at a dinner at Moyo Zoo Lake, Johannesburg, after conducting the ILO/NIOH Training Workshop on Prevention of Pneumoconiosis, November 2016. Back L-R: Cornelia le Roux, Spo Kgalamono, David Rees, Jaco Folmer; Front L-R: Dingani Moyo, Vanessa Govender, Odette Volmink** *Photograph: Guy Hall*

**Lars Barregård**

*Physician and senior professor: Occupational Medicine, University of Gothenburg, Sweden; Sahlgrenska University Hospital, Gothenburg, Sweden*

David, this very skilled researcher and clinician in occupational medicine, has been my friend for a long time. I think it was in the early 1990s that we first met, probably at a scientific meeting. We started exchanging experiences on clinical work, with David spending some time at our Occupational and Environmental Medicine Department in Gothenburg, Sweden, and I did the same at the NIOH. I learnt a lot from this, and I think David did too. The first time I visited Jo'burg, it was also my first visit to a gold mine (Durban Deep) and to a manganese smelter. It was probably around 1994 because I remember seeing Nelson Mandela on TV, maybe as the newly elected president.

Later (in the 2000s) we arranged, at the NIOH, a course for registrars and occupational health physicians, which was very nice and provided further contacts with South African colleagues. Other nice and clever staff (Spo Kgalamono and Adri Spies) have visited us in Gothenburg.

But, apart from interesting professional discussions (the latest ones on kidney disease), my long-term relationship with David would probably not have developed if he had not been an extremely kind, warm-hearted, fair, and honest individual. It has also been a pleasure meeting David's nice wife Susan, who also had the opportunity to visit us in Gothenburg. I will continue to ask David for professional comments when needed, and maybe Wits and the NIOH will be able to do the same.

I hope we will meet soon again David, at least on the computer screen.

**Guy Richards**

*Emeritus professor: Critical Care, University of the Witwatersrand, South Africa*

Dave and I go back to Medical School where he sat next to me in first year, as both our names began with 'R'. He always was the most laid back member of our class, taking more of an interest in the cricket at Wanderers than botany, with both of us regularly 'escaping' to watch important games. He was politically active at the time and this was fueled by the tragic death of his brother, which had a tremendous impact on his whole family, but on Dave in particular. He managed to recover from this and continued with his studies where he later met Susie, his life-partner, who was not only instrumental in providing a stabilising influence on him in terms of work, but who also encouraged and reinforced his political involvement. Whereas he was always somewhat halfhearted about his studies at Medical School, when he discovered occupational medicine, he realised and achieved his role in life, drawing attention to the plight of the under-privileged by performing cutting-edge research into the harm caused to individuals by unregulated mining and industrial activities, particularly during the Apartheid years, but after this time as well. Dave is retiring but his expertise in and his contribution to this field will always be valued. I have no doubt that he will continue to be consulted for years to come and will continue to nurture those who will replace him.

**Edith Ratshikhopha**

*Medical scientist: Immunology & Microbiology Section, National Institute for Occupational Health (NIOH), South Africa*

I am grateful to have worked under your leadership and have gained a lot from your wealth of knowledge and experience. Have a wonderful future with lots of time to enjoy with your loved ones.

**Derk Brouwer**

*Distinguished professor: Wits School of Public Health, University of the Witwatersrand, South Africa*

Despite living in Johannesburg all his life, it is still sometimes difficult for David to find his way home. Hilarious are the anecdotes that David tells about getting lost in unknown buildings and being unable to find his way back to the lecture theatre from the bathroom... everything suggests that David has trouble finding the right direction.

In contrast, in his professional life, David has demonstrated being able to choose promising directions, especially regarding the importance of occupational hygiene in occupational health. His vision drove him, in the early years of this century, to initiate the occupational hygiene field of study within the Wits MPH programme, and to develop a curriculum (MPH-OH).

He was also the driver of the Anglo American-Wits endowment to establish a Chair in Occupational Hygiene to further support the capacity-building of occupational hygiene in South Africa. His open mind and critical scientific attitude made him a partner in our endeavour to transform occupational hygiene in South Africa. David significantly supported and contributed to the implementation of the ideas of exposure science into a teaching and learning (T&L) programme, and the phasing out of the MPH-OH programme that he established decades ago. With this, he surpassed himself and chose a new direction where science-based interventions to reduce (occupational) exposures are considered more important than the traditional approach of sampling/monitoring for compliance testing.

David has done a lot to connect the medical side of occupational health with assessing stressors in the workplace, both in his own research and in his contributions to the Wits T&L programmes. I am personally grateful that his vision and efforts in this field resulted in my affiliation with Wits; happily, he also became a friend. I can testify from personal experience that reaching the age of 65 does not necessarily mean that you should end your contributions to your field of expertise. Therefore, I hope and trust that David will continue to contribute to the development of occupational and environmental health in South Africa, and guide it in the desired direction.

**Derk Brouwer and David Rees playing chess at the Rand Club, 2016.** *Photograph: Gill Nelson*

**Brian Gibson**

*Chairman: Kgalagadi Relief Trust (established in 2006 to support former asbestos mine workers); Counselor to Everite Building Products since 1982 on the company's transition to non-asbestos products and the management of legacy issues*

Thank you for being the voice of reason and common sense in the world of occupational health and safety over the past 30 or more years. Your pragmatic approach to problem-solving, your sound judgement, and your thoughtful advice freely given, have set a fine example for the next generation of practitioners and researchers that care about workplace health and safety. Your humility, accessibility and sanguinity are shot through by a resolute commitment to equity and fairness. Time and again, you have helped translate arcane research outcomes into practical solutions. Your sensible counsel has helped many industrialists achieve ever higher standards of occupational health and safety. Your wisdom and experience remain invaluable. Please stay available to academia and industry as a counsellor.

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**Shanaz Hampson**

*Marketing and communications manager: Communication and International Liaison, National Institute for Occupational Health (NIOH), South Africa*

Prof. Rees – you are one of the most humble, honest and intelligent people I have ever met. You exude a quiet confidence and willingness to listen to others, no matter what their stature/position in the company. Your door is always open and, despite me arriving unannounced, you make time to lend me you ear. You offer valuable insight into any discussion we have or stressful situation I am faced with – especially those that require guidance, prudence and a level head. You embody Horace's spirit of *Sapere Aude* (Dare to Know) and your faculty for reason and innate ability to think critically and laterally is what I admire most about you.

I will miss seeing your veldskoene walking down the halls of NIOH and your beaming smile that can illuminate a room. We will miss you very much, David. While you may be leaving this office, your legacy at the NIOH and your contribution to workers' health will live on forever.

I have had the distinct privilege of working with you, for which I will be eternally grateful. Thank you for being an inspiration to us all! Wishing you lazy days and good quality time with your family – soaking up the sun and doing the things you love most.

*Au Revoir*

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**Lindsay Zurba**

*Director: Education for Health Africa*

The name 'Prof. David Rees' is widely known throughout the occupational health community in South Africa and beyond. David, as you now shift gears into the next chapter of your journey, I would like to add my thanks for your contribution to the continued development of occupational health and your support of me, personally, in my professional walk. When I have had a question or needed advice about spirometry, that no-one else could help with, I was always able to ask you and you always responded. I appreciate the time you have given me over the years. In the coming years, I wish you quality time with your family, and time for the pursuit of personal interests. I wish you peace and contentment, knowing that you have given much to improve the world and your community. I, with your other colleagues far and wide, honour and thank you, and wish you well.

# Tributes

**Denise Minnie**
*President: SASOHN; on behalf of SASOHN members*

The South African Society of Occupational Health Nursing Practitioners (SASOHN) would like to honour and congratulate you on your legacy of hard work, an outstanding career, and the many valuable contributions you have made to the occupational health industry, David. You have not only devoted years of your life to this industry but have left a positive mark on all professionals, both national and international. This has made a huge difference and touched many of us along the way.

While many of our members only had the chance to work with you briefly, it is clear that your dedication has made a huge and positive impact on the broader industry. Your contributions have helped so many to thrive, as they have been fortunate to have your expertise to rely on.

For many in the industry it was great working with you – your work truly made a lasting impact, and one that has changed the landscape for the better in so many ways. Most mere mortals walking this earth will leave a more modest legacy that doesn't necessarily change the world, but does leave a lasting footprint that will be remembered by those whose lives you touched.

You are a true professional who has shown, by example, that excellence is something to aim for every day. Thank you for being a tireless professional and a game changer. Congratulations on your very well-deserved retirement.

**Kate, Jan and Nicki Rees**
*David's daughters*

Our earliest memories of David, our father, and his work, are of visits to his office at the NIOH over the weekends. We loved the creepy atmosphere of the empty building. He would hide in doorways and jump out to give us a fright, sending us screaming and laughing along the corridors.

Over the years Dad has shown us how fascinating he finds occupational medicine. He is always talking about an interesting patient he saw, or project he is working on. His enthusiasm for his work is infectious and reflects his attitude to most things in life.

As adults, and particularly in the public health and NHLS worlds, we realised how well respected and admired he is and how rare his expertise is. But also, how many long-term friendships he has formed among his colleagues – no doubt due to his kindness, humility and sense of humour. He used to tell us his job was shuffling papers around, and a classic joke about public service: "Why are public servants not allowed to look out of the window in the morning? Because they would have nothing to do in the afternoon". This belies his ethical approach to his work, and a career dedicated to public service.

Dad always says that the wonderful thing about medicine as a career is that there is a place for everyone, and he certainly found his place in occupational medicine. Thank you for showing us how to be passionate about your job, and that work is about more than earning a salary. We are looking forward to the adventures still to come.

**SPONSOR**

# The Kgalagadi Relief Trust

The Kgalagadi Relief Trust was formed in 2006 when Becon, on behalf of the former Swiss Eternit Group, established a fund to provide financial relief to individuals who contracted compensable asbestos-related diseases (asbestosis, asbestos-related pleural thickening, lung cancer and mesothelioma) as a result of exposure to the Kuruman Cape Blue (KCBA) and Danielskuil Cape Blue (DCBA) asbestos mines between 1952 and 1981.

The Kgalagadi Relief Trust is administered by the Asbestos Relief Trust (ART), established in 2003 to similarly provide financial relief to former employees of asbestos mines.

From the start of the Trusts to date, some 18 928 people have applied for benefits from the Trusts. Of these 15 588 have qualified for further assessment because of their work records or geographic location.

Thirty-two percent of the qualifying claimants have received monetary benefits from the Trusts, amounting to just over R501 million.

In addition to these benefits, the Trusts set up a Palliative Care Medical Service in 2007 for those suffering from terminal diseases, as well as a prosection service so that ex-miners may avail themselves of an autopsy examination for hitherto uncompensated conditions.

They are also the major sponsor of the NGO Asbestos Interest Group (AIG), which raises awareness in the greater Kuruman area about the dangers of asbestos and related environmental management issues.

In response to the COVID-19 hardships the KRT has additionally instituted a food voucher scheme to soften the economic blow of the lockdown on families who are living with an asbestos disease sufferer, or who have lost a loved-one to asbestos.

Guided by the respective Trust Deeds and in the spirit of righting the harms of the past, the trustees are intent on leaving a positive legacy in the asbestos-mining areas which they serve.

| Statistic | Explanation |
|---|---|
| 18 928 people have applied for benefits from the Trusts | Number of claimants on ARTMIS/Inyosi |
| 15 588 have qualified for further assessment | Number of files in the medical office |
| 32% of the claimants have received monetary benefits | 4 985 (# paid)/15 588 (# in medical office) |
| Benefits from the Trusts, amounting to just over R501 million | R391 753 496 (ART) + R109 671 897 (KRT) |

**Stephen Tollman**

*Research professor; Director: MRC/Wits Rural Public Health and Health Transitions Research Unit, Wits School of Public Health, University of the Witwatersrand, South Africa*

## EARLY ENCOUNTERS

My first memories of David are of a thoughtful, modest and sincere person who, as a student, for years spent holiday periods on SAVS (South African Volunteer Service) 'camps' in rural South Africa, working in the (then) bantustans as a volunteer, building schools and other infrastructure where the need could not be greater. David did much of this together with his partner, Sue, and perhaps this laid the basis for their lifelong, mutually supportive and continuing partnership.

Though we shared a common network of friends and crossed paths professionally, we never worked directly together – although my awareness and understanding of occupational health and workplace exposures owes much to David. As our research on complex health transitions in rural South Africa gained momentum – with studies on internal labour migration a key element – it's clear the potential for future research collaboration with David remains; I would welcome this.

## RURAL RESEARCH

In Agincourt, a sub-district of Bushbuckridge in northeast South Africa that abuts on the Kruger National Park and thence southern Mozambique, we're following a 'whole population cohort' of some 120 000 persons of all ages, living in 31 contiguous villages. Doing so for over 25 years has resulted in a versatile research platform (in formal terms, a health and socio-demographic surveillance system or HDSS), the backbone of which is the regular and repeatedly updated recording of vital events through longitudinal follow-up, viz. births, deaths and in/out migrations, along with household composition. While efforts to strengthen South Africa's vital registration system have made great progress in recent decades, it remains the case that around half of deaths in rural environments do not occur in hospitals or clinics (and so are not readily accessible) but take place at home and elsewhere in local communities.

An HDSS research infrastructure like Agincourt is well suited to life-course studies traversing birth and childhood, through adolescence into young adulthood and onward into middle and older age. This progression across key life stages enables causal work over the longer term, linking, for example, the evolution of physiological and behavioural risk at younger ages with expressions of disease in later life. Similarly, the contribution of more distal or structural determinants (such as health and education systems or employment regimes) becomes tractable.

It is fair to suggest that no study in an HDSS is simply cross-sectional; rather, such studies serve at least as baselines, the later health outcomes of study participants being observed through longitudinal follow-up. Furthermore, the conduct of trials and other forms of intervention-evaluation, including policy impacts, are enabled by the research infrastructure, and benefit from the solid community engagement that is an enduring feature of research practice in Agincourt.

**David Rees with his wife, Sue Goldstein**

*Photograph: Sue Goldstein*

## MINING AND MIGRATION

Over the years, most men throughout their lives, and increasingly women, especially those younger, seek jobs and livelihoods outside of Bushbuckridge. Hence labour migration is ubiquitous – some to nearby farms and game lodges, but much to towns and coal mines on the route to Johannesburg, some 500 km to the south-west. It was only when the CEO of Anglo-Coal visited Lillydale village in Agincourt sub-district – to convey the company's substantial support for the newly established Bhubezi Health Centre – that I appreciated the extent to which Bushbuckridge communities contributed their menfolk to the distant coal mining industry. Thus, the study of mining exposures (or other occupational or environmental influences) and their effects on later health outcomes after migrant labourers return to their rural homes, remains highly pertinent.

I confess that until I read Charles van Onselen's recent book *The Night Trains*, where he delves into the brutal journey of Mozambican mine workers from the Sul do Save on the Eastern Main Line (from Lourenço Marques to Ressano Garcia/Komatipoort and on via Waterval Onder and Waterval Boven to the Witbank coalfields on the Highveld, ending in Johannesburg at Booysens Station), I had not appreciated that mine labourers from southern Mozambique comprised a majority of those working South Africa's gold mines by the late 19th/early 20th centuries. Nor was I aware of the scale of exploitation involved from which the Portuguese colonial administration also benefited. Learning about this brings far deeper meaning to our research involving sizeable numbers of Mozambican immigrants (many former self-settled refugees) who departed Mozambique in the course of a civil war and, after an arduous journey, settled long-term in the Agincourt sub-district and environs.

With labour migration so prominent a feature of daily life in rural South Africa – then and now – concerns about 'loss to follow-up' in observational or intervention studies are well founded. To counter this, the MRC/Wits-Agincourt Research Unit has adopted approaches that have earned some success, and so are shared briefly:

- First, as with most effective cohort or panel studies and trials, to ensure that relationships with study participants remain positive and are reinforced through regular ongoing contact;
- Second, to build a specialised capability for participant follow-up along the routes followed by migrant workers, both near at hand and further afield; and
- Third, to invest in setting up a telephonic call centre with well trained, supported and monitored call centre agents – a system for sustaining contact with study participants which is proving invaluable, not least in a time of COVID.

## CONCLUSION

In South Africa, 'retirement' for many comes in one's mid-60s, an age where some are quite youthful with far more to give to a society riven by profound inequalities and the distortions of unbalanced social development. The Wits School of Public Health can ill afford to let go of David's wisdom, expertise and presence which, together, add exceptional value. Equally, the door to partner with the Agincourt team is wide open. May the closing of this chapter simply mark the beginning of the next, with occupational and public health the abiding themes.

**Daan Kocks**
*Chair: SASOM; on behalf of SASOM members*

The South African Society of Occupational Medicine (SASOM) takes the opportunity on this auspicious occasion – your official retirement – to honour your long and illustrious career in occupational health and occupational medicine, and as a member of our society, with honorary life membership of SASOM. Your life's work has made invaluable contributions to the development of occupational health and occupational medicine in South and southern Africa, and SASOM and its members are grateful and appreciative of your insights and inputs over the past four decades.

As a full-time specialist practitioner in occupational medicine in the posts of head: Occupational Medicine Section and Occupational Medicine and Epidemiology Division at the National Institute for Occupational Health (NIOH); professor of Occupational Health, University of the Witwatersrand; director and acting director of the NIOH and its predecessor organisation, the National Centre for Occupational Health (NCOH); acting chief director: Occupational Health; researcher; collaborator; reviewer; editor; examiner; supervisor of postgraduate studies; lecturer; invited presenter; and member of numerous committees – your work speaks for itself.

In all the posts that you have held over the years, your work in various capacities has made a positive difference to the health and safety of our working populations, by promoting, protecting and enhancing the wellbeing of workers across numerous sectors.

Your teaching and training activities, at both undergraduate and postgraduate levels, have developed occupational health practitioners across the three occupational health pillars – medicine, nursing and hygiene – as well as sociology and engineering; and have extended beyond tertiary institutions to workers and trade unions. You were instrumental in establishing and overseeing the Diploma in Occupational Health (DOH) and Master of Public Health (MPH) degree at the University of the Witwatersrand, as well as a four-year training programme for registrars in occupational medicine.

Your profile as an active researcher and your experience as research manager and study supervisor in a range of topics, including compensation, occupational asthma, mesothelioma, pneumoconioses, occupational health services, occupational allergy, and surveillance of occupational lung disease, have inspired many of your past students to become researchers in parallel with their practice of occupational health and the specialty discipline of occupational medicine.

Throughout your professional career, you have embodied the vision and mission of SASOM, and to honour your invaluable contribution to furthering all aspects of occupational health and occupational medicine in South Africa in an ethical manner, SASOM takes great pride and pleasure in offering you honorary life membership.

May your retirement be as rewarding as your long and illustrious professional career, and may your collaboration with SASOM continue for many years to come.



# The South African Society of Occupational Medicine (SASOM)

Website: www.sasom.org, e-mail: info@sasom.org

The South African Society of Occupational Medicine (SASOM) and its members salute the brilliant career of Prof. David John Rees in various facets of occupational health and occupational medicine over many years. In recognition of his invaluable contributions and dedication, SASOM is pleased to award him the prestigious title of 'SASOM Honorary Life member' and congratulates him on his well-deserved retirement – may it be happy, healthy, hopeful, and fulfilling.

SASOM is a professional society, registered as a special interest group with the South African Medical Association (SAMA) and affiliated to the International Commission on Occupational Health (ICOH).

## SASOM VISION

- To enhance the quality of life of the working population of South Africa during employment and into retirement

## SASOM OBJECTIVES

- Health
- Wellbeing
- Elimination of hazards
- Sound communication
- Continuous education
- Knowledge contribution
- Professional standards

## SASOM AIMS

- Ensuring the health of workers
- Promoting and protecting healthy and safe working environments
- Continuing professional development through accredited activities
- Enabling workers to lead productive lives and to contribute to sustainable development
- Developing occupational medicine as a distinct and recognised speciality
- Contributing to national and international health strategies and policies

In existence for 72 years, SASOM continues to have a positive impact in the South African world of work. It has harnessed medical insights and combined these with practical solutions to promote, protect and enhance the health of the working population of South Africa. The Society is well respected and regarded as the guardian of ethical and medical standards in South African occupational medicine. It furthers the knowledge base and skills development of the sector by continually providing professional information resources on occupational health matters.

**Kerry Gardiner**

*Visiting professor: University of the Witwatersrand, South Africa; Former director: Institute of Occupational Health, University of Birmingham, UK; CEO: Odyssey Occupational and Environmental Solutions Ltd., UK; Chief scientific officer: IHP-Analytics Ltd., UK*

First, with your indulgence, I would like to note how truly honoured and privileged I am to be able to say that not only do I know you, David, but I consider you a lifelong friend – well, at least from my side! I am also profoundly grateful that I have been given the opportunity to write something to mark your retirement.

So, where do I begin? The journey started in the late 1990s. I had been communicating with David for some time whilst I was at the Institute of Occupational Health in Birmingham, England, and David at the NIOH and Wits, regarding the possibility of taking up a Visiting Professorship at Wits. He had laughed when I recounted how I had informed my father of this possibility, and he was a little reticent until I stated that it was Wits, at which point he was so pleased as historically the academics had proudly and resolutely stood up for what was right.

If my memory serves me well, we had started to design the Occupational Hygiene MPH by long-range e-mail tennis and, hence, at that point had not met. However, before I ever came to South Africa, David and I met for the first time in Chiang Mai in northern Thailand, as fellow directors of the World Health Organization Occupational Health Collaborating Centres. It was wonderful to have David mentor me through the process of these international meetings, where an enormous amount is said (but remarkably little of any consequence) but, strangely, always in the most beautiful locations.

Anyway, sometimes things happen that help you define someone. About 10 miles outside Chiang Mai is the famous and truly beautiful temple called *Wat Phra That Doi Suthep* that resides on top of the mountain – some 1 100 metres above the city. Thai people often say that there are two seasonal temperatures "really hot" and "even hotter", with the humidity fluctuating from "very humid" to "saturation". Well, on one day of "even hotter saturation" weather conditions, a trip to experience the temple was arranged. I looked for David at the hotel as everyone boarded the bus – he was nowhere to be found. The bus drove to the base of the mountain and then proceeded to rise up the mountain through all the 'switchbacks' where the elevation had become truly steep. As we neared the top, the driver exclaimed something in a most alarmed and animated way – but I did understand the word *'Farang'* – the colloquialism for 'white person'. A few seconds later, we did indeed pass a crazy white man running up this mountain in the midday heat. As I looked back, I caught a glimpse of his face and it looked a lot like David. As we were disembarking, who should run into the car park, but David. He looked in far too good condition for someone who had just run that far up that gradient in the most extreme weather conditions. As an occupational hygienist, I promised to one day teach him about the uncomfortable effects on the human body of high dry bulb temperature, radiant heat, increased (self-induced) metabolic rate, and relative humidity. Even more disturbingly, David refused the air-conditioned bus and again ran back down the mountain to the hotel and, remarkably, was ready for the next session.

I think that it is safe to say now but, in 2012, David had realised that the British Lions were coming to South Africa to play the Springboks. He carefully set the dates so that I could arrive on the Saturday to see the 2nd test and leave straight after the 3rd test. Imagine my disappointment, when I arrived, that the Lions were already 1 - 0 down in the series after a blind New Zealand referee didn't realise that the loose head prop is supposed to drive parallel with the touchline, rather than with his entire body pointing through the Lions' hooker at the touchline. So, there I am at the 3rd test, hoping for a referee who was not visually impaired, only to see a French ref run out! Anyway, David was supposed to join me for the 3rd test at his beloved Ellis Park but, unfortunately, could not make it – a shame as it was a good match and one that much more accurately reflected the gulf between the two teams! But thank you, David, for enabling that incredible experience.

I have David to thank for SO many things. Resultant from his vision, drive and desire, South Africa created a brilliant MPH to train occupational hygienists of the future, not replicating the mundanity of the past, and I was humbled for him to want me to be part of that. Many people had said that Africa is special, and I felt it the moment my feet touched Africa at O.R. Tambo International Airport. David was the most gracious host and immediately introduced me to his wife, Susan, and their lovely family. He has always remained as such; for that, I thank you! His love and enthusiasm for Africa has always been so infusive that I decided to live in Zambia. We don't yet have a rugby team capable of taking on the Springboks – but we will soon!!.

Humility is rarely a comfortable bedfellow of excellence, but David pulls off this balance with effortless aplomb. Wherever I have travelled around the world, people talk about this particular occupational health physician in reverent terms; they look at me in wonderment when I say, "I know him". For example, a short while ago, I was with the head of Occupational Health for Zambia who was eulogising that the world's top expert in evaluating chest radiographs had graced and humbled them with his presence. I asked, "Do you mean David Rees?" He was amazed that not only did I know of him but I also knew him – my 'stock' in Zambia has, since, increased infinitely.

David, thank you for everything that you have done for the NIOH and Wits. Thank you too for your enormous contribution to occupational health in South Africa, Africa and the wider world. A truly heartfelt thank you, too, for everything that you have done for me and, most of all, for being a true friend. I pray that we will never lose touch and I promise to buy you a ticket for the 3rd test in 2021. Take really good care of yourself, my friend.

