Acting Director:
Prof David Rees

National Institute for Occupational H

2003-2004

Introduction

In 2003, the National Centre for Occupational Health (NCOH) joined the NHLS as the National Institute for Occupational Health (NIOH). The Department of Health remains the primary funder of the NIOH, and hence will continue to guide the Institute in its goal to promote good occupational health and working life.

The current functions of the NIOH are:

- *Advisory services which include giving advice on establishing occupational health services at provincial, district and enterprise levels; serving on t echnical committees, and consultations with individuals and enterprises on hazard control and the monitoring of workers.*
- *Information services, including South Africa's national reference library, a toxicology query handling service, the SADC Clearing House for occupational health and the ILO/CIS function.*
- *Support services, eg. Specialised laboratories and health hazard evaluations.*
- *Applied laboratory and epidemiological research.*
- *Surveillance of occupational disease and indicators of occupational h ealth practice.*
- *Development of occupational health professionals and specialists.*
- *The statutory autopsy services in terms of the Occupational Diseases in Mines & Works Act (ODMWAct).*

The new environment will bring many changes, but one of the challenges will be to ensure that the NIOH responds to the changing world of occupational health and that it continues to develop knowledge and services in psychosocial aspects of work, ergonomics, bio-aerosols and molecular biology.

Services

The NIOH provides a range of services to support occupational health, including the statutory autopsy service, advisory services, information services, specialised laboratories and health hazard evaluations.

Statutory autopsy service

In terms of the Occupational Diseases in Mines & Works Act [78 of 1973], the NIOH Pathology section examines the cardio-respiratory orga ns of deceased miners. This post mortem service is used by 80% of families of men who die while in mining service. To increase the efficiency of the compensation process, the NIOH, Medical Bureau for Occupational Diseases and Compensation Commissioner for Occupational Diseases are being linked by a web-based computer network. Work on this new system is well under way and the infrastructure is now in place at the three sites. Staff training on the new system has begun and full deployment of the n ew system will take place in 2004.

The computerised Pathology database (PATHAUT) has made the information derived from the service more accessible. The data reflect disease trends in the mining industry and the database is a unique national resource. A detailed report of the database giving demographic data and disease rates by exposure is produced annually. During 2003, 2318 cases came to autopsy compared with 2529 cases during 2001 and 2518 in 2002. In 2003, the overall disease rate for tubercu losis was 223 per 1000, for emphysema 190 per 1000 and for silicosis 189 per 1000.

Advisory services

These are mainly specialised consultations with individual workers, professionals or occupational health services in the public and private sectors. About 300 new patients were attended to, each of whom is a sentinel event for possible adverse

working conditions, and over 1000 chest radiographs were read.

The NIOH serves on many professional and technical committees and groups. The Legionella Action Group (LAG) is a good example. The Group's main objective is to promote awareness of Legionella in South Africa. Ms T Soogreem is the chairperson of this Group and Dr D Bartie is an active member. LAG is actively involved in organising the Terminators conference for 2004.

Information services

A core function of the NIOH is to provide specialist information serv ices in occupational health and safety. Technical and scientific information covering a wide range of topics was provided to practitioners from all nine of the South African provinces and from the SADC.

The national reference library, the only specialist reference library dealing exclusively with the subject, improved its holdings in occupational hygiene, ergonomics and psychosocial aspects of work.

The SADC Clearing House for OH&S information was further developed during the reporting period. Th is effort is being harmonised with the NIOH's commitment to the WHO/ILO Joint Effort in Occupational Health and Safety in Africa. Particular emphasis is being given to the areas of practical OH&S solutions, training, national policies, programmes and legislation, and the promotion of OHS involving workers in the informal sector.

Specialised laboratories

A wide range of tests was conducted to support hazard control and the diagnosis of over-exposure of workers. These included tests of sensitisation (skin prick tests (SPTs), patch tests and radio-allergosorbent assays); waterborne microbial pathogens particularly Legionella bacteria; toxic metals mainly lead, cadmium, mercury, manganese, copper, zinc, nickel, chromium, aluminium, vanadium, uranium, cobalt, molybdenum, antimony in biological and air samples; organic assays included RBC and plasma cholinesterase, acetic acid, trichloroethylene, trichloroacetic acid, mandelic acid, toluene, styrene, phenol, o-cresol, MEK, MIBK, N-methylformamide, methanol, ethylene oxide, methyl chloride and xylene in biological and air samples; established methodologies were used to provide service in the assessment of the toxicology and genotoxicity of medicinal plants investigated at the University of Pretoria. In addition, the levels of DNA damage was investigated in scleroderma patients using the Comet assay.

Pathology provides a scanning electron microscopy (SEM) service for occupational disease and environmental monitoring. Tissues, dusts, fumes and fibres are analys ed to determine possible adverse health effects.

Surveillance

The NIOH continued to manage the national surveillance programme on occupational respiratory disease (called SORDSA), introduced a new programme on upper limb musculoskeletal disorders (called SAMOSA) which included a series of workshops to promote awareness of musculoskeletal disorders and SAMOSA, and contributed to a programme on surveillance of tuberculosis in healthcare providers in the public sector. The programme to develop performance indic ators for occupational health and safety for South Africa and to collect data on them and publish periodic reports continued. The next report is due in late 2004.

Health hazard evaluations

These evaluations measure workplace hazards or the health status of groups of workers or both, and are conducted to generate practical recommendations to improve occupational health.

Hazards were measured in automotive repair shops, an armature shop, a cable junction room, a forensic laboratory, a histopathology laboratory, hospitals, a n IT company, a leather producer, a mining machinery manufacturer, a printing works and a utility company.

The mobile X-ray van was used in factory surveys conducted at four workplaces, namely a power station, a ferrous foundry, and factories in the packaging and gypsum industries. Workers exposed to silica and asbestos dusts were investigated for radiographic changes in the lungs.

New developments

Two new units were established in 2003/4, in Ergonomics and Bioaerosols, and the Organics laboratory was further developed. One of the key functions of the Analytical Services is to expand the analytical capacity to meet the requirement listed in the national Regulations for Hazardous Chemical Substances. A number of new methods introduced

during the year included mercury in soil, filters and water samples, antimony and molybdenum on filters and also vanadium and cobalt in urine and blood samples. A new method was developed, with shorter digestion time, to measure mercury in blood samples. In Organic Chemistry, new methods introduced were N-dimethylformamide, methyl chloride, xylene, methyl chloroform, and styrene in biological samples and/or air samples. A new x-ray diffractometer was commissioned primarily for quartz determinati on so that the NIOH can contribute to the elimination of silicosis in the region.

