Capacity development programme for the use of the ILO International Classification of Radiographs of Pneumoconioses in southern Africa: a case study from the SATBHSS and TIMS projects

N Khoza [1,2], C Chamdimba [1], P Rathebe [2], MD Masekameni [3,4], O Rikhotso [5], T Mbonane [2], M Lekganyane [6], C Sandy [1], Y Moyo [8], Q Said-Hartley [9], VS Sichizya [10], L Chikwava [11], E Tulisha [12], M Urasa [12], N Mulima [12], EM De Capitani [13], E Algranti [14], K Ngosa [15], S Adams [16], M Mafukata [3], D Moyo [4,11,17,18]

1 Human Capital and Institutional Development, African Union Development Agency-New Partnership for Africa's Development (AUDA-NEPAD), Johannesburg, South Africa
2 Department of Environmental Health, University of Johannesburg, Johannesburg, South Africa
3 Developmental Studies, University of South Africa, Pretoria, South Africa
4 School of Public Health, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa
5 Department of Environmental Health, Tshwane University of Technology, Tshwane, South Africa
6 Statistical Sciences, Sefako Makgatho Health Sciences University, Ga-Rankuwa, South Africa
7 Planning, Monitoring and Evaluation, The Minister in the Presidency, South Africa
8 National TB and Leprosy Elimination Programme, Ministry of Health, Lilongwe, Malawi
9 Radiation Medicine, University of Cape Town, Cape Town, South Africa
10 Radiology, University Teaching Hospital – Adult, Lusaka, Zambia
11 Baines Occupational Health Services, Harare, Zimbabwe
12 East, Central and Southern Africa Health Community (ECSA-HC), Arusha, Tanzania
13 School of Medicine, State University of Campinas (UNICAMP), São Paulo, Brazil
14 FUNDACENTRO, São Paulo, Brazil
15 Occupational Health and Safety Institute (OHSI), Kitwe, Zambia
16 Centre for Environmental and Occupational Health Research, University of Cape Town, Cape Town, South Africa
17 Department of Community Medicine, National University of Science and Technology, Bulawayo, Zimbabwe
18 College of Health Sciences, University of KwaZulu-Natal, Durban, South Africa

N Khoza, MD Masekameni, N Mulima, and O Rikhotso are members of SAIOH
D Moyo and S Adams are a members of SASOM

ABSTRACT

Background: The International Labour Organiza-tion (ILO) International Classification of Radiographs of Pneumoconioses (ICRP) is a method for describing and systematically recording radiographic abnormalities in the chest caused by the inhalation of dusts. The objective of this classification system is to codify the radiographic signs of the pneumoconioses in a simple, reproducible manner. The Southern Africa Tuberculosis and Health Systems Support (SATBHSS) project developed a capacity-building training programme for doctors to improve their knowledge and practical skills regarding the use of the ILO ICRP at an A-reader level.

Objective: The aim of this case study was to describe the delivery of the ILO ICRP training programme and the performances of the course participants in terms of the written pre- and post-training assessments, and the practical examination.

Methods: Eleven cohorts from seven countries participated in a nine-week A-reader training programme in the use of the ILO ICPR. Pre- and post-training assessments and a practical assessment were completed and scored. The differences in pre- and post-training assessment scores were assessed using the student's t test.

Results: One hundred and fifty-six medical practitioners underwent the training. All participants from nine cohorts in which both pre-and post-training was conducted failed the written pre-training assessment. Two participants failed the written post-training assessment and one failed the practical test. There was a notable improvement in all cohorts; the mean improvement in scores ranged from 43% to 70%. The t-test analysis showed a statistically significant improvement from the mean pre-training (25.76 ± 8.76) to post-training scores (87.90 ± 5.50) ($p < 0.01$).

Conclusion: The SATBHSS and TB in the Mining Sector in Southern Africa (TIMS) projects have contributed positively to capacity building in southern Africa. The training programme increased clinicians' confidence and ability to recognise the pneumoconioses, and improved their understanding of the ILO ICRP system. There is, however, a need to provide funding for sustainability of programmes aimed at diagnosing pneumoconioses.

Correspondence
Mr Norman Khoza
e-mail: normankhoza75@gmail.com

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INTRODUCTION

The pneumoconioses are a group of diseases resulting from the deposition of mineral dust in the lungs, which causes fibrotic lung tissue reactions.[1-3] The diagnosis is usually made on chest imaging through recognition of interstitial opacities, which may appear long before impairment of pulmonary function or symptoms manifest. The risk of disease is associated with exposure characteristics, such as cumulative dose and peak exposures. The most common types of pneumoconioses are silicosis, coal workers' pneumoconiosis, and asbestosis.

