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Occupational asthma as identified by the Surveillance of Work-related and Occupational Respiratory Diseases programme in South Africa

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Summary

Background The nationwide Surveillance of Work-related and Occupational Respiratory Diseases in South Africa, SORDSA, was established in 1996 to provide systematic information on occupational respiratory diseases.
Objective SORDSA's objectives are to monitor the nature, extent and distribution of occupational respiratory diseases, and to increase awareness of their diagnosis and prevention. This paper describes the programme and results obtained for occupational asthma in the first 2 years, ending in October 1998.
Methods SORDSA identifies newly diagnosed cases of occupational respiratory disease through voluntary reporting by pulmonologists, occupational medicine doctors and occupational health nurses. Initially, recruitment of the above health care providers was done through the membership infrastructure of their respective professional societies. Booklets with prescribed monthly reporting forms were distributed annually to all reporting members and a core of reporting providers was established through a proactive method of data collection. Information dissemination and reporting feedback takes place through quarterly newsletters and issue-specific brochures on certain hazardous agents.
Results Over the initial 2-year period, 3285 cases of occupational respiratory disease were reported to SORDSA by 203 doctors and 97 occupational health nurses. After pneumoconiosis and associated respiratory conditions, occupational asthma was the second most commonly reported disease with 225 cases (6.9%). The average annual incidence for occupational asthma in South Africa was 13.1 per million employed people, with the highest incidence reported from the Western Cape province (37.6 per million). Latex was the most frequently reported agent for occupational asthma, followed by isocyanates and platinum salts. Low molecular weight agents accounted for 59.6% of the cases of occupational asthma.
Conclusion The results from this initial phase show that despite some limitations, SORDSA has the potential to obtain useful data on the industries, agents and occupations causing occupational asthma in South Africa.

Keywords: work-related respiratory disease, occupational asthma, surveillance, incidence, South Africa

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Introduction

Occupational asthma has been reported as the leading respiratory disease caused by occupational exposure in countries which publish results from wide surveillance programmes [1–3]. A large number of agents cause occupational asthma, and affected workers often leave the workplace where their asthma originated, thus wide surveillance of occupational asthma using medical doctors, hospital discharge records, and other sources is proving to be the best method for the identification of sentinel cases and causative agents, and for the ascertainment of the magnitude of the disease in the population [4,5]. In South Africa, where mining-related diseases such as pneumoconiosis, chronic obstructive pulmonary disease and silica dust-related tuberculosis are still the leading occupational respiratory diseases, the burden of occupational asthma and the agents causing the disease are not known. However, with expanding nonmining industrialization, increasingly more cases of occupational asthma are likely to be diagnosed and the issue is becoming of public health importance in South Africa.

Based on the principles of the SWORD surveillance programme in the United Kingdom [4], the nationwide Surveillance of Work-related and Occupational Respiratory Diseases in South Africa, SORDSA, was initiated in October 1996. The main goals of SORDSA are: to monitor the extent and distribution of work-related respiratory diseases; to identify hazardous industries, occupations and agents for the purpose of prevention; and to create awareness of work-related respiratory diseases, their diagnosis and the causative agents. In this paper we describe the surveillance programme and results obtained from October 1996 to October 1998 with special emphasis on occupational asthma.

Methods

SORDSA was established as a collaborative project between the National Centre for Occupational Health (Department of Health) and the South African Pulmonology Society (SAPS), South African Society for Occupational Medicine (SASOM), South African Society for Occupational Health Nurses (SASOHN) and the Department of Labour. The professional societies provided their membership infrastructure for recruitment of reporting doctors and nurses, as well as their journals for information dissemination. The SORDSA reporting structure took cognisance of the existence of nine provincial administrative regions to develop its reporting structure which consists of: (1) provincial representatives who assist with disease diagnosis, reporting of cases and representing SORDSA at the provincial level; (2) reporting physicians and medical doctors; and (3) reporting occupational health nurses from workplace medical services who report cases diagnosed by medical doctors.