Sources of research funding

- Safety in Mines Research Advisory Committee (SIMRAC).
- Health & Safety Laboratory, UK
- University of Michigan/Fogarty
- CDC: NIOSH (via the WHO)

Research projects

A.MINERAL DUSTS AND FIBRES

Surface characterisation of mineral particles in relation to their ability to peroxidise lipids
Project supervisor : Dr M Gulumian (Biochemistry & Toxicology Research Section)
Project manager : Ms M Semano (Biochemistry & Toxicology Research Section)
Collaborations & affiliations :Mossbauer Laboratory, Department of Physics, University of the Witwatersrand
The aim of this study is to show a detailed knowledge of the surface composition and the morphology or other characteristics of different asbestos fibres. This may allow a more complete understanding of the mineral reactivity and, in turn, may elucidate the effect of the variability of these characteristics on toxicity and carcinogenicity of these minerals. The interactions of lipids (linoleic acid) with different kinds of mineral fibres (crocidolite, amosite, chrysotile and erionite) are studied in order to analyse the surface physicochemical properties of these minerals. Lipid peroxidation products are measured to evaluate induced damag e, and changes in mineral particle surface characteristics following lipid peroxidation are studied.

Attribution of lung cancer to asbestos exposure in miners in South Africa
Project supervisors :Dr J Murray (Pathology Section); Dr D Kielkowski (Epidemiology & Surveillance Section)
Project manager : Mrs S Chauhan (Epidemiology & Surveillance Section)
Collaborations & affiliations: University of the Witwatersrand
The Helsinki Criteria for Diagnosis and Attribution is applied to lung cancer case reports of deceased miners submitted to the NIOH between January 2000 and June 2003 to determine the proportion attributable to asbestos.

Intrapulmonary lymph nodes in South African miners - an autopsy survey
Project supervisor and manager :Dr J Murra y (Pathology Section)
Collaborators: Dr K Honma (Department of Pathology, Dokkyo University School of Medicine, Mibu, Tochigi, Japan); Ms G Nelson (Wits Health Consortium)
This study describes the prevalence and histological appearances of intrapulmonary lymph nodes in an autopsy-based study of South African miners and ex-miners.

Asbestos, SV40 and mesothelioma
Project supervisor and manager: Dr JI Phillips (Pathology Section)
Collaboration & affiliations: Prof R Nolan (Brooklyn College, City University of New York); Prof S Aaronson and Dr J Manfredi (Mount Sinai Medical School, New York)
The study aims to determine the presence of SV40 DNA in mesothelioma tissue from South Africa and to correlate this presence with tumour cell type, asbestos fibre burden and fibre type. It further aims to determine if large T antigen is expressed in tumour tissue that is positive for SV40 DNA. This study is part of a multi-centre study which will compare the findings in South African tumour tissue with tumour tissue from other participating countries. These countries are the USA, UK, Russia, Ukraine and Turkey.

Markers for prediction and early detection of silicosis
Project supervisors: Dr J Murray (Pathology Section); Dr M Gulumian (Biochemistry & Toxicology Research)
Collaboration & affiliations: Prof P Borm (Institut fur UmweltmedizinischeForschung gGmbH, Dusseldorf, Germany); Dr V Castranova (NIOSH, Morgantown, West Virginia, USA); Prof K Donaldson (University of Edinburgh, UK Medical School, Edinburgh, Scotland); Dr V Vallythan (NIOSH and West Virginia University Medical Center, Morgantown, West Virginia, USA); Mr L Darwin (NIOH -Toxicology); Ms G Nelson (Wits Health Consortium, NIOH -Pathology)

This study has been commissioned by the Safety in Mines Research Advisory Committee (SIMRAC). It involves a comprehensive literature review of biological, chemical and immunological biomarkers for the prediction and/or early detection of silicosis. A proposal for a framework against which current and future studies on biomarkers can be evaluated will be drawn up. A meta-analysis of data, if appropriate, will be done and a workshop of international experts will be held to identify sources of info rmation not explored, to clarify controversies in the literature, and to discuss whether any of the biomarkers identified warrant further study (phase 2). A proposal for further evaluation of any potential markers identified will be drafted.

B.BACTERIAL AND VIRAL INFECTIOUS DISEASES

The effect of mineral dusts on the activation and function of human mononuclear cells with a view to investigating silica-induced susceptibility to infection with mycobacteria
Project supervisor: Dr M Gulumian (Biochemistry & Toxicology Research)
Project manager: Ms S Makhubela (Biochemistry & Toxicology Research)
Collaborations & affiliations: Haematology & Molecular Medicine, Wits; University of Turin, Italy
The study aims to determine the ability of silica t o activate human mononuclear cells and ascertain how silica influences free radical and cytokine production in these cells. It is also investigating changing the ability of macrophages and lymphocytes to resist mycobacterium infection by altering their ability to generate free radicals and a variety of cytokines.

The effect of HIV on morbidity and mortality in South African gold miners
Project supervisors: Dr J Murray (NIOH); Dr S Shearer (Occupational Medicine Consultant, Gold Fields Ltd.); Dr P Sonnenberg (London School of Hygiene and Tropical Medicine)
Collaborations/affiliations: University of the Witwatersrand Sch ool of Public Health, Faculty of Health Sciences; Gold Fields Ltd; A Bester (Medical Manager, HIV/AIDS Programme, Gold Fields Limited); P Sonnenberg, J Glynn, K Fielding (The London School of Hygiene and Tropical Medicine); K Porter (Clinical Trials Unit, Medical Research Council, UK).
This study involves the following components: 1) comparing the mortality rate of mineworkers with and without HIV infection; 2) determining the causes of death of mineworkers with HIV infection by duration of infe ction; 3) describing the clinical course of HIV infection and health service utilisation; 4) measuring the effect of HIV-associated morbidity on the workplace (eg. as days off work, ill-health retirement), and 5) comparing the natural history of HIV in mineworkers in South Africa with that of men of the same age with known dates of seroconversion in the UK.