**L-R: Rob Ferrie, Mary Ross, Ina Naik, Danuta Kielkowski, and David Rees in Milan for the ICOH2006 Congress**

*Photograph: Claudina Nogueira*

**L-R: David Rees, Jill Murray and Vera Ngowi at the WAHSA Programme dinner, Maputo, 2008**

*Photograph: Claudina Nogueira*

**Mary Ross**

*Honorary professor: University of the Witwatersrand, South Africa; Honorary life member: SASOM; Honorary life member: MMPA; Member: International Advisory Board for Occupational Medicine; Director (2004–2007): National Institute for Occupational Health (NIOH), South Africa; Board member (2009–2015): International Commission on Occupational Health (ICOH)*

*"A gentleman is one who puts more into the world than he takes out."*
George Bernard Shaw

David Rees is the epitome of Bernard Shaw's definition; he is a long-standing colleague who has not only contributed significantly to global occupational health but also encouraged me at a career and personal level. Some 30 odd years ago, he taught our Diploma in Occupational Health (DOH) class as Wits when he was already well established in the field of respiratory occupational health and, since then, he has been my 'go to' guru from my various hospital, mining, and academic positions. In those days, we worked together on developing the medical undergraduate occupational health course and workplace visits at Wits to establish occupational health teaching at a level far surpassing many international medical schools. He also supported the development of the academic hospital occupational health service that I started when we followed up latex allergies among the health personnel.

David was involved in negotiations, instigated by the late Stuart Shearer, with the UK Faculty of Occupational Medicine (FOM), to support postgraduate training in occupational medicine, and we were both honoured in 1997 with the award of membership of the FOM. David organised opportunities for rotations and supervised research projects to enable local doctors to obtain the specialist qualification from the UK prior to the establishment of the Division of Occupational Medicine within the South African College of Public Health Medicine. When the latter was established, David was among the first to be recognised with a fellowship associated with the local status of specialist in occupational medicine.

Working with David has always been a pleasure. Our earliest literary collaboration was the co-authoring of two chapters on 'Occupational medicine in clinical practice' and 'Occupational epidemiology' in 1999 for EasiLearn's undergraduate series on public health medicine. To mark the 50th anniversary of the National Institute for Occupational Health (NIOH) in 2006, David, Prof. Tony Davies and I, as the past and current directors, published an article, summarising the achievements of the Institute since its inception while, for the annual Webster Day, David and I presented the role of the NIOH in global occupational health.

David was solely responsible for luring me to the NIOH in 2004 and, with the amazing NIOH staff support, ensuring some of the happiest and productive years of my career. The 50th anniversary celebrations enabled us to surpass NIOH publication records and achieve global recognition, such as becoming a World Health Organization (WHO) collaborating centre, and having an impressive research presence at the centenary congress of the International Commission on Occupational Health, in Milan, in 2006. David has been an ongoing stalwart behind local, regional and international efforts to promote the discipline, support research, and train expertise in occupational health.

On a personal note, I have many fond memories of David's leisure-related support. When I arrived in Cairo for the 3rd Pan-African Conference on Occupational Health, David helped me navigate the challenges of persuading the organisers to honour the accommodation and session scheduling commitments, i.e. getting a hotel room and a presentation time slot. During the conference sight-seeing time, he very kindly chaperoned Gill Nelson and me to see the camel market and Coptic Church and, on a trip to Alexandria, he helped persuade the bus driver to stop in a militarised zone so that Susan, his wife, and I could visit the sand dunes for physiological needs – the military were at the bus by the time we returned but, luckily, none of us was arrested. Over a decade later, it was David who came to collect me from the train station in Stresa, Italy, to join the WHO Collaborating Centres meeting while the others were dining! My only contribution, in return, was to assist him later to choose gifts for his family.

Our daughters were in the same year at Wits University and his wife, Susan, is an accomplished public health specialist who trained when I was lecturing in the School of Public Health. Both David and Susan have achieved success and continue to further the two disciplines of occupational health and public health medicine that I hold dear. Together, they remind me that:

*"Behind every great man stands no woman. There is no greater man than the man that can acknowledge the woman standing right next to him."* (unknown)

**Sparkle and shine – David with Danuta Kielkowski and Mary Ross (front) at the NIOH dinner during the ICOH2006 Congress, Milan** *Photograph: Claudina Nogueira*

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**Tanusha Singh**

*Head: Immunology & Microbiology Section, National Institute for Occupational Health (NIOH), South Africa*

Here's wishing you a sterling retirement of good health, happiness and joy. You've been such a great boss to me and made the many years I reported to you pleasurable ones. You never smothered or suffocated me, but trusted me enough to get on with what I was meant to do, which allowed the Section to grow into what it is today. But, most importantly, you're the finest person I know, and you never put your qualifications or status above being a true gentlemen, respecting me as a woman, and also for just being me. There are very few people of your calibre with such qualities, and I am most very grateful to have spent the many years of my career in your shadow. We all knew we'd bid you farewell for your retirement someday, but never thought it would be today. So, indeed, it is a very sad moment in time, but thank you for grooming me into who I am today. You fulfilled your professional ambitions, and served a great innings, Prof. So reach for your personal aspirations, enjoy the many restful days and uninterrupted cricket matches in whichever shape or form they may come. With the utmost respect and gratitude to you Prof, I wish you all the very, very best!

**Jukka Takala**

*President: International Commission on Occupational Health (ICOH)*

My first memorable visit to the National Institute for Occupational Health and South Africa was in 1983 after a conference in Kenya, where I had stayed for three years as the chief technical adviser for the ILO, at the Ministry of Labour's Factory Inspectorate. I cannot recall David at that time; probably he was not on the NIOH payroll yet. But I remember three scientists that had baboons and chimps in cages and the animals were exposed to high concentrations of asbestos fibres – to demonstrate that asbestos is safe! They further had asbestos materials on their desks and threw dust in the office air to show the inert and great properties of the fibres. Years later, I heard that all three had passed away due to mesothelioma or lung cancer, most likely caused by their earlier industry exposure. Indeed, it was high time for David and colleagues to jump in and change the culture.

More detailed opportunities for me to see action with David, Jonny Myers from Cape Town, Danuta Kielkowski and others was in the early 1990s. At that time, a key focus was on miners' health and safety, silicosis, silicotuberculosis and lung problems. I had also an opportunity to visit a deep gold mine. I was, at that time, working already in Geneva; my three years in Nairobi were followed by setting up a new institute in Bangkok, Thailand, and I had already moved to the ILO head quarters in Geneva.

The National Institute for Occupational Health was obviously now well established and had a very reasonable programme, led by Tony Davies at that time. There was also a proper information centre/library organised by Tony Cantrell.

I recall many interesting discussions and some parties and events David took me to, and gatherings outside in dark African evenings with grilling fires.

I was surprised and impressed by the thorough programme of post-mortem lung tissue examination of miners who had died from lung diseases. That was probably one of the very few locations, globally, if not the only one, to study such issues carefully. The ILO, in turn, made the X-ray classification standard for various levels of silicosis – today all in digital format. At that time, silica dust was not really identified as a carcinogen; studying pneumoconioses was the key target.

The change in the political life of South Africa was in the air. I understood that, while there was still support in the non-African (white) population for the old regime, I felt at home with David's reasonable attitude in the divisive conflict. We had useful discussions and I sensed the feeling of solidarity in David's thinking. It was not surprising, then, to see Nelson Mandela take over and become the president of South Africa and the icon of democracy.

One further crossing of roads was the ICOH Congress in 2009 in Cape Town – another impressive way to show the progress in South Africa in occupational health, and in general.

So, for me to ask David to represent the African region in the Global Policy Forum of the ICOH2018 Congress in Dublin was a logical choice, as a highly qualified expert in occupational health, and as a real human – humanitarian – being.

I know from experience that retirement from a job should not stop our humanitarian efforts. David, please continue in any way you feel it right!

**Samantha Iyaloo**

*Occupational medicine specialist: National Institute for Occupational Health (NIOH), National Health Laboratory Service (NHLS), South Africa*

*"A mentor is someone who allows you to see the hope inside yourself."*
Oprah Winfrey

The last few months have flown by rather strangely and eerily without Prof. Rees walking the corridors of the NIOH. He would walk up and down numerous times during the day, while clicking his pen to 1) get up and stretch, and 2) refill his mug with coffee. The year has been strange indeed without a single clinical case discussion (I never thought I would miss those) and without getting Prof's advice on a case I had just seen.

Even though I have only known Prof. Rees since I started as a registrar at the NIOH in 2016, he has had an everlasting impact on my life. Prof. Rees represents the epitome of what I strive to be as an occupational medicine specialist – although I do not have his photographic memory. He is a stalwart among giants in the field of occupational and environmental medicine. He is a thorough and caring physician, an A-class researcher/academic with a love for learning, and the most humble, fair and kind-hearted person I have had the pleasure of meeting. Prof. Rees does not assume that his word is final since he is usually the smartest and most accomplished person in the room. He would often ask for my and others' advice and input on many important topics. What could I, then a mere junior registrar, offer Prof. Rees in terms of input? He knew already – a different perspective informed by different experiences. I am proud and honoured that I was under his tutelage. Of the many lessons I learnt from Prof. Rees in my short time at the NIOH, the ones I value the most include 1) remaining open-minded and seeing things from a different perspective, 2) never taking short cuts – even though he is a seasoned expert, he thoroughly examines each of his patients and writes comprehensive medical notes (we registrars are ever watchful, and often take our cues from our supervisors), 3) the art of simplifying complex information for diverse audiences, and 4) producing quality work, consistently.

Thank you Prof, for the invaluable wisdom, knowledge, integrity and ethical conduct that you have imparted to me. I will forever aim to exemplify and be a champion of occupational medicine because of what I learnt from you. I will definitely come knocking on your door for you to be my supervisor when I do my PhD – one day. I wish you everything of the best in your retirement.

**L-R: David Rees, Tebogo Maeteletja, Samantha Iyaloo, Mollen Magombo, and Spo Kgalamono**
*Photograph: Courtesy of Samantha Iyaloo*

**Audrey Vukosi Banyini**

*Board member: Mine Occupational Health Advisory Committee, Mine Health and Safety Council; Technical advisor: Board of Compensation commissioner for COIDA; Technical advisor: Joint Tripartite Technical Committee, Department of Employment and Labour; Certification Committee member, ODMWA*

*Previous positions:*

*Mine medical officer; Senior occupational medical practitioner; Director: Medical Bureau for Occupational Diseases; Deputy health advisor: Minerals Council South Africa; SIMRAC health programme manager: MHSC; Principal adoption MOSH specialist for dust: Minerals Council SA; Project manager for COVID-19 research projects: Minerals Council South Africa*

My first encounter with Dave was in 1988 when I doing my Diploma in Occupational Health with the National Centre for Occupational Health (NCOH), as it was called at the time. As a young mine medical officer at the Ernest Oppenheimer Hospital in Welkom, and the only black and female medical officer, I could not have wished for a better mentor who believed in me. The rest of my occupational health professional journey is history, thanks to you, Dave. I know I am just one of the many.

The second encounter was when Dave called me in 1996 to join the Certification Committee at the Medical Bureau for Occupational Diseases (MBOD), as the call for transformation of institutions, particularly government ones, was made. Dave has been my one strong professional rock. Dave, you extended support when I grappled with being a public servant (director of the MBOD), while you were the director of the NCOH. We would remark at the challenge of being an academic (him) and having to physically look for ex-mine workers (me), while still being expected to be at CIVITAS often. You contributed to my academic network, which became an invaluable resource in my career.

The third encounter was when, as Safety in Mines Research Advisory Committee (SIMRAC) health research programme manager, I begged him to submit a proposal on behalf of the NCOH, for the Mine Health and Safety Council (MHSC) Silicosis Research Programme Track C: Silicosis Awareness Programme. Dave's passion to be academic yet relevant was indeed enlightening. I am honoured to have witnessed the final product, which mine workers still use today.

The last encounter was a strange one – suffice it to say that he agreed to co-supervise my PhD.

Dave, I consider you to be a friend and a colleague. You were easy to get along with, and always smiling, even when the going got tough. Above all, I remember that there were offers of certain work positions that you would always pass up because they were not academic.

For all of the above, I cannot express my gratitude enough. However, I can shout out to the world that I feel blessed to have crossed paths with you. I wish you well as you retire. I hope you will have the time to not only jog around the block, but to take up a new hobby.

**L-R: Peter Orris (USA), Sagie Pillay (NHLS) and David Rees at the WHO Collaborating Centres in OH meeting, Geneva, 2009** *Photograph: Claudina Nogueira*

**Jim Phillips**

*Visiting professor: University of Johannesburg, South Africa*

David and I were colleagues for more than 25 years. During this time, our friendship was sparked by a mutual passion for test match cricket. We had fascinating conversations about the team selection and performance of the Proteas. In addition to cricket, we would discuss research at the NIOH. David is extremely well read and has a vast knowledge of, and experience in, medicine and science. He and Professors Jill Murray and Tony Davies were excellent sounding boards for research ideas. David has a wonderful ability to hone in on and define a research question. His knowledge, clarity of thought and patience make him an excellent teacher, and many healthcare professionals have benefitted from his wisdom over the years.

His clarity of thought is particularly evident in his writing. As a co-author of several peer-reviewed articles and a book chapter, I found David to be an excellent writer and, perhaps more importantly, a pleasure to work with.

**Jeanneth Manganyi**

*Head: Occupational Hygiene Section, National Institute for Occupational Health (NIOH), South Africa; PhD student: Wits School of Public Health, University of the Witwatersrand, South Africa*

I know you have tried to stop me calling you "Prof" but we couldn't find a proper replacement for this address and your first name is still not an option. I guess we have to agree to disagree.

I first met you in the late 1990s when I used to come to the NIOH as a student from Wits Technikon and also when I was allowed to spend time at the Institute on a voluntary basis, pending my employment. It was in 2009, when I later joined the NIOH as an employee, with my academic life being skewed in relation to my field experience at the time. I was very comfortable with what defined me as an occupational hygienist but research and statistics were foreign; I always appreciated and valued your comments at research forums. Little did I know that you would be the very same person to mentor me during my academic studies. You helped me shape my academic life and showed me how to transform my mistakes into skills. I am now in possession of a MPH degree because of your guidance, supervision and encouragement. As my supervisor for my PhD, I continue to see your undying support and guidance. I hope that, when I finally get my PhD, you will join me at my graduation ceremony in your best formal attire, which will challenge your 'normal' simple character as I know it, i.e. shirt sleeves rolled up, no tie and a missing belt! You have been consistent about this since I met you, and it has always fascinated me.

You continue to inspire me with your humble personality, which enables every soul to relate to you easily, despite your high-level position and wealth of wisdom. I see you as someone who is humble, honest, transparent, expressive and constructive in your criticism, which I believe are great qualities for an honourable professional. I think it should please your heart to see me manage the NIOH Occupational Hygiene Section, fulfilling your best intentions, as you were instrumental in building it. I know you promised to tell me more about it – I am looking forward to that.

I don't have the words to qualify or quantify the guidance, supervision and support that you gave me. I will be forever grateful for the knowledge and skills that I continue to gain under your mentorship. I wish you all the best in your retirement. However, I would like to apologise that, with my PhD studies underway, you may not get that much of a break from me. You are a great supervisor who is simply irreplaceable.

# Tributes

**Leslie London**
*School of Public Health and Family Medicine, University of Cape Town, South Africa*

## A Tribute to David

There once was a runner called Dave
Who clinical medicine did crave
But when he realised
That the act he most prized
Was workers' health from silica to save
… he paused …
… and …
By hook and by crook
He said I will take a look
At this field of occupational health
And he devoured the good book
Of Ramazzini, he of old,
And it proved to be knowledge like gold
Which made him ever more bold
And on his career completely sold

And gold was the ore mined by men who came to the NCOH
Coughing, debilitated and breathless
Victims of a system of profound unfairness
Along with Tony and Co.
David spearheaded a plan for redress
A clinic to treat and fight for compensation
The first in the nation
And what a great combination
Research, teaching and social justice
Workers finally getting a deal that was less unfair than before
even if not completely fair
An ongoing deficiency that David continues to declare

Workers' health now had a leader
A tireless fighter and feeder
Of those younger and keen
Many to be seen
In this virtual room and other rooms of influence


**Mrs de Villiers and David** *Photograph: Courtesy of Engela Venter*

Of David, I have many memories.
Odd ones, actually.
Like the occasional cigarette David would puff
At an occupational health conference discussing the stuff
… of what to do about health and safety, over a beer
And then the reluctant primary care physician, called to attend to
Phyllis, my wife, who had sprained her ankle on a potholed Cairo street.
I think it's an ankle sprain, try some anti-inflammatories…
Or the leader of a project funded by SIDA
That required high levels of schmooze, no easy cruise
Health and safety capacity for all in southern and East Africa
What we expected
was not reflected
in the votes of the Swedish electorate
and WAHSA sank like its eponymous 17th Century Swedish shipwreck

We also shared a love of two wheels
exchanging the stories of our bicycle deals
… and appeals for sponsorship (one-way from me).

To his family, I know he is one loyal and loving family man
Balancing work as he ran
Trying as best as he can
To save the world and be your best fan

So, again, join me in …

There once was a physician called David
Committed to unshackling workers enslaved
By workplace conditions
and unhealthy positions
The path to retirement is with our best wishes paved
Though you might still get no rest till the world has been saved

Go well, David

**Deodat Kritizinger**
*On behalf of the Rand Mutual Assurance team*

For the past 20 years, since our closer involvement in occupational health, we have had the privilege of attending many of your lectures and presentations, but also personal engagement in interesting cases. It was not only the extensive and broad knowledge on the subject of occupational health that impressed, but also your availability and willingness to make time for a visit to discuss difficult or interesting cases. Thank you for the assistance you gave to Rand Mutual Assurance when cases were referred or discussed.

In our interactions and cases referred to, the wellbeing and interest of the worker was always at heart, with your thorough history-taking and analysis, and the outstanding knowledge of the subject backed by extensive literature research and experience. RMA is indebted to your immense contribution and commitment in furthering occupational health as a discipline.

It is with great sadness to think of an NIOH without the presence of the person, David Rees. Your friendly and shy smile when presenting or discussing cases will be missed.

# LEADING THE WAY IN OCCUPATIONAL INJURIES AND DISEASES

Our clients work in one of the most important industries that drive the country's economy while ensuring that many families who depend on it can eat and afford basic needs. We are also aware of how much they love and care for their work and how they go out of their way to perform with the highest standard of safety to avoid injuries. However, accidents can happen even where all the precautions have been adhered to. So, what will happen should a worker get injuries that are detrimental to their ability to do their job and earn further income? What happens to their families?

That is where we come in. Rand Mutual (RMA) is the administrator of choice for injury on duty claims in South Africa for the mining, iron, steel, metal and related industries. For the past 124 years, we have made sure that any worker who gets injured while at work can receive payments to cover medical costs, disabilities, pensions and ongoing income in case of death.

This is in terms of the compensation for Occupational Injuries and Diseases Act (COIDA) 130 of 1993 as amended under license from the Minister of Labour.

Beyond COIDA requirements,we have also developed other innovations to assist with the recovery of our beneficiaries, like our mobile prosthetic clinic, funeral and top up covers to add value to the quality of life of our members. All claims for medical expenses, temporary disability, and pensions are processed speedily and efficiently.

Let RMA protect your employees needs 24/7 with our additional insurance products that cover beyond COID.

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**email: sales@randmutual.co.za**

**The MPH Occupational Hygiene and Diploma of Occupational Health classes of 2004/2005, with NIOSH guest lecturer, Eric Esswein (middle row right)**
*Photograph: Kevin Renton*

**Zubaydah Kirsten**
*Research technologist: Immunology and Microbiology Section, National Institute for Occupational Health (NIOH), South Africa*

In life, we meet many people, but it is just some special individuals who make that mark on a person. One of those, without doubt, is Professor David Rees. Prof, you fulfil all the criteria of understanding, your open door policy, support and encouragement – all coupled with the broadest smile. What stands out for me are your positivity and comments to all; be it a general conversation or research issue, you see potential in all of us. I thank you. May the Almighty bestow His richest blessings on you, always. Enjoy your retirement years. Maybe I will see you as part of the *Tour de France* Team management, with your vast sporting knowledge.

Take care, go well, *Inshallah Ameen*.

**Beauty Senabe**
*Occupational health policy, Department of Mineral Resources and Energy, South Africa*

Thank you for the opportunity we have had with you in the journey we have walked in occupational health so far. I say "so far" because, with the knowledge and experience that you have, we are expecting you to continue building occupational health during your retirement. NIOH retirees continue to contribute valuably in society (that is the trend that I have witnessed). We have very few people who have walked the journey that you have in occupational health, so as long as you can breathe, we expect you to continue enriching occupational health practice as you would deem fit.

We wish you the best in your retirement but, most of all, we are hoping that you will join entrepreneurs in this area so that safety, health, environmental and quality (SHEQ) management will be positively impacted. The public health sphere still needs your wisdom, knowledge and skills. All the best as you transit from an active job environment into real work.

We would also like to thank your family for supporting you to the best of their ability throughout. All the best, and may you find fulfillment in your retirement.

**David W Stanton**
*Head (1995–1999): Occupational Hygiene and Toxicology Directorate, National Centre for Occupational Health (NCOH), South Africa*

It is now more than 20 years since I worked at what was then the National Centre for Occupational Health (NCOH), as head of the Occupational Hygiene and Toxicology Directorate. However, I still remember the strong support I received from Prof. David Rees for a variety of initiatives at the NCOH (now the NIOH) from 1995 to 1999. This included the WHO/South Africa Technical Cooperation Programme in Occupational Health, which Prof. JCA (Tony) Davies had tasked me with. David was involved with the programme development and took part in the provincial workshops. A key workshop held in 1997, which David helped organise and participated in, was the southern African meeting on occupational health and safety (OHS) education and training, to develop a coordinated approach to address the acute shortage of OHS personnel and the lack of OHS education and training opportunities in southern Africa. This meeting was attended by representatives from 13 of the 14 Southern African Development Community (SADC) member states, the World Health Organization, the International Labour Organization, and the SADC Employment and Labour Sector (ELS) Coordinating Unit. Only one SADC country was not represented as its airport was bombed at the time! The resolutions of the Johannesburg meeting were approved by the ELS and the SACD Council in Mauritius in 1998, which was one of the first reports on OHS, if not the first, to be approved through the SADC system.

The WHO/South Africa Technical Cooperation Programme also provided important financial support to *Occupational Health Southern Africa* in its early days, through sponsored articles. This included a six-page spread on OHS courses in South Africa in 1997, based on the responses from 22 universities and 15 technikons. While professional qualifications in occupational hygiene had now been established, this article and the southern African workshop, showed the need for a university higher degree in occupational hygiene. I proposed this to David and he immediately suggested that we discuss it with Wits, which we then did. At the time, the NCOH analytical equipment in the various laboratories was in dire need of replacement, and I put together the budget for this, which, together with David, we successfully argued for in Pretoria.

David also provided support for the submission to Wits, in 1999, of a posthumous PhD thesis for Mr REG Rendall, the former head of Occupational Hygiene at the NCOH. At this time, I was informed that my contract at the NCOH would not be renewed as I was a white foreigner and should go home. David kindly invited me to go to Pretoria with him to argue the case for my contract being extended, with the chief director, but this meeting was unsuccessful. I left the NCOH in 1999 and the development of the Wits Diploma and Master's degree in occupational hygiene was carried out by David and NCOH staff.

In my work as an occupational hygienist, I have worked in many countries around the world in west Africa, western Europe, the middle east and the USA. In South Africa, the support and kindness provided by NCOH senior staff, including Prof. David Rees, was particularly memorable.

**Belinda Dias**
*PhD student (2004 – 2014); Lead specialist medical officer: Liberty*

Prof. Rees taught me the basics of occupational health as my boss in 1999. I am so grateful to him for introducing me to research and risk management. I have always admired his passion and knowledge of occupational health, his excellent teaching skills, and ethics. His inspiration and enthusiasm were appreciated as my supervisor, and as a co-supervisor.

# Tributes

**Eric J Esswein**

*Captain: US Public Health Service (retired); CEO: Emeritus Health and Safety; LLC contractor; Centers for Disease Control and Prevention (CDC), USA; National Institute for Occupational Safety and Health (NIOSH), Western States Division, Denver, Colorado, USA*

I met Prof. Rees in 1995 when I was invited to South Africa to teach a series of courses in occupational hygiene that were organised by a former NIOH employee that I later learned troubled David (and indeed many others) over the years. I immediately knew I liked David; I perceived his genuine passion for worker health and his no-nonsense approach to so many things (e.g. an occupational hygiene section meeting where David declared: 'rubbish!' to a statement made by the aforementioned troublesome employee). I particularly enjoy David's keen intellect, his calm demeanour, and honest sense of outgoing friendliness. The fact that we both enjoy cycling, the outdoors, and beer made everything all that much better!