Reporting of new cases to SORDSA is done voluntarily on a monthly basis. Booklets with 12 forms are sent out annually to the reporting doctors and nurses. The reporting forms were based on those used by the surveillance schemes SWORD and SHIELD in the United Kingdom [6, and personal communication, Sherwood Burge 1995]. The information collected by SORDSA is simple and includes the disease, the industry and job in which the exposure occurred and the putative causative agent. A more detailed form for each case of occupational asthma collected further information, including the method of diagnosis and subsequent history of the patient. SORDSA provides minimum guidelines for the diagnosis of diseases. The cases reported were those that the attending physicians decided were respiratory diseases due to workplace exposure.

An active method of data collection includes telephone contacts with reporting members, responding to a variety of queries, and a quarterly newsletter providing feedback to the doctors on reporting patterns and relevant information on occupational respiratory diseases. As part of the disease prevention programme, SORDSA also produces and distributes brochures on hazardous respiratory agents in the workplace (e.g. isocyanates, latex, silica and asbestos).

SORDSA was designed to include only cases from the non-mining sector and ex-miners, since current mine workers are subject to active medical surveillance while in service and are seen by mine medical doctors. Duplication of an existing system was considered unnecessary and would add a large administrative burden to SORDSA.

For comparison of SORDSA's occupational asthma results with results from surveillance programmes in other countries [7], we estimated annual incidences using a derived denominator of 8572 301, which represented South Africa's population employed in all sectors excluding mines and quarries, according to the October 1996 South African census results [8]. To estimate provincial incidences, the corresponding provincial figures for employed South Africans, excluding those employed in mines and quarries in each province [8], were used. The source of this denominator figure was reasonably reliable for those employed in the formal sector.

Results

In total, 3285 cases of occupational respiratory diseases were reported to SORDSA by 203 doctors and 97 occupational health nurses from October 1996 to October 1998. The reporting according to the membership in medical societies indicated that 53% of practitioners

Table 1. Diseases reported to SORDSA during the period 10/1996 to 10/1998

Disease	No. of cases	% of total	% males
Pneumoconiosis	2030	61.8	58
Combination tuberculosis and pneumoconiosis	252	7.7	80
Combination chronic obstructive pulmonary disease and pneumoconiosis	214	6.5	95
Occupational asthma with latency	195	5.9	61
Inhalation accident	146	4.4	94
Tuberculosis, work-related	90	2.7	83
Non-malignant pleural disease	83	2.5	73
Mesothelioma	51	1.6	94
Latex allergy	47	1.4	20
Chronic obstructive pulmonary disease	38	1.2	92
Asthma induced by irritants	30	0.9	77
Irritant reaction	23	0.7	88
Bronchitis	23	0.7	86
Lung cancer	22	0.7	94
Byssinosis	13	0.4	77
Other	13	0.4	92
Rhinitis	12	0.4	55
Allergic alveolitis	3	0.1	100
Total number of cases reported	3285	100	67

registered with the South African Society for Occupational Medicine, SASOM, and 9.7% of members of the South African Society for Occupational Health Nurses, SASOHN, reported during this period. The proportion of members belonging to the South African Pulmonology Society (SAPS) likely to see cases of occupational lung disease is unknown; however, 24% of SAPS members in total have reported to SORDSA during this period. Only 3% of the cases were reported by occupational health nurses. The majority of cases were reported by members of SASOM (83.4%), followed by members of SAPS (12.1%). The reported cases are shown in Table 1.

Occupational asthma with latency was the second highest reported disease, with 195 cases. Pneumoconiosis, on its own and in combination with tuberculosis and chronic obstructive pulmonary disease, was the most frequently reported disease ($n = 2496$). Of the pneumoconiosis cases, 2150 cases (86.1%) were attributed to asbestos only, and 268 cases (10.7%) attributed to silica. The remaining 78 cases (3.1%) were caused by combinations of mineral dusts.