Silicosis is the most common form of pneumoconiosis in southern Africa. A recent analysis from the Global Burden of Disease study showed that the 1990–2017 age-standardised incidence rate (ASIR) of pneumoconioses increased in the southern sub-Saharan African region over the 27-year period, mainly due to an increase in silicosis incidence.[4] Several cross-sectional studies in southern Africa and South America have documented high prevalences of silicosis, ranging from 9 to 51%.[5-11] There is strong evidence that silica exposure substantially increases the risk of tuberculosis (TB), even in the absence of silicosis.[12] The association between silicosis and TB often presents difficulties in the diagnosis of silicosis.[13] The high burden of human immunodeficiency virus (HIV) infection in southern Africa reinforces the need for improving public health interventions in this area.[11,14] Human immunodeficiency virus and silicosis have a multiplicative risk for TB infection and have the potential of fuelling a TB epidemic in southern Africa.

The process of improving the interpretation and recording of pneumoconiosis radiographs evolved progressively from 1930 to the 1980 International Labour Organization (ILO) Classification System and its subsequent updating.[15] The classification system has been used to systematically describe radiographic abnormalities that occur in any type of pneumoconiosis. It is designed for classifying only the appearances seen on postero-anterior chest radiographs and has undergone eight revisions. The tool is available online but requires users to undergo training to understand the theoretical and practical concepts. Although readily available, its use remains limited in southern Africa due to inadequate training in both occupational respiratory disease recognition and diagnosis. The small numbers of trained occupational physician specialists and radiologists also limit its use. The superimposed high TB and HIV infection rates add complexity to the interpretation of radiological changes.

Globally, occupational health services are poorly developed due to inadequate legal frameworks, human capital deficits, and poor infrastructure for the prevention, diagnosis, and management of occupational diseases.[16,17] This situation is worse in southern Africa where the burdens of both TB and pneumoconioses are concentrated. A case series described by Maboso et al. (2023) revealed challenges in the health systems of southern African countries in diagnosing pneumoconiosis in the context of high TB burdens.[13] These challenges sometimes lead to under- or over-treatment of silicosis and/or TB. A missed diagnosis of silicosis and/or TB negatively affects workers' eligibility for, and access to, compensation and appropriate treatment.

To address these challenges, the African Union Development Agency-New Partnership for African Development (AUDA-NEPAD) conceptualised and developed a customised A-reader training programme based on the ILO International Classification of Radiographs of Pneumoconioses (ILO ICRP) to address the unique needs of southern Africa nations in the context of high HIV and tuberculosis burdens. The A-reader training programme was tailored for the region; assessments are based on the ILO ICRP syllabus. A-readers are certified as being trained and accredited to interpret chest X-rays (CXRs) for the presence of pneumoconiosis. A-reader training can be offered by anyone who has been trained by a certified B-reader, viz. someone who has an even higher level of proficiency and expertise in reading CXRs. B-reader experts are physicians who have successfully completed an ICRP course offered by the National Institute of Occupational Safety and Health (NIOSH).[18] All the selected trainers were subject-matter experts from academic institutions; two were B-reader certified experts.

The aim of this case study was to describe the delivery of the ILO ICRP training programme and the performances of the course participants in terms of the written pre- and post-training assessments, and the practical examination. This paper describes the development and delivery of the capacity-building training; the knowledge and practical skills gained by the participants; and the lessons learnt through the related challenges and opportunities.

METHODS

In 2018, the AUDA-NEPAD extended an invitation to occupational medicine specialists and radiologists (from the University of Cape Town and the University of the Witwatersrand in South Africa, the University of Zambia; the University of São Paulo in Brazil, the Occupational Health and Safety Institute in Zambia, and others) to undertake A-reader ILO ICRP training at the Centre of Excellence at the Occupational Health and Safety Institute (OHSI) in Kitwe, Zambia. This inaugural training proved successful, garnering enthusiasm for further training and formalisation of the programme and training material. No formal assessment of the participants was conducted during at the three-day inaugural training.

The AUDA-NEPAD subsequently submitted training invitations and letters to the permanent secretaries of the ministries of health of Lesotho, Malawi, Mozambique, and Zambia – the SATBHSS project countries – requesting nominations of medical practitioners and radiologists working in occupational health centres and district hospitals who would benefit from the A-reader ILO ICRP training. The main purpose of the training was to improve the knowledge and practical skills of the participants in the ILO ICRP, in order to strengthen capacity in the diagnosis and surveillance of occupational lung disease in the southern African region.