Over more than 20 years, David and I became reacquainted when I returned to South Africa for assignments at the NIOH and Wits. David always made me feel supported and appreciated, both as a friend and a colleague at the NIOH, which was really important when you are solo and far from home, as I was. I recall once, in 2000, when he made mention of the fact I was often referring to the work at the NIOH and my colleagues as "we". He said he appreciated that I felt like I was part of the NIOH, and indeed I was, in no small part due to David's unyielding support, making sure I got to know people in all the sections. Dinners at his house with his family were also greatly appreciated!

I recall, prior to arrival in 1999 for my year 'in-country', asking David what he had planned for me at the NIOH. He said he had four "biggish ideas" in mind. Indeed, his ideas were big – they were elephantine! I was kept fully engaged with his slate of challenging and fulfilling work for the entirety of my assignment. I also got to see a good deal of the country and it was absolutely one of the most fulfilling and enjoyable years of my career.

From 1995, the time of my first visit, South Africa quickly began to feel like home to me and, in many ways that I cannot clearly explain, I know David's support and friendship were reasons for that feeling. I always felt his strong sense of enthusiasm, camaraderie, commitment and drive, and I think these aspects of his personality, indeed his soul, became a fundamental basis of our long-time friendship. But at the core of it all was a deep respect for him as a physician, an educator, a colleague, and a friend.

David connected me with his friend Taffy Adler who connected me to a local cycling club where I made so many friends, rode the Argus (and so many other great rides) for such a delightful year working, living and adventuring in South Africa. David, I can't thank you enough for all those times that you fetched me from the airport or my hotel and drove me safely to the NIOH, or Wits or wherever, the list of your acts of Ubuntu and inspiration runs very long, my friend.

I recall the time I was fly fishing (alone) on the Vaal River and ended up with a nasty gash in my lower leg which bled markedly and made me ponder how Chuck Norris (he's a friend of David's) would stem the flow of all the blood? My anxiety was further enhanced, seeing what appeared to be a small noodle poking out of my lower leg. "Is that a blood vessel?" I needed Dr David Rees, not Chuck Norris! So, the next day at the NIOH, I sought out the best doctor I knew in southern Africa and requested that he inspect this horrible leg wound. Dr Rees scrutinised my injury, then solemnly pronounced: "looks like we'll have to amputate…" His patient immediately declined the procedure.

David and I agree on many things factual and fictional: that cycling is challenging, fun and exciting, that the right work and career are meaningful lifelong endeavours, that a cold beer on a hot African day is refreshing, that Jack Reacher (despite being a fictional character) is a bada$$; and that occupational health is indisputably a noble profession, and I will state that Prof. David Rees practises it nobly. Moreover, I know, first-hand, that Prof. Rees is likely a better driver than Jack Reacher.

Some work to make an income, some work to make a career, and some work to make a difference. Thank you, David, for all the differences you made in occupational health in southern Africa, and for all those you treated and influenced around the world. I'm proud to be your friend and colleague.

**Sharon Fonn**

*Professor: Wits School of Public Health, University of the Witwatersrand, South Africa; Co-director: Consortium for Advanced Research Training in Africa*

Anyone who knows David Rees will know that he has a quiet, wicked sense of humour. Sometimes it is not clear – maybe even to David – that he is making a joke, but he has a profound sense of irony. Competent, ridiculously productive (have you seen his publication output?), and ambitious – the kind of ambition that one can only admire and respect. David was never personally ambitious; he was, and is, ambitious for the field of occupational health and hygiene which gave Wits an edge. But he does have some inadequacies. However, being the insightful person he is, he knows them. Here is one example where this self-knowledge became my problem. David has had a long academic relationship with Sweden, which supported us in our occupational health and hygiene training at the Wits School of Public Health. The Swedish National Institute for Working Life worked to support research and training in South Africa until it was closed down – some say because they voted in a neoliberal-oriented government, but there may be other explanations (see Closing the Swedish National Institute for Working Life [editorial]. Occup Environ Med. 2007; 64(12): 787-788. DOI: 10.1136/oem.2007.034207). Now, Swedes have a particular way of being; quiet, sombre even. On one of their first visits, David, too clever by half, understood the role of a boss and, technically, I was his boss. David insisted that it would be correct and decorous for me to entertain the Swedes for dinner. In reality, he had no idea how he would maintain a social event with such austere visitors, and his idea was that I would come along to carry the conversation. It turned out that, after a beer with our visitors, there was no problem at all and the evening went along at a jolly pace. David continued a long and fruitful academic relationship with an increasing number of our Swedish colleagues – some of whom became good friends. Funnily enough, I was never asked to entertain them again; I had been easily replaced by a beer, and Wits and occupational health and hygiene benefitted.

# Tributes

**Jonny Myers**

*Professor Emeritus: Centre for Environmental and Occupational Health, School of Public Health and Family Medicine, University of Cape Town, South Africa*

My earliest and strongest recollection of David was when I was asked by the University of the Witwatersrand to review his Master's thesis on the respiratory health effects of pottery workers in the 1980s. I read his thesis with increasing disbelief as it was clear that the work that he had put into it was the equivalent of a PhD thesis. It was by far the most substantial Master's dissertation I had ever seen, and was executed with the excellence that has characterised all his work in occupational health and safety. Why, I wondered, had his supervisor at Wits not encouraged him to upgrade to a PhD so that his work could receive the appropriate degree of recognition? I concluded that he must have been jealous. This disservice to David resulted in his having to take on, some years later, the burden of completing a full PhD project on mesothelioma in South Africa. This too, was a wonderful piece of research. I always suspected, though, that despite the pressure this put him under, he enjoyed this type of deeply focused research, which so many academics consider their most satisfying research experience. Although I was formally his supervisor for this thesis (which, as I recall, won a prize for the best thesis that year at UCT) he really was, by that stage, having already done PhD-equivalent work at Wits, able to supervise himself and once again produce excellent work.

David was one of my favourite people with whom to collaborate in research. Such a humble, thoughtful, intelligent, insightful, and friendly human being is a rare bird in cutthroat academia. He helped facilitate much of my principal research activity after I transitioned from respiratory epidemiology to neurotoxicity research. It was always an added pleasure to be working with him and the other fine researchers at the NCOH, as it was called then. Through contact with him, I met Victor Nell, a neuropsychologist of note, who shared space in the same building as the NCOH. This led to an exhilarating journey into the mysteries and plasticity of the brain and its functioning. It included the laborious development of an entire neuropsychological test battery appropriate for South African workers and conditions. Neurotoxicity investigations with David and others, of various chemicals, culminating in manganese dioxide at a smelter in Gauteng, ultimately led to a dead end for me. After so many studies in such diverse industries where exposures to known neurotoxins had resulted in negative findings for even subclinical (never mind clinical) neurotoxicological effects, I decided to abandon ship.

Throughout, I was always more than a little envious of David and other colleagues who had stuck to respiratory health, where every study revealed a clear effect of exposure. Consequently, the field of policy development was ripe for the scientific inputs of this impressive and prolific health scientist and his many collaborators. I consider David to have balanced his role as a senior public servant and a health scientist with great aplomb. He always proceeded carefully, thought a lot, and spoke the truth.

David was also superbly physically fit and, on a few occasions when I travelled to Johannesburg, it was a terrifying experience jogging with him. Climbing the staircases in the NCOH building was enough to cause me to puff and pant, coming from a life at sea-level where the air pressure is high. Add to this the chronic effects of having been a smoker until the age of 40, and you can imagine the challenge of keeping up with him while running or, alternatively, the embarrassment of knowing that he would have been running more slowly than he would have liked to do, had he been on his own. It has been a privilege to know him, work with him, and learn from him. I am sure that he will continue to contribute to the development of our field for many years yet.

**Natasha Sanabria**

*Head: Toxicology and Biochemistry Department, National Institute for Occupational Health (NIOH), South Africa*

*"To part is the lot of mankind. The world is a scene of constant leave-taking, and the hands that grasp in cordial greeting today are doomed ere long to unite for the last time, when the quivering lips pronounce the word – farewell."* RM Ballantyne

Thank you for all the time taken, and effort made to help where you can. I am very grateful for all that you have done for me personally. Thank you for your encouragements. It has been an honour and a privilege to sit quietly and listen to your vast knowledge and absorb some of your wisdom. You will be sorely missed! I wish you all the best!

**David at the Christmas market in Skansen in 2002, during his visit to Stockholm to prepare for the Work and Health in Southern Africa (WAHSA) Programme** *Photograph: Ocka Petersson*

**Kerry Wilson**

*Epidemiologist: National Institute for Occupational Health (NIOH), South Africa; National Health Laboratory Service (NHLS), South Africa*

It feels like the end of an era at the NIOH, with David retiring. I worked with David as both my direct and indirect boss and, sometimes, the head of the NIOH. With a door that is always open, and a calm and friendly demeanour, it was inspiring to work under him. I respect his willingness to always take on new students and new ideas. His interests are wide-ranging and he has never limited our ability to grow and develop our own research interests and focuses. He has been an inspiration to many students and registrars over the years.

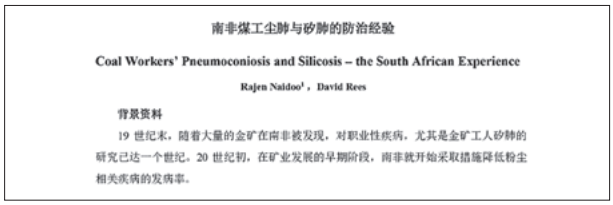
David's attention to detail is unmatched, and his reviews are always thoughtful, thorough and well referenced. Receiving his comments on my papers was as if a family of very busy red or black spiders had crawled across the page and over onto the other side. They were always very valuable comments and there were many ideas for improving the papers. My own writing improved as a result of working with David; his willingness to accept and work on reviewer comments, even at the end of his tenure at the NIOH, with international recognition, is humbling.

I know this is not the end – many mentors at the NIOH stay around into their 80s. David, I expect to see you filling Tony Davies' shoes for many years to come because replacing you will be impossible. Thank you for all the unselfish advice and support over the years. May your next chapter be as fulfilling as this one. I hope you enjoy your time with your family.

**Rajen Naidoo**
*Head: Occupational and Environmental Health, University of KwaZulu-Natal, South Africa*

The first time that I met David was as a student doing my postgraduate Diploma in Occupational Health at UCT, and he was a guest lecturer on one of our modules. By this time, David had already established himself as one of the national leaders in the discipline. Although the NIOH and its predecessors were long since recognised as the pioneers of occupational health in South Africa, it was David, with his mentor, Tony Davies, and colleagues such as Jonny Myers, Rodney Ehrlich and, subsequently, Mohamed Jeebhay and Leslie London, who provided the discipline with its national flavour and brought it into mainstream clinical medicine.

David and I began working together with the Fogarty-funded programme in South Africa, then southern Africa. David and I jointly drafted the proposal with colleagues from the Swedish National Institute of Working Life that led to the Swedish International Development Agency-funded Work and Health in Southern Africa. Although we have not jointly collaborated on research, we managed to publish one paper together – unique because it was an invited review in the journal, *Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi* (the Chinese Journal of Industrial Hygiene and Occupational Diseases), printed completely in Chinese (we could only hope that nothing was lost in translation; it was indexed on PubMed: https://pubmed.ncbi.nlm.nih.gov/17498361/!



南非煤工尘肺与矽肺的防治经验

**Coal Workers' Pneumoconiosis and Silicosis – the South African Experience**

Rajen Naidoo[1]，David Rees

背景资料

19 世纪末，随着大量的金矿在南非被发现，对职业性疾病，尤其是金矿工人矽肺的研究已达一个世纪。20 世纪初，在矿业发展的早期阶段，南非就开始采取措施降低粉尘相关疾病的发病率。

I have no doubt many others will document David's role in the development of occupational health, generally, and occupational medicine, specifically, in South and southern Africa – this was no small feat, and cannot be accomplished in a couple of paragraphs! I would like to place on record his ongoing commitment to the development of academic occupational health in KwaZulu-Natal (KZN). David has repeatedly served as a guest lecturer, spending days at a time in Durban, teaching in our postgraduate Diploma programmes, as well as in our international courses at UKZN. As such, he expanded the network of occupational health beyond that of its focus in Gauteng, and provided the base for the next generation of occupational medical practitioners. As part of this ongoing foresight, David ensured that, when opportunities presented themselves, he was as inclusive as possible, and that KZN was part of those considered.

I have no doubt that occupational health in southern and South Africa still has many years to extract from David, and that these are not the last words on his contribution, but perhaps an opportunity for him to develop new projects to carry forward his agenda.

**L-R: David Rees and Andrew Swanepoel** *Photograph: Gill Nelson*

**L-R: David Rees, Mary Ross and Vusi Nhlapho at the Anglo American Wits Endowment launch, 2014**
*Photograph: Courtesy of Gill Nelson*

**Andrew Swanepoel**
*Former PhD student*

You have only one flaw, and that is supporting the Lions rugby team… I want to thank you for everything you have done for me! You were not only a mentor to me throughout my PhD studies, but also somebody I could look up to when I needed it the most. Thank you for all the opportunities you have given me and all the effort you have made to help me in my career. But most of all, thank you for your friendship, you were never unapproachable! I wish you and your family all the best in the future!

**Wits Postgraduate Diploma in Occupational Health (DOH) class of 2020–2021**
*School of Public Health, University of the Witwatersrand, South Africa*

It was a great privilege for the DOH class of 2020 to learn from Prof. Rees. In a year where conventional face-to-face teaching drastically changed, his commitment to sharing his knowledge and experience greatly contributed to our academic experience. His expertise, as well as the manner in which he taught – with humility and kindness – were highly appreciated as he guided his students to a better understanding. We would like to thank Prof. Rees for the beacons that he has left us in the literature and his research, which will make a lasting impact on occupational health. As medical professionals, we will strive to build forth on his teachings to create a healthier future.

# Tributes

**Sophie Kisting**

*Occupational medicine specialist; Trustee: Tshiamiso Trust; Chairperson and trustee: Q(h)ubeka Trust; Executive director (2014–2018): National Institute for Occupational Health (NIOH); Director (2005–2011): ILO Global Programme on HIV/AIDS and the World of Work*

On the occasion of the retirement of David Rees, there is so much one can say about his enormous contribution to occupational health and safety (OHS) in South Africa and globally as a clinician, a distinguished scientist, an academic, a teacher, a colleague, a friend, a distance runner, a cyclist and a dedicated family person. I would, however, like to make a few observations about David as part of the collective OHS teams of the National Institute for Occupational Health (NIOH) of which he has been an integral part for about four decades.

I first heard about the work of David Rees on OHS in the early1990s when I worked together with his wife, Susan Goldstein, in the Soweto Community Health Centres linked to Chris Hani Baragwaneth Hospital in Soweto. Those were deeply hopeful yet uncertain and, sometimes, violent times in South Africa with many preventable deaths. The clinics also served many of the hostels where mine workers lived, who carried a particularly heavy burden of preventable respiratory diseases. What we fully understood at the time was the importance of working amongst the poor and, at that time, still the disenfranchised, of our people. During tea breaks, we would at times refer to our fears for our young families and discuss aspects of the many health and safety challenges our people and our country faced.

Prof. Tony Davies was our postgraduate lecturer on occupational lung diseases at Wits, and he stressed the work that David Rees and his colleagues were doing on asbestos-related diseases, on silicosis, and the tragic post-mortem pathology occupational lung disease findings amongst deceased mine workers who had managed to have a post-mortem examination. In my many years based at UCT, I started to work more closely with the NIOH on OHS of health workers, and met David and colleagues – especially when the NIOH and UCT became WHO Occupational Health Collaborating Centres. The period witnessed collaboration on the Fogarty grant for occupational health skills development in southern Africa, the Swedish hygienists supporting greater control of silica dust in southern Africa, and the WHO/ILO initiative to develop an OHS resource centre at the NIOH.

In 2014, I was appointed executive director of the NIOH, and David Rees was part of the wonderfully vibrant and hard-working team at the NIOH who reported to me. Amongst the many tasks we undertook a few stand out because of the overall impact on OHS. David, with his encyclopaedic knowledge of OHS and of the NIOH, was a most dependable pillar of strength during the following exciting and hopeful years when we built on the excellent work already done by so many. OHS service delivery for greater prevention was extended to more government departments, public and private sector workplaces, and the informal economy; teaching and training interactions with more trade unions increased, and research and OHS communication was strengthened. David was one of the core contributors to a concept paper on occupational health commissioned by the NIOH and written by Prof. Jonny Myers, on international best practice in OHS and the place and the role of national institutes of occupational health in many different countries. This concept paper helped the NIOH and the very supportive broader OHS fraternity to unite around a more informed understanding of OHS. This, in turn, assisted in the democratic parliamentary process that made occupational health part of the process of the National Public Health Institute of South Africa (NAPHISA). The NAPHISA Bill was recently signed by President Cyril Ramaphosa.

For the NIOH National Women's Day of 2018, I challenged David to provide the keynote address to the NIOH staff, on the importance of gender equity in OHS. He surprised us all by selecting to look at the gender concerns through the eyes of his three daughters and his wife, Susan. It was an enriching and heartfelt contribution, and many present were deeply moved by the sensitive manner in which David grappled and tried to address this often-overlooked challenge in the world of work.

David is amongst the most gifted and fastest editors with whom I have ever worked. I have known him to review and edit papers while taking care of his elderly mother or watching over her recovery in hospital. His minimal use of words to express complex concepts is well known, and many at the NIOH and far beyond have benefitted, suffered and grown under that editorial style. Inevitable references by some colleagues to "Park Town Boys High" invariably resulted in lots of joint laughter.

It is one of my observations that David seems happiest and most enthused when he sees patients and when he is teaching clinical occupational health to the many students who continue to hone their occupational health clinical skills under his excellent tutorship. I joined several of his teaching sessions as well as some of the X-ray reading sessions for occupational lung diseases (using the ILO international classification for the pneumoconiosis). These sessions were not only scientifically enriching but also conducted with compassion – challenging everyone to improve their skills as much as they possibly could as the patient deserves our very best skills, knowledge and dedication to arrive at the most accurate diagnosis.

What a gift and treasure South Africa and the world have in David and colleagues like him who so selflessly share their special abilities. They go all out to make that correct diagnosis – and to take the patient and the student along to a better understanding and the increased possibility of a better health outcome or compensation or new policy. Thank you so much, David, for your lifelong dedication to OHS and for enriching our lives, and thank you, Susan and family, for sharing David with us.

I can only wish you and your family happy cycling, more time for reading and writing, less editing, and much more time for travelling and indulging in great music and dancing. We, of course, look forward to you demonstrating the Jerusalema at your farewell function.

**Anna Fourie**

*Medical scientist: Immunology & Microbiology Section, National Institute for Occupational Health (NIOH), South Africa*

With sadness we need to say goodbye, but I need to acknowledge a hero whose dedication, understanding of, and contribution to, occupational health has always inspired me. Prof, you have contributed in a very real way to my development as a researcher/scientist in occupational health. Your support, understanding and realistic advice have been invaluable. I hope that your vast experience will not be lost to the occupational health circles! I wish you all of the very best in this next phase of your life.

**David Rees and Jill Murray enjoying a meal in Beijing, 2007**
*Photograph: Gill Nelson*

**Hans Kromhout**
*Editor-in-chief:* Occupational and Environmental Medicine*; Institute for Risk Assessment Sciences, Utrecht University, Utrecht, The Netherlands*

I cannot remember the first time I saw/met you, David. Was it at the EPICOH Congress in Dublin in 1984? Was it at the 1986 EPICOH meeting in Los Angeles when EPICOH was still called the International Symposium on Epidemiology in Occupational Health? Or even later? Anyway, through you, Jonny Myers, Leslie London and Rodney Ehrlich, it rapidly became clear that not all white South Africans were bad descendants of my tribe, whom we boycotted in the 1970s, by not buying Outspan oranges or buying petrol from Shell (I never did, given that I only ride a bicycle). Meeting you was an enlightenment, especially when it came to the difference in occupational health and the research devoted to it, in the South versus the North. Having been able to contribute to research in the Cape, KZN and Gauteng still makes me feel humble and good. Knowing that you're retiring is a bit of a shame. I hope that others in South Africa will continue what you started and provide the global occupational health research community with the 'Southern' perspective. Having visited your country several times, I have been reminded that doing research in occupational health is not value-free and that it shouldn't be. A good reminder!

David, I hope our paths will cross in the future, either at a conference or when visiting your great country. Enjoy a well-deserved and baaie lekker retirement.

*Het ga je goed*

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**Marianne Felix**
*Occupational medicine practitioner; youth mentor; yoga instructor*

In the late 1980s and early 1990s, David Rees, Kim Goodman, Rodney Ehrlich, Prof. Tony Davies and I spent many jolly hours discussing occupational medicine issues. We all took our work fairly seriously – all of us wanted to make a difference. Most of our work focused on the diagnosis of lung diseases. David Rees took the initiative to ensure that the (then) NCOH Occupational Medicine Clinic developed expertise in other occupational diseases. I remember him collaborating with Jonny Myers to measure the neurobehavioural effects of organic solvent exposure. Perseverance paid off, and the studies were completed and papers published. I think it was this work with Jonny Myers and Victor Nell, and the papers that came out of it, that made David realise he was good at writing papers. Since then, he has published prolifically and made a significant contribution to occupational medicine in the South African setting.

**Jill Murray**
*Pathology Division (1988–2012): National Institute for Occupational Health (NIOH), South Africa*

It has been some three decades since David and I first met at the NIOH. Since then, David's expertise and dedication to occupational health have influenced hundreds of students and colleagues, and impacted on the lives of many thousands of workers. His influence has extended beyond South Africa, to surrounding countries and the wider international community. David's powerful intellect is tempered by his unassuming manner, his generosity of spirit, and his deeply held belief in the dignity of mankind.

David's research career has been exemplary – with over a 100 peer-reviewed articles and chapters in books. I'd like to highlight some of the studies he engaged on in collaboration with the Pathology Division of the NIOH. With regard to asbestos, he made important contributions to the mesotheliomagenic potential of fibres, explored the presence of asbestos in and around dwellings in Soweto, provided insights to better understand the limitations of clinical and radiological diagnoses of asbestosis, lung cancer and mesothelioma, and explored the persistence of the problem of asbestos beyond the ban of its utilisation in the workplace. Silica dust and its associated diseases – in particular, silicosis and tuberculosis – have been a second focus of his collaboration. David has published invited reviews on these intertwined epidemics, including their relationship to HIV and the social ills of the migratory labour system.

Throughout his career, David has had a strong focus on practical interventions in the workplace. He was a leader in the multinational Work and Health in Southern Africa Programme, and the principal researcher in the Mine Health and Safety Council Silicosis Elimination Programme's project to develop educational and training materials for managers and workers. Not content with merely suggesting interventions, he has also explored problems with evaluating the effectiveness of occupational health interventions in the workplace.

David has had an exemplary career and he leaves the NIOH with a rich legacy of research and dedication to public service. Go well – hamba kahle.

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**Deon Jansen van Vuuren**
*General manager: Southern African Institute of Occupational Hygiene (SAIOH)*

I remember the first time I met Dr David Rees – at the (then) National Centre for Occupational Health (NCOH). I delivered some occupational hygiene training organised by Kevin Renton. It was a bit frustrating, as you know Kevin can sometimes ramble on, and I perceived that he was wasting valuable time and changing the scope of what I was tasked to do. Then a distinguished-looking gentleman stood up at the back of this famous hall, and really set the scene – he welcomed me, asked the attendees to participate and contribute to the day's proceedings, and sat down. Later in the day, he did his magical appearance act again, endorsing and summarising what I'd said. Before I left, I asked Kevin who he was. And so I came to know David. After that, for many years and at many different forums, I met him again – always knowledgeable and contributing to the occupational hygiene profession. What a nice man! He will be sorely missed by the NIOH. David, enjoy your retirement; it is well deserved.

**Mohamed Jeebhay**

*Head: Occupational Medicine, School of Public Health and Family Medicine, University of Cape Town, South Africa*

I never imagined that I would be participating in an act of serendipity 30 years later, as we celebrate and honour the scholastic contribution of Prof. David Rees. I have followed a similar path in occupational health as David except that, in my case, it occurred a decade or so later. Yet, the seeds were planted in the late 1980s as a senior house officer working at the Hillbrow Hospital in the midst of my 'distant' exposure to David when he participated in the Wits Respiratory Unit/ICU academic clinical meetings. At the time, he was presenting complicated cases of pneumoconiosis to the meeting in the quest of obtaining the best management and compensation for his patients – the workers in the mining industry. This was indeed one of my foremost exposures to the practice of exemplary occupational medicine at the time. Added to this has been David's scholarship around the epidemiology and compensation of occupational lung diseases, primarily in the mining industry, recognised both locally and abroad. These scientific communications covered silicosis, pulmonary TB, asbestos-related disease, including mesothelioma, and occupational asthma, among others.