Thirty cases of asthma induced by irritants were reported, which, when added to the cases of occupational asthma with latency, resulted in a total of 225 cases of occupational asthma (6.9%) and an average annual incidence of 13.1 per million employed people. The annual incidence for 1996–1997 was 16.2 per million employed people, and for 1997–1998, 10.0 per million employed people. Inhalation accidents were the third most frequent reported condition, making up 4.4% of the cases. Most of the reported cases were males, except in the case of latex allergy, where only 20% of the cases reported were males.

Because reporting to SORDSA was unevenly distributed across the nine South African provinces, which differ substantially in the availability of general and occupational health care facilities, the average annual incidences for occupational asthma (including irritant-induced asthma) are presented by province in Fig. 1. The Western Cape, KwaZulu Natal and Gauteng provinces have the highest reporting rates and incidences of occupational asthma (37.6, 21.5 and 15.6, respectively), and are also the only provinces with established occupational medicine referral clinics. Practitioners in the Free State and the Northern Cape had not reported any occupational asthma cases to SORDSA during this period.

Of the occupational asthma with latency cases reported to SORDSA, 40.4% were caused by high molecular weight agents, and 59.6% by low molecular weight agents. Latex was the most common high molecular weight agent reported, causing 60.3% of these cases and 24.1% of asthma cases overall. The second most frequent high molecular weight agents were flour and grain: 29.5% of these cases, and 11.8% of asthma cases overall. Animal proteins caused only two cases (1.03%). Of the low molecular weight agents reported, isocyanates were most important, 33.0% of the low molecular weight cases, followed by platinum salts, 20.9% of these cases. Other important low molecular weight agents were glue and resin,

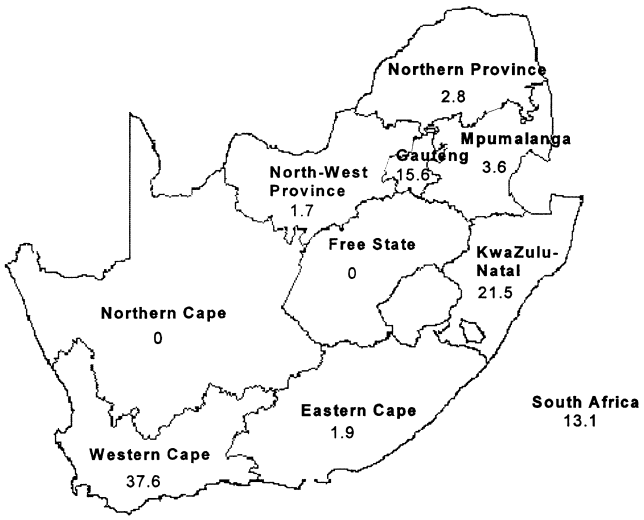

Fig. 1. Map of South Africa showing provinces and average annual incidences of occupational asthma reported to SORDSA. Denominators derived from total employed in each province, excluding those employed in the mining industry, according to the South African October 1996 national census figures [8].

colophony and welding fumes, acrylates and vanadium. Table 2 shows the frequencies of putative causal agents for occupational asthma reported to SORDSA.

A wide variety of causative agents were reported for irritant-induced asthma or reactive airways dysfunction syndrome (RADS). The most frequently reported were welding fumes (five cases), isocyanates (three cases), chlorine (two cases) and ammonia (two cases). Other reported agents for RADS included flour, wood dust, paint, formaldehyde, platinum salts, methyl methacrylate, caustic soda, sulphur dioxide, indomethacin, brick dust and cement.