Incidence of tuberculosis in healthcare workers in Gauteng
Project supervisor: Dr D Kielkowski (Epidemiology & Surveillance Section)
Project manager: Ms S Sawry (Epidemiology & Surveillance Section)
The investigators aim to determine the i ncidence of tuberculosis in healthcare workers (HCWs) in South Africa. They are also studying the effects of pre-disposing factors such as environments in the hospital/clinic where the HCW is employed, degree of contact with patients and type of hospital, and the effects of other pre-disposing medical or environmental conditions/factors. The potential for further follow-up studies on cases using pilot study for informed consent will be determined.

C.TOXIC METAL IONS

Speciation of manganese in serum
Project supervisors: Dr M Gulumian (Biochemistry & Toxicology Research); Dr E Cukrowska, Dr M Stewart
Project manager: Ms M Semano (Biochemistry & Toxicology Research)
Collaborations & affiliations: Toxicology and Biochemistry Research (NIOH); Analytical services (NIOH); NHLS; School of Chemistry, Environmental Analytical Chemistry Research Group, WITS; Department of Occupational and Environmental Medicine, Goteborg University, Sweden
Manganese (Mn)-binding ligands in sera of control and occupationally exposed subjects are studied in order to define the oxidation states of Mn and their qualitativ e distribution between low and high molecular mass fractions. These parameters are correlated to the total serum Mn concentration. Specific objectives are to develop a liquid chromatography technique in bovine serum/plasma that will separate ligands of Mn into fractions according to their molecular mass (HPLC and AA), to determine, quantitatively, concentrations of Mn in said fractions (AA) and to determine the oxidation states of Mn binding to the ligands in said fractions (Adsorption Stripping Voltammetry).

D.OCCUPATIONAL ALLERGY AND CONTACT DERMATITIS

Sensitisation to maize in the maize milling industry: a prospective study
Project supervisor: Prof D Rees
Project manager: Dr D Bartie (Immunology & Microbiology Section)
Collaborations & affiliations: African Products (Pty) Ltd; Epidemiology Unit, NIOH; Occupational Medicine Section, NIOH
The value of tests currently used in the maize milling industry for predicting sensitisation to maize products is not known. As a result, the NIOH was approached to investigate the value of commercial skin prick tests and in-house extracts of maize products to which workers in the industry are exposed. The main purpose of the study is therefore to evaluate the role of these tests of sensitisation to maize and common allergens in predicting maize-related respiratory disease, and to evaluate the role of these tests in monitoring exposed workers. Specific objectives are:

- *To evaluate changes in respiratory symptoms and lung function in workers during employment in the maize industry and to relate these to maize exposure and to tests of sensitisation.*
- *To compare responses to skin prick tests using commercially available extracts and in-house extracts of products manufactured at the study workplace (NIOH) and to determine whether in-house extracts are more strongly associated with symptoms and signs of maize-related allergic disease.*
- *To study sensitisation of workers to additional allergens that may be present in the working environment (ie. fungi, yeasts, bacteria, storage mites and grain weevils).*

Sensitisation of soybean and dust exposure measurement
Project supervisor: Prof D Rees
Project managers: Mrs A Fourie (NIOH); Dr J Elms (UK)
Collaborations/affiliations: Mr E Robinson, Dr S Rahman, Dr D Fishwick, Dr A Beswick, Dr G Evans, Mr H Mason (Health & Safety Laboratory, UK)
The objectives are to identify the prevalence of sensitisation to soybean and the association with defined respiratory symptoms. The investigators aim to determine whether the South African soybeans contain proteins that are different from the European soya and whether individuals demonstrate antibodies to any proteins present in South African extracts that are not present in the European commercial extract.

Work-related asthma associated with endotoxin exposure in dental workers in South Africa
Project supervisors: Prof A Duse (University of the Witwatersrand); Dr M Jeebhay (University of Cape Town)
Project manager: Ms T Singh (Immunology & Microbiology Section)
Work-related asthma associated with endotoxin exposure from contaminated aerosols generated during dental procedures in various academic institutions in South Africa will be investigated through determining: 1) the levels of endotoxin in dental unit waterlines of dental clinics/surgeries in various public sector academic institutions; 2) the levels of endotoxin in ambient air of the dental clinics/surgeries conducting dental procedures through environmental sampling; 3) serum levels of endotoxin in dental workers and students; 4) the prevalence of work-related asthma symptoms in dental workers and students using health questionnaires and lung function assessments; 5) whether the asthma symptoms are associated with increased eosinophil cationic protein (ECP) or myeloperoxidase (MPO) levels; 6) whether asthmatics exposed to endotoxins have more frequent asthma episodes, and 7) whether asthmatics exposed to high levels of endotoxins have high MPO levels and low ECP levels. The investigators aim to characterise the relationship between current exposure to endotoxins and work-related asthma symptoms which control for potential confounders such as age, gender and smoking.

E.EVALUATIONS OF SPECIFIC INDUSTRIES OR LOCATIONS

A birth cohort mortality study in Prieska
Project supervisor and manager: Dr D Kielkowski (Epidemiology & Surveillance Unit)
The rationale of this study is to investigate a cohort using the birth register of the Prieska district, for the period 1925-1944 inclusive. The mortality patterns of this cohort with respect to asbestos-related diseases will be studied and the feasibility of doing record linkage studies in South Africa will be explored.

Cancer mortality of paper pulp workers - a cohort study
Project supervisor and manager: Dr D Kielkowski (Epidemiology & Surveillance Unit)
Various types of exposures in the pulp mills studied will be described and quantified. The mortality in pulp and paper workers will be compared with national/regional mortality (any cause).

Furthermore, the mortality in pulp and paper workers from different departments/exposures will be compared (any cause, internal comparison), as well as the cancer mortality in pulp and paper workers with national/regional mortality (for any corresponding reference rates available) and the cancer mortality in pulp and paper workers from different departments/exposures (internal comparison for any cancer site).