David has led the way from very early on in his academic and scientific career while at the NIOH. Under his direction, the NIOH became a national and international centre of excellence, being designated as a WHO Collaborating Centre in Occupational Health, alongside the UCT Centre for Occupational and Environmental Health Research (COEHR) at the time. Aside from his leadership and research endeavour, I have worked closely alongside him on various initiatives, reimagining a prominent role for occupational health nationally in post-apartheid South Africa and the SADC region. Through the National Committee on Occupational Health established by the then minister of health in 1995, as well as the research development and training initiatives of the Fogarty ITREOH and WAHSA programmes that followed a decade later, we organised a number of meetings, workshops, seminars and research training initiatives in various SADC countries.

In addition to these laudable academic achievements, David has also been a mentor to many individuals who have moved on to occupy leadership positions in various sectors of our country. This mentorship has not only focused on promoting socially engaged scholarship and scientific rigour in the conduct of research, but also created opportunities for broadening the scope and funding of the occupational health research endeavour. David, your support for the occupational allergy and asthma research in South Africa has not gone unnoticed, both at public level through your published work, and at a more personal level through engagement with myself and other colleagues in the field.

**L-R: Mohamed Jeebhay, Shahieda Adams, Zahida Sonday, Roslynn Baatjies, Itumeleng Ntatamala, Faranaaz Bennett, Jarrod Matthei, Amy Burdzikat the UCT Occupational Medicine Division, UCT School of Public Health and Family Medicine**

*Photograph: Courtesy of UCT Occupational Medicine Division*

On behalf of the Occupational Medicine Division at the UCT School of Public Health and Family Medicine, we would like to convey our indebtedness to you for your phenomenal contributions to occupational health through this period. We wish you all the very best in the next phase of your life, which undoubtedly will be just as enriching and fulfilling to you as has been the legacy you have left behind.

**Jorma Rantanen**

*Specialist physician in occupational health; Director general emeritus: Finnish Institute of Occupational Health (FIOH); Visiting scientist: Department of Public Health/Occupational Health, University of Helsinki, Finland*

David, you have made an enormous impact in your own country through occupational health research, and your advisory role on miners' occupational health, and prevention of pulmonary diseases, asbestos-related hazards, silicosis, tuberculosis, and several other outcomes. You have also worked hard for the development of occupational health services in South Africa and thus implemented your research in the workplace practices. But you have not limited the focus to your home country only. You have also taken care of the development of occupational health and safety in the rest of Africa, and in the whole world. You have served as an active member in the World Health Organization (WHO) Global Network of Collaborating Centres in Occupational Health and you took the lead in the WHO Intensive Partnership in Africa Task Group, which was organised to support the WHO/ILO Joint Effort on Occupational Health and Safety in the African Region. The Joint Effort coordinated actions of over 100 institutes from 22 countries for the development of African occupational health.

The International Commission on Occupational Health (ICOH) has enjoyed your professional and intellectual support. Just to mention two of many examples: you were instrumental in the organisation of one of the most successful ICOH Congresses in Cape Town in 2009 and, more recently, you gave an important contribution to the ICOH Dublin Congress 2018 Asbestos Special Session: *Policies for elimination of Asbestos-Related Diseases (ARDs): A global picture* and the *Global Forum on Prevention of Occupational Cancer,* both of which contributed to the drafting of the *Dublin Statement on Occupational Health: New avenues for prevention of occupational cancer and other severe occupational health hazards.*

We, the former senior staff of the Finnish Institute of Occupational Health (FIOH), and members of the Finnish Association of Occupational Health Physicians, and many colleagues in ICOH have learned to know you, David, as a prominent occupational health leader, excellent epidemiologist and occupational medicine researcher, and great educator and practical actor in occupational medicine and occupational health. We are grateful for all we have learned from you and have very much enjoyed working with you.

Have the most enjoyable 'third age'. Maybe, you one day will legally retire but, we believe, never intellectually. Modifying Edward J Stieglitz's famous statement, we wish you many years in life and much life in your years!

# Tributes

**Claudina Nogueira**

*Project and data manager: Faculty of Health Sciences, University of Pretoria, South Africa; Vice president for Scientific Committees (2018–2021): ICOH; Executive committee member: SASOM; Board member: Workplace Health Without Borders (WHWB); occupational health consultant*

*"A truly great mentor is hard to find, difficult to part with, and impossible to forget – you will be missed!"* (unknown)

My salutations to you on the special occasion of your official retirement.

I had the privilege and honour of working with you in 'all-things-occupational health' during my 21 years at the National Institute for Occupational Health (NIOH). I joined the NIOH in 1990 as a young and newly qualified medical biochemist with a BSc Honours degree from the University of the Witwatersrand, to work in a part-time post as a medical natural scientist. I knew very little about occupational health at that time and, in my first official employment, I felt quite overwhelmed and daunted by what I did not know!

Although I worked in various capacities at the NIOH, starting out in the Section of Biochemistry Research and Toxicology, the post that I enjoyed the most was working in the Section of Communication, Training and International Liaison under your leadership and guidance. The work that we were involved with at the NIOH made a visible difference to the wellbeing of the working populations in southern and South Africa, and the NIOH's links and partnerships with well-established international organisations made for very rewarding programmes in the SADC region in terms of outreach, capacity-building and training in occupational and environmental health. Collaborative programmes and partner institutions that come to mind include the Fogarty International Center/University of Michigan Training Programme; the Work and Health in Southern Africa (WAHSA) Programme, particularly Project 7 – Action on Silica, Silicosis and Tuberculosis; WHO; ILO; ICOH; NIOSH-USA; FIOH; Swedish NIWL and NIPH; HSE-UK; and, locally, South African government departments such as Health, Labour, Mineral Resources, and national councils and societies such as SA-MRC, MHSC, NRF, CSIR, SASOM, SASOHN and SAIOH. Who can ever forget the intensive preparation and groundwork that was required for the NIOH to be awarded the status of WHO Collaborating Centre in Occupational Health?

Over the years you were always a sympathetic ear and a role model to emulate, whether in the role of colleague or manager. You were a mentor, first and foremost, and always eager and happy to share your vast knowledge and expertise. I am grateful for, and appreciative of, your contribution to my continuing development, both professionally and personally – my heartfelt thanks!

For many years you have been dedicated to education and training in occupational health. It is now time to sit back, relax, and watch those seeds you planted grow… or have a beer or two instead! Enjoy your retirement and may it be as rewarding and successful as your distinguished professional career!

**Brian Williams**

*South African Centre for Epidemiological Modelling and Analysis (SACEMA)*

He is a good man and a good friend. He encouraged and inspired all of us, both in science and in life.

**Kathleen Kahn**

*Personal professor; Senior scientist: MRC/Wits Rural Public Health and Health Transitions Research Unit (Agincourt); Head: Interdisciplinary PhD Programme in Public and Population Health, Wits School of Public Health, University of the Witwatersrand, South Africa*

Alongside an illustrious career in occupational health, Professor David Rees has played a vital and consistent role in strengthening capacity in the field in South Africa. As a postgraduate student, David completed the Diploma in Occupational Health in 1986 and wasted no time sharing what he'd learnt, as he lectured on the course in 1987. He has contributed to this highly successful programme ever since.

However, to suggest that David 'steadily built capacity' is to greatly underestimate the scale of his contributions. He expanded and enhanced the training offered, infusing innovation in two vital areas. Under David's leadership, the Wits School of Public Health, together with the National Institute for Occupational Health (NIOH), launched a successful Master of Public Health (MPH) in Occupational Hygiene in 2006. This ground-breaking programme – along with a Diploma in Occupational Hygiene – was established to address the serious shortage in occupational hygiene skills and the lack of formalised knowledge in the discipline in South Africa. David then proceeded to introduce a high-quality registrar programme to establish a cadre of occupational medicine specialists, by establishing the four-year Master of Medicine (MMed) degree at Wits University – another first for the country.

Always generous with his time, David supported the Interdisciplinary PhD Programme in Public and Population Health from the outset, assisting with the evaluation of prospective candidates in the fields of occupational health and hygiene.

David has made an exceptional contribution to professional training and education as well as to doctoral students and early-career researchers in the fields of occupational health and hygiene. With his vision and commitment to strengthening capacity, and a willingness to capitalise on the MPH and MMed foundations, David has shown true leadership. In so doing, he has bridged significant gaps in South African practice, and put in place much that today we regard as 'the norm' in professional and research training in occupational health and hygiene.

With his deep sensitivity to the South African context, great sincerity and quiet determination, David's legacy resides in the many graduates who have benefited from programmes established through his leadership – and in the programmes themselves that are now well placed to contribute to future generations.

**L-R: Daan Kocks (SASOM chair) and Claudina Nogueira**

*Photograph: Courtesy of Claudina Nogueira*

**Engela Venter**

*Retired 2006, National Institute for Occupational Health (NIOH), South Africa*

From having an office next to David's, and slowly over years getting to know this soft-spoken serious man, I can with confidence say that occupational medicine was the great passion of his life, and that he approached his clinic sessions with purpose and dedication, always with a quiet respect towards the sick workers and their families. He is a modest person and not very keen on occupying high office positions, and was quite relieved when Mary took over from him as director of the NIOH. However, as director, he managed the transition from the Department of Health to the National Health Laboratory Service (NHLS) successfully, and with a wisdom that made it easier for us to accept the change.

David was an appreciated member of the Occupational Medicine Section, and we will fondly remember many happy moments shared. As head of the Section, he was responsible for all the speeches, as well as some less verbal activities!

David, herewith a short poem – the simplicity of the words illustrates the unexpected honesty and freedom of retirement.

*When I was younger*
*It was plain to me*
*I must make something of myself.*
*Older now*
*I walk back streets*
*admiring the houses*
*of the very poor:*
*roof out of line with sides*
*the yards cluttered*
*with old chicken wire, ashes,*
*furniture gone wrong;*
*the fences and outhouses*
*built of barrel-staves*
*and parts of boxes, all,*
*if I am fortunate,*
*smeared a bluish green*
*that properly weathered*
*pleases me the best*
*of all colors.*
*No one*
*will believe this*
*of vast import to the nation.*

William Carlos Williams, 1883–1963, pediatrician, obstetrician, writer of poetry, Pulitzer Prize winner

Good wishes for this great adventure.

**Occupational clinic staff, Back L-R: Sr Ruth Mkwelo, person not identified, Mrs de Villiers, David Rees; Middle L-R: Clifford Panter, Cecil; Front L-R: Engela Venter, Marianne Felix** *Photograph: Courtesy of Engela Venter*

**Mary Kawonga**

*Department of Community Health, Wits School of Public Health, University of the Witwatersrand, South Africa; ; Charlotte Maxeke Johannesburg Academic Hospital, South Africa*

I know you have been 'threatening' to retire for a while; I can't believe it is actually happening! What? Well, apparently it is true and I have no choice but to believe it. This is such a loss to the School of Public Health and the National Institute for Occupational Health, and the Colleges of Medicine. I selfishly wish you could continue working in all these spaces, but alas!

I can't recall when exactly we first met. All I know is that you were around when I joined the Wits School of Public Health in 2004. Yup, that long! This feels like the end of an era! You will be missed. You and I sat in different divisions of the School, so we did not work closely on a day-to-day basis. However, we did interact at times – for instance, when serving together on the School Exec Committee, when developing the curriculum for the new MMed in Occupational Medicine, and when developing teaching materials for the medical students. I will miss your super calm demeanour and your humility – such admirable characteristics that are few and far between. In all our interactions I always admired you for many other qualities – too many to mention – but the ones at the top of my mind include your excellent occupational medicine expertise (a walking occupational health encyclopaedia!) and your willingness to share your knowledge and expertise. But most of all, without a doubt, yours have been the best advice and explanations I have ever received on epidemiological concepts. You will forever remain in my heart as THE case control studies guru. Who will be my case control studies go-to guy now, David? You had better clone yourself – otherwise, I promise to seek you out of your retirement if I have to!!

But seriously, I am very happy for you and wish you all of the very best in this next chapter of your life. I hope you get the rest and relaxation you deserve, and do the things you have always wanted to but never did because work got in the way.

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**Vijay Nundlall**

*Group environmental engineer: Sibanye-Stillwater*

I'd like to wish you a very wonderful and happy retirement, Prof. Rees, and many thanks for all your private seminars trying to educate us in occupational health, and also in occupational safety. We'd like to thank you for that because the knowledge you imparted has helped us to make mine workers safe and healthier. Thank you very much, and enjoy your retirement.

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**Dave Barnes**

*Occupational medicine specialist; Director: Healthy Mining*

I have known Dave for nearly 30 years. He has always come across as easy to talk to, even humble, despite his deep insight into occupational health. He has never let me down in the answers he has for difficult questions, often surprising with a different (but justified) take. What I consider one of Dave's most important skills is his ability to talk to those of us who have careers in mining and industry as colleagues and not from an 'ivory tower academic' perspective. This attribute means that we are able to discuss issues frankly and move the real practice of occupational health forward, rather than feel that we are being critiqued.

**Anthony Zwi**

*Professor of Global Health and Development: Faculty of Arts and Social Sciences, University of New South Wales, Sydney, Australia*

I'm not sure if this note of celebration and recognition should be addressed to you, Dave, or about you to others… it probably makes no difference… Writing this is a memory and a reminder and, in small part, a fragment of the public record… We go back a long way… to the early days of an emergent progressive National Centre for Occupational Health (NCOH), around 1983/4. Apartheid was very much in place, but it was being resisted and contested, and a growing number of institutions, individuals and organisations were openly and transparently challenging the state and its unjust laws, practices and procedures. An under-recognised and under-supported group were factory and other industrial workers. People, of course, need and desire to work, but in many cases their work made them sick and many employers treated their workforces as disposable – an 'acceptable' (but often undeclared) loss in the pursuit of profit. While mine workers were represented by powerful national unions, which sought to secure health and safety at work, industrial workers were often less powerful, involved in a wider variety of settings with a greater range of hazards, and with less protection and support in law.

Dave, we worked together, along with other trusted and committed colleagues, notably Rodney Ehrlich but many many others too, within supportive networks, amidst growing confidence in the changes required if a more progressive South Africa were to be born. Our work evolved over time, backed by knowledgeable mentors, comradeship, collegiality and friendship. Although I was only at the NCOH for around three years before I departed for further study in the UK, those three years were immensely and intensely formative and transformative. I knew that what I was leaving behind was, in many ways, special – a progressive group of young professionals working within a state institution, seeking to promote a non-racial, socially just and equitable country. Even from the UK, where I settled, I continued to hear of many of the ongoing projects and activities that continued to be developed and implemented over time.

Our work was centred around individuals – their stories, their histories and narratives. From their day-to-day lives, we sought to understand systems, workplaces, inequities, and what needed to change. The intense focus on the individual patient also required the development of trust and reciprocity with the private sector and with their health personnel. Teaching was an essential component to building those relationships and trust. From the individual came an understanding of the socio-ecologic and political economy of work and ill health. There was a commitment to offering an engaged, respectful, and action-oriented clinical service where workers could be carefully assessed, their stories heard, and frequently, their workplaces assessed on-site. From the individual developed an understanding of working conditions and of the hazards that required control or transformation. You always identified the centrality of securing for all working people improved working conditions and, where necessary, support and compensation for work-related ill-health.

Dave – from the time you started those many years ago, to the time ahead when you catch your breath and turn your commitment and talents to other things, you were rock solid. Your commitment to clinical work, research, and teaching inspired others and facilitated the recruitment of the next generation of impressive occupational health workers. What I always remember about you was your calm, quiet, committed approach. Your work was about listening, exploring, recording and researching. It was always respectful, always collegial and always undertaken with humility.

Work in occupational health was a privilege for all of us – an opportunity to understand people's lives, the challenges they faced, the inequities that prevailed, and what could be done to make their lives better and systems more supportive. You always took that comprehensive set of challenges seriously. Alongside a commitment to family, you have always been concerned about working people, individually and collectively, and to making South Africa a better place. You have always been highly dedicated – a sound occupational physician and researcher working to bring about safer and more enriching workplaces. You provided leadership, collegiality, thoroughness and continuity.

Departing from a work-environment that has been so central to your life and to the life of the institution is difficult. But I am sure that you will appreciate, through what people write and say about you, that you have earned some time to do other things – to be with family, to nurture other interests and, perhaps, to take life more slowly. After all, we live in strange times, and cool heads, good hearts and much wisdom are required.

I wish you, Dave, and your family, and especially Sue – another long-time friend from many a decade ago – my very best wishes and congratulations. I hope that we will meet again, in person, before too long!

**Back L-R: Malcolm Steinberg, Danuta Kielkowski, Rosalie Lowe, Fazel Randera, Rodney Ehrlich, David Rees**
**Front L-R: Susan Landau, Anthony Zwi, Anne Hilton, Tony Davies, Margot Becklake**

*Photograph: Courtesy of Anthony Zwi*

**Jakes Jacobs**

*Immediate past president: International Occupational Hygiene Association (IOHA)*

Here is to wishing you well in your retirement years, David. I thought it best to extract some text from the acknowledgements section of my MPH research report (written more than a decade ago) to summarise the sentiments I believe I share with many a fellow student that you have assisted: "Professor David Rees, who assisted greatly in making this research report possible with much advice and encouragement." Thanks David – I see you not only as a sincere and helpful person but also as someone dedicated to the health profession and passionate about the well-being of workers. *Deus benedicat!*

**Kevin Renton**

*Visiting lecturer: Wits School of Public Health, University of the Witwatersrand, South Africa; Member: South African Institute for Occupational Hygiene (SAIOH)*

I first met David at the Wits Medical School in 1972, sitting at the back of the Harveian Lecture Theatre, a place that I also favoured! I was in awe of his laid-back demeanor, and perhaps I emulated him a little too much because I flunked halfway through that year, and moved to the more sedentary field of biochemistry, ultimately landing up at what was then the NCOH. How surprised I was when I again ran into him, in the Occupational Medicine Department.

How would I describe David as a colleague? Democratic, dedicated, benevolent, hardworking and perceptive. He is good-natured and progressive and, while he appears soft on the outside, inside he has a steely core; when the occasion demands it, the stern interior breaks out to keep the ship on course and afloat.

One of David's outstanding skills, which, thankfully, he was not called on often to practise, was defusing pugnacious altercations between staff. He had to exercise this skill during occupational hygiene department meetings, smoothing out fights between the (then) head of the department and a misdirected staff member!

He takes the occupational health message to heart, demonstrating this on occasions such as when he decreed Health and Safety Days to motivate staff to take the OSH Act 85 of 1993 more seriously – for how could the organisation dictate to others when its own house was not in order? He steered the health and safety committee himself, as an example to all to reducing workplace risks.

David has a sense of humour and has an innate sense of the big picture. For that reason, I have been happy to work with him to promote the occupational hygiene profession. I don't think this is a farewell as I believe we will meet in other forums. David's dedication to occupational health is a beacon in an often-neglected field.

**National Centre for Occupational Health (NCOH) staff in the 1980s. Back L-R: Keith Botha, Steven Steyn; Third L-R: Clive Wills, Rosalie Lowe, David Rees, Pienkie; Second L-R: Gill Nelson, Julie Hills, Khathatso Mokoetle, Malcolm Steinberg; Front L-R: Magda de Beer, Danuta Kielkowski, Shelley Arkles, Kim Goodman**

*Photograph: Courtesy of Marianne Felix*

**Kevin Renton, Andrew Swanepoel and David Rees with a Swedish colleague at Moyo's Restaurant in Melrose Arch, Johannesburg, Work and Health in Southern Africa (WAHSA) Programme dinner, 2006** *Photograph: Claudina Nogueira*

**Kaj Elgstrand, Christer Hogstedt, and Nils 'Ocka' Petersson**

*Swedish friends and colleagues in global occupational health*

The programme of Work and Health in Southern Africa (WAHSA) was to be a regional support for national competence development. There was a five-year long preparation, from 1998 to 2003, during which you, David, were the counterpart to the Swedes who were bringing financial support. During this period, there was a feasibility study in the region, workshops in Stockholm and Malawi, and elaboration of a final programme proposal.

It was not an uncomplicated thing. Many actors were involved in the preparations: the Southern African Development Community (SADC), the Swedish International Development Cooperation Agency (Sida), the Swedish National Institute for Working Life (NIWL), the Swedish National Institute of Public Health (NIPH), and several institutions in the southern Africa region. Sida offered to finance the first four-year phase, with 2 650 000 US dollars. WAHSA was launched at the SADC headquarters in Gaborone, Botswana, in October 2004.

The fact that this programme was established at all was, to a great extent, dependent on your knowledge, actions and personality. You knew persons and institutions in the region, you were a respected researcher in the field of occupational health, and your humour and light touch facilitated discussions, negotiations and actions.

WAHSA was planned to be a 12-year programme. The first phase was to lay the ground for the following eight years: establishment of resource complexes; profiling occupational safety and health; creating the basis for future interventions; training of health and safety professionals; improving access to information; advocacy and awareness-raising; actions on silica, silicosis and tuberculosis; action on pesticide poisoning; and action on health and safety in informal small-scale enterprises.

At the time, WAHSA was an original construction and it might have been a great success if it had not been for a new Swedish government that took over in 2006. The new government put a lower priority on occupational safety and health, and closed the Swedish NIWL. As a consequence, Sida decided to halt support for WAHSA. What was intended to be a 12-year programme ended with the first four-year phase, in 2008. However, several of the initiatives continued with local funding, and at least one doctoral exam was based on studies that started as WAHSA projects.

We appreciate your endurance, deep understanding of applied research and preventive actions, and talent for cooperation. It was indeed a great privilege to have collaborated with you. We hope that your time after retirement will be just as you and your family want it to be.

# Tributes

**Marilyn Fingerhut**

*Consultant: The National Institute for Occupational Safety and Health (NIOSH), USA*

First, my sincere congratulations upon your retirement! Second, you have earned a long, happy and healthy next phase of life! Third, I sincerely hope you will find a way to continue contributing to occupational safety and health of workers in South Africa and globally! We need you! You have been such a great leader and researcher. Your work has immensely improved worker lives everywhere.

My special memories relate to our working together for NIOSH, NIOH, the WHO Network of Collaborating Centers (WHO CCs), and the International Commission on Occupational Health (ICOH). You were so active serving on the WHO CC Network Leadership Advisory Committee when you were director of the NCOH/NIOH, and as a leader in the CC Network Global Plan of Action throughout your career, and as head of Occupational Medicine at the NIOH. I have warm memories of working with you and Gerry Eijkemans when I was at the WHO in 2001–2002 on the WHO CCs' Intensive Partnership in Africa, an alliance on occupational health to provide training, research, and information dissemination. Partners included the ILO, the NIH Fogarty Program, and the University of Michigan.

I also have wonderful memories of you and NIOH director, Mary Ross, hosting the WHO CC Network Planning Committee at the NIOH in 2005, where we evaluated the 2001–2005 Global Plan and concluded it was a success, with all 64 CCs, ICOH, IOHA and ILO contributing projects. We identified 'lessons learned', and implementation of our recommendations for the 2006–2010 work plan made that one a bigger success. The planning meeting was followed by the International Occupational Hygiene Association (IOHA) conference in nearby Pilanesberg National Park. Your wonderful kindness is remembered especially by my husband, David Haartz. You loaned him your four-wheel-drive vehicle while we attended the IOHA conference, so he could do his own safari through the park.

You have always been an active member of ICOH. My favourite involvement with you when I was ICOH vice president was the development of the 2018 ICOH Statement on Preventing Tuberculosis among Silica Dust Exposed Workers, led by Perry Gottesfeld, with input from yourself and other valuable South African colleagues. Your strong work and numerous publications regarding elimination of silicosis in many types of dusty jobs, and on the connection between silicosis and tuberculosis, were so important in providing evidence for the ICOH Statement. Inclusion of a publication of yours on the importance of selecting appropriate respirators and fit testing, even in resource-constrained settings, provided a key recommendation in the ICOH Statement on Preventing TB among Health Workers, led by Sophie Kisting – see http://www.icohweb.org/site/ICOH-TB-Statements.asp. These Statements and our international efforts to bring attention to the TB crisis in low-income countries and to this ICOH effort enabled successful inclusion of ICOH wording in the 2018 United Nations Resolution on Tuberculosis, in which countries "Commit to …implementing primary prevention in high-risk occupations by reducing silica dust exposure in mining, construction and other dusty workplaces, and worker tuberculosis surveillance and infection prevention and control in health-care settings". We have a long way to go, now impeded by COVID-19, but the effort is advanced thanks to you and your colleagues.

Sincerely and with great appreciation for you and your wonderful work.

**Gareth Raman**

*Class representative: Postgraduate Diploma in Occupational Health (2018/19), Wits School of Public Health, University of the Witwatersrand, South Africa*

On behalf of the 2018/19 DOH class we want to take this time to wish you everything of the best in your retirement. As much as there is some sadness in retiring, this is truly a moment for you to celebrate your success, in getting to that pinnacle in life.