Table 2. Frequencies of agents causing occupational asthma reported to SORDSA

Agent	Frequency	%
Latex	47	24.1
Isocyanates	38	19.5
Platinum salts	24	12.3
Flour, grain	23	11.8
Other*	18	9.2
Glue and resin	9	4.6
Solder, colophony, welding fumes	7	3.6
Acrylates	6	3.1
Vanadium	5	2.6
Amines	4	2.1
Cotton dust	3	1.5
Paint	3	1.5
Carbon dioxide	2	1.03
Formaldehyde	2	1.03
Animal proteins	2	1.03
Unknown	2	1.03
Total	195	100

*Other = silica, cold air, guar, starch, garlic powder, chlorofluorocarbon, thinners, laundry chemicals, darkroom chemicals, ethylene glycol, organophosphates, carbide, lead oxide, sodium dichromate, trimellitic anhydride, acetone, plastic and cement.

The industry, job and agents reported to SORDSA are summarized in Table 3 for both occupational asthma with latency and asthma induced by irritants. Health care, 48 cases, was the most frequently reported industry, followed by platinum refining, the food industry and the motor industry. A fairly large proportion of the cases (13.3%) were reported from industries that were unusual, or did not fit into any general category. These are designated as 'other' in Table 3. Only two cases were reported in mine workers. Since the exposure was to vanadium dust, and thus would not have been covered by the routine surveillance of mine workers, these cases were accepted by SORDSA.

Fig. 2 shows the tests used to investigate cases of occupational asthma for high and low molecular weight agents. Where the agent was high molecular weight, specific IgE testing was most frequently used to support the diagnosis (68.2%). Serial peak flow monitoring was used most frequently where low molecular weight agents were concerned (55.0%). Overall, serial peak flow testing was most commonly used (43.0%), followed by specific IgE testing (33.3%). The least used tests were measurements of bronchial hyperresponsiveness using histamine or methacholine, specific inhalation challenge and total IgE measurement. Other tests used included exercise challenge and lung function testing pre- and post-bronchodilator.

Discussion

SORDSA's results suggest that in South Africa, in contrast to many developed countries, mineral dust-related respiratory diseases, such as pneumoconiosis, pulmonary tuberculosis and chronic obstructive pulmonary disease, are still the most frequently occurring occupational lung diseases, but in concordance, the results also indicate that the occurrence of occupational asthma is potentially of great importance in the non-mining industry.

In the first 2 years the proportions of SASOM and SASOHN members reporting to SORDSA was fairly low. This was probably due to the SORDSA programme not being widely known throughout South Africa at this stage. Subsequently, through ongoing recruitment procedures, the numbers of reporting members have increased. In this period, only 3% of the cases were reported by occupational health nurses. Occupational health nurses were only

Table 3. Industry, occupation, agents and frequency of asthma cases reported to SORDSA from 10/1996 to 10/1998

Industry	Occupations	Agents	*n*
Health Care	Nurse, theatre/ICU worker, laboratory worker, pharmacy assistant, general assistant, family planning advisor, caterer, painter, radiographer	Latex, amines, paint, ethylene glycol, ammonia, darkroom chemicals	48
Platinum refining and mining	Boilermaker, chemical engineer, electrician, laboratory worker, process controller, security guard, fitter, operator, environmental officer, miner	Platinum salts, chlorine gas, chemical fumes	25
Food processing, bakery, flour mill, and animal feeds manufacturer	Baker, flour bagger, labourer, operator, flour packer, flour delivery, supervisor, food pelleter	Flour, grain, rye, maize, wheat, oats	25
Motor industry, panel beating and spray painting	Welder, panel beater, spray painter, final checker	Isocyanates, carbon dioxide, welding fumes, latex, paint	24
Printing, plastic, foam and acrylics	Liquid polyurethane caster, laboratory worker, blow moulder, quality control, operator, printer, maintenance, mattress filler	Isocyanates, methyl methacrylate, ozone, paint	20
Construction and engineering	Welder, bricklayer, foreman, supervisor, grinder/polisher, final checker, tar mixer	Welding fumes, cement, epoxy resin, paint, sulphur dioxide, silica, isocyanates, sulphuric acid fumes, epoxy resin	15
Leather and shoe manufacture	Shoe maker, bag maker, general assistant	Isocyanates, glue, acetone	7
Welding and foundry	General manager, welder	Bronze, copper, aluminium, zinc, brass, welding fumes	5
Railways	Plans processor, welder	Ammonia, vanadium, welding fumes	5
Chemical and pharmaceutical	Laboratory worker, technical assistant, tablet polisher	Chlorine, colophony, carbide, indomethacin	5
Textile	Machinist, artisan	Cotton dust, amines	5
Agriculture	Cleaner, fumigator	Formaldehyde, chicken droppings, chlorine, ammonia, caustic soda	4
Refrigeration	Labourer, fridge and air conditioner servicer	Cold air, chlorofluorocarbons	3
Vanadium mine	Operator, miner	Vanadium dust	2
Diamond mine	Security guard	Latex	1
Latex glove factory	Packer	Latex	1
Other	Cleaner, operator, laboratory worker, nurse, painter, sprayer, supervisor, chemical worker, technician, technical assistant, welder, packer, cleaner, foreman, tyre, repair, chemist, lab. technologist	Ammonia, methyl methacrylate, animal proteins, glue resin, organophosphates, guar, vanadium dust, colophony, wheat dust, shampoo, perfume, chlorine, laundry chemicals, oak wood dust, garlic powder, milk powder, trimellitic anhydride, amines, formaldehyde	30