Airborne concentration of ethylene oxide in public and private hospitals in Gauteng
Project supervisor: Dr D Kielkowski (Epidemiology & Surveillance Section)
Project manager: Mr A Baker (Occupational Hygiene Se ction)
The objective of the study is to provide information regarding the airborne ethylene oxide (EO) levels in Gauteng public hospitals to support a study by Dr D Gresie-Brusin aiming at assessing the association between the incidence of adverse reproductive outcome and occupational exposure to EO during pregnancy in women sterilising staff. Depending on the outcome of the study, recommendations will be made to Gauteng Health Department for the effective and adequate control of EO in public hos pitals.

Ethylene oxide exposure in women sterilising staff in Gauteng
Project supervisor: Dr D Kielkowski (Epidemiology & Surveillance Section)
Project manager: Dr D Gresie-Brusin
This study will assess the association between the incidence of adverse reproductive outcome and occupational exposure to ethylene oxide (EO) during pregnancy in women sterilising staff working in Gauteng Province, SA. The current ethylene oxide exposure in women sterilising staff working in units using EO in Gauteng will be determined and the information validated on the last recognised pregnancies collected through a standard questionnaire and to assess their outcome.

Assessment of the exposure and the associated health effects to hexamethylene diisocyanate (HDI) in automotive spray-painting processes in small, medium and micro enterprises
Project supervisor: Prof D Rees
Project manager: Ms A Spies (Occupational Hygiene Section)
Exposure assessments will be conducted to identify and quantify exposure to HDI in selected South African small, medium and micro enterprises belonging to Highveld SAMBRA, identify sentinel cases of occupational asthma to HDI in exposed workers, and to investigate exposure-response relationships. Recommendations for reducing the exposure levels to prevent disease development will be proposed. The implementation and effectiveness of the proposed recommendations after completion of Phase 1 will be evaluated.

Prevention of needlestick injuries: a pilot project
Project supervisor: Ms S Wilburn (International Council of Nurses, Geneva, Switzerland)
Project manager: Ms B Nyantumbu (Occupational Medicine Section)
Collaborations/affiliations: World Health Organization; Safe Injection Global Network
It is aimed to raise awareness among healthcare workers of the risks of sharps-related HIV and hepatitis B and C transmission. The study will assess the frequency of unsafe injections, determine if the facilities mee t the requirements for equipment, supplies and waste disposal, identify unsafe practices that may lead to infections, assess policy gaps and implement and evaluate the impact of the WHO toolkit.

Honours

Ms B Nyantumbu was awarded the 2003 W Harding le Riche Gold Medal in Epidemiology.

Teaching and training

The development of occupational health professionals was a major aspect of the NIOH's activities in the reporting period.

The NIOH manages and presents two postgraduate occupational health programmes: an MPH in the field of o ccupational hygiene; and a Diploma of Occupational Health (DOH). The MPH is the only programme of its kind in sub-Saharan Africa, is supported by a range of international agencies and has students from South Africa and four neighbouring countries. Presently there are about 45 students at various stages of the programme. The first students graduated in 2003/4 and the programme is producing professional hygienists and building tertiary level infrastructure in the discipline. The DOH trains medical doctors in occupational medicine and related topics and has over 25 students in the current class.

A new course, "Introduction to Occupational and Environmental Toxicology" was presented in 2003 by the NIOH's Toxicology and Biochemistry Research Unit.

NIOH staff contribute to occupational health and environmental health courses at most of the tertiary institutions around the country at undergraduate and postgraduate levels as teachers and external examiners.

Every year the NIOH presents seminars and workshops on topical occupational health issues. The focus in 2003/4 was biological monitoring, ergonomics, musculoskeletal disorders (particularly hand-arm vibration syndrome), toxicology, legionella, contact dermatitis, bio-aerosols, occupationa l allergy, latex allergy, the radiology of occupational lung disease and HIV in the workplace. Continuing medical education programmes in occupational medicine are held each Friday.

NIOH staff are supervising about 20 higher degrees in occupational health and four sections have interns gaining experiential training. The Toxicology and Biochemistry Research Unit had 11 interns in 2003.

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Director:
Prof Mary Ross

2004-2005

Overview

The NIOH, with a total staff establishment of 90 people, is a national multidisciplinary resource within the NHLS and is South Africa's major centre for occupational health, focusing on developing and supporting effective occupational health services in South Africa. In collaboration with the national Department of Health, which is the primary funder of the Institute, the NIOH serves the various stakeholders involved in occupational health, including the State in its broader context of government departments and academic institutions, labour and industry within South Africa, as well as in the Southern African Development Community (SADC) region. The NIOH provides advice and assistance, conducts research and develops

capacity through teaching and training for the purpose of promoting healthy conditions in the workplace and improving occupational health. NIOH staff supervise about 20 postgraduate research projects and teach and examine postgraduate and undergraduate students at tertiary institutions throughout South Africa.

The NIOH has longstanding associations with a number of international organisations through both formal agreements and informal collaboration and many sections and individuals within the In stitute have collaborative research, service and training projects with organisations such as the WHO, ILO, NIOSH (USA), the HSL (UK), the University of Birmingham Institute of Occupational and Environmental Medicine (UK), the Swedish National Institute for Working Life (NIWL), the Swedish National Institute of Public Health (NIPH) and the Fogarty International Center (FIC), USA. During 2004, collaborative projects and exchanges continued with these organisations both within South Africa and the SADC.

During the reporting period, Prof M Ross was appointed as the Director of the NIOH, taking over from Prof D Rees who had been Acting Director since the NIOH joined the NHLS in 2003. A tragic loss to NIOH and occupational health in South Africa was the death of Prof Neil White, an Occupational Respiratory Physician of international repute and a longstanding research collaborator and supporter of NIOH research, service and teaching activities. The NIOH participated in the strategic planning process of the NHLS and, as a result, realigned the sections into three divisions and overall institute support services. For the first time, a formal quality function was established to fast track the accreditation process for the NIOH laboratories. With the support from the NHLS Quality and Accreditation Division and restructuring within NIOH, the NIOH staff undertook SANAS internal auditing training and focused attention on preparing the laboratories for SANAS ISO 15189 accreditation in 2005/6. With the support of the Information Technology (IT) Department of the NHLS and the NIOH IT unit, headed by Mr L Darwin, the NIOH was transferred successfully to the NHLS server after a difficult period of electronic communication. Activities are coordinated through monthly head of sections and research committee meetings and a research forum.