I must congratulate you on an excellent career, but more importantly, for the impact you have made on many a student's life. Your composure and definitely relaxed approach is something many of us 'stressed' individuals aspire to. It is either that, or you conceal it very well, but still, it is something we admired in how you handled situations. We were very fortunate to have you guide us thorough the Diploma – the newer students will be at a disadvantage, for sure.

Truly, you are a man with manners, an academic decorum of excellence and a unique lectureship style that will leave a void in classes going forward. Your in-depth knowledge in occupational medicine leads, naturally, to setting the bar high in academia, and this provided students with the necessary tools for their respective careers. Your teaching style and approach was valuable, extremely relevant, and thorough. You always managed to engage and keep us engaged with such subject matter that, at the time, seemed daunting.

You are a valuable resource to be lost in retirement. You must make the absolute best of it. It's well deserved and well needed! Time with family and loved ones is always sacrificed in this profession. This is your opportunity to make up for all those lost hours and also to do things that you love to do!

All the best for the future and once again, thank you so much for playing an important role in our lives.


**Diploma in Occupational Health class of 1990/1991. Back L-R: R Rendall, D Rees, J Petersen, L McBey, R Dowdeswell, N Tshupe, M Warren; Middle L-R: T Fakude, N Purohit, A Graham, D Naraidu, W Alexander, M Abdullah; Front L-R: D Kielkowski, S Naidoo, P Back, P Kranidiotis, L Blumberg** *Photograph: Courtesy of NIOH Archive*

**Braimoh Bello**
*Director: Centre for Statistical Analysis and Research (CESAR), South Africa*

One of my best understood concepts today in the field of epidemiology is odds and odds ratios. And that's because, while I was doing my Master's degree in 2004 at the Wits School of Public Health, Prof. David Rees was the one who taught case control studies and, as part of that topic, he explained odds and odds ratios so brilliantly that I could never forget. That's a concept that's central to the field of epidemiology. And as fate would have it, two years after my programme, he interviewed me at the National Institute for Occupational Health, and he employed me. I worked there for three years – an amazing time I had under him as a divisional head and under Dr Kielkowski as the head of department.

David is a very inspiring person who has raised a lot of research scientists and doctors and other professionals, and I'm one of them, and I'm here to say, "Thank you, Prof". Yes, he was inspirational, hard-working, and very humble. I remember he always wanted me to call him David and, being a west African who was new to the culture in South Africa, that was an impossibility for me. You know how I won that tussle? Whenever I met him, I would just say, "Good afternoon" without adding "Prof" because he just wanted to be called David and I would want to say "Prof Rees".

So, Prof, I want to thank you very much for being a role model to me. Thank you for teaching me, for employing me, and for providing a nurturing environment that enabled us to do all the awesome things we did in the three years that I worked under you and Dr Kielkowski. I believe that I have learned a thing or two from you that I am passing to those I meet, the next generation. I pray that God continues to bless you, your offspring and everything that you do. I'm indescribably grateful for the person that you are and for everything that you did for me. May God bless you.

**Tony Davies**
*Past director (1983–1996): National Centre for Occupational Health (NCOH), South Africa; Professor emeritus: University of the Witwatersrand, South Africa*

In 1983, Prof. du Plessis's advice was "recruit bright young graduates" and this is exactly what happened. Looking back, and glancing at the list of those to whom the request to contribute toward David Rees' Festschrift was extended, shows how many able young women and men were beginning their careers at the time. David was among the galaxy of talent that has now reached maturity, not only as members of the staff of the NCOH but, as the list shows, in a much wider field. We can all be pleased, even if we were not so young, to have been part of this process.

**With Dr Carlos Dora at a 2009 WHO meeting in Santiago, Chile** *Photograph: Courtesy of Jorma Rantanen*

**Workplace Health Without Borders (WHWB) training with Tom Fuller** *Photograph: Kevin Renton*

**Umesh Lalloo**
*Pulmonologist and physician in private practice: Busamed Gateway and Life Mount Edgecombe Hospitals, Durban; Executive director: Enhancing Care Foundation, Durban; Principal investigator: Durban International Clinical Research Site, University of San Diego, California (through a US NIH Adult Aids Clinical Trials Group Research grant); Vice president: Society of Pulmonologists of the Indian Ocean Islands; Professor: Durban University of Technology, Durban, South Africa*

I have had the pleasure of knowing Dave since I worked at the (then) National Centre for Occupational Health, as a Richard Ward Endowment Research Fellow in 1985. Both of us had the unique privilege of working under the guidance of the late Prof. Margot Becklake. Dave became an academic colleague and friend, and our professional relationship has endured since. He is, in my humble opinion, an astute occupational health specialist with a balanced view on occupational health issues. He has contributed greatly to the South African Thoracic Society meetings and workshops. I also had the opportunity to undertake research with him, with the Surveillance of Occupational Respiratory Diseases in South Africa (SORSA) progamme. I can reflect on my time spent at the NCOH as the golden years of occupational lung disease as we had the privilege of working with Margot Becklake, Tony Davies, Anthony Zwi and Nicky Padayachee.

I hope that Dave's retirement does not signal an exit from academic occupational health as his expertise is required now more than ever. I lament the fact that people are obliged to retire at the peak of their careers when their expertise, maturity of thought, and mentorship are needed to guide the next generation of leaders in South Africa.

All the best Dave, and thank you for being such a great colleague; I trust we will stay in touch. There is so much still to do!

**Shelley Arkles**
*Epidemiology Unit, National Centre for Occupational Health (NCOH), South Africa (1980s)*

I didn't have much contact with David during my time at NCOH, largely due to being in a different section and on a different floor; and also, because I spent so much time in Lesotho! But I do remember him with great fondness as a person with a cheeky grin, an extraordinary quiet achiever, and a thoroughly decent, honest man of integrity, purpose and commitment. I wish him everything of the best for his retirement and decades of happiness, health and new adventures.

**Rodney Ehrlich**

*Emeritus professor and senior research scholar, School of Public Health and Family Medicine, University of Cape Town, South Africa*

One of my more productive career acts was to recruit David Rees to the National Centre for Occupational Health (NCOH) in 1984. He might even admit to my having saved him from a career in urology that he was pursuing at the time. The occasion was the Federation of South African Trade Unions (FOSATU) Health and Safety Day. On chancing upon our mining lung disease stall, he was intrigued to know whether I did this work for a living. Not only did I, I could tell him, but there was a recent vacancy at the NCOH. The rest is the history being celebrated in this Festschrift.

Occupational medicine in the state sector, and specifically at the NCOH led by Tony Davies, offered a paradoxical space in the 1980s. The white minority government had liberalised black trade union activity in an effort to contain economic disruption, making the shop floor an arena for negotiation. The Department of Labour was trying to modernise health and safety legislation and the Department of Health had inherited the NCOH as a stepchild unwanted by others. Under Tony Davies' protective guidance, it became a space where clinical and laboratory science, technology, and worker advocacy could converge. In this space, David flourished, and went on to head Occupational Medicine, to direct the Centre (renamed the NIOH), and occupy a chair in Occupational Health at Wits University.

David's work in occupational medicine has remained rooted in clinical practice at the NIOH. In attempting to resolve the predicament of a worker becoming ill as a result of his work, many types of questions have to be answered, requiring breadth and depth inquiry and engagement. David's research in clinical medicine, epidemiology, occupational hygiene, and prevention and compensation policy, reads like a primer of occupational health in South Africa over the past 30 years.

Of David's many publications, two stand out for me because of their timely distillation of the science of the plight of former gold miners: 'Silica, silicosis and tuberculosis' (2007) with Jill Murray, and 'Oscillating migration and the epidemics of silicosis and tuberculosis and HIV infection' (2010) with Jill Murray, Gill Nelson and Pat Sonnenberg. These articles anticipated the revitalisation of social engagement with the burden of occupational lung disease among those who had dug the wealth of South Africa and continue to do so. Scientific understanding of these diseases, their interrelationship and their historical trajectory has informed the current legal and political action that may bring a measure of justice to this population.

David's professional style is characterised by a lightly worn erudition, and an ability to remain surprised by new data and ideas, and to be prepared to change his mind. His interventions at academic gatherings are often in the manner of thinking aloud, offering a different way of looking at the issue at hand. He is free of self-importance and dogmatism and generous to others regarding their own work and presentations. I wrote my first paper on pneumoconiosis with him in 1988 and look forward to at least a few more. To his close colleagues for whom his retirement represents a loss in their own professional environment, I can only encourage them to get out there and recruit.

**David Jones**

*Manager: National SHE Department, National Health Laboratory Service (NHLS), South Africa; National Institute for Occupational Health (NIOH), South Africa*

I met you for the first time in 2004 when I was afforded the privilege of doing the Diploma in Public Health and, if I remember correctly, you and Rob Ferry were the course coordinators.

I remember that, when I was studying the DPH and needed some advice regarding a situation at a workplace on the West Rand, I called you one evening. We chatted for quite a long time about the situation and, at the end, we found a solution and a way forward. Little did I know then that our paths would cross again when I came to know you as a colleague rather than as a professor, when I joined the NHLS in 2007 and eventually moved to the NIOH in 2012.

Given the challenge of setting up an occupational health and safety department, without a medical background, I had to draw extensively on someone with that knowledge and experience – that was you. I remember us discussing the ideal ratio of health worker to employees, how to interpret 'exposure' in light of the Hazardous Biological Agents Regulations, and even flying to Durban to meet with the Provincial Department of Labour (as it was then) to debate the appropriate medical surveillance for laboratory personnel. I also remember all the times you came across a journal article or piece of information that was relevant to our situation and you passed it on. Not only that, but you were also ready to discuss it if necessary.

These are just a few of the specifics. I have not mentioned the occasions that I walked past your office and popped in for a brief chat, or the times that we shared a cup of coffee (not decaf – what is the point of decaf coffee?).

Although you are a highly respected medical academic, you never looked down on me as someone who was not from a medical background. Rather, you accepted me as a part of a team, made inputs into my life, and did your best to ensure that I grew and developed. I guess, to cut to the chase, you have always been a friend, a source of valuable information (and a very generous one at that), and I will always be indebted to you. Thank you.

**L-R: Bill Harrison, Egon Behringer, Marianne Felix, Mrs de Villiers, Pienkie, Sr Ruth Mkwelo, David Rees, Rodney Ehrlich, Keith Botha, Dixie Rouillard, Anne Hilton**

*Photograph: Courtesy of Marianne Felix*

# Advocating the use of relative risk ratio (RRR) for describing multinomial logistic regression exponentiated coefficients

*Written for Dave Rees on the occasion of his retirement and Festschrift, and in celebration of his academic leadership, scholarship and contribution to workers' health.*

**Brendan Girdler-Brown,** School of Health Systems and Public Health, University of Pretoria, South Africa

## INTRODUCTION

This short essay is inspired by memories of discussions with David Rees over the years when we have worked together. I believe this essay contributes, to some extent, to an ongoing and unresolved debate online concerning the use of 'RRR' ('relative risk ratio') to describe the exponentiated coefficients that are obtained, following multinomial logistic regression. I start by briefly describing the context in which multinomial logistic regression is used. I follow with a brief description of some of the names that have been proposed for the exponentiated coefficients. I then make use of contingency tables to work through the derivation of the exponentiated multinomial logistic regression model outputs. Finally, in conclusion, I defend Stata's use of the term 'relative risk ratio' for the exponentiated coefficients obtained following multinomial logistic regression.

## MULTINOMIAL LOGISTIC REGRESSION

Multinomial logistic regression is carried out if one wants to model an outcome with more than two categories/levels of outcome; and where the outcome categories are not ordinal. The alternative outcome states should be independent of each other (the so-called 'independence of irrelevant alternatives', or 'IIA' assumption).

If there are n levels of the outcome where n > 2, then multinomial logistic regression fits n-1 models. In the scenarios used in this essay, with three outcome levels, this means that there are (3-1) = 2 models. For example, in the first scenario presented, the first model relates Type 1 diabetes mellitus (DM) to seromarkers, while the second relates Type 2 DM to seromarkers. The third reference outcome level, in this case, was 'no diabetes'. I refer to the outcome groups as A, B and C.

## THE CONTINGENCY TABLE AND THE USE OF RRR TO DESCRIBE OUTCOME MEASURES

Figure 1 shows the numbering of the cells and the row and column counts that are used in the discussion that follows.

What is the correct name to use for the exponentiated coefficients obtained following multinomial logistic regression? Stata calls them 'relative risk ratios' (RRRs). SAS calls them 'odds ratios' (ORs). SPSS sits on the fence and simply calls them 'exp(B)'. R also avoids naming them, and calls them 'exp(coef)'. Hosmer and Lemeshow (2000)[1] refer to these ratios as 'odds ratios' while Fleiss, Levin and Paik (2003)[2] have proposed the use of 'adjacent odds ratios' (AORs, not to be confused with 'adjusted odds ratios', although they are, in fact, also adjusted ratios). Hilbe (2009),[3] who contributed to many of the algorithms used for Stata's logistic regression models, uses RRR, and this may explain why Stata uses RRR.

Hilbe (2009)[3] asserts that, as these outcomes, A ,B and C, are independent and unordered, it is legitimate to consider the proportion in each group as a 'risk' of someone in the study sample being in that outcome group. He makes no qualification as to the type of study design that gives rise to the data. Hence, in Figure 1:

- The risk of a participant being in group A = (a+d)/T
- The risk of a participant being in group B = (b+e)/T
- The risk of a participant being in group C = (c+f)/T

Furthermore, the relative risks (RRs) are as follows:

- RR of group A (exposed) vs group A (unexposed) = a/(a+b+c) ÷ d/(d+e+f)
  = (a/d) * (d+e+f)/(a+b+c)
- RR of group B (exposed) vs group B (unexposed) = b/(a+b+c) ÷ e/(d+e+f)
  = (b/e) * (d+e+f)/(a+b+c)
- RR of group C (exposed) vs group C (unexposed) = c/(a+b+c) ÷ f/(d+e+f)
  = (c/f) * (d+e+f)/(a+b+c)

The relative risk ratios (RRRs) comparing outcomes A and B, in turn, to outcome C, are as follows:

- RRR (A vs C ) = (a/d) ÷ (c/f) (because the other terms cancel each other out)
  = af/cd (this may be obtained by exponentiation of β, and looks like an "odds ratio" (since it is a ratio of two odds; as we have seen); however, it is also an RRR)

Similarly,

- RRR (B vs C) = (b/e) ÷ (c/f)
  = bf/ce

The above demonstrates how a ratio of two relative risks, in this context, looks like a straightforward odds ratio, since it is a ratio of

| Exposure variable | | Effect (outcome) group: Type 1 DM coded as 3 A | Type 2 DM coded as 2 B | No DM coded as 1 C | |
|---|---|---|---|---|---|
| Coxsackievirus | Yes | a | b | c | a+b+c |
| B1 seromarkers | No | d | e | f | d+e+f |
| | | a+d | b+e | c+f | T |

**Figure 1. Contingency table for diabetes outcome category vs seromarker category**

| Exposure variable | | Effect (outcome) group: Cluster 1 DM coded as 1 | Cluster 2 DM coded as 2 | Cluster 3 DM coded as 3 | |
|---|---|---|---|---|---|
| Coxsackievirus | Yes | a | b | c | w |
| B1 seromarkers | No | d | e | f | z |

**Figure 2. Contingency table for the severe diabetes cluster vs the seromarker category**

two odds; but is actually, also, a relative risk ratio (a ratio of two relative risks) in terms of its derivation. This is an important distinction because, when it comes to interpretation, this conclusion (that it is actually an RRR) allows us to interpret the exponentiated β value in terms of risks rather than in terms of odds. In this scenario, where 'no diabetes' may be considered a true control, the RRR is also a ratio of two odds ratios, but it is not the same as a regular odds ratio which is only a ratio of two odds.

Following the use of the appropriate command for multinomial logistic regression in Stata, SASA, SPSS and R, the exponentiated effect measures that are produced compare the relative risk of disease in each outcome group with the relative risk of disease in the reference group. Stata will, by default, use the lowest number outcome as the reference category. If you wish to use a different outcome category as the base outcome then you specify *"mlogit outcome exposure, baseoutcome(code)"* where code identifies the coding value that you want to use as the reference category.

## EXTENSION OF THE ARGUMENT TO A SCENARIO WITHOUT AN EXPLICIT CONTROL GROUP (NO DISEASE)

In the example illustrated in Figure 1, the reference category was a group without the disease of interest. However, this need not be the case, although one of the groups will have to stand in as the reference group. For example, consider a hypothetical scenario, illustrated in Figure 2. In this scenario, it is assumed that the study population consisted of patients known to have DM. The types of DM were classified into five different clusters (after Ahlqvist et al., 2018),[4] three 'severe' and two 'mild'. The research question is now changed and the researchers ask, for the severe clusters, whether the prevalence of Coxsackie B1 seromarkers is different between the three categories. There is no conventional 'control' group where there are participants present without severe diabetes. The three severe clusters are described as follows:

- Cluster 1: Severe autoimmune diabetes
- Cluster 2: Severe insulin-deficient diabetes
- Cluster 3: Severe insulin-resistant diabetes

Now, the following relationships apply:

- Relative risk 1 for cluster 1 | seromarkers = (a/w) ÷ (d/z)
- Relative risk 2 for cluster 2 | seromarkers = (b/w) ÷ (e/z)
- Relative risk 3 for cluster 3 | seromarkers = (c/w) ÷ (f/z)

Stata will select cluster 1 as the reference level (because it is coded as 1; if you prefer, you could stipulate that cluster 2 is used as it is the largest group). Stata will then produce output for the following two models:

- The first model will describe the ratio of the RR2 to RR1 and (w/z) cancels out, so RRR = bd/ea
- The second model will describe the ratio of the RR3 to RR1 and (w/z) cancels out, so RRR = cd/fa

These outcome measures (bd/ea and cd/fa) are certainly ratios of odds in their reduced form. However, they are not 'odds ratios' in terms of the way that the statistic called the 'odds ratio' is defined. They are, however, ratios of relative risks. Therefore, it is not incorrect to refer to them as relative risk ratios (RRRs). For this reason, we may interpret the RRRs in terms of risks rather than in terms of odds, even if there is no explicit control group with no disease present.

## INTERPRETATION OF THE RRR

Let us assume that the RRR for Coxsackievirus B1 antibodies and cluster 1 vs cluster 2 = 2.3 (using cluster 2 as the reference group); this means that the relative risk of being in cluster 1 vs cluster 2 is 2.3. A person with severe diabetes, and who has antibodies to Coxsackievirus B1, is 2.3 times more likely to have autoimmune diabetes than insulin-deficiency diabetes. Similarly, if the RRR for cluster 3 vs cluster 2 = 1.0, then this means that a person with antibodies is as likely to be in either the insulin deficiency or insulin resistance group.

## CONCLUSION

If we were to argue that these 'RRR' ratios are simply 'odds ratios', then we would need to explain why the so-called 'odds ratio' is equal (exactly equal, in fact) to the 'RRR'. Such a proposal would be counter-intuitive, since we know that it cannot be true. The best approach would be to jettison any use of 'odds ratio' to describe these complex relationships, and to stick to relative risk ratio. However, it is also fair to mention that, while there is nothing wrong with relative risk ratio, Fleiss et al.'s (2003)[2] term, 'adjacent odds ratio' is also perfectly defensible (but may be confused with 'adjusted odds ratio' if one uses the acronym AOR). Irrespective of the study design used, these various ratios are calculated in the same way as the exponentiated values of β, or ('ad/bc' in a 2 x 2 contingency table) when one performs multinomial logistic regression. Furthermore, it is justifiable to refer to these exponentiated coefficients as RRRs.

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# Silicosis elimination awareness for persons affected by mining operations in South Africa (SIM 030603)

In June 2005, the Mine Health and Safety Council (MHSC) embarked upon a three-year project that would devise a strategic programme for the elimination of silicosis. The Safety in Mines Research Advisory Committee (SIMRAC) is a partner in the World Health Oganization/ International Labour Organization initiative for the global elimination of silicosis. Since its establishment in 1994, the MHSC has funded SIMRAC research projects in dust measurement and control but silica exposure, with related silicosis and tuberculosis, remains a priority challenge for the mining industry. It was essential to evaluate existing practice with regard to control requirements, to set exposure reduction targets, and to establish best practice for these targets for silica exposure to be met. In addition, new technologies for preventing or allaying dust pollution needed to be reviewed and research conducted, if necessary. Therefore, this elimination project aimed to research the containment/elimination of silicosis in the South African mining industry as identified in regional and national workshops, and was known as the SIM 030603 project.

The project consisted of three parts:

1. Track A – Dust measurement and reporting
2. Track B – Environmental engineering/dust control
3. Track C – Human resources training and management

Prof. David Rees was the lead investigator for Track C, assisted by Prof. Jill Murray.

## TRACK C: HUMAN RESOURCES TRAINING AND MANAGEMENT

In the 1960s, the South African mining industry held a leading position in research on dust exposure and control, and also in education and training about dust. This position needed to be re-established through the use of existing educational methods and technology, which had been developed in the intervening years, to raise awareness about dust exposure and health effects. SIMRAC targeted the area of human resources training/technology transfer as one of the priority areas for the Silicosis Control Programme. Close collaboration was required with the dust measurement and dust control projects on silicosis elimination. The NIOH Occupational Medicine and Pathology Divisions undertook this part of the project.

Throughout the project, the input of the key stakeholders was sought. These included representatives of the employers, employees, government departments and academics. During early strategy work, three priority target groups of mine personnel were identified:

- underground mine workers;
- part-time, elected health and safety representatives; and
- managers (including other levels of influence such as supervisors and trade union leadership).

Consequently, most of the programme work on Track C, such as formative research, and message and materials development, was focused on the researched needs of these three target groups. The main aim of the project – research-based awareness materials development – was achieved through the development of four primary outputs.


**SIMRAC Track C awareness-raising materials**

*Photograph: Shanaz Hampson*

The awareness-raising materials, developed as part of Track C, aimed to build sustained motivation across the industry for a comprehensive programme to control silica dust and to ensure that the knowledge to achieve this control was widely available to all stakeholders in appropriate formats. Although they were scientifically based, the learning materials spanned literacy competencies and covered many levels of knowledge. Through research, piloting and formal evaluation, the content and design were considered culturally appropriate and were presented in such a way as to stimulate engagement with the material.

The materials were designed to build confidence and capacity for action among health and safety representatives in particular, and a sense of urgency in other groups. The primary targeted users were all members of the mining industry in which silica dust exposure occurs, i.e. workers, managers, occupational health and safety practitioners, health and safety representatives, mine workers, and mine management supervisors. The materials were, and still are, of value to all silica industries in South and southern Africa.

## THE FOUR PRIMARY OUTPUTS

These were:

1. Silicosis prevention programme slogan and logo
2. Four digital video discs (DVDs) for mine personnel targeted at specific groups:
   - *Ke pale ya Ntate Thabang le Sello* (the story about Thabang and Sello) for workers and health and safety representatives – South Sotho-language edutainment set in a mine, with English subtitles
   - *Uthuli* (dust) for workers and health and safety representatives – powerful Zulu-language drama set in a mine, with English subtitles
   - Reflections: mining, silica and lung disease for all mine personnel. The DVD documents the real experiences of silicosis sufferers with input from mining and medical practitioners, in local

South African languages with English subtitles
- Silica dust: it's everyone's problem – for managers, supervisors, team leaders and trade union leaership. Essential information for dealing with silicosis in South Africa, with perspectives from health, mining and labour authorities, in English

3. Facilitators' guides for all of the DVDs
   A facilitators' guide was produced for each DVD. Research had shown that, in adult education and training, a DVD watched with the guidance of a mediator or learning facilitator had more lasting impact on the viewers. The guides provided trainers or facilitators with general ideas about using films/DVDs for training and facilitation examples/suggestions relating to each DVD. The facilitators' guides were short, written in simple English and designed in a small format that fitted into the DVD cover.
4. Print materials for health and safety representatives and managers of mines with the following titles:
   - Preventing silicosis: a guide for health and safety representatives
   - Facilitators' notes for preventing silicosis: a guide for health and safety representatives
   - Silicosis information note pad to be used by managers, supervisors and trade union leadership

Other enabling outputs:
A number of reports emanating from the research development phase were produced, including:
- Report on literacy levels and language profiles on South African gold and coal mines
- Literature review of modalities for low-level literacy training programmes
- What does silicosis mean to mine managers and supervisors?
- What does silicosis mean to health and safety representatives?
- What does silicosis mean to mine workers?
- Table of commodities in the mining industry with a silica risk

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# OCCUPATIONAL ALLERGIES: IMMUNOLOGY, DIAGNOSIS AND COMPENSATION

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**Summary**

Occupational allergies are diseases resulting from an immune hypersensitivity to workplace agents. Inhaled and contact forms of allergens are the most important causative agents. There are 3 basic mechanisms of immune hypersensitivity underlying occupational allergies, and these are explained. Since occupational allergies are clinically no different to other allergies, these are differentiated on the basis of occupational history, evaluation of the working environment and identification of the allergens to which hypersensitivity exists. The frequency, diagnosis and treatment of occupational allergic rhinitis, asthma, contact dermatitis and hypersensitivity pneumonitis are discussed. Compensation of the South African worker suffering from these diseases is also considered.

