Screening and surveillance of workers exposed to mineral dusts

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Preface

Screening and surveillance are two complementary tools used by public health professionals to follow the status of and trends in the health of various populations. These tools enable health professionals to identify problems, assess them and plan appropriate interventions. Both screening and surveillance are of particular significance for occupational health professionals responsible for assessing the health of people at risk for disease as a result of exposure to hazards in the workplace.

Screening and surveillance provide information on the health of working populations and contribute to the collation of national occupational health statistics. Moreover, such information is necessary for the planning and implementation of occupational health and safety programmes directed at the reduction of harmful exposures, improvement in working conditions and prevention of occupational diseases and injuries. As these efforts are international in scope and are carried out under a variety of conditions, they can benefit from a harmonization of definitions, approaches and methodologies.

In response to this need, the World Health Organization (WHO) initiated a project resulting in the present publication. A meeting of an international group of experts (see Annex 1 for a list of participants) was held, where a consensus was reached on the need for and methods of screening and surveillance of workers exposed to mineral dust, and a draft text of the current publication was discussed and revised.

The first part of this publication provides the reader with definitions of screening and surveillance and describes the main elements of such programmes. The second part describes in greater detail practical aspects of the screening and surveillance of working populations exposed to selected mineral dusts. It is hoped that this publication will encourage the implementation of appropriate screening and surveillance programmes in WHO Member States.

Occupational respiratory diseases, particularly those induced by inhaling mineral dust, are prevalent in developing as well as many

developed countries. Although the health impact of the so-called "silent epidemic" of occupational respiratory disease is significant, to know its true magnitude requires an improvement in diagnostic criteria and notification and reporting systems, all components of the screening and surveillance of working populations. In this respect, the present publication, written with the practitioner in mind, provides information that is useful for all health professionals, but particularly for occupational physicians, epidemiologists, occupational nurses, occupational hygienists and others like primary health care workers who are dedicated to protecting and promoting the health of working populations.

It is my great pleasure to acknowledge the work of all the experts who participated in the WHO Meeting on the Screening and Surveillance of Workers Exposed to Mineral Dust. In particular, I would like to thank Dr M. R. Becklake, who chaired the meeting and made valuable contributions to the manuscript, and Dr G. R. Wagner, who drafted the manuscript, served as rapporteur at the meeting and subsequently finalized the text. The contribution of the International Labour Office (ILO) and its representative Dr M. Lesage and the technical and financial support given by the National Institute for Occupational Safety and Health (NIOSH) in the United States are gratefully acknowledged. Special thanks are also offered to Dr F. He, the scientific coordinator of the project.

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CHAPTER 1
Introduction

Diseases caused by exposure to mineral dust persist in both developed and developing countries despite substantial knowledge about the means of their prevention. Disease prevention can be achieved by the application of engineering techniques that limit workers' exposure to mineral dust. Such technologies can also be supplemented by administrative strategies and by the use of personal protective equipment. An optimal distribution of public health resources would emphasize primary prevention through exposure control. Medical screening and surveillance are secondary strategies which are, however, integral parts of a disease prevention programme.

Exposure to mineral dust occurs in a variety of circumstances. Workers subject to exposure may be engaged in mineral extraction, refining and use, as well as in quarrying, tunnelling and construction. The social, political, public health and economic context in which exposure to mineral dust occurs is also diverse. Any programme for screening and surveillance of workers exposed to mineral dust should reflect the physical as well as the general legal and economic environment in which it is established.

This monograph provides information that would be useful for the establishment of an effective health screening or surveillance programme. The screening and surveillance of workers exposed to mineral dust are considered within the framework of generally accepted principles for screening and surveillance programmes. These principles are reviewed, and specific approaches to the screening and surveillance of workers exposed to mineral dust are then discussed.