Highlights

During 2004, the NIOH went through a lengthy process involving site visits from WHO officials, an audit of the available facilities, and documentation o f the scope of occupational health priorities and functions of the NIOH. The culmination was the recognition of NIOH as a WHO Collaborating Centre in Occupational Health in January 2005.

Another highlight was the launch of the "Work And Health in Southern Africa"(WAHSA) programme for the SADC regions in October in Gaborone, Botswana. This "Strategic Programme in Occupational Safety & Health, Phase I, 2004 - 2008" is a Swedish International Development Cooperation Agency (Sida)-funded initiative i n southern Africa and is organised into 10 projects with R20 million funding. The NIOH is specifically involved in the training of health and safety professionals, improving the access to information and action on silica, silicosis and tuberculosis, the latter in collaboration with Zambia. The WAHSA programme has numerous synergies with other occupational health and safety programmes in the SADC region, such as the Fogarty International Centre/University of Michigan Training Programme in Researc h in Environmental and Occupational Health Capacity Building in southern Africa; and the various WHO and ILO programmes in the region, e.g. WHO/ILO African Joint Effort; Global Elimination in Silicosis Programme, etc.

The NIOH contributed significantly to information dissemination and capacity development through publications and participation by staff at international, national and local conferences organised externally. In addition, NIOH organised a number of seminars and workshops during the y ear. At the very successful NIOH Research Day in October 2004, NIOH presenters from all sections covered the wide spectrum of research conducted at the institute and with external collaborators. The Webster Day, in November 2004, comprised a very successful workshop on Occupational Allergies which included presentations by NIOH staff and collaborators from the University of Cape Town and University of KwaZulu-Natal, and a panel discussion with healthcare workers affected by debilitating occupati onal allergy to latex.

PATHOLOGY DIVISION

Head: Dr J Murray

The Pathology Division has two sections: histopathology and electron microscopy, served by a surveillance function. Dr S Seopela joined the division as a principal pathologist to head the histopathology unit and also serve as quality manager for the process of obtaining accreditation for NIOH.

Histology and mortuary services and surveillance

In terms of the Occupational Diseases in Mines & Works Act: Act 78 of 1973, the NIOH fulfils the statutory requirement of examining the cardio-respiratory organs of deceased miners, a service utilised by 80% of families of men who die while in mining service. Full deployment of the web-based link between the NIOH, the Medical Bureau for Occupational Diseases and the Compensation Commissioner for Occupational Diseases took place in 2004.

The computerised pathology database (PATHAUT) is a national resource used for disease surveillance in the mining industry and in international collaborative research. A detailed report of the database, giving demographic data and disease rates, is produced annually. During 2004, 2056 cases came to autopsy compared with 2318 in 2003, 2529 during 2001 and 2518 in 2002. The decrease may reflect both the decrease in the number of miners employed and the decreased mortality due to the introduction of anti-retroviral therapy within the mining industry.

The his topathology section is also a national reference centre for lung pathology. Specimens for diagnosis, consultation and review are received from many centres in South Africa.

Teaching and training is a major function of this section. Registrars rotate through the section and staff contribute to undergraduate and postgraduate teaching at a number of Universities in South Africa. Dr Murray and Dr Seopela hold honorary appointments at the Universities of the Witwatersrand and Stellenbosch, respective ly. Staff contributed to clinical pathology meetings for the respiratory unit, courses at various venues in mortuary training techniques and the Medical Bureau for Occupational Diseases Compensation committee meetings.

Electron microscopy

The Pathology Division provides a scanning electron microscopy (SEM) service for occupational disease and environmental monitoring. Tissues, dusts, fumes and fibres are analysed to determine possible adverse health effects. Analyses are carried out for other sections of the NIOH, other Government departments, as well as private industries and laboratories. In 2004, 571 specimens were analysed, compared to 384 in 2003. SEM provides morphological data and this is combined with energy dispersive spectroscopy which analyses the chemical composition of the specimen. Diagnosis is supported by use of transmission electron microscopy.

Research

Research focuses on projects relevant to South African workers and is of national importance. The results of completed studies have been widely dis seminated through research reports, publications and regional seminars to the various stakeholders (see publications and presentations).

Several of the projects involve international collaboration with prestigious institutions and scientists acknowledged as world leaders in their fields of study. During 2004, results from the cohort study on HIV seroconversion and health effects in miners were analysed and staff attended meetings with the collaborators from the London School of Hygiene and Tropi cal Medicine in London. The division continues to forge links between the NIOH and scientists and institutions in South Africa and other countries. National and international institutions and collaborators currently include: University of Pretoria; School of Pathology of the University of the Witwatersrand; Public Health and Clinical Medicine; University of Stellenbosch; CSIR Miningtek; Health and Safety Laboratory, and Occupational and Environmental Lung Injury Centre, Sheffield University, UK; Brooklyn College, City University of New York, USA; Mount Sinai Medical School New York: USA; National Institute for Occupational Health and Safety, USA; Dokkyo University School of Medicine, Japan; London School of Hygiene and Tropical Medicine; Clinical Trials Unit, Medical Research Council UK; University of Edinburgh Medical School, Edinburgh, UK; Institute fur Umweltmedizinische Forschung gGmbH, Dusseldorf, Germany.

The NIOH staff establishment is complemented with personnel and visiting res earchers funded by a number of local and international organisations. Current research funders are: Colt Foundation, United Kingdom; International Environmental Research Foundation, USA; National Institute of Occupational Health, USA; Mine Health and Safety Council, SA.

Major research projects in the Pathology Division are:

Trends in the frequency of HIV-associated lung infections in South African miners in the 1990s : a population-based autopsy series

With the advent of the HIV epidemic in the 1990s in

South Africa, the rate of tuberculosis has increased. As the HIV epidemic matures, other pulmonary infections, which occur with lower CD4 cell counts, have been described in South Africa. There is, however, no information on the trend in prevalence of these diseases in the 1990s. This study was initiated to analyse trends of pulmonary tuberculosis, Pneumocystis carinii pneumonia and Cryptococcal pneumonia diagnosed at autopsy in South African miners and to evaluate the accuracy of the clinical diagnosis of these diseases. The study was expanded to include Nocardia infections.