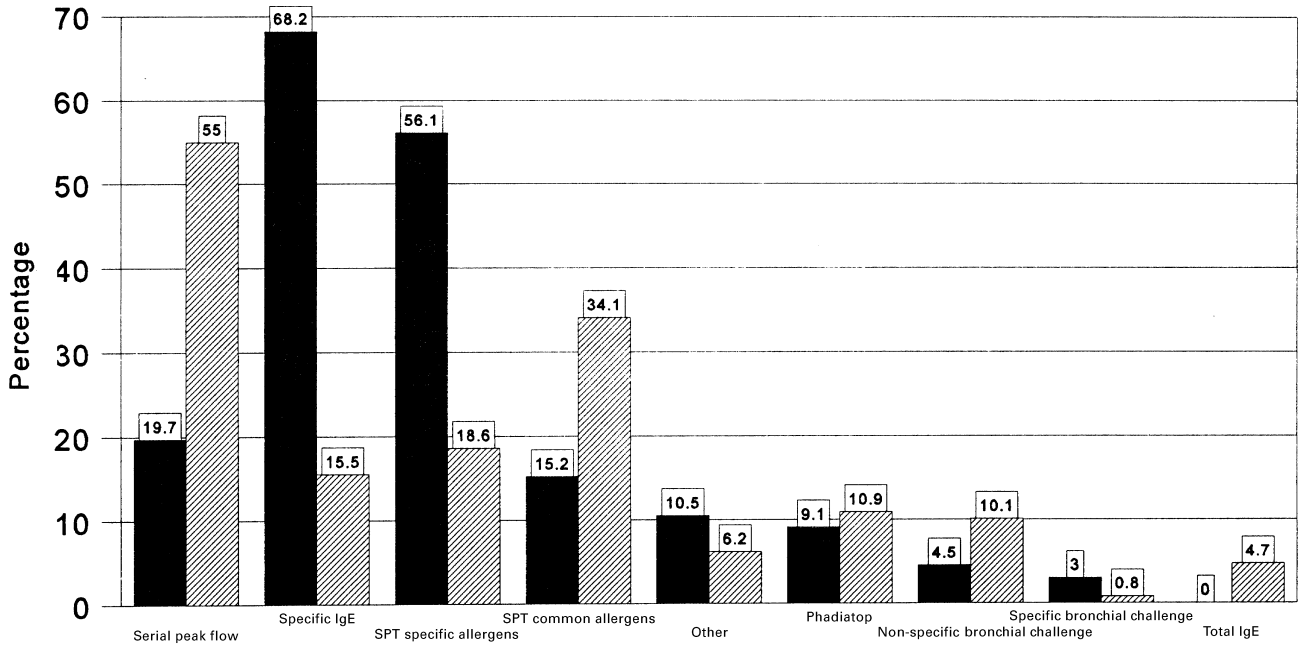

Fig. 2. Tests used to investigate occupational asthma cases reported to SORDSA. ■ = high molecular weight agents; □ = low molecular weight agents; SPT = skin prick test.

included in SORDSA's reporting structure from January 1998, 15 months after the physicians had started reporting.