Chapter 2 distinguishes screening from surveillance and describes the objectives and methods of each. In Chapter 3, important considerations for the design and implementation of screening programmes to identify the toxic effects of workplace exposure to mineral dust are reviewed. Chapter 4 enumerates the specific elements of a screening or surveillance programme. Chapter 5 reviews the diseases that are the

targets of screening and surveillance programmes. Chapter 6 considers the characteristics of existing screening tests. Chapter 7 offers recommendations for the screening and surveillance of workers exposed to respirable crystalline silica, coal mine dust and asbestos dust. Technical guidance that will aid test administration and quality assurance is included in the annexes. A summary of the current practices of a limited number of selected screening and surveillance programmes is also annexed.

CHAPTER 2
Definitions

The terms screening and surveillance are often used interchangeably, with confusing results. Throughout this monograph, screening, described more fully below, denotes the use of medical testing for the presumptive identification of a disease in an individual at a time before medical care would ordinarily be sought, and when an available intervention can favourably affect the health of the individual (Wilson & Jungner, 1968).

Surveillance, on the other hand, involves the periodic collection, analysis and reporting of information relevant to health for the purposes of disease prevention (Halperin & Baker, 1992). In contrast to screening, surveillance is directed towards the improvement of the health of populations and is a component of public health practice. Medical surveillance should be distinguished from hazard surveillance.

Screening

Screening is the administration of a test or series of tests (such as laboratory tests, medical examinations and questionnaires) to individuals in order to detect organ dysfunction or disease at a point when intervention would be beneficial. Positive screening tests may indicate the presence of disease, or the strong likelihood of disease and the need for confirmatory testing. Screening is designed to detect disease before an individual would normally seek medical care; it should ideally detect disease in its "preclinical" stage. The objectives of screening in a particular workplace may vary. The goal of medical screening, however, should ultimately be the secondary prevention of disease, i.e. the identification of disease at a stage when its progression can be reversed, arrested or slowed (Wilson & Jungner, 1968; Matte et al., 1990; Weeks et al., 1991).

Screening in the workplace is primarily intended to benefit the

individual; however, screening may also be used to benefit others in the same or similar workplaces if cases of occupational disease are seen as "sentinel events". In these instances, the recognition of an occupational disease such as silicosis indicates that exposure controls have failed and that further investigation is warranted. Investigation of the workplace and of the health of co-workers can lead to the discovery of previously unrecognized disease, the identification of the source of noxious exposure, and ultimately, the reduction or elimination of hazardous working conditions (Rutstein et al., 1983; Mullan & Murthy, 1991).

Detection of disease through screening reveals deficiencies in environmental controls that might otherwise go unnoticed. Periodic screening of workers should be tied to comprehensive efforts of environmental monitoring and control.

Surveillance

Surveillance is "continued watchfulness over the distribution and trends of [disease] incidence through the systematic collection, consolidation, and evaluation of morbidity and mortality reports and other relevant data", as well as the timely dissemination of data "to all who need to know" (Langmuir, 1963). Over time, the practice of surveillance has progressed from the passive documentation of disease to the active analysis of data in order to generate an appropriate public health response (Halperin & Baker, 1992). The usefulness of passive surveillance systems, such as death certificate counts for specific diseases, is substantially increased when the population at risk for disease is known or estimated and disease or death rates are calculated. This extension of passive monitoring permits a more useful assessment of disease trends over time and can help to focus preventive efforts on those populations where the incidence of disease is greatest.

The major components of surveillance programmes are: (1) the periodic identification and collection of health information; (2) the evaluation and interpretation of the information; and (3) reporting and intervention for the purpose of prevention (Ordin, 1992). Surveillance programmes may be conducted by government agencies, large companies and unions, or occupational medicine clinics.

Surveillance programmes are established to achieve one or more of the following goals:

— tracking trends in disease incidence across industries, over time and between geographical areas;
— defining the magnitude or relative magnitude of a problem;
— identifying new hazards, risk factors or populations subject to risk;

— targeting interventions;
— evaluating efforts of prevention and intervention.