Subsequently, participants from additional southern African countries were added under the Tuberculosis in the Mining Sector in Southern Africa (TIMS) project, viz. Angola, Botswana, the Democratic Republic of the Congo, Eswatini, Namibia, Tanzania, South Africa, Madagascar, and Zimbabwe. A total of 156 participants, divided into 11 cohorts, participated in the training.

Eight regional training facilitators were selected and recruited, based on their qualifications and experience in the use of the ILO ICRP following the AUDA-NEPAD procurement procedures.[19] They signed contracts with the AUDA-NEPAD to support the curriculum's implementation for two years (2022 and 2023). The facilitators included occupational health specialists, radiologists, health practitioners, and B-reader experts. To improve learning and stimulate discussion during the training of Portuguese-speaking trainees, two Portuguese-speaking B-readers with experience in teaching ILO Classification courses were added to the facilitator team from September 2022.

The training sessions were delivered to 10 of the cohorts at the regional Centre of Excellence on Occupational Health and Safety (CoE-OHS) in Kitwe, Zambia, hosted by the Occupational Health and Safety Institute (OHSI) in that country.[20,21] The 11th cohort was trained in Lesotho. The CoE-OHS has nine state-of-the-art B-reading medical display monitors and computers pre-loaded with the NIOSH

reading materials. The CoE-OHS is implementing a comprehensive occupational health service in Zambia, which made it a good fit for the ILO training, catering for both theoretical and practical format requirements.

The first five days of training comprised didactic lectures in the mornings and practical ILO chest radiograph training sessions in the afternoons. Participants were given a multiple-choice question test to assess their theoretical knowledge prior to the training (baseline knowledge). They were then taught the ILO-ICRP in addition to principles of occupational health and basic chest radiology in preparation for the practical sessions. Lectures focused on the radiographic presentations of TB and HIV-related lung disease, given the high TB-HIV burden in southern Africa. This was followed by interactive sessions, using the B-reader software installed on each of the diagnostic reading systems. Participants were given selected cases to read while applying the ILO principles and practising completion of the NIOSH reading sheet. They underwent a formal assessment on Day 5 of the first week in addition to completing a post-training assessment. The formal assessment consisted of 10 CXRs selected by facilitators from the available NIOSH resources at the CoE, where participants were given 90 minutes to 1) assess the radiographic quality and presence of small and large opacities with the corresponding grading of size and profusion, and 2) assess the CXRs for pleural and other abnormalities. The assessments were scored by facilitators. Both the pre- and post-assessments consisted of 30 multiple-choice questions, which covered the training coursework. These were also marked by the facilitators.

The theory and practical examinations were executed at the end of the first week of face-to-face training. The remaining components of the curriculum were delivered over eight weeks. To be considered successful, candidates were required to obtain at least 50% in the case studies, attend at least 75% of the four Extension for Community Health Outcomes (ECHO) sessions, and attend all of the occupational health clinic visits, which were signed off by the supervising local facility medical practitioner.

For the training conducted in Lesotho, lectures were delivered in the mornings with practical CXR training sessions in the afternoons, using cases from selected occupational health facilities within Lesotho. These were compared to the ILO standard radiographs. The major challenge faced in Lesotho was the inadequate number of X-ray viewing boxes. The group was divided into two; both practical sessions and practical assessments were done in groups. The majority of participants from Lesotho were selected to attend the ILO ICRP training hosted at the CoE in Kitwe.

RESULTS

A summary of the results of the training is shown in Table 1. From September 2021 to the end of March 2023, 156 medical practitioners, divided into 11 cohorts, from seven southern African countries underwent training on the ILO ICRP, supported by the Southern Africa Tuberculosis Health Systems Support (SATBHSS) project. The first two cohorts, 1 and 2, did not undertake the written pre- and post-training assessments. Cohort 1 undertook an assessment at B-reader level; none of the participants attained a pass mark. There were no available records of the marks, since this training was administered by NIOSH trainers.

Prior to undertaking the training, all the participants in Cohorts 3 to 11 lacked the required minimum knowledge and skills required for the ILO ICRP, as shown by the failure to attain 50% in the pre-training assessment. There was notable improvement in the post-training assessment across all cohorts; the mean improvement in scores ranged from 43% to 70%. In the pre-training assessment, Cohort 3 attained the lowest score (mean of 18%), followed by Cohort 6 with a mean score of 20%. The practical assessment for Cohort 6 was scored as pass or fail for each participant; the pass mark was set at ≥ 50%. Cohort 7 attained the highest pre-training assessments mark (mean of 48%).