Occupational asthma was the second most frequently reported disease. The average annual incidence of occupational asthma estimated from the SORDSA data for 1997 and 1998 was 13.1 per million workers. The annual incidence for the Western Cape province of 37.6 per million workers is greater than SENSOR's reported occupational asthma incidence for 1989–1992 of 27 cases per year per million [5], and equivalent to the SWORD incidence of 37 cases per year per million from 1989 to 1991 [7]. The differences by province imply great under-diagnosis and under-reporting of occupational asthma in many of the provinces, all of which have industrial and agricultural activities known to be associated with occupational asthma.

A large proportion of the occupational asthma reported was due to low molecular weight agents, of which isocyanates were the most important followed by platinum salts, glue and resin, solder, colophony and welding fumes, and acrylates. Of the high molecular weight agents, latex and flour and grain were most important, whereas few cases due to animal protein were reported. On the whole, the types of agents reported were similar to those reported by SWORD and SENSOR surveillance schemes, but the frequency with which agents were reported was different from those published from other surveillance schemes.

The most important agents reported to SWORD were isocyanates (22%), animal allergens (9.8%), flour and grain (7.1%), solder (5.6%), resins and glue (5.2%), wood dust (4.1%), aldehydes (3.2%) and welding fumes (2.3%) [7]. In Finland the most important sensitizers appear to be animal allergens (45.4%), flour and grain (24.5%), plant proteins (4.7%), welding fumes (4.5%) and isocyanates (2.9%) [7]. In a Quebec registry, the most important agents were isocyanates (25.2%), animal allergens (14.5%), flour and grain (14.0%) and wood dust (12.6%) [7]. The most common inducers reported to the SENSOR registry were isocyanates (19.4%), followed by oil mist (9.9%), resins and glue (6.5%), and aldehydes (5.2%) [7].

These differences in reporting patterns may reflect differences in industrial processes in different countries. For example, the large percentage of platinum salt cases reported to SORDSA is due to the large platinum refining industry in South Africa. Case-finding activities in specific settings will also affect the relative proportion of cause-specific cases. An active case-finding survey of latex allergy in a major referral hospital in the Western Cape accounted for the prominent position of latex in the SORDSA data. The fact that very few cases due to animal allergens, oil mist or wood dust were reported in South Africa, suggests a relative lack of awareness about the agents, leading to under-diagnosis and under-reporting. Most of the asthma cases (87%, 195 cases) were reported as occupational asthma with latency, and thus ascribed to immunological mechanisms, and 13% of the asthma cases were reported as irritant-induced asthma (RADS). The SHIELD surveillance scheme reported 56% allergic

asthma, 18% ascribed to irritation, 2% pharmacological, and 24% unknown [9].

There was, however, considerable overlap in the causative agents reported to SORDSA for occupational asthma with latency and RADS. Of the 30 cases reported as RADS, almost 50% were due to known sensitizers such as isocyanates, welding fumes, flour and grain, wood dust, platinum salts, etc. Whether this was a misdiagnosis, or the cases developed asthma after one large inhalation exposure to these agents, needs to be investigated.

Inhalation accidents made up the third most frequently reported disease group, and the agents responsible were mainly sulphur dioxide, chlorine and isocyanates. The SWORD surveillance scheme reported inhalation accidents as its fifth most common cause of illness, with 903 cases reported from 1990 to 1994. The most common agents reported to SWORD were chlorine and oxides of nitrogen [10]. There were three times as many men as women affected in SWORD's results [10], but in SORDSA's results the occurrence is 23 times higher in males.