Process-based performance review for the diagnosis of pulmonary tuberculosis

The purpose of this collaborative project in conjunction with mine medical officers, Chris Hani Baragwanath Hospital, and the School of Clinical Medicine, Faculty of Health Sciences, University of the Witwatersrand, was to identify, produce and distribute appropriate material to facilitate implementation of best practice with regard to TB in the mining industry. This project has developed innovative methods and technology to meet the needs of the end-users (doctors as well as allied health care workers such as nurses and laboratory technologists).

The adverse health effects of noise and vibration in the South African mining industry

This collaborative project with the CSIR, Stellenbosch University and the Health and Safety Laboratory, UK, was concluded. It included studies on the deployment of a hearing conservation programme at two mines and the follow up of a cohort of gold miners with hand arm vibration syndrome (HAVS), identified in a previous study by the NIOH ergonomics unit. A rapid diagnostic screening tool for HAVS has been developed and the effect of temperature on HAVS has been investigated in a cooler mine. A comparative study of rock drills was carried out to determine their noise and vibration outputs. These studies along with data on whole body vibration, HAVS and noise-induced hearing loss are now available in a book and on an interactive CD. Production of these outputs is in progress and their launch is planned for 2005/6.

The association between SV40, asbestos and malignant mesothelioma

This was a collaborative study with Brooklyn College, City University of New York and the Medical School, Mount Sinai Hospital, New York, USA. The natural hosts of SV40 are Macaque monkeys. SV40 was introduced to the human population between 1955 and 1963 through contaminated polio vaccines. It is known that vaccines produced in the USA and used in the USA and parts of Europe were contaminated. South Africa produced and used its own polio vaccines. Available evidence suggests that these vaccines were free from contamination. SV40 induces malignant mesothelioma in hamsters. SV40 DNA has been found in patients with malignant mesothelioma in the USA. Simian virus 40 (SV40) has recently been suggested as a cofactor, along with asbestos, in the aetiology of malignant mesothelioma. This project examined the association between asbestos, SV40 and malignant mesothelioma.

The effect of HIV on morbidity and mortality in South African gold miners

This was a collaborative retrospective cohort study with Gold Fields Ltd, the London School of Hygiene and Tropical Medicine and the Clinical Trials Unit, Medical Research Council UK. Most of the information on HIV in developing countries is based on prevalent cases (persons known to be HIV-positive, but for whom the date of infection is unknown). In order to have a full picture of the course and impact of HIV, it is important to have information from seroconversion (point of infection with HIV) and to follow individuals over time. The study is assessing long term survival (10-year follow-up) and sickness in nearly 2000 miners with known dates of HIV infection. The study used routine records from the mines and the Employment Bureau of Africa, together with field visits to check survival status of those thought to be alive. The death rates, causes of death, time off work, and rates of occupational injury of these HIV-positive men are being compared with that of HIV-negative miners to establish the impact of HIV at different time intervals since infection.

Markers for prediction and early detection of pneumoconiosis

Silicosis is the currently used health outcome for silica dust dose-response assessments and clinical detection is dependent on radiology. If scientifically acceptable existing biomarkers for silica dust exposure can be identified, industry could utilise these for the early detection of adverse health effects, rapid evaluation of dust-allaying projects that may be introduced in the near future, and timely implementation of intervention strategies. Phase 1 of the study in collaboration with the NIOH Toxicology and Biochemsitry Research Section and multiple international collaborators has been completed, namely a comprehensive literature survey to identify biomarkers for the early detection and/or prediction of silicosis; development of a systematic framework for the evaluation of studies on biomarkers and

analysis of available data. Phase 2 was commenced to evaluate 10 candidate biomarkers for use in the mining industry.

OCCUPATIONAL MEDICINE AND EPIDEMIOLOGY DIVISION

Head: Prof D Rees

This division comprises three sections: Occupational Medicine, Epidemiology and Surveillance, and Immunology and Microbiology. Prof Rees has a joint appointment with the University of the Witwatersrand as Professor of Occupational Medicine in the School of Public Health.

Occupational Medicine Section

Head: Dr S Kgalamano

The Occupational Medicine Section continued with its core functions of providing refe rral clinical and radiological services, conducting research and field surveys, and providing teaching and training for occupational health practitioners. Clinical services were provided to other NIOH sections for surveys (e.g. soybean research project) and routine functions (skin prick testing). One factory survey was conducted by clinic staff utilising the mobile X-ray van at a company's request. All 112 workers assessed had exposure to zinc oxide, zinc sulphate and copper sulphate.

Staff organ ise and teach on the postgraduate Diploma in Occupational Health, presented in four block weeks at the NIOH each year. Computer-based learning material on ergonomics was developed for GEMP undergraduate medical students and lectures were presented to undergraduate medical and dental hygiene students. The section, in conjunction with the Immunology and Microbiology Section gave presentations to various professional groups and workforces, including a workshop held at St Benedictine Hospital, KwaZu lu-Natal provincial unit.

Occupational Medicine referral clinic

Of 206 workers assessed at the Occupational Medicine Clinic, 56 cases were submitted to the Compensation Commissioner. The most frequently submitted cases were for asthma (20), asbestos-related lung disease (12), silicosis (12) and tuberculosis (8). As part of patient evaluation, five walk-through visits were made and an assessment was requested for the NHLS TB laboratory since assistance was sought to institute a medical surveillance programme for the staff. Prof Davie s continued to run clinics around Limpopo province to assist ex-miners who have asbestos-related diseases to apply for compensation. One of the rotating public health registrars was given an opportunity to visit this site for a week, learning occupational and environmental health under Prof Davies' guidance.

Radiological Unit

Chest X-ray reading and reporting have been extended to a variety of mining and non-mining industries. Weekly X-ray teaching on occupational radiology continuedat theDepartment of Radiology, Johannesburg Hospital, and sessions were run at NIOH for all interested medical practitioners. Topics and cases were based on patients presenting to the NIOH clinic and the Medical Bureau for Occupational Diseases.

Ergonomics Unit

Six ergonomic workplace risk assessments were completed in 2004 to identify ergonomic risk factors and how they can be reduced or eliminated. Five of the assessments were initiated by the employer as a result of the worker/s experiencing musculoskeletal problems. An ergonomics module was presented for the Master in Public Health students at the University of the Witwatersrand. A workshop conducted to raise awareness about work-related musculoskeletal disorders was attended by more than 100 occupational health practitioners from various industries in Gauteng.