Cohort 9 had the highest mean post-training assessment score of 94%, while Cohort 6 had the lowest mean score of 77%. The highest mean score in the practical assessment was 73% (Cohort 3), while the lowest score was 59% (Cohort 5). The median score for the practical training was 71%, which was slightly higher than the mean score of 69%. Only one participant failed the practical assessment.

Table 2 shows the t-test analysis of the pre- and post-training assessment scores. There was a statistically significant improvement from the pre-training assessment scores ($p < 0.01$).

Table 1. Assessment scores for medical practitioners trained on the International Labour Organization International Classification of Radiographs of Pneumoconioses (N = 156)

Cohort	Participating countries (no. participants)	n	Assessment score (%)						
			Pre-training		Post-training		Improvement	Practical	
			Mean	Range	Mean	Range	Mean	Mean	Range
1	Lesotho (2), Mozambique (3), Zambia (9), Malawi (3)	17	NR	NR	NR	NR	NR	NR	NR
2	Malawi (12), Zambia (2)	14	NAC	NAC	NAC	NAC	NAC	72	60–89
3	Zambia (9)	9	18	10–24	86	61–96	68	73	60–78
4	Zambia (13)	13	27	15–51	88	77–93	61	71	61–83
5	Malawi (6), Lesotho (4), DRC (1)	11	23	7–77	91	72–100	68	59	52–68
6	Lesotho (21)	21	20	10–36	77	36–95	57	≥ 50	≥ 50
7	Malawi (6), Lesotho (11)	17	48	25–75	91	75–100	43	71	51–72
8	Mozambique (9)	9	24	7–41	93	88–97	69	70	51–85
9	Namibia (5), Swaziland (2), Zimbabwe (3), Malawi (2), Tanzania (4)	16	24	13–69	94	87–100	70	63	43–75
10	Botswana (4), Tanzania (4), Zimbabwe (4), South Africa (2)	14	25	13–44	89	30–98	64	71	61–81
11	Angola (5), DRC (4), Madagascar (4), Mozambique (2)	15	23	8–67	82	53–95	59	72	53–84

DRC: Democratic Republic of the Congo, NR: not recorded in the training records, NAC: no assessments conducted

Figure 1 shows that the median score for the post-training assessment (88%) was much higher than that for the pre-training assessment (26%) for the nine cohorts.

The course facilitators reported good aspects of the training but also noted challenges that needed to be addressed to improve the training programme. The training facilities met international standards for the delivery of the training course and were adequate for a maximum of 18 participants. However, the slide projector screen was noted to have poor image resolution and needed replacement. The facilitators recommended that work experience and previous training in occupational medicine should be a prerequisite for candidates to attend the training course as the ILO Classification of Radiographs is highly specialised. This concern applied to all the participants as they all failed to demonstrate minimum knowledge on the use of the ILO ICRP during the pre-training assessment.

DISCUSSION

This case study shows that knowledge and competence in the use of the ILO ICRP can be improved through a training programme. There was notable improvement in both the theoretical and practical assessments across the nine cohorts that underwent pre- and post-training assessments. Several researchers have noted the importance of capacity building on the ILO ICRP for medical practitioners.[22-24] The improvement was similar to that reported by Ngatu et al. (2010) who reported post-training improvements in physicians' skills on the use of the ILO ICRP.[22] They showed that, for the reading/identification of small opacities, *"there was an increase in the proportion of physicians with good specificity, from 42% to 60%"*. Tamura et al. (2022) emphasised the importance of developing and improving training methods and materials for physicians with limited experience in reading CXRs.[23] Halldin et al. (2017) noted that, due to A-readers' lack of skills in the use of the ILO ICRP, there was little agreement between the A- and B-readers (most of whom were radiologists) with respect to the quality of CXRs, the presence of pneumoconiosis, small opacity profusion, and identification of pleural disease.[24] This emphasises the need for ongoing capacity building.

Table 2. Difference between pre- and post-training assessment results (N = 9)*

Assessment	Mean (%)	SD	95% CI	p value
Pre-training	25.76	8.76	19.03–32.49	< 0.01
Post-training	87.90	5.50	83.67–92.13	

CI: confidence interval, SD: standard deviation
*Cohorts with both pre- and post-training assessment scores