## Introduction

The term allergy was originally used to describe altered reactivity to antigenic stimulation, irrespective of whether this resulted in immune protection or pathological hypersensitivity.[1] Nowadays, the terms 'allergy and hypersensitivity' are frequently used synonymously to describe any exaggerated response of the immune system to external antigenic or allergenic substances. Since an 'exaggerated' response is necessary to effect normal, protective immunity, the term allergic disease would be more precise, and is usually what is meant by 'allergy'. Occupational allergy, therefore, refers to diseases resulting from a hypersensitivity of the immune system to substances encountered in the work environment. In terms of this rather permissive definition, allergies which are either caused or aggravated by workplace agents qualify as "occupational" in nature. In reality, a stricter definition is usually applied, since the occupational allergy must be shown to have been caused by workplace exposure to qualify for compensation benefits. Occupational allergies are no different to other allergies in that they are all characterized by a latent sensitization period of weeks to years between first exposure and development of symptoms. Since only a minority of exposed individuals become sensitized, a role for genetic predisposition has been suggested. A recent study from Finland has shown that occupational allergies constitute about 15% of all occupational diseases[2]. The inhaled and contact forms of allergens are the most important in occupational diseases and result in two main body systems being affected, namely the respiratory system and the skin. Manifestations of occupational allergies therefore commonly include allergic rhinitis (with associated conjunctivitis), asthma and contact dermatitis, which may co-exist. Food allergy, where exposure occurs through the gut, is not often encountered since workers are generally discouraged from ingesting work products for reasons of hygiene and economy. However, exposure to food allergens (e.g. cereals, coffee, tea, seafood, eggs, nuts, garlic) through contact and inhalation result in well-described allergic reactions occurring in food-industry workers.[3]

## Immunological mechanisms

The word 'allergy' is frequently used as a synonym for IgE-mediated hypersensitivity. However, IgE mediated responses are only one of the four basic mechanisms, originally proposed by Coombs and Gell,[4] underlying immune hypersensitivity. Three of these are important in occupational allergies, namely *immediate* (type I), *cell-mediated* (type IV) and quite rarely *Arthus* (type III) reactions. Immediate (or anaphylactic) hypersensitivity results from the generation of IgE antibodies which bind to Fc receptors on mast cells and, when cross-linked by specific allergens, trigger the release of mediators such as histamine and leukotrienes. This results in vasodilation, oedema, bronchoconstriction and mucous formation and the acute symptoms of asthma, allergic rhinitis, acute allergic urticaria and anaphylaxis (Fig 1). It

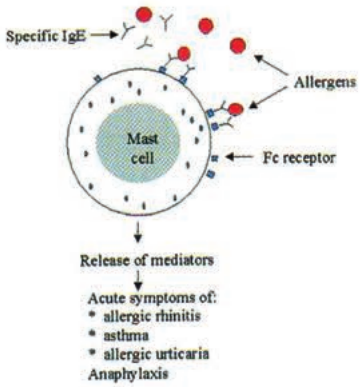


*Fig. 1. Immediate hypersensitivity (type I).*

is becoming increasingly appreciated that usually more than one kind of immunological process is involved in any one allergic disease. Thus, while acute reactions are initiated by type I mechanisms, late phase asthmatic responses and chronic rhinitis are mediated by "delayed" or "late phase" hypersensitivity. In this situ-

ation, specifically sensitized **T-helper 2** cells react with allergens deposited in the airways and the secretion of type 2 lymphokines encourage eosinophil-rich inflammatory cells to the site. It is thought to be the eosinophils which are primarily responsible for airways hyperreactivity and increased epithelial damage[5] (Fig 2).

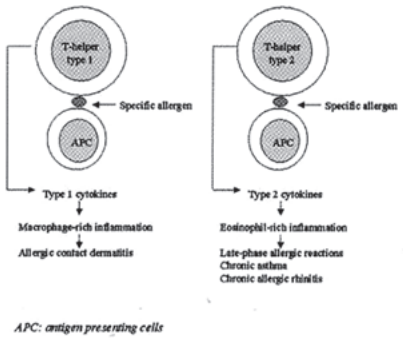


*Fig. 2. Delayed hypersensitivity (type IV).*

Allergic contact dermatitis is mediated by a type IV reaction, though in this case it is the **T-helper 1** cells which are sensitized to, and react with allergens deposited in the skin, attracting macrophage-rich inflammatory cells to the site and causing an eczematous tissue reaction which usually peaks 24 - 48 hours after exposure (Fig 2).[6] The type III (Arthus) reaction occurs when antigen/antibody (Ag/Ab) complexes deposit in the capillaries and activate complement which in turn leads to neutrophil infiltration and tissue damage (Fig 3). For

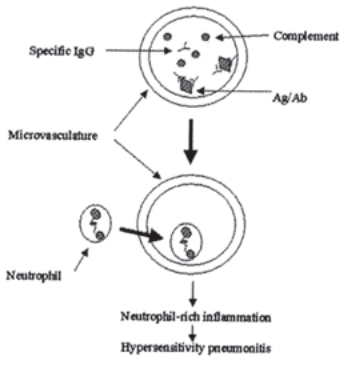


*Fig. 3. Arthus hypersensitivity (type III).*

many years this was considered to be the major mechanism operative in a rather rare group of inflammatory interstitial lung diseases known as hypersensitivity pneumonitis (or extrinsic allergic alveolitis). Occupational aetiological agents include microbial polysaccharides or glycoproteins, animal proteins, certain drugs and diisocyanates (see Table I). The underlying immunological pathogenesis was long thought to be the formation of toxic Ag/Ab complexes which deposited in and around the alveolar capillaries, triggering complement activation. More recently, sensitized T-cells have also been identified in patients with hypersensitivity pneumonitis, implicating an additional type IV hypersensitivity component in this disease[6].

**Differentiating occupational from environmental allergies**

As with all allergic diseases, a thorough clinical examination is fundamental to diagnosis. Since no discrete clinical symptoms differentiate occupational from other environmental allergies however, the distinction requires a detailed history, an evaluation of the working environment and identification of the causative agent(s).

*History*

It has been said that in no other medical disease is the history more important than in allergy[7] and this is particularly true of occupational allergies where a complete and individualized occupational history is essential for establishing the diagnosis. It is also true, however, that a history can be feigned and this possibility should be borne in mind. Determining whether the symptoms are seasonal or perennial and how they relate to a work/away-from-work cycle will usually provide important clues. However, a prolonged period away from work may be needed before symptoms improve and a 10-day break is not unusual, for example in long-standing occupational asthma. A good history should also furnish preliminary information regarding the types of substances encountered at work, and patients (particularly those with immediate hypersensitivity) will often be able to reliably suggest which of these induce symptoms. Once allergic disease becomes entrenched, responses to non-specific triggers may occur (e.g. cold air in asthma), masking the relationship between work exposure and symptoms. When delayed hypersensitivity responses predominate, the worker may have little idea what is causing the disease. In these situations a thorough evaluation of the working environment is needed to identify the aetiological agent.

*Evaluation of working environment*

In most developed countries, occupational hygienists accept much of the responsibility for performing risk assessments and hazard control in the workplace. These are the professionals who evaluate the hazards by reviewing agents to which workers are exposed. This is usually done by using material safety data sheets (MSDS), on-site inspections and/or measuring levels of exposure. Qualified occupational hygienists are unfortunately in short supply in South Africa and occupational nurses, doctors or Health and Safety officers are often expected to fill the gap.

*Confirmation of causative agent*

The first step in this process is to seek a known cause of occupational hypersensitivity in the place of work. Comprehensive lists may be accessed from CD-ROM databases at the National Centre for Occupational Health in Johannesburg and are also available in the published literature.[8-11] Between 200 - 300 agents have been identified as causing occupational asthma and lists of these may also be used as a loose guide for allergic rhinitis since the respiratory tract is the final common pathway for all inhaled pollutants. About 3 500 agents which may cause occupational allergic contact dermatitis have been identified[12] and lists of some of these have been published.[10] The organic dusts implicated in hypersensitivity pneumonitis contain either microbial spores that grow in vegetable matter or animal proteins, particularly those derived from pigeons and budgerigars. In addition, diisocyanates and certain therapeutic drugs have also been associated with development of the disease[13] and a selection of causative agents is shown in Table I.

**Table I. Selected causes of occupational hypersensitivity pneumonitis[12]**

| Source of antigen | Antigen | Disease |
|---|---|---|
| Mouldy hay, straw, compost | *Thermoactinomycetes* spp. *Micropolyspora faeni* | Farmer's Lung |
| Mouldy bagasse | *Thermoactinomycetes sacchari* | Bagassosis |
| Spores, mouldy compost | *Thermoactinomycetes* spp. *Micropolyspora faeni* | Mushroom worker's lung |
| Mouldy maltings | *Aspergillis* spp. | Malt worker's lung |
| Damp, stored bark | *Aspergillus* spp. | Bark stripper's lung |
| Cheese mould | *Penicillium caseii* | Cheese-worker's lung |
| Damp wood | *Rhizopus* spp. | Sawmill worker's lung |
| Air conditioning systems | *Thermoactinomycetes* spp<br>*Acanthamoeba castellani, Naelgeria gruberi* | Ventilation pneumonitis |
| Bird bloom, droppings, | Avian proteins | Bird breeder's disease |
| Polyurethane foam | Toluene diisocyanate | Hypersensitivity pneumonitis |
| Spray paints | Diphenylmethane diisocyanate | Hypersensitivity pneumonitis |
| Therapeutic drugs | Amiodarone, gold, procarbazine, minocycline | Hypersensitivity pneumonitis |

The patient's suspicions should always be taken seriously, especially with immediate type hypersensitivity. These 'hunches' may help in the selection of allergens to be used in confirmatory tests such as skin prick tests and measurement of specific IgE. High molecular weight agents are better candidates for testing than low molecular weight agents, although acid anhydrides (e.g. phthalic anhydride) and some metal salts (platinum) are exceptions. Although easy to perform, SPTs may cause severe local reactions and rarely anaphylaxis and should therefore always be conducted in a facility where emergency and resuscitation facilities are available[7]. Some training in performing the technique and interpreting results is also necessary. *In vitro* measurement of specific IgE is less sensitive than skin prick testing and may be expensive since it can necessitate testing patient serum against multiple putative allergens. However, IgE tests have certain advantages in that they are convenient, pose no risk to the patient and the results are not influenced by concomitant drug treatment.[10] Cost has generally limited the use of these tests in allergic diseases, but is justified in occupational allergies for a number of reasons. Perhaps most important is that once the cause is established exposure can be reduced or prevented, resulting in potential protection of co-workers and/or improved prognosis in the sentinel case. This is particularly true in workplaces with restricted allergen distribution. Another consideration is that workers whose allergy can be shown to be caused by workplace exposure are usually eligible for workers' compensation (see below).

At present, only about 10% of the allergens available from Pharmacia are classified as 'occupational' and it has still not been established whether commercial allergens obtained from other countries (notably Europe and the USA) are relevant to the SA workplace. This may be particularly important in occupational exposure to indigenous plants, woods, grains, seeds and pollens, and endemic fish species. Specific IgE is usually not demonstrable against low molecular weight agents and although these cause allergic disease, the immunological mechanisms have yet to be delineated.

Identification of causative agents is often more difficult in allergic contact dermatitis, sometimes referred to as the prototype of delayed hypersensitivity.[14] Because the response is cell mediated, skin prick tests and specific IgE are not useful confirmatory tests. Delayed recovery after removal from exposure often clouds the cause of disease. On-site visits, obtaining a list of all agents the patient works with, or uses at work, and perusing the relevant literature might therefore be required. Once a list of agents to which the worker is exposed is obtained, patch tests can be selectively performed. These tests involve exposing the skin surface to suspected agents and assessing the reaction after 48 and 96 hours. If for practical reasons only 1 reading is possible, this should not be done before 72 hours, since a significant number of reactions (32% in one recent report15) will not be positive before this. Commercial extracts are usually placed under the patches, though the patient's 'own series' in the form of diluted samples of suspected solutions, in-house extracts or immobilized solid substances (in inert jellies) may also be used and are considered by some to be more relevant (*personal communication: Prof Gail Todd, Dept* Dermatology, Groote Schuur Hospital, University of Cape Town). Care should be taken not to expose the skin to corrosives, or concentrations of allergens which exceed the irritant threshold, for example when testing solvents, soaps and detergents etc.

The diagnosis of hypersensitivity pneumonitis is assisted by identification of a potential source of antigen in the patient's environment. Some of these are listed in Table I. The demonstration of precipitating antibodies (usually IgG) to the causative agent is considered a hallmark of hypersensitivity pneumonitis. However, such antibodies indicate exposure rather than disease, so up to 50% of exposed subjects may demonstrate precipitins yet remain asymptomatic.[13]

**Frequency, diagnosis and treatment**

*Allergic rhinitis*

Allergic rhinitis is one of the most common chronic illnesses[16] and the most common form of atopic disease, affecting up to 22% of the population in the USA.[17] In most countries, including South Africa, rhinitis has been underemphasized as an occupational health problem and is grossly under reported. Studies from Finland show that 20% of all diagnosed cases of rhinitis are work-induced, that most of these are allergic in nature[18] and that the incidence of the disease is rapidly increasing.[2]

There are a number of features distinguishing allergic and non-allergic rhinitis. The hallmark of allergic rhinitis is the temporal correlation of nasal symptoms with exposure to allergen; accompanying fever is absent; nasal discharge is characteristically clear and watery,

and serum total IgE levels show up to 10-fold increases. Nasal smears usually show clumps of eosinophils and nasal fluid mast cell tryptase levels are elevated.[19] Nasal provocation tests, exposure elimination, skin prick tests and specific IgE may identify causative allergens. Some frequently encountered work allergens are listed in *Table II*.

**Table II. Some common causes of occupational allergic rhinitis and associated occupations**

| Agent | Associated occupations |
|---|---|
| Animal products | Veterinarians and their helpers, farm workers, poultry workers, laboratory animal technicians |
| Flour | Bakers, millers, granary workers, dockworkers |
| Wood dusts | Flooring specialists, sanders, furniture makers, carpenters, lumberjacks |
| Latex | Medical and paramedical workers, hairdressers, domestic workers, food industry workers |
| Reactive dyes | Printers, dye workers |
| Washing powder enzymes | Domestic workers, laundry workers, production workers |

ies have not been done in South Africa, but since 1996 a programme for the Surveillance of Occupational Respiratory Diseases in South Africa (SORDSA) has been in place which will soon provide some data for this country.

The relationship of asthma to workplace exposure may be complex, but is usually considered to be induced by *de novo* exposure to a respiratory irritant or sensitizing agent encountered at work (see Table III). Alternatively, pre-existing asthma may be exacerbated by occupational exposure(s) to inciting agents which include irritants, cold air and physical exercise.[11] Asthma triggered by inciting agents is not considered 'occupational asthma' because workplace exposure has not *caused* disease. This has important medico-legal ramifications such as the rejection of compensation claims. Asthma caused by irritants is not an allergic response and is considered non-immunological in nature. The condition is termed *reactive airways dysfunction syndrome (RADS) and is* distinguished from hypersensitivity asthma by the development of disease shortly after exposure to high concentrations of inhaled irritants. Fire fighters exposed to toxic smoke and workers exposed to chlorine following spills are good examples of workers developing RADS.

Hypersensitivity asthma characteristically requires a *period of sensitization which may last from weeks* to years. Once disease occurs, it is provoked by low concentrations of sensitizing agent which would previously have been tolerated. Another feature is that hypersensitivity asthma develops in only a minority of exposed subjects. The straight-forward case of occupational asthma will have objective evidence of asthma, expo-

**Table III. Some common causes of occupational asthma[a] and associated occupations**

| Agent | Associated occupations |
|---|---|
| Allergenic proteins[b] (dander, urinary proteins, milk, flour, detergents, eggs, storage mites) | Veterinarians and their helpers, poultry workers laboratory animal technicians, farm workers, dairymen, bakers, millers, granary workers, domestic workers, warehouse workers |
| Wood dusts | Sawmill workers, sanders, cabinet makers, carpenters, lumberjacks |
| Latex[b] | Medical and paramedical workers, hairdressers, domestic workers, food industry workers |
| Isocyanates[b] | Workers exposed to polyurethanes, coatings, adhesives, plastic fibre |
| Epoxy resins | Workers who use reinforced plastics, adhesives, moulding resins, surface coatings |
| Metallic salts[b] (of nickel, chromium, vanadium, platinum) | Mainly refinery workers |

[a]Since the respiratory tract is the final common pathway for all inhaled pollutants, many causative allergens are the same as for allergic rhinitis.

[b]Currently, the most common *reported* causes of occupational asthma in SA are latex (28%), flour/grain (12.7%), platinum salts (10.2%) and isocyanates (10.2%).[22]

The most effective treatment of allergic rhinitis is avoidance of exposure to the offending allergen(s). It is now *accepted that allergic rhinitis may precede the development* of asthma[20] and, particularly in the work environment, should be viewed as a potential early warning of progressive disease. For this reason, no effort should be spared in identifying the causative agent(s) and devising strategies to prevent exposure. Despite this, a recent study has shown that 50% of workers in the USA manage their allergic rhinitis with over-the-counter medications, most of which contain sedating antihistamines known to alter cognitive and motor function.[16]

*Occupational asthma*

Published reports on the frequency of occupational asthma vary, indicating that from 2 - 15.4% of adult asthma is due to occupational exposure.[11] Similar studsure to a known cause of the disease and evidence of work-relatedness (e.g. symptoms or lung function parameters which vary with workplace exposure). A positive test of sensitisation (e.g. skin prick or specific IgE) supports the diagnosis as it confirms exposure to a specific agent and immunologic recognition, but the positive predictive value for allergic disease varies by agent so a positive test must be interpreted agent-specifically. A comprehensive approach to diagnosing occupational asthma[21] and the practical problems in diagnosing and managing occupational asthma in South Africa[22] are available. The stringency of the diagnostic criteria used in occupational asthma should fit the severity of the *consequences of the diagnosis. If job loss is likely (e.g.* to avoid further exposure) then a confident diagnosis is required with rigorous documentation of exposure, asthma and objective airflow response to exposure; but

if relocation to another job is easily achieved, without any financial penalty or disruption of industrial relations (including promotion prospects) then a convincing history with objective evidence of airflow limitation may suffice. The likely outcome should be established so that the work-up of the case can be rationally planned.

Removing the cause is the preferred treatment of occupational asthma, but the means of achieving this (e.g. substituting the offending agent or relocating to another job within the same company) may be impractical or resisted for a variety of reasons. So, workers may have to resign or manage as best as they can, exposed and on treatment. Given the high unemployment rates in South Africa, remaining exposed may be unavoidable, resulting in a poorer prognosis and the slight chance of a fatal episode. One approach in this situation is to prioritise the worker for future relocation within the company (i.e. longer-term planning in discussion with the company). In the interim the worker can seek another job, even if finding one takes a number of years. Simply giving a worker a medical note recommending avoidance of further exposure may provoke dismissal, even though this is illegal. Workers exposed to the causative agent are at risk of a serious episode and must be monitored. Temporary total disablement (sick leave on 75% of monthly salary in terms of the Compensation for Occupational Injuries and Diseases Act, 1993 — COIDA) should be considered if the condition deteriorates or is moderate or severe on diagnosis.

**Table IV. Some common causes of occupational allergic contact dermatitis and associated high-risk occupations**

| Agent | Associated occupations |
|---|---|
| Epoxy resins | Workers who use reinforced plastics, adhesives, moulding resins, surface coatings |
| Fragrances | Beauticians, domestic workers, hairdressers and anyone else using soaps, creams, detergents etc. |
| Chromate | Construction workers, tilers, plasterers and anyone working with cement and cement products |
| Nickel (found in almost all metal products) | Constant exposure to metal levers, handles etc. |
| Rubber chemicals | Workers exposed to anything containing rubber. Also found in personal protective equipment |
| Dyes | Fabric, printing and paint industries |
| Plants (e.g. Rhus, nettle) | Gardeners, horticulturists, nurserymen |
| Biocides | Domestic workers, and all workers using cleaning agents |

*Allergic contact dermatitis (ACD)*

Contact dermatitis constitutes more than 90% of all occupational skin disease. Most occupational contact dermatitis is caused by exposure to irritants, but 20 - 30% of cases are allergic in nature.[23] No accurate statistics on the frequency of occupational skin diseases in the general population of any country are known but, based on the 1995 Household Survey, it is conservatively estimated that more than 250 000 South Africans suffer from occupational contact dermatitis.[24] This translates into 50 000 - 75 000 workers with the allergic form of this disease.

The clinical spectrum of irritant contact dermatitis (ICD) is much wider than that of ACD. However, the initial reaction is usually clearly restricted to the site of contact and the rapidity of the response usually means that the cause is obvious.[14] ACD characteristically presents as erythema and swelling, with subsequent development of papules and papulovesicles, which can progress to vesiculation, blistering and exudation. Macules, papules and vesicles may be synchronously present in a single area. Pruritus may be intense and with time the skin may become dry and scaly. Acanthosis, hyperkeratosis, lichenification, infiltration and fissuring characterize the chronic form of ACD.[14] The site and pattern of dermatitis may suggest possible allergens. For example, most occupational ACD presents on the hands, while involvement of the eyes and face (in women) suggests a reaction to cosmetics[14] or may be due to rubber compounds in personal protective equipment. Patch tests are used to identify allergens, and without this tool, it has been suggested that at least 50% of relevant allergens in ACD will be missed.[14] Intelligent interpretation of patch test reactions is imperative since placing irritants on the skin will also lead to a reaction. Some common workplace allergens causing ACD are listed in Table IV.

Removal from exposure is the best way of controlling ACD, yet topical steroids remain the principal means of symptom control. Experience has shown that, through fear of jeopardizing their income, the majority of South African workers are reluctant to report their condition, and many prefer to manage symptomatic control themselves, even if this requires 'shopping around' for prescriptions from various general practitioners. Early diagnosis and removal from exposure prevents the most significant complication of ACD, namely progression to chronicity. The frequent neglect of *occupational* ACD is particularly unfortunate since the workplace represents an environment where exposure to offending allergens may be significantly reduced or avoided. For example, contact allergens often have a more restricted distribution than inhaled allergens, allowing transfer of the allergic worker to another work area; agents containing the offending allergens may be substituted (allergen replacement) or personal protective equipment may be effectively used.

*Hypersensitivity pneumonitis (extrinsic allergic alveolitis)*

Most of the published information on hypersensitivity pneumonitis has been of single or multiple case reports of patients referred to specialist centres. Many are of uncommon causes and in industrialized countries the disease appears to be diminishing as occupational expo-

sures are reduced following improved work practices. For example, the risk of developing mushroom worker's lung has been considerably reduced by mechanical spawning and bagassosis may be prevented by drying raw bagasse and inhibiting moulding by spraying with propionic acid. The incidence of disease in less developed countries is unknown but is likely to be much higher than in industrialized countries.[12] Frequency of disease depends, among other things, on climate, working conditions, work practices and diagnostic variation. South African cases have been reported, including a printer who developed occupational hypersensitivity pneumonitis following exposure to humidifier vapour.[25]

Clinical presentation may be of two forms, with possible overlap: patients with acute, potentially reversible disease typically present with self-limiting episodes of fever, chills and dyspnoea, 4 - 6 hours after antigen exposure, which is usually intermittent but intense. In contrast, the chronic form of disease is associated with an insidious onset after continuous exposure to high concentrations of antigen, and the development of irreversible pulmonary fibrosis. Chest radiography typically shows reticulonodular interstitial infiltrates, whilst lung function tests commonly reveal a restrictive dysfunction. Routine laboratory tests include serology to detect precipitating antibodies against the antigen. Skin prick tests are not usually undertaken, though it has been suggested that they may be useful for diagnosing bird breeder's disease[26,27] and their use for this and other forms of hypersensitivity pneumonitis should probably be re-evaluated.[12] Treatment relies on cessation of exposure and, in severe cases steroid therapy to prevent progression to fibrosis.[28]

**Table V. Assistance with compensation claim procedures can be obtained from:**

| City | Organization | Contact person |
|---|---|---|
| Johannesburg | National Centre for Occupational Health | Engela Venter (011) 720-5743 X 2014 |
| Johannesburg | Medical Bureau for Occupational Diseases | The Director (011) 403-6322 |
| Cape Town | Workhealth, University of Cape Town Industrial Health Research Group | Dr Rodney Ehrlich (021) 406-6435 Sophie Kisting (021) 650-3508 |
| Durban | Industrial Health Unit | Dr Mandy Ryan |

### Compensation

Compensation is available, in theory at least, for all cases of occupational hypersensitivity, although it may be limited to the payment of medical costs in cases without permanent impairment.