Information generated by screening can be the "raw" data of a surveillance programme if these data are collected over time, analysed periodically and reported to those in a position to advocate or act in support of change, as well as to those exposed. Other than screening, sources of data for surveillance systems include workers' compensation claims, health insurance statistics, government records of worker illness and injury, hospital discharge information, disease registries, national health surveys, death certificates and physician reporting (Ordin, 1992). Effective health surveillance systems are characterized by simplicity, flexibility, acceptability and timeliness. Surveillance systems should be sensitive indicators of the level of disease in the population at risk (Klaucke, 1992).

The utility of medical surveillance is ultimately related to the level of participation in the programme and the adequacy of data collection, analysis, dissemination and intervention. Surveillance programmes are incomplete without the application of their results and conclusions to disease prevention and control. The dissemination of surveillance information so that it is generally available, for instance through computerized national and international databases, is an important step towards achieving prevention and control. Surveillance reports that are exclusively internal to an administrative agency, company or union do not fulfil this goal. Because of the cyclical, repeating process of data collection, analysis and reporting, the value of a surveillance system increases the longer it is in place.

In some countries it is required or customary to perform periodic health examinations of workers for a range of purposes which may include the assessment of overall health and fitness for hazardous work or the detection of occupational disease. Screening may take place as part of these examinations. If the data derived from such periodic health examinations are collected, analysed and reported for purposes of prevention, these efforts constitute medical surveillance. Surveillance programmes for workers exposed to mineral dust are established in a number of countries. Each programme operates with different strategies and methods for reporting, data analysis and information dissemination. Two programmes, the SWORD programme (Surveillance of Work-related and Occupational Respiratory Disease) in the United Kingdom and the SENSOR programme (Sentinel Event Notification System for Occupational Risks) in the USA, have been described (Baker, 1989; Meredith et al., 1991). Elements of other selected programmes are summarized in Annex 2.

CHAPTER 3

Screening for toxic effects of workplace exposure

Screening primarily benefits the individuals who submit to testing. Criteria applicable to the evaluation of medical screening tests performed in community settings (Wilson & Jungner, 1968; Preventive Services Task Force, 1989; Braveman & Tarimo, 1994) and in the workplace (Halperin et al., 1986; Matte et al., 1990; Weeks et al., 1991) have been described in detail. In general, the following conditions should be considered before a screening test is adopted.

The disease:

— causes significant morbidity and mortality;
— can be identified at a pre-symptomatic stage before the individual would ordinarily seek medical care;
— responds to acceptable, available and effective intervention and treatment;
— is prevalent in the population undergoing screening.

Moreover, the test:

— is acceptable to those at risk for disease;
— has adequate sensitivity, specificity and predictive value in the target population;
— is available at a reasonable cost;
— is sufficiently standardized to be performed with consistency, accuracy and reproducibility.

If these conditions are satisfied, the screening test can be adopted. Note that there are a number of qualitative terms in this list. What is considered "reasonable cost" in the workplace may differ from what is considered "reasonable cost" in a community setting (Halperin et al., 1986). "Acceptable" interventions and treatments may also vary according to regional or cultural practice. An "adequate" level of sensitivity and specificity may depend on the severity of the condition and the

benefit achieved through intervention. In general, sensitivity should be given priority over specificity in screening programmes.

In addition to focusing on appropriate diseases and identifying reasonable tests to use in screening, the administrator or institution responsible for establishing a screening programme needs to address other issues, including the availability of suitable personnel to administer screening tests and interpret results and the presence of the appropriate equipment and facilities to perform, interpret and follow-up on tests. The desired frequency of screening examinations should also be determined.