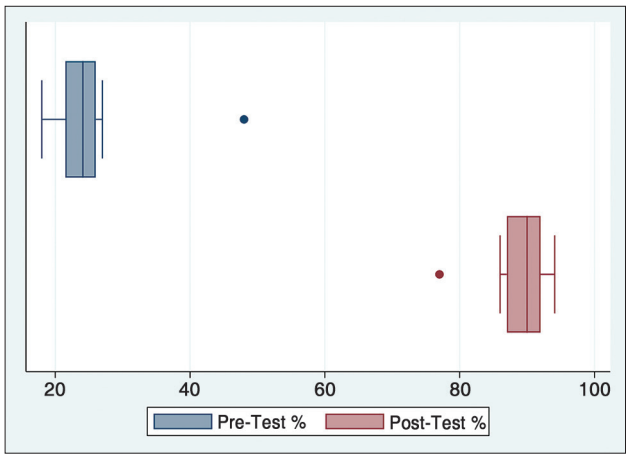

Figure 1. Median scores for pre- and post-training assessments

Taking into account the lessons learnt in the inaugural training conducted in 2018, where all participants were unsuccessful in attaining B-reader status, the SATBHSS project developed and implemented a stepwise A-reader training and mentorship programme on the ILO ICRP curriculum. The approach taken by SATBHSS is similar to that of the University of Fukkui in Japan in its development of the Asian Intensive Reader of Pneumoconiosis (AIR Pneumo) certification programme.[25] Similar to the AIR Pneumo certification programme, the SATBHSS A-reader training consists of didactic lectures, case presentations, and practical sessions developed by an expert committee of occupational physicians and radiologists. In contrast, the AIR Pneumo certification programme offers a validated proficiency examination after the training programme. However, the SATBHSS training is more intensive than the two-day Air Pneumo programme, as it comprises five-day face-to-face lectures, four ECHO sessions, occupational health clinic visits, and case presentations by candidates over a nine-week period. Almaleh et al. (2019) emphasise the importance of implementing a framework to bridge the gap between acquired curricula and required market skills, using the Align My Curriculum (AMC) framework.[26] The development process of the SATBHSS ILO ICRP curriculum was similar to that of the AMC framework.

During the SATBHSS project implementation, it was found to be necessary to develop and implement a regional ILO ICRP curriculum to harmonise, standardise, and provide a systematic approach to assist and support both participants and facilitators.[27] The curriculum outlines a stepwise approach for a nine-week training programme. It includes the training content, criteria for selection of participants and facilitators, duration of training, and assessment methods. The ILO-ICRP regional curriculum is structured in a stepwise format, comprising a one-week face-to-face training and assessment component, four virtual mentorship programmes, the reading and interpretation of 20 occupational lung disease (OLD) cases using the ILO ICRP criteria, and two one-day visits to occupational health service centres. A once-off competence certification system is adopted in the curriculum; re-certification is not required once someone has been assessed as competent. The competency certification assessment comprises the following elements: 40 single best answer questions, practical examination of 10 OLD cases and 20 OLDs case studies.

CONCLUSION

The SATBHSS and TIMS projects have contributed positively to capacity building of occupational health and safety of medical practitioners, radiologists, occupational hygienists, OHS inspectors, and law enforcement officers in southern Africa. This has increased confidence among trained clinicians in their abilities to use the ILO ICRP system and to recognise pneumoconioses. Continuous medical training on the ILO ICRP and the necessity for resources, such as the ILO standard films and online access to the NIOSH and Centers for Disease Control (CDC) websites, were emphasised. There is a need for funding for the sustainability of these programmes that are aimed at improving clinicians' recognition of pneumoconioses. Requirements include ongoing support and mentorship to participants as they apply the knowledge gained from the ILO ICRP, and the development of a community of practice and learning to raise the standard of occupational health surveillance for pneumoconioses in Africa. The regional CoE-OHS has successfully adopted the ILO ICRP and established a state-of-the-art B-reading facility with nine B-reader machines that any country can access.

KEY MESSAGES

1. Occupational health professionals without a basic occupational health and A-reader background find it difficult to master the B-reader course.
2. The capacity development of occupational health professionals in Africa is possible with appropriate training.
3. The SATBHSS and TIMS projects have contributed positively to capacity building of occupational health and safety of medical practitioners, radiologists, occupational hygienists, OHS inspectors, and law enforcement officers in southern Africa.

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DECLARATION

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

The project report was prepared in accordance with the Declaration of Helsinki and with permission from the AUDA-NEPAD.

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AUTHOR CONTRIBUTIONS

Conception and design of the study: NK, DM, CC, SA, QS-H, VSS, EA, EMDC, NM

Data acquisition: NK, KN, CC, NM

Data analysis: ML, CS, PR, DM, QS-H, MDM, TM, NK, CC

Interpretation of the data: LC, ET, LC, YM, KN, EMDC, EA, VSS, MM, LC

Drafting of the paper: DM, NK, YM, QS-H, LC, ET, MDM, EMDC, CC, CS, OR, PR

Critical revision of the paper: PR, MDM, NK, CS, CC, DM, ML, TM, OR, MM, EMDC, MU, ET, SC, QS-H

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