South Africa has two compensation systems for occupational diseases: one for miners (Occupational Diseases in Mines and Works Act) and one for industrial workers (COIDA). The COIDA contains Schedule 3, a list of diseases and exposures. The presence of a listed disease and the corresponding exposure confers a presumption that the disease arose from work. This promotes acceptance of a claim but by no means guarantees it. Extrinsic allergic alveolitis (hypersensitivity pneumonitis), occupational asthma, contact dermatitis and a multitude of agents are listed, but not allergic rhinitis. Even if the disease or agent is not scheduled, claims for occupational hypersensitivity should be submitted as COIDA makes provision for compensating these cases (Section 65 1 (b)). In these circumstances the burden of proof is on the claimant. A good case must therefore be made by the submitting practitioner that the disease arose out of, and in the course of the claimant's work.

Before submitting claims it is useful to discuss the procedure with the Compensation Commissioner's office, or an organization (Table V) or practitioner with suitable experience. The information needed to make a successful claim for occupational asthma has been described.[29]

Allergic contact dermatitis, no matter the occupational origin, is compensable in terms of Schedule 3 of COIDA. A hurdle to overcome is that the Compensation Commissioner's office expects a positive patch test. If this is not available, its absence needs to be explained. A dermatologist's opinion should also accompany the claim.

Under the ODMWA compensation for respiratory hypersensitivity, including occupational asthma (for instance in welders on gold mines) is generally problematic. An exception is platinum salt sensitivity, the only scheduled occupational hypersensitivity in ODMWA. Although non-scheduled *permanent* cardiorespiratory conditions can be accepted under ODMWA, hypersensitivity diseases are not thought of as permanent and therefore unlikely to be accepted unless chronicity has induced fibrosis (hypersensitivity pneumonitis) or chronic airflow limitation (asthma).

In conclusion, since avoiding or reducing exposure to offending agents is the best way of treating and managing occupational allergies, medical practitioners and workers alike need to become more aware of the existence of these diseases and the potential for effective prevention and control. This can only be achieved through early and improved diagnosis, specific allergen identification and implementation of strategies in the workplace to eliminate or reduce exposure.

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# Silicosis elimination in South Africa

**South Africa has a serious silicosis problem with inadequate dust control and high disease rates in traditional 'silica industries'. The strong association between silicosis and tuberculosis in southern Africa combined with the HIV epidemic make elimination of silicosis an important public health issue. Substantial activities to achieve this elimination have been initiated, including the National Programme for the Elimination of Silicosis, under the leadership of the Department of Labour, the Mine Health and Safety Council's Elimination of Silicosis Programme and the Sida-sponsored regional Work and Health in Southern Africa initiative. These programmes are briefly described in this paper. The elimination of silicosis has raised a number of issues. Three are mentioned: an appropriate occupational exposure limit for quartz, the burden of disease in retired formerly exposed workers and prioritisation of industrial sectors for intervention.**

**A sustained and thoughtful effort over many years is required if South Africa is to eliminate silicosis and silica-related diseases.**

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## 1. INTRODUCTION: THE NEED

A powerful case can be made for substantial efforts to eliminate silicosis in South Africa: (1) dust control is inadequate in both mining and non-mining sectors[1,2,3]; (2) there is a large burden of undetected lung disease in former silica exposed miners now living in labour-sending areas[4,5]; (3) silicosis is common in industrial workers[1,2] and in gold miners[6,7,8], and the attendant tuberculosis risk is high[9,6,10]; and (4) fairly recent research has found that silica dust, independent of silicosis, increases the risk of tuberculosis[11], and that this risk is compounded in HIV infected workers[12].

Inadequate dust control is widespread in the region. For example, only 24% of South African foundries responding to a postal questionnaire actually measured dust, and an uncontrolled dust hazard was evident in all foundries surveyed by the National Centre for Occupational Health, South Africa, between 1983 and 1992[2]. In the late 1990s, only 8 of 48 gold mines[13] had all estimated quartz concentrations below the widely used reference level of 0,1 mg/m$^3$.

Silicosis rates in former gold miners now living in labour-sending areas illustrate the importance of silicosis in the region. Steen and co-workers[4] found a silicosis prevalence of 26 to 31% in former miners living in Thamanga, Botswana, and Trapido *et al.*[5] 22–37% in Libode, Eastern Cape, South Africa. Generalising these rates to an estimated two million former miners living in southern Africa produces an astonishing 480 000 cases of pneumoconiosis[14].

### *Silica, silicosis and tuberculosis*

The elimination of silicosis would probably not be a priority in South Africa, a country faced with many major occupational and general health problems, were it not for the association between tuberculosis and silica exposure. The association is well known, and has been for centuries[15], but the impact of this increased risk in countries with high background tuberculosis rates, such as South Africa, is often not fully appreciated.

One example of the increased risk of tuberculosis is described by Cowie[9] who found an increasing incidence of the disease with increasing severity of silicosis in South African gold miners: 1% per annum in men without silicosis; 2,2% in men with mild silicosis; 2,9% with moderate silicosis; and 6,3% with advanced silicosis. Cowie[9] suggested that one quarter of his subjects with silicosis would have developed tuberculosis by 60 years of age. This was before the surge in the HIV epidemic.

Recent studies have found that it is not only silicosis but silica dust itself that confers an increased risk of tuberculosis and that this risk persists even after silica dust exposure ends, probably for life[11]; a finding with profound implications for public health policy including surveillance of workers and workers' compensation. The concentration of silica dust at

**Table 1. Estimates of occupational exposure to silica in South Africa.**

| Major industrial division | Number employed | Potential number of exposed | | |
|---|---|---|---|---|
| | | 20% | 50% | 80% |
| Mining and quarrying | 356 289 | 71 258 | 178 145 | 285 031 |
| Manufacturing | 286 782 | 57 356 | 143 391 | 229 426 |
| Construction | 352 451 | 70 490 | 176 226 | 281 961 |
| Total | 995 522 | 199 104 | 497 761 | 796 418 |

20% = 20% of all employees in the division.

which the risk of tuberculosis is increased to a clinically important degree is not known, so theoretically communities heavily exposed environmentally may have increased rates of tuberculosis.

The relations between silica and tuberculosis are compounded by HIV. Corbett *et al.*[12] have shown that the risks of silicosis and HIV infection combine multiplicatively for tuberculosis, so that tuberculosis remains as much a silica-related occupational disease in HIV-positive as in HIV-negative miners.

Combined with significant levels of migrant labour and among the highest HIV infection rates in the world, the interactions between inadequate silica dust control, high rates of silicosis, HIV infection and tuberculosis, including the multi-drug resistant forms, present major challenges for occupational and general public health in the region.

## 2. WHO IS AT RISK?

Describing the population at risk of silica-related diseases is a preliminary part of many elimination programmes; an example is the United States[16]. South Africa's National Institute for Occupational Health has tentative data based on the Statistics SA Census 2001 Database and an estimate of the proportions of workers potentially exposed in usual 'silica industries' (Sawry *et al.*, in prep). Table 1 shows only a part of the NIOH data. It can be seen that the preliminary estimate is that between 199 000 to 796 000 workers are exposed in South Africa.

There are many uncertainties in these estimates, the most obvious being the proportion of workers exposed in a particular industrial sector, hence the 20%, 50% and 80% options. Another is which industries to exclude.

Agriculture is not included in Table 1 as the authors do not consider this industrial sector to present a real risk to the vast majority of farm workers, but a case could be made that at least some are at risk of silica-related diseases. Quartz percentages in the respirable fraction of some sandy-loam soils from farms in North Carolina, USA, have been shown to range from 9,1 to 21,3%[17]. Also, surprisingly high levels of respirable silica were found on personal sampling of farm workers in North Carolina[18]; by far the highest being a mean of 3,91 mg/m$^3$ for 5 sweet-potato transplanters. Case reports of silicosis in farm workers, particularly tractor drivers, are not unknown, albeit with unconvincing histories; some cases have been reported in South Africa[19]. The NIOH Occupational Medicine Clinic has not seen a case of silicosis in an agricultural worker since its inception in 1975; nevertheless an evaluation of respirable quartz exposure in geologically 'promising' farming areas would be of value.

## 3. SUBSTANTIAL PROGRAMMES

Despite competing needs, infectious diseases and traumatic injury prominent examples, silicosis elimination is gaining momentum. Three large programmes make the point.

1.1 *National Programme for the Elimination of Silicosis*

This Programme, under the leadership of the Department of Labour, is a major development, but is described elsewhere in this publication by Motshelanoka.

1.2 *Silicosis Elimination Programme, Mine Health and Safety Council*

Planned for five years initially, there are three parts to what is probably the largest research-based effort to eliminate silicosis ever in South Africa. The Programme is for the mining industry but many products will be of general value. Part A is to improve exposure assessment and the measurement of dust and quartz; Part B to improve dust control methods and reduce exposure; and Part C to develop training methods and materials for miners, mine managers and health and safety representatives, and to communicate the importance of silica control and the elimination of silica-related diseases. The Safety in Mines Research Advisory Council (SIMRAC) website has details of the Programme: www.simrac.co.za.

***"South Africa has isolated capacity to reliably measure quartz even at 0,1 mg/m$^3$, and many enterprises have yet to achieve this level of control."***

*1.3 Work and Health Southern Africa (WAHSA)*

This is a strategic 12-year programme to build sustainable capacity in southern Africa and to undertake key interventions to improve occupational health. It is supported by Sweden's National Institutes for Working Life and Public Health, and has interventions on Silica, Silicosis and Tuberculosis. The major objectives are reduction of dust exposure in key industries and improved prevention of tu-berculosis in silica-exposed workers. Details of WAHSA are available from the NIOH in Johannesburg: www.nioh.ac.za.

## 4. SELECTED ISSUES

*An appropriate occupational exposure limit (OEL) for quartz*

A typical OEL for respirable quartz is 0,1 mg/m$^3$.

But there is increasing evidence that this limit is not pro-tective against silicosis. South African gold mine data has been used to support this contention[8]. Also, OELs should be protective against all the major health effects of an agent. Tuberculosis is a major concern following silica exposure and a South African standard that does not address this health outcome will be partially satisfactory at best. But, although a case can be made for lowering the respirable quartz OEL, South Africa has isolated capacity to reliably measure quartz even at 0,1 mg/m$^3$, and many enterprises have yet to achieve this level of control.

What will be gained by introducing an OEL that cannot be assessed? It might be sensible to vigorously and widely enforce the 0,1 mg/m$^3$ limit while capacity to measure quartz is further developed and the tuberculosis issue is considered.

*Sectoral prioritisation*

South Africa has limited resources, so focus on the key industrial sectors is necessary to use these efficiently. There is sufficient data to conclude that gold mining tops the list, but what of the others? We cannot decide with available information. Exposure while working clay deposits illustrates the difficulty. It is well known that some South African clay deposits have high quartz concentrations, although these vary by location and through profiles. Quartz percentages of 30% are not unusual and can reach 60% in the Grahamstown area clay deposits[20], but the risk to workers has not been determined reliably, and it has been suggested that other minerals in clay may alter quartz surface charac-teristics[21]. A good argument can be made for simple dust measuring and case-finding surveys in sectors with a poorly defined risk, but the disease rates in former workers may need to be established to assess the importance of the sector.

*Silica-related disease in former workers*

Silicosis and silica related diseases may manifest many years after exposure has stopped[6]. This latency has many implica-tions: cross-sectional surveys are likely to underes-timate disease burdens, substantially if there is heavy ex-posure and high staff turnover; many former workers will present to general health services, rather than workplace services, and so aware-ness of the conditions needs to be created among health care professionals; and new cases will continue to be diagnosed years after dust control is adequate.

## 5. Conclusion

Silicosis elimination is gaining momentum in South Africa, and large programmes are being implemented. Activity is uneven across industrial sectors, however, and while the mining industry has publicly-stated targets, industry-specific programmes with substantial funding and numerous enter-prise level interventions, the non-mining industries' response has been desultory. Possible explanations for this disap-pointing response have been pub-lished elsewhere[22], but it shows clearly that a sustained and thoughtful effort over many years is required if South Africa is to eliminate silico-sis and silica-related diseases.

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# Silica, silicosis and tuberculosis

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**SUMMARY**

**Exposure to crystalline silica dust causes multiple diseases, but silicosis and silica dust-associated tuberculosis (TB), in particular, are the two diseases that remain high on the list of occupational health priorities in low-income countries and that still occur in some high-income countries. The prevalence of silica-related TB is exacerbated by the human immunodeficiency virus (HIV) epidemic in low-income countries. This review describes the morphology of silica and the variable potency of the different forms. Sources of crystalline silica are discussed, with emphasis on less commonly recognised sources, such as small-scale mining operations and agriculture. Trends in the prevalence of silicosis are also presented. Although efforts have been made for many years in most countries to reduce silica dust levels, silicosis continues to occur even in young people. The clinical and pathological features and diagnosis of silicosis, with emphasis on chest radiography, are described. The high risk of mycobacterial infection in silica-exposed individuals is given particular attention, with emphasis on control. Treatment for latent TB is recommended. The management of silicosis and silica-associated TB, including monitoring for early detection of disease and surveillance to identify disease-causing workplaces, are discussed in detail. Prevention of disease, in the form of dust control, remains the focus of the World Health Organization and International Labour Office Global Elimination of Silicosis Campaign. However, clinicians must be aware that silica-associated diseases will be around for many years to come.**

**KEY WORDS:** silica; silicosis; tuberculosis

SILICA-ASSOCIATED DISEASES remain an important public health concern in the twenty-first century because crystalline silica is one of a handful of toxins that causes multiple serious diseases and increased mortality.[1] Exposure contributes to serious epidemics of tuberculosis (TB) in southern Africa and other low-income regions of the world, and silica exposure is still common in both low- and high-income countries. At least 1.7 million workers in the United States are potentially exposed,[2] and an estimated 119 000 are overexposed in some industries.[3] Many millions are exposed in low- and middle-income countries such as India (with about 3 million exposed workers[4]), China and Brazil. Workers in mining countries such as South Africa are particularly affected by silica-associated diseases.

Diseases associated with silica exposure include silicosis, a fibrotic nodular disease of the lung parenchyma, pulmonary TB, lung cancer, chronic obstructive pulmonary disease (COPD) and autoimmune and renal diseases. It is not surprising that the International Labour Organization (ILO) and the World Health Organization (WHO) have embarked upon a Global Elimination of Silicosis Campaign.[5]

This review focuses on sources of exposure to silica, silicosis and silica-associated TB, which is of particular concern in low-income countries, and aspects of management and prevention. Although the focus of this article is silicosis and silica-associated TB, silica is linked to a range of pulmonary and extra-pulmonary diseases (Table 1) which have recently been reviewed by the National Institute of Safety and Health (NIOSH)[2] and the American Thoracic Society (ATS),[7] and are com-

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**Table 1** Diseases associated with respirable crystalline silica

| |
|---|
| Pneumoconiosis |
| Chronic silicosis |
| Accelerated silicosis |
| Alveolar lipoproteinosis |
| Progressive massive fibrosis (PMF) |
| Chronic bronchitis |
| Emphysema |
| Mineral dust airways disease (MDAD) |
| Mycobacterial disease |
| Pulmonary and extra-pulmonary tuberculosis |
| Non-tuberculous mycobacterial (NTM) disease |
| Lung cancer |
| Autoimmune diseases |
| Scleroderma |
| Systemic lupus erythromatosis |
| Rheumatoid arthritis |
| Renal disease |

Adapted from *Murray and Nadel's Textbook of Respiratory Medicine* (Table 61.2), with kind permission from Elsevier Saunders.[6]

prehensively described in Parkes.[8] Silica-associated lung cancer is of concern in many countries but is not discussed here, as it has been reviewed recently.[9]

## CRYSTALLINE SILICA

In the health context, silica usually refers to respirable crystalline silica dust, respirable dust being the fine particles, usually invisible to the naked eye and mostly smaller than 7 microns in diameter. Silica comprises an atom of silicon and two atoms of oxygen ($SiO_2$) uncombined with other elements, hence sometimes called 'free silica', i.e., free of other elements. Because silicon and oxygen are so abundant in the earth's crust, many minerals contain $SiO_2$ usually combined with other elements, often cations. These minerals are known as silicates, rather than silica, and are ubiquitous; even the varieties of asbestos are silicates.

There are six natural forms or polymorphs of free crystalline silica, most quite rare and produced by extreme heat and pressure.[8] By far the most common polymorph is quartz, a constituent of many sands, stones and rocks. Because of this, quartz is sometimes confusingly used as a synonym for crystalline silica. Besides quartz, tridymite and cristobalite are hazardous polymorphs of silica that may be present when high temperatures are used in industrial processes.[8]

Free silica in a non-crystalline structure is amorphous silica, a form less hazardous than crystalline silica; but heat and pressure can change amorphous silica to crystalline forms. For example, diatomaceous earth, used commercially as a filtering and insulating material, is amorphous silica formed by skeletons of diatoms which is converted to cristobalite on heating and milling.

### *Variability in respirable silica potency*

Recent publications have considered factors that may affect the disease-causing potential of silica from different sources.[10,11] Differences in three cohorts of Chinese tin, tungsten and pottery workers suggest that silica dust characteristics may affect the risk of silicosis.[11] The United Kingdom's Health and Safety Executive (HSE) reviewed potency factors with regard to their ability to cause silicosis and summarised their conclusions in a respirable crystalline silica potency matrix.[10] The HSE concluded that extremely small particle size enhances potency, while wetting, ageing and aluminium-containing clay coatings reduce potency. For the practitioner, this means being on the alert for exposure settings producing very fine, freshly fractured, dry silica (high speed dry drilling of rock and sandblasting are good examples).

## SOURCES OF EXPOSURE TO RESPIRABLE SILICA

Free crystalline silica (referred to as silica from now on) is so common in the earth's crust that whenever the surface of the earth is disturbed—for example during mining or when sand, stones or rocks are drilled, moved, crushed or processed—potentially hazardous exposure may occur, particularly when dust suppression measures are inadequate.

Due to its crystal structure, quartz is resistant to being broken into smaller and smaller sizes, and thus the percentages of silica in bulk samples of materials are often higher than in the fine respirable dust. The percentage of silica in the unworked raw material may therefore be a misleading measure of risk; the respirable levels of silica need to be determined. In general, though, the greater the mechanical forces applied, the more likely is the generation of respirable dust.

A surprisingly large number of industries generate respirable silica dust, as shown in Table 2. A comprehensive description of exposures is available from several sources,[2,8] but the most common exposures occur in mining and mining-related occupations, such as milling ores, quarrying, tunnelling and excavation. Country rock, i.e., the rock in which the mined mineral is located, often determines the silica risk. Hence, coal mining, for example, is a silica risk in some regions. Industries with well known silica risks include ceramics, construction and foundries. Occupations associated with furnace masonry, stone-working or cutting (e.g., monumental masonry and working tombstones), cutting and polishing gem stones and those in which fine silica materials are used (e.g., in fillers and abrasives) have a long history of producing silica-associated disease. Abrasive blasting with sand, which has widespread applications in engineering, shipbuilding and in the metal and automotive repair industries, is particularly dangerous, and recommendations have been made to ban sand blasting in some countries.[12]

Small workplaces and those with less well known uses of silica remain of concern because, even in high-income countries, there may be a relative lack of awareness of the hazards of silica outside the occupations traditionally associated with silicosis. This contention is supported by data from the USA showing that recent

**Table 2** Sources of exposure to respirable crystalline silica

| Sources of exposure | Comment |
|---|---|
| General | |
| Moving, drilling, working, processing, crushing or mining sand, stones or rocks | Free silica content in respirable fraction of dust determines risk |
| Mining and related activities | |
| Mining and milling | Country rock* an important determinant of risk. Gold, coal, tin, copper, mica, uranium, crocidolite, iron, important in some regions |
| Small-scale mining | Under-researched, but exposure may be high |
| Mining related | Quarrying, tunnelling, excavating, digging wells and boreholes. Country rock and mineral determines risk. Quarrying granite, sandstone, flint, quartzite, shale and slate may produce high levels of quartz. Potency of silica may be reduced in some clays |
| Major industrial sources | |
| Foundry | |
| Ceramics | Pottery, tiles, brick and refractory articles |
| Glass manufacture | |
| Furnace masonry | Cutting, grinding, etc., refractory articles |
| Construction | Cutting, grinding, etc., concrete, tiles or bricks. Digging foundations |
| Stoneworking and monumental masonry | Making, cutting, abrasive polishing, etc., of tombstones, billiard tables, slate pencils, cladding and surfaces, including granite counter tops |
| Abrasive blasting with sand (sandblasting) or siliceous material | Very high exposures common. Usually cleaning or preparation for coating of metal pieces, but also unusual applications, e.g., sandblasting jeans |
| Minor industrial sources | |
| Fillers and scourers | Fine silica may be used for fillers in paints, coatings, plastics, rubber, explosives, dental supplies, etc., or in scouring materials (such as cleaning agents and those used for polishing flour) or grinding materials |
| Jewellery | Cutting, buffing, etc., semi-precious gems |
| Diatomaceous earth | Calcined material contains cristobalite |
| Craft work | Stone carvers, sculpture, pottery. Cases unusual unless frequent exposure, e.g., most working days |
| Less well established sources | |
| Agriculture | High levels of quartz exposure possible in farming sandy soils but silica-associated disease rare |
| Non-occupational | Frequent exposure to sand storms |

* Country rock = rock hosting the mineral or being mined. Silica content varies from location to location, even within a mine.

silica-associated deaths in younger subjects have occurred after exposure in the construction and manufacturing sectors, with none from mining.[13]

*Agriculture*

Although listed in some publications as an activity associated with silica exposure,[2,14] agriculture is not widely recognised as a significant risk for silica-associated diseases. Although good studies show that farming activities in sandy soils can produce respirable silica levels well above generally accepted safe levels[15] and that sandy soils are commonplace in drier regions of many countries, silica-associated diseases are rarely reported in agricultural workers. The paucity of cases may be because silica potency is reduced by other soil components such as iron oxides and clay silicates. In addition, silica in soils is likely to be aged, with most farming activities producing little freshly fractured material. Under-diagnosis is also a possible explanation. Cases of silicosis have been reported, however,[16] and silica exposure in farming deserves further research.

*Construction*

Building and related work have become prominent considerations for silica exposure. Cement is usually low in silica, but cutting, grinding or drilling building materials containing sand and stone, such as concrete, brick, granite and tiles, will generate respirable quartz, as will digging deep foundations, especially in confined spaces.[17] Many construction jobs carry a risk of excessive silica exposure and silica-associated diseases.[18] The risk is reduced when the percentage of time spent grinding, cutting or drilling concrete or building materials is low.[19]

*Small-scale mining*

Small-scale mining is on the rise in many low-income countries, employing an estimated 13 million people in 1999,[20] but little is known about silica exposure in this setting. Despite being typically labour-intensive with low levels of mechanisation, silica levels can be high, obviously depending on the country rock, as shown in small-scale mining in Tanzania.[21]

*New and unusual applications*

Silica-containing materials are plentiful and relatively cheap, and new and unusual applications are to be expected. Consequently, exposure is found in unexpected occupations, as illustrated by recently described cases of silicosis from sandblasting jeans with silica-rich sand,[22] exposure to fine dust from heat-dried mud used in Tatami mat manufacturing in China,[23] and dental supply factory workers using quartz- and cristobalite-containing fillers in the USA.[24]

*Non-occupational exposure*

Unlike asbestos, there is little evidence that low-level exposure to silica causes adverse health effects, but this does not mean that significant non-occupational exposures do not occur, as dangerous levels of silica can be encountered in the environment and domestically. Silicosis, including advanced disease, has been found in Himalayan villagers exposed to frequent dust storms,[25] in women hand-milling corn in South Africa (hut lung)[26] and in children living among stonecutters in India.[27]

## SILICOSIS

*Pathology*

The pathological features of the different forms of silicosis are well described in a number of texts, such as *Murray and Nadel's Textbook of Respiratory Medicine*[6] and *Pathology of Occupational Lung Disease*, edited by Churg and Green.[28] Chronic (nodular) silicosis, the most common form of the disease, occurs after 10–20 years of exposure to silica dust. Silicotic nodules (Figure 1), which first develop in the hilar lymph nodes,[29] are the distinguishing feature. In the lungs, the nodules initially involve both upper lobes (Figure 2) and measure around 3 mm in diameter. As

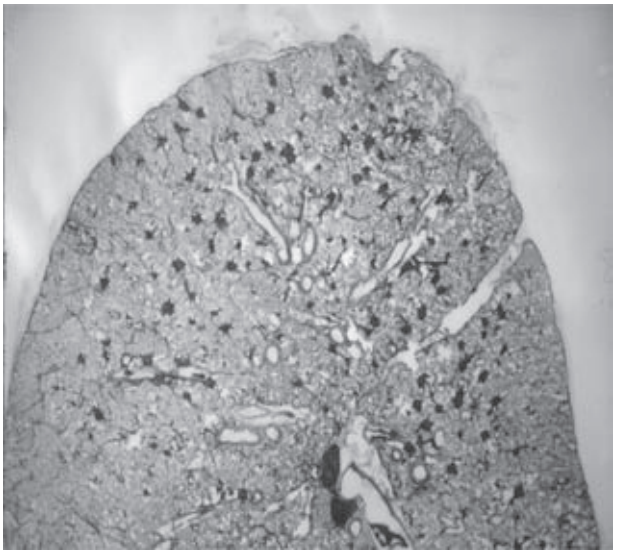

**Figure 1** Whole lung section with chronic silicosis. Small circumscribed nodules are seen in the upper zone.

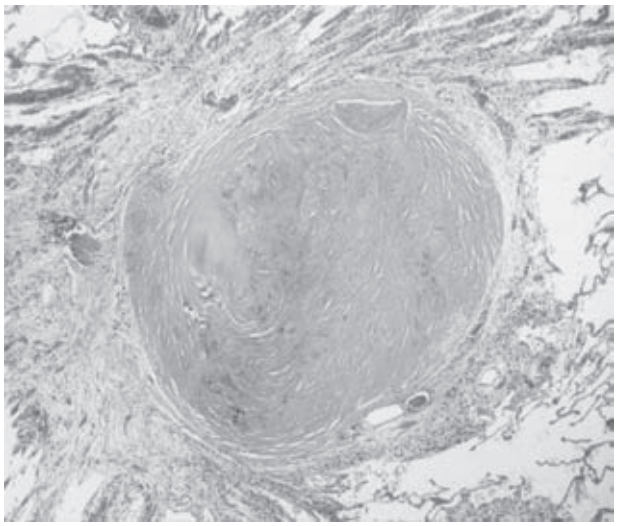

**Figure 2** Silicotic nodule characterised by a central zone of hyalinised collagen with a whorled appearance and peripheral dust-containing macrophages.

disease progresses, they may be found in the mid and basal zones. Nodules can also be found in the visceral pleura. Each nodule has a well-demarcated central area of whorled hyalinised collagen fibres, with aggregates of dust-laden macrophages at the periphery; the intervening lung parenchyma is normal. Using light microscopy, birefringent particles can be seen in the nodules.