The relationship between the natural evolution, in the absence of intervention, of the disease for which screening is proposed and the duration of previous and current levels of the exposure that causes the disease should influence the timing of screening. Screening should be conducted when there is an opportunity to detect the disease or disease-related conditions. For example, if detectable disease indicators do not occur until at least 10 years after first exposure, intensive screening could be delayed until that time, once baseline examinations have been conducted. Knowledge of exposure levels would also influence the timing of screening, since some diseases progress more quickly with high exposures. In such a case, however, knowledge of high exposures should trigger action to reduce exposure levels. The course of disease progression following the cessation of exposure should also affect decisions about screening (e.g. after a change of job or retirement).

It is also necessary to consider the appropriate dividing point between normal and abnormal test results for the screened population, since often the difference is not clear-cut. This issue is considered more fully below in the discussion of tests of pulmonary function.

It is also important to assess the level of risk, if any, from the testing programme. Naturally, the risks and benefits of the tests that are performed must be considered and weighed in light of the seriousness of the disease being screened for.

Moreover, the perceived value of the programme to workers must be taken into account. Screening programmes that are perceived to have no value or benefit to the worker are likely to be poorly supported by the target population. Numerous examples have been reported of medical information being used to deny employment or dismiss employees without sound justification (Rothstein, 1984). Provisions should be adopted to protect the privacy of workers and to ensure that the screening programme does not result in the inappropriate use of medical data. Likewise, when screening is accompanied by educational programmes and concerted efforts to control harmful exposure, workers

are more likely to trust its intent. Lastly, screening programmes should be undertaken in light of the available resources.

The actions to be taken following abnormal test results should also be defined before the establishment of a screening programme. *Some actions should always be taken*:

- Confirmation of the test result. A screening test is the first level of evaluation; further evaluation may be required to confirm a positive screening test.
- Notification of the workers (in writing) of their test results and their medical significance. Workers should be informed of any legal implications of their test results, recommendations for changes in their work practices or exposure conditions, the predicted risk from continued exposure, the nature of any disclosure of test results to the employer and any sources of additional information about their medical condition. When removal from the work environment is medically recommended, notification of the workers should include personal counselling on options for alternative employment.
- Notification of the employer and workers of the aggregate results with personal information removed.

Additional actions and interventions may vary according to the judgement of the administrator of the screening programme as well as the social, economic, legal and political environment in which the programme is offered. *Additional actions and interventions include the following*:

- Workplace modification (i.e. redesign of the work process or changes in work practice) when a toxic effect is established or strongly suspected.
- Reduction of exposure for affected workers. This may be effected by changes in the work itself or by administrative controls such as job rotation. Occasionally the use of personal protective equipment may be warranted as a temporary measure.
- Worker and employer education.
- Medical treatment and counselling; periodic follow-up evaluations if the employee has disease without clinical manifestations.
- Notification of other workers in similar industries who are at risk for disease.

CHAPTER 4

Elements of screening and surveillance programmes

In addition to the selection and implementation of appropriate medical tests, an occupational medical service engaged in screening or surveillance activities should make provision for the programme components described below.

Qualified occupational health professionals

Programmes should be managed by health professionals with specific knowledge, training and experience in the disciplines of occupational health (toxicology, biostatistics, epidemiology, industrial hygiene and medicine) and who are knowledgeable about the relevant laws, regulations and rules. Moreover, the staff responsible for the medical testing, interpretation and communication of results, the analysis and reporting of data and quality assurance should have the skills and training appropriate for their roles. Training programmes that focus on a programme's specific features are useful for orienting staff and updating their skills. Local laws and regulations may dictate the licensing and certification requirements for programme staff.

Record-keeping

The security and confidentiality of medical records should be maintained. They should therefore be separated from general personnel and employment records. The medical records should include comprehensive information on employee exposure, and should be kept current by means of periodic examinations. Because of the long latency between exposure and onset for most diseases caused by mineral dust, records should be retained for an extended period (perhaps 30 years) beyond the date of last employment. Records may be kept by the employer, government agencies, the worker or employee representatives.