Research in this section included:

An ergonomics audit in South African public hospitals

The feasibility pilot project was initiated by the national Department of Health and the WHO. It has been developed to determine the prevalence of musculoskeletal pain among female nurse s working at the intensive care and trauma units and to identify ergonomic risk factors and will be conducted in 2005/2006.

Prevention of needle stick injury and transmission of HIV in healthcare workers

This collaborative project involving the WHO, International Council of Nurses, Department of Health, Democratic Nurses Organisation of South Africa and the NIOH is being conducted at Pretoria Academic Hospital and Skinner Street Clinic in Pretoria. The project is piloting the effectiveness of training healthcare workers in following safe procedures when handling sharps duri ng injections. The training material is contained in a toolkit which was developed by the Blood Safety and Clinical Technology “Safe Injection Global Network” alliance at WHO. Phase 1 results indicate that needle

stick injuries are common and underreported and that universal precautions are not widely practised.

South African Musculoskeletal Occupational Surveillance Action Group (SAMOSA): a pilot study of upper limb work-related musculoskeletal disorders in Gauteng province
SAMOSA was concluded in 2004 as a comprehensive surveillance system was being developed to cover all occupational diseases. A SAMOSA newsletter and a poster on work-related upper limb musculoskeletal disorders were published.

Epidemiology and Surveillance Section
Head: Dr D Kielkowski
The main activities of the section were surveillance, research and teaching of occupational epidemiology. The section provides epidemiological and biostatistic s support for all sections of NIOH and conducts operational research, particularly disease surveillance and provision of occupational health services in the industry. Two scientists were appointed to the section to assist in research programme of the section. Post-graduate epidemiology courses were given to Diploma in Occupational Health and Master in Public Health students and supervision and advice were provided for a number of research projects including MSc and PhD students.

The surveillance of work related & occupational respiratory disease in South Africa (SORDSA) programme continued while development of an "all occupational disease" inclusive surveillance system, RODISA, was underway. The RODISA programme was discussed extensively with the Department of Labour and Compensation Commissioner and Minerals and Energy Department with the intention to pilot a new programme in 2005. The process has been delayed until late 2005/2006 by the impending combination of occupational health and safety legislation and the need to develop new comprehensive reporting forms. Final data and analysis of SORDSA were prepared for publication.

The surveillance and research programme for the epidemiology section included:

Surveillance of tuberculosis (TB) among healthcare workers
This research was conducted with collaboration of National TB Programme and provincial TB managers in response to a ministerial enquiry. During the two-year surveillance programme, 396 cases of TB were reported in healthcare workers. The highest burden of TB was in the 24-44 yea rs age group and 55% cases occurred in nursing personnel. The most common form was pulmonary TB and none of the cases reported community exposure to Mycobacterium tuberculosis . Cases clustered by facility showing poor control, the mode of infection could be patient to health professionals and within healthcare personnel.

Provision of occupational health services in industry survey
A mail shot survey was conducted at the request of the national Department of Health to determine the provision and content of health services in different industries. Questionnaires were sent to 1800 ran domly selected industrial concerns in the agriculture, forestry, iron and steel, garages, building and construction sectors. Despite repeated mail shots and a telephone survey of 20% of non-respondents, the response rate was 35%. Preliminary analysis indicated that hazardous substances or processes were reported by 53% of respondents; health & safety committees were present in 43% companies overall and in 83% of companies with over 100 workers; health services were reported by 59% of which only half diagnosed and managed occupational disease. Industries ranked as being very important provision of regional occupational health centres accessible to small enterprises plus central occupational health advisory and information facilities.

Lung cancer attribution to asbestos exposure
Work continued on the analysis of data to establish whether lung cancer cases in gold and other miners could be attributed to asbestos exposure. A comparison of NIOH and Helsinki criteria for asbestos attribution was used.

Immunology and Microbiology Section
Head: Ms T Soogreem
The section was restru ctured around its main functions into an Occupational Allergy Unit, an Occupational Microbiology Unit and a Bioaerosol Monitoring Unit. All three units were involved in specific and collaborative NIOH surveys to assess risks and advise on appropriate control measures in different industries. The section was responsible for the organisation of the annual NIOH Webster Seminar on occupational allergy.

Within the section, the major development was the establishment of a P3 laboratory to conduct envi ronmental measurements of tubercle bacilli. The microbiology services expanded to include testing for coliforms and total plate counts.

A major focus within the allergy unit was on work-related asthma within two projects: investigation of soy bean processing with the development of test allergens from different components of the bean to compare with standard international allergens, and investigation of endotoxin exposure in dental workers. The most commonly tested occupational allergens were bakery and latex allergens and approximately 50% of patients tested with the rubber series of allergens were positive.

A total of 445 tests (patch tests, skin prick tests, legionella and other microbiological tests) and 145 questionnaire interviews were conducted in 2004 and a further 24 patients had allergy tests plus 17 microbiological tests were conducted in 2005. A visit to Limpopo province was organised in collaboration with other sections.

Research projects in Immunology and Microbiology were:

The pro-inflammatory effects of platinum in human neutrophils in vitro
The study was completed and results demonstrated that platinum (Pt), in the form of chlorinated salts, interacts prooxidatively with hum an neutrophils, an activity which may contribute to Pt-mediated airways diseases in occupationally exposed individuals, especially those who smoke.

Sensitisation to maize in workers in the maize milling industry
Although the study had the limitations of a small dataset and differing service history and locations, employees who were shown to be atopic at employment were shown to be at no more risk of subsequent sensitisation to maize allergens than non-atopic employees. Sensitisation to maize allergens was not associated with symptoms and signs of respiratory disease but an apparent loss in employees' lung function, was a possible concern which requires further investigation.

Occupational allergy in workers exposed to soybeans
Since soybeans are one of the richest and cheapest sources of protein and vegetable oil and are cultivated and used on a large scale in South Africa, this prospective cohort study of allergic disease in exposed workers was undertaken at a newly commissioned soybean processing plant in North West Province, South Africa. The results showed a substantial increase in the positive te sts of sensitisation to soybean using a soybean reagent prepared from factory soybean material. Overexposure to soybean dust was likely in the bean offloading area which required improved dust control measures.