With increasing duration and intensity of exposure, the nodules in the lung become confluent, obliterating normal intervening lung parenchyma and resulting in progressive massive fibrosis (PMF). The lesions may reach many centimetres in diameter and completely efface the upper lobes.

Accelerated silicosis occurs after 3–10 years of exposure. Although the changes are similar to those seen in chronic silicosis, the nodules develop sooner and are more cellular than fibrotic in nature.

Alveolar lipoproteinosis is uncommon and develops after intense short exposures, sometimes only months, to fine dust with a high silica content.[7,28] The alveolar spaces become filled with granular lipoproteinaceous material, comprising alveolar surfactant. If not too small, silica particles may be seen in this lipoproteinaceous material.

Duration and intensity of exposure are not the only determinants of the pathogenicity of silica dust. Host factors influence individual susceptibility, and smaller particles increase the fibrogenicity of the dust. The processes of inflammation and fibrogenesis induced by silica dust are well described by Donaldson.[30]

Silicosis is often progressive even without further exposure,[31,32] and may first present radiologically well after exposure has ceased. In a cohort study of gold miners, 57% of those with silicosis developed the disease after exposure ceased, on average 7.4 years after, but some after more than 20 years.[33]

*Clinical features*

Chronic silicosis is often a radiological diagnosis, the silicosis itself not producing symptoms. Exertional dyspnoea may occur if silicosis progresses to PMF, or if TB, lung cancer or COPD develops. A productive cough may be present and is usually due to chronic bronchitis; it may, however, be due to lung cancer or TB. Clubbing or systemic symptoms, such as fever and weight loss, should be attributed to lung cancer or TB until proven otherwise. The clinical features of accelerated silicosis are similar to those of chronic silicosis, but develop sooner. Patients with acute silicosis may become disabled within months of exposure, with clinical features similar to alveolar proteinosis of other aetiologies.

*Chest imaging*

Chronic silicosis is characterised by symmetrically distributed, small (usually 1–3 mm) rounded opacities, initially in the upper zones of the chest radiograph[34] (Figure 3). However, these opacities may occasionally not be visible on a chest radiograph, even in advanced silicosis determined by histology.[35] The ILO has developed standard chest radiographs and guidelines to assist with the reading of the radiographs of pneumoconioses.[34]

PMF is defined by opacities larger than 1 cm (Figure 4); they usually appear bilaterally in the upper zones and can be very large, occupying most of both lung fields. Over time, the fibrotic masses contract towards the mediastinum, leaving hypertranslucent zones at their margins. With the development of PMF, discrete small rounded opacities may disappear, making the diagnosis of silicosis more difficult.

**Figure 3** Typical 1.5–3 mm in diameter rounded opacities of chronic silicosis predominantly in the upper zones of the lungs. The radiograph is from the set of International Labour Organization (ILO) standard films. International classification of radiographs. Reproduced with the kind permission of the ILO. Copyright © 2000 International Labour Organization.

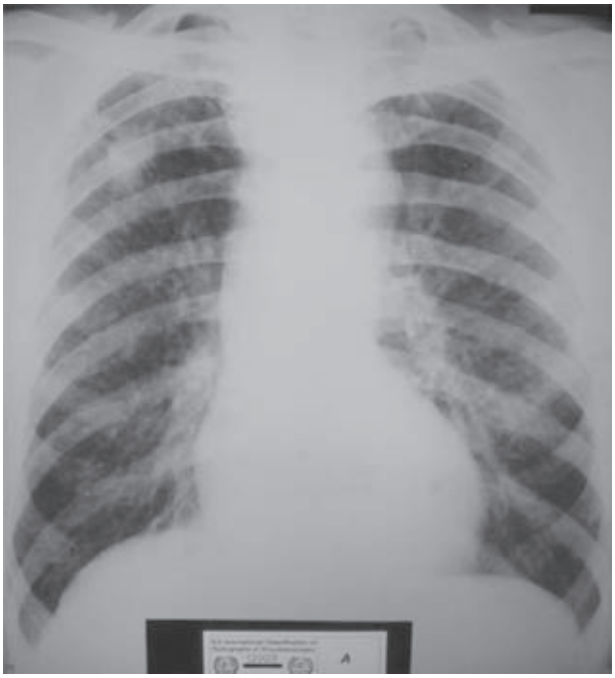

**Figure 4** A massive opacity in the right upper zone of the lung. Massive opacities may be much larger and bilateral. The radiograph is from the set of International Labour Organization (ILO) standard films. International classification of radiographs. Reproduced with the kind permission of the ILO. Copyright © 2000 International Labour Organization.

Somewhat surprisingly, high resolution computed tomography (HRCT) has not been shown to be consistently more sensitive than chest radiography in detecting early silicosis,[36] but is useful in detecting lymph nodes, emphysema and accompanying pathology, e.g., of the pleura. HRCT should be reserved for cases with unexplained significant symptoms or atypical radiological features.

*Lung function*

In chronic silicosis, spirometric tests are often normal in early disease. As disease progresses, airflow limitation may develop,[7,32] but it is likely that much of this is attributable to associated emphysema[37] or TB.[38] Occasionally, even in the absence of radiological silicosis, there may be airflow limitation.

*Diagnosis*

Silicosis is diagnosed on the basis of a history of exposure, the characteristic radiological features and exclusion of other conditions; the differential most commonly includes TB, sarcoidosis and histoplasmosis. Lung biopsy is rarely necessary, but may be required to distinguish PMF from lung cancer or TB.

A history of silica exposure is necessary to make the diagnosis, and this is usually available because

most often long-term exposure, typically over 20 years, in one of the common dust-generating industries has preceded disease onset. In lower-income countries or uncontrolled environments, exposure may be shorter and disease onset more rapid. However, an exposure history may be difficult to ascertain—exposure may have occurred many years ago, or be forgotten, short or in an unusual occupation. Consequently, a thorough and comprehensive occupational history is necessary in patients with typical radiological features.

For diagnosis and to assess current risk, it may be useful to objectively evaluate silica exposure. Airborne concentrations of agents below which most workers are safe from adverse health effects are generally known as occupational exposure limits (OELs). OELs exist for quartz, cristobalite and trydimite, and are expressed as the weight of respirable material per cubic metre of air (mg/m$^3$) averaged over a shift or substantial part of it. In theory, then, provided respirable silica dust has been measured, it should be possible to ascertain whether or not workers have been over-exposed, but practitioners need to be alert to analytic and interpretative issues, some of which are listed in Table 3.

**Table 3** Considerations in interpreting workplace air concentrations of respirable silica and occupational exposure limits (OELs)

*OELs are occupational standards*. OELs are mostly 8-hour standards, but environmental exposure may be for much longer and populations often include the young, the elderly and other vulnerable groups.

*Occupational exposure is highly variable*. Production rates, varying concentrations of silica in raw materials and country rock and variable ventilation and wetting (natural and engineered) greatly affect air levels of respirable dust. 8-hour shift concentrations have been estimated to vary between 3- and 4000-fold.[39]

*Free crystalline respirable silica must be measured*. Silica ($SiO_2$) combined with other elements is present in many minerals.

*Current concentrations may underestimate past exposure*. Dust control improvements over time are not unusual.

*Measurement error is to be anticipated.* Very small amounts of dust and silica are collected for analysis: respirable quartz OELs are typically at or below 0.1 mg/m$^3$ and these concentrations are often close to detection limits for most laboratories. Experienced, quality-assured occupational hygienists and laboratories are needed for reliable measurement.

*Some OELs have been greatly reduced in recent times*. For example, an OEL known as the threshold limit value (TLV)* was 0.1 mg/m$^3$ for respirable quartz in 1999 and 0.025 mg/m$^3$ by 2006. Many OELs are not protective against silica-associated diseases.[1]

*Visible dustiness may be misleading.* Respirable dust is very fine: extremely dusty operations may have little respirable dust and ostensibly clean processes may be 'dusty'.

* TLV is an exposure guideline of the American Conference of Governmental Industrial Hygienists.[40]

### *Trends in the prevalence of silicosis*

As sources of silica are so common, disease potential is high. Nevertheless, the prevalence of silicosis has been decreasing in some high-income countries such as the USA,[41] and some, such as Sweden, have virtually eliminated significant exposure.[42] In contrast, lower-income countries have large at-risk populations, poor capacity to control dust and to enforce legislation and standards, and many competing public health needs, traumatic injury and infectious diseases among them. Consequently, silicosis is still common. During the period 1991–1995, China recorded more than 500 000 cases of silicosis, with around 6000 new cases and more than 24 000 deaths occurring each year.[43] Up to 20% of older, in-service gold miners in South Africa have silicosis,[44] and higher prevalences are found in ex-miners.[45,46] High prevalences have also been reported in Chinese pottery workers and tin and tungsten miners,[11] as well as in certain Brazilian workforces—about 54% of stone carvers.[47] Serious forms of the disease are common in high-exposed groups[48] and occur even in young workers with short exposure.[22] Cross-sectional studies will underestimate eventual disease burdens, well shown in southern African gold miners (Table 4), and former workers need to be monitored even if exit medicals are negative.

## SILICA-ASSOCIATED TUBERCULOSIS

The association between silicosis and TB has been known for a long time, but more recent findings show that exposure to silica, without silicosis, may also predispose individuals to TB.[49–51] The increased risk of both pulmonary and extra-pulmonary TB is lifelong even if exposure ceases.[50] TB rates in subjects with advanced simple silicosis in high background TB settings can be very high, up to three-fold higher than those in the same workforce without silicosis,[49] and

**Table 4** Proportion of gold miners in South Africa with silicosis, by study design and vital status

| Authors | Study design | Study population | Diagnostic tool | Rate of silicosis % |
|---|---|---|---|---|
| Churchyard et al., 2004[44] | Cross-sectional | Employed miners (>37 years) | Chest X-rays | 18.3–19.9* |
| Steen et al., 1997[45] | Cross-sectional | Living ex-miners | Chest X-rays | 26.6–31.0* |
| Trapido et al., 1998[46] | Cross-sectional | Living ex-miners | Chest X-rays | 22.0–36.0* |
| Murray and Hnizdo, 2005 (personal communication) | Cohort study | Deceased gold miners | Autopsy | 51.6 |

* Radiological reader-dependent.

the risk increases with severity of silicosis. The risk is considerably higher in patients with acute and accelerated silicosis.[7] The combined risks of silicosis and HIV infection are multiplicative, with the result that TB remains as much a silica-related occupational disease in non-HIV-infected as in infected miners.[52] Pulmonary TB rates can be extremely high in silica-exposed groups with high background population TB and HIV rates, as is the case in South African gold miners with pulmonary TB rates of 3000 per 100 000.[53]

Non-tuberculous mycobacteria (NTM) may account for a large proportion of the mycobacterial disease in some populations,[7,54,55] *Mycobacterium kansasii* being the most common type. The clinical features and treatment of NTM lung disease are discussed in a recent review.[56]

An integral component of the management of silicosis is the control of mycobacterial disease. New onset radiological findings or the presence of typical features of TB such as persistent cough, haemoptysis, weight loss and fever should be pursued to exclude the infection. In general, the diagnosis can be made on sputum smear and culture, but active disease may be more difficult to detect in the silicotic than in the non-silicotic subject. In many instances, it is the chest radiograph rather than clinical features that gives the first indication of TB in the presence of silicosis. Periodic radiographic screening has been shown to be as effective as, if not more than, sputum examination for the early detection of TB, but the radiological features may be subtle.[57] Therefore, detection is enhanced by comparing sequential films in good reading conditions.

Individuals with active pulmonary TB respond well to directly observed rifampicin-based short-course chemotherapy even in the presence of HIV infection.[58] There is evidence of an increased case-fatality rate,[59] but silicosis and silica dust exposure are not risk factors for recurrence, relapse or reinfection and drug susceptibility.

Treatment for latent TB infection in people with silicosis (especially those with HIV infection) is recommended[7] and may be warranted even in those without silicosis, given the high risk associated with long periods of silica exposure even in the absence of radiological evidence of silicosis.[49–51] A recent study of HIV-infected gold miners with a high prevalence of silicosis reported a reduction in TB incidence of 38% overall, after routine isoniazid (INH) preventive therapy.[60] Screening for latent TB can be problematic. In countries with low background rates of TB, tuberculin skin tests are used to diagnose latent TB, after which a 9-month course of INH is recommended.[61] However, in countries with high background rates of TB, tuberculin skin tests do not accurately and reliably diagnose latent TB infection. Interferon-gamma assays are promising alternatives to these tests.[62] In these cases, it is advisable to offer treatment to everyone with silicosis and/or long silica dust exposure, but care must be taken to exclude individuals with active TB. Treatment uptake and adherence need to be considered before instituting treatment for latent TB.

Although active case-finding other than household contact screening is not indicated for TB control in most settings, this is not the case for silica-exposed populations.

Early identification and treatment of active TB not only limits disability in the individual, but also protects silica-affected individuals and assists in controlling spread to co-workers and the community (see Management, below).

## MANAGEMENT

As silicosis is incurable, the management goals are to detect early cases of silicosis and TB through monitoring of both currently and formerly exposed workers; to establish surveillance programmes; to slow progression; to prevent TB; and to reduce disability.

The interaction between silica exposure and smoking in the development of TB, lung cancer and COPD[37] makes it particularly important to implement smoking cessation programmes in the workplace.

### *Monitoring*

Baseline, periodic and exit questionnaires, physical examination, chest radiography and spirometry are the usual monitoring tools.

Removal from any further occupational exposure to silica is generally recommended after the diagnosis of silicosis, but in many poorer countries this would result in job loss and prolonged or permanent unemployment, often without unemployment benefits. In these cases a more flexible approach is necessary. A considered approach may be based on current dust levels—it is unclear that low levels of exposure increase disease progression significantly;[31] the feasibility of improving dust control in the current job, even if some time is required; the possibilities of job modification (the most dusty tasks could be re-allocated); and the proximity of retirement, including early retirement (continued exposure for a few years at lower levels may be less harmful than job loss). If immediate relocation to a low-exposure job is not feasible, affected workers can be retained in service but prioritised for relocation as positions may become available over time. Of course, decisions should only be made in consultation with a fully informed patient and recorded in patient notes.

Apart from reporting cases, health care workers should monitor disease rates and maintain record keeping for many years, given the latency of the diseases.

### *Surveillance*

Surveillance systems able to identify disease-causing workplaces for targeted intervention are important aspects of prevention. Public health officials need to

respond to newly identified cases of silica-associated disease at the enterprise level, ideally by assessing current dust control measures in the source workplace and by medical evaluation of current and former co-workers, as appropriate. Surveillance can take many forms, from voluntary reporting of new cases by doctors to a national register or follow-up of workers' compensation claims, but, at least in parts of the US, hospital discharge records identify the greatest number of cases and problem worksites and are the most cost-effective approach.[63] Usually, cooperation by diagnosing doctors is necessary for a successful system.

Wagner comprehensively reviewed screening and surveillance of workers exposed to mineral dust,[64] and the American College of Occupational and Environmental Medicine (ACOEM) more recently published an evidence-based statement.[65]

Key questions in designing surveillance programmes are whom to include in surveillance and how often to perform the periodic evaluations. There are no universal answers, as the primary determinants will often be the risk of TB and the past and current concentrations of silica: higher risks and exposure prompt increased frequency of testing, up to 6-monthly in some settings.

If TB rates are high, periodic active case finding should be complemented by passive case finding: worker and management education on symptoms and benefits of early diagnosis; job protection on diagnosis; easy access to caring workplace services; and ambulatory treatment are all important. If silicosis is the major concern and respirable silica levels are below 0.05 mg/m$^3$, a baseline evaluation, a 1-year follow-up, then 3-yearly for the first 10 years and 2-yearly thereafter, is recommended by the ACOEM.[65] The WHO recommendation for routine periodic evaluations is less precise, every 2–5 years, but includes the comment: 'Ideally, health surveillance, particularly for workers exposed to silica dust, should be life-long'.[64]

In high HIV infection regions, the prevention of TB is especially important; workers leaving employment need to be re-informed of their life-long increased risk of silica-associated conditions even in the absence of extant diseases, and the need to inform attending health care professionals about their past exposure.

### *Compensation*

Workers' compensation benefits in poorer countries may be critical in providing financial support for families and covering medical costs. Even in the absence of respiratory impairment, workers with silicosis may be excluded from many jobs due to an abnormal chest radiograph, so compensation benefits are generally provided.

The value of active case finding in former workers has been demonstrated in southern Africa.[45,46] Surveys of retired gold miners who had returned to rural labour-sending areas identified many undiagnosed and uncompensated individuals.

## PRIMARY PREVENTION—DUST CONTROL

There is no cure for silicosis or other silica-associated diseases apart from TB. Under the guidance of the ILO/WHO global elimination campaign, a number of countries have established national silicosis elimination programmes, including some classed as low- or middle-income; South Africa and Thailand are examples. A comprehensive approach is required to prevent silica-associated diseases. Elements of these programmes include awareness, education, strengthening enforcement of standards, targeting priority industries for dust control, improved case finding and compensation.

Primary prevention of silicosis, the control of dust to concentrations at which disease will not occur—more comprehensively covered in industrial hygiene publications—is the optimum form of prevention and should be the overriding goal of national and workplace occupational health programmes. It may be cost-effective in both high- and low-income countries ($106–$109 saved per healthy year or disability adjusted life year).[66] Even if silica concentrations cannot be lowered to levels that will prevent all silica disease, it is important, for at least two reasons, to reduce concentrations to the lowest level that can be achieved. First, to prevent serious disease, e.g., rapid radiological progression and PMF have been associated with higher cumulative exposures and lung dust burdens, and acute silicosis is a consequence of intense exposure.[8,31] Second, even relatively short excursions over control limits, particularly if well above these limits, have been found to increase the risk of silicosis dramatically.[67]

Widely used current standards of 0.05–0.1 mg/m$^3$ have been shown not to be protective.[1] Greaves calculated that the risk of silicosis following a lifetime of exposure at 0.05 mg/m$^3$ is likely to be 20–40%.[68] The American Conference of Governmental Industrial Hygienists (ACGIH) has recommended a threshold limit value (TLV) of 0.025 mg/m$^3$.[40] Attaining legislated levels is challenging, especially in low-income countries and in small enterprises, and even these low levels may not be protective against some silica-associated diseases such as TB.[1]

## CONCLUSION

Silica-associated diseases can be prevented, as has been shown in Sweden and other high-income countries. However, even with a focus on primary prevention, silica-associated diseases with long latency will occur well into the future due to contemporary exposure. In low-income countries, new cases of silicosis and associated lung cancer, COPD and TB are likely for decades because reduction to very low concentrations of silica, necessary to prevent disease, will take time to

achieve, and protective standards have not even been established for some silica-associated diseases such as TB.

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**RÉSUMÉ**

**L'exposition à la poussière de silice cristalline provoque de nombreuses maladies, mais la silicose ainsi que la tuberculose (TB) associée aux poussières de silice en particulier sont les deux affections qui restent fréquentes sur la liste des priorités de santé du travail dans les pays en développement et qui existent toujours dans certains pays développés. La prévalence des TB liées à la silice est exacerbée par l'épidémie de virus immunodéficience humaine (VIH) dans les pays en développement. Cette revue décrit la morphologie de la silice ainsi que la puissance variable de ses différentes formes. On y discute les sources de la silice cristalline en insistant sur les sources moins généralement connues telles que les opérations de mine à petite échelle ainsi que l'agriculture. Les tendances dans la prévalence de la silicose sont également mentionnées. Quoique depuis de nombreuses années on ait fait des efforts dans la plupart des pays pour réduire les niveaux de poussière de silice, la silicose continue à se développer, même chez les sujets jeunes. Les caractéristiques cliniques et anatomo-pathologiques ainsi que le diagnostic de la silicose sont décrits en insistant sur le cliché thoracique. Le risque élevé d'infection mycobactérienne chez les individus exposés à la silice fait l'objet d'une attention particulière avec insistance sur le contrôle de la maladie. On recommande le traitement de la TB latente. La prise en charge de la silicose et de la TB associée à la silice, y compris le suivi pour détection précoce de la maladie et la surveillance pour identifier les lieux de travail générateurs de maladies, font l'objet d'une discussion détaillée. La prévention de la maladie, sous forme de contrôle des poussières, reste l'objectif de la Campagne Mondiale d'Elimination de la Silicose conduite par l'Organisation Mondiale de la Santé et le Bureau International du Travail. Toutefois, les cliniciens doivent être conscients du fait que les maladies associées à la silice resteront encore présentes pendant de nombreuses années.**

**RESUMEN**

**La exposición a los polvos de sílice cristalina causa múltiples enfermedades, pero la silicosis y la tuberculosis (TB) asociada con silicosis en particular, son dos enfermedades que siguen ocupando un puesto de primer orden en las prioridades de salud laboral en los países en desarrollo y se presentan aún en algunos países desarrollados. La epidemia de infección por el virus de la inmunodeficiencia humana (VIH) ha exacerbado la prevalencia de TB asociada con silicosis en los países en desarrollo. En esta revisión se describe la morfología de la sílice y la potencia variable de sus diferentes formas. Se analizan las fuentes de sílice cristalina, con énfasis en aquellas menos conocidas, como las operaciones de minería en pequeña escala y las actividades agropecuarias. Asimismo, se presentan las tendencias de la prevalencia de silicosis. Si bien en la mayoría de los países se han realizado esfuerzos durante muchos años, con el propósito de disminuir las concentraciones de polvo de sílice, la silicosis sigue presente, incluso en personas jóvenes. Se describen las características clínicas y patológicas y el diagnóstico de la silicosis, haciendo hincapié en la radiografía de tórax. Se concede particular atención al alto riesgo de enfermedades por micobacterias en las personas expuestas a la sílice y sobre todo a su control. Se recomienda el tratamiento de la infección tuberculosa latente. Se expone en forma pormenorizada el tratamiento de la silicosis y de la TB asociada con silicosis, incluidos el seguimiento a fin de detectar en forma temprana la enfermedad y la vigilancia con el propósito de reconocer los ambientes de trabajo que generan enfermedad. La prevención de la enfermedad, mediante el control de la concentración del polvo, sigue siendo el principal objetivo del Programa Mundial de Eliminación de la Silicosis de la Organización Mundial de la Salud y de la Organización Internacional del Trabajo. Sin embargo, los médicos deben tener presente que las enfermedades causadas por la silicosis seguirán presentes durante muchos años.**

MASOYISE
Health Programme

MINERALS COUNCIL
SOUTH AFRICA

# OCCUPATIONAL LUNG DISEASES (OLDs)

## in the mining industry:

### Tuberculosis:

1% of South Africa's population develop active TB each year.

### Silicosis:

is caused by inhaling silica dust, commonly found in underground mines.

### Black lung disease:

also known as coal workers' pneumoconiosis, is caused by inhaling coal dust.

**Goal:**

The Masoyise Health Programme aims:

**"To reduce the impact of TB, HIV, OLDs and NCDs as occupational health threats in the mining sector"**

- The Masoyise Health Programme has committed to screening 100% of employees annually
- From 2016 to 2018 the number of screenings achieved is around 90%

OCCUPATIONALhealth
SOUTHERN AFRICA

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# Contents