Methods used to investigate cases of occupational asthma for SORDSA were similar to those reported by the SHIELD scheme, with serial peak flow monitoring being the most commonly used test, followed by specific IgE testing [9]. SORDSA's results show a wider variety of tests than SHIELD's results, and include other tests of sensitivity such as skin prick testing.

Interpretation of SORDSA's results has limitations. Incomplete and uneven reporting coverage by provinces is the main limitation. To a large extent, reporting to SORDSA reflects the availability of health care services in the nine provinces of South Africa. In total 94.4% of the cases were reported from the three provinces which have the best health care facilities: Gauteng (74.5%), Western Cape (12.6%) and KwaZulu Natal (7.3%). The numbers of specialists, general practitioners and nurses is highest in Gauteng (50.7 per 10 000 population), followed by Western Cape (47.2) and KwaZulu-Natal (37.2). The least well-equipped province is Mpumalanga with 17.2 health personnel per 10 000 population [11]. The poorer provinces have the largest numbers of retired miners with mineral dust-related lung diseases.

In the case of occupational asthma, under-reporting is evident by the provincial incidences shown in Fig. 1. Occupational asthma is a compensatable disease in South Africa, and 325 cases were submitted for compensation for occupational asthma during 1996 and 1997 [12]. One way to ensure more complete ascertainment of diagnosed cases is to link cases submitted for compensation with those reported to SORDSA.

As previously stated, the SORDSA data do not include occupational lung diseases diagnosed in current miners. Most of the approximately 500 thousand current miners employed in South Africa undergo annual screening for lung disease whilst working on the mines. Approximately 2000 current miners are compensated each year for pneumoconiosis only, and reliable figures are available on the incidence of occupationally-related respiratory diseases in current miners. Of the mining-related diseases, only those identified by medical practitioners in ex-miners are reported to SORDSA. Under-reporting of these diseases is likely to be high because most retired miners live in impoverished rural areas of South Africa with poor access to medical services.

To overcome the under-reporting of diseases and to increase information dissemination, occupational health nurses were incorporated into SORDSA's reporting structure. The inclusion of the nurses has increased reporting figures, but also raised the issue of duplication of cases reported to SORDSA. This has been dealt with to an extent in the reporting of the identity number of the patient, although this is voluntary for ethical reasons. Duplicate identity numbers can be identified by SORDSA's database programme. In cases where the identity number is not reported, the patient's initials are used if duplication is suspected. We also individually investigate whether the nurse or a consulting doctor reports the cases. The accuracy of the reporting nurse's interpretation of the physician's diagnosis cannot be ascertained, and should also be borne in mind as a possible limitation of the data.

The diagnosis of occupational diseases, and recognition of an occupational cause may be difficult. Consequently the degree of accuracy of diagnosis is likely to vary both within and between reporting members. For this reason, the precision of the data should not be taken for granted. The distribution of quarterly reports and information brochures may influence subsequent reporting results by increasing awareness of certain exposures or diseases.

It should be realized that in the South African setting, a surveillance system cannot expect to identify even a substantial proportion of all new cases. SORDSA's aims were to identify key industries generating cases, so that intervention could be better targeted. Despite under-reporting, SORDSA has demonstrated that a problem exists by establishing at least minimum figures.

Conclusion

The results from SORDSA's initial 2-year surveillance illustrate that prevention of mineral dust-related lung diseases is still an important public health issue in South Africa, but also important is the prevention of occupational asthma in the non-mining industry. Occupational respiratory disease surveillance in South Africa provides valuable information, and the programme should be expanded to include other occupational diseases. A better measure of

the extent of occupational lung disease would be obtained by merging SORDSA's results with compensation statistics and data from the surveillance of current miners. Identification of hazardous agents, occupations and workplaces is the main strength of the SORDSA programme.

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