Sensitisation to soybean and dust exposure measurement
This study commenced in order to develop effective prevention strategies and methods for measuring soybean in air and for the monitoring of exposed workers.

OCCUPATIONAL HYGIENE AND ANALYTICAL SERVICES
Head: Prof M Ross
This division comprises three sections: Occupational Hygiene; Analytical Services; and Toxicology and Biochemistry.

Occupational Hygiene Section
Contract consultant: Mr R Fe rrie
The section continued to offer technical services, undertook applied research, provided a specialised hygiene service, delivered teaching and training, collaborated with local and international health professionals, and applied occupational hygiene principles to promote the control and prevention of work-related discomfort, injuries, illness and diseases. The major function is workplace health hazard evaluation and control. Emphasis was placed on assistance to government institutions and pro vincial structures. As many of these bodies are not yet suitably resourced to undertake occupational hygiene work, assistance in setting up occupational health and safety programmes was offered to the provinces and visits were co-ordinated with the epidemiology section around health risks for healthcare workers. In addition, the section provides support for health and safety at the NIOH.

The Occupational Hygiene Section has been involved in various technical committees and standard generating gro ups representing the NIOH and the national Department of Health. One member of staff represents southern Africa on the Board of the International Occupational Hygiene Association.

Exposure to noise, asbestos fibres and quartz-containing dust; and poor indoor air quality are still the major occupational health issues. The NIOH continues to be the national reference centre for such work. The section has carried out specialised testing for asbestos fibres and crystalline silica using X-ray

diffraction (XRD) for many years. A new XRD instrument was purchased late in 2003 and commissioned in 2004. It is now planned to use this more sensitive instrument to carry out workplace air monitoring of crystalline silica analyses "direct-on-filter".

The section contributed to research by participating in, and supporting, a number of research projects, both within the NIOH and externally:

- The main research focus in the year was on ethylene oxide, environmental asbestos concentrations, occupatio nal exposure to soybean and isocyanate exposure in automotive spray shops.
- A study of a new initiative in risk control methodology, "Control banding" has been developed by Mr K Renton following his participation at the WHO and International Program on Chemical Safety meeting in Utrecht, Netherlands, 2004. The pilot project will be presented at the International Occupational Hygiene Association's 6th International Scientific Conference, to be held in South Africa in September 2005.

Analytical Services

Head: Ms I Naik

The co re function of the section is to render specialised analytical services in environmental and biological monitoring to support the practice of occupational and environmental health to the industries and public sector. During 2004, the section also supported research projects of national importance, to academic institutes, continued the quality assurance scheme for blood lead and cadmium for laboratories countrywide, and quality control samples for ethylene oxide in charcoal tubes were sent from O SHA, USA for proficiency testing for which a 100% recovery was obtained. Eight diploma students from Tecknikon Witwatersrand and Vaal Technikon received in-service training.

A number of new methods were developed and introduced as routine tests, to meet the continuous challenge to increase analytical capacity. These included methods to estimate cobalt levels in blood and arsenic in filter and water samples. In the Organic Chemistry unit, new methods developed were to measure hexane, dichlorometha ne, perchloro-ethylene, aniline, a combination estimation of trichloroacetic acid and trichloroethanol, furoic acid and methyl hippuric acid in urine samples.

Routine diagnostic and research project tests included analysis on blood, urine, tissues, bulk, filters, water, soil and on charcoal absorption tubes. Assays requested on toxic metals were mainly for lead, cadmium, mercury, manganese, copper, nickel, chromium, aluminium, vanadium, cobalt, molybdenum, antimony, thallium, arsenic and tungsten in biological and air samples. Organic assays included trichloroethylenetrichloroacetic , acid, mandelic acid, toluene, styrene, phenol, O-cresol, MEK, MIBK, methyl hippuric acid, hexane, cholinesterase, xylene and ethylene oxide in biological and/or air samples.

A total of 7290 samples was analysed during 2004 with total units of 340 250 and a further 968 samples with 39 920 units were analysed to end March 2005.

Two important external collaborative research projects were conducted by the section:

Birth to Twenty

This was a longitudinal population-based study of reproductive and psychosocial maturation in urban South African youth aged 10 to 20 years. In a sub study on the relationship between elevated blood lead levels and onset of puberty all the environmental and biological samples were analysed by the Analytical Services for the Medical Research Council.

The health status and risk factors associated with adverse health outcomes among the Durban South community

The samples for this study were analysed by the Analytical Services as a collaborative project with the Department of Community Health, Nelson Mandel a School of Medicine, KwaZulu-Natal.

Toxicology and Biochemistry Section

Head: Dr M Gulumian

The section focuses on research, application and development of new methods, and teaching and training. Research in biomarkers has continued with the addition of a new international collaboration to investigate the possible biomarkers of silicosis.

Established methods were used in the assessment of the toxicology and genotoxicity of medicinal plants investigated at the University of Pretoria. In addition, the levels of DNA damage were investigated in scleroderma patients using the Comet assay.

Training included in-service training for students from different technikons, honours students from the Department of Haematology & Molecular Medicine,

University of the Witwatersrand, training for two students on specific WHO-funded projects entitled "Are there sufficient effective programmes in place for the prevention and eradication of silicosis in the pottery industry in South Africa?", and "Glue sniffing in street children". Technikon students produced a total of 11 technical reports under supervision.

Research projects conducted by staff in Toxicology and Biochemistry Research were:

Mineral dusts and fibres
Investigations on the increased predisposition to Mycobacterium tuberculosis infection following exposure to silica were completed, and a thesis submitted. Investigations on the surface activity of particles collected from a number of gold mines in South Africa continued. The WHO-funded project investigating programmes in place to eradicate silicosis in the pottery industry was completed and a final report submitted to WHO. A new project, funded by the Mine Health and Safety Council, commenced to investigate the surface properties of silica dust collected from South African gold mines.

Pesticides
Investigations commenced on biological monitoring of endosulfan and chlorpyrifos in blood and urine.

Toxic metal ions
Work on the speciation of manganese in biological fluids continued in collaboration with the Department of Chemistry, University of the Witwatersrand.

Solvents and glue sniffing
Research resulted in a very successful workshop to present the outcomes.

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