IS THE US COAL MINER CHEST X-RAY SURVEILLANCE PROGRAM SUCCEEDING IN CONTROLLING LUNG DISEASE?

GREGORY R. WAGNER,* M.D. • Emily A. Spieler,† J.D.

*Marshall University School of Medicine, Huntington, WV
†West Virginia University, Charleston, WV, USA

The 1969 Federal Coal Mine Health and Safety Act established a system of periodic chest X-ray examinations for underground coal miners in the United States.[1] The program, as operated by the National Institute for Occupational Safety and Health since 1970, has both surveillance and screening components.

The surveillance component of the program is directed toward observation of the incidence of coal workers' pneumoconiosis in the population of working miners. There is an expectation that the program can document decreasing disease incidence as exposure controls are put in place.

The purpose of medical screening is detection of asymptomatic disease in individuals at a point at which intervention will favorably affect disease outcome. It is a back-up mechanism to reduce impairment when environmental controls are insufficient to prevent disease in individual miners.

This paper explores whether the current surveillance and screening program is functioning adequately to contribute significantly to the reduction or elimination of lung diseases in underground coal miners. Both the surveillance and screening components depend upon the use of tests which can identify lung diseases of importance. They require high levels of participation by miners at greatest risk of disease and acceptance of preventive interventions. Ultimately, the measure of the success of the program is the extent to which the development of pulmonary impairment in coal miners is abated.[2]

PROGRAM STRUCTURE

The 1969 Coal Mine Health and Safety Act was the first legislation to establish a national program for medical surveillance. The X-ray program was continued under the Federal Mine Safety and Health Act of 1977 [MSHAct]. The MSHAct also contained an expanded mandate to utilize medical screening as a preventive strategy. When a determination is made that miners may suffer "material impairment of health or functional capacity" as a result of hazardous exposures, removal from exposure and reassignment must be offered.[3] To date, the periodic X-ray program is the only effort to fulfill the mandate for ongoing screening for dust diseases.

The MSHAct requires that all miners receive chest X-rays on entering the work force and after three years of work. Thereafter, periodic X-rays must be made available to coal miners at no less than five year intervals. The X-rays are offered at no cost to the miners and, according to regulation, at locations and times convenient to the miners. Acceptance of the later X-rays is voluntary.

The law provides for transfer of miners from areas of higher to lower dust exposure if they show signs of the development of pneumoconiosis on the basis of the X-rays or "other medical examinations." Alternatively, low dust levels can be achieved in the miner's current job through engineering controls. By regulation, exposure control for miners who participate in the program must be confirmed through frequent personal dust sampling.[4] Exercise of these transfer rights is at the discretion of the affected miner.

In practice, the right to transfer is offered only on the basis of X-rays read as positive for coal workers' pneumoconiosis utilizing the ILO method of X-ray interpretation.

TEST SELECTION

The MSHAct obligates the Secretary of Labor to develop mandatory health standards including, where appropriate, medical examinations to determine whether workplace exposures are adversely affecting a miner's health. The medical literature at the time the X-ray program was initiated concentrated on coal workers' pneumoconiosis as the characteristic and single important response of the lungs to inhalation of coal mine dust. Prevention of impairment from dust exposure was assumed to depend on elimination of Progressive Massive Fibrosis.[5] The transfer option is predicated on the assumption that PMF can be eliminated if the progression of simple CWP can be halted or slowed or through reduction of ongoing exposure in affected individuals.

The current literature is broader in its focus. Recent studies consistently demonstrate a range of pathological and physiological abnormalities in miners.[6] For example, pathologically confirmed emphysema is found more commonly in miners than non-miners even when the analysis controls for smoking status.[7,8,9] Symptoms of chronic bronchitis occur with increased frequency in both smoking and non-smoking miners as duration of coal mine dust exposure increases.[10] These symptoms may be associated with clinically significant impairment.[11,12] Miners with symp-

toms of chronic bronchitis tend to retire earlier with disability than those without these symptoms.[13]

Longitudinal studies in the US and UK demonstrate excess loss of FEV_1 in miners when compared to control populations.[14,15] This excess loss is related to dust exposure after the effects of cigarette smoking are considered. A subset of miners may develop severe pulmonary impairment in the absence of PMF.[11]

Further, both smoking and non-smoking miners have manifested abnormalities of gas exchange demonstrable on exercise testing.[16,17] Mortality studies of miners have consistently demonstrated that former coal miners die from chronic respiratory diseases at excess rates.[18]

People manifesting dust-related impairments do not necessarily have radiographically demonstrable CWP.[15,16] The chest X-ray appears to be neither sensitive nor specific for the identification of individuals with functional loss resulting from coal mine dust exposure. One cannot differentiate between miners with lung disease and those without through exclusive reliance on the chest X-ray.

PARTICIPATION

The periodic X-ray program has been plagued by low and diminishing participation by eligible miners. Administratively, program activities have been divided into four time periods or "rounds" thus far. If the compulsory films required of miners entering the work force are eliminated from consideration, approximately 32% of eligible miners participated in round three (1978–81), the latest round for which data is available. This is down from the 44% participation rate during round two (1973–8), and approximately 50% participation in the initial round (1970–3).[19]

The distribution of participants by mining experience is also significant. (see Table I) Approximately 35% of participants in round one had worked for twenty or more years in mining. In round two, only 12.4% of participants had worked this long. By round three, the percentage of participants with twenty or more years' experience was further reduced to 10.4%. In part this may reflect an evolution of the work force with older miners retiring and younger miners being hired. However, this hypothesis cannot be tested at this point; the necessary demographic data detailing the age and tenure distribution of the mining work force over time is lacking.[19]

A number of problems contribute to poor participation in the program. Some approved facilities are not, in fact, convenient for miners. Miners must take examinations during their off-work hours. Travel time can be as much as an hour from the mine site, and may be further from the miner's home. The facilities are selected by the employer and may be the same ones that provide pre-employment examinations as well as evaluative examinations used to contest workers' compensation claims. There is limited understanding of the nature and purpose of the program among coal miners, employers, and health care providers in the coal mining areas. Concerns about confidentiality and adverse impact on future employment are widespread.[20]

Miners who have worked longest on average have the greatest lifetime dust exposures. Low participation rates by the most experienced miners could distort understanding of disease patterns in the mining population and diminish the value of the screening function of the program.

TRANSFER ACCEPTANCE

The primary preventive intervention offered by the X-ray program is transfer with pay rate retention from a high to lower dust exposure job for individuals demonstrating CWP on chest X-ray. Miners are permitted to exercise this transfer option any time after notification of their eligibility status. Through the life of the program, 9138 miners have been eligible for transfer but only 2119 have exercised this option. The number of miners actually working who have exercised the option has declined from a total of 550 at the end of 1981 to 140 by the end of 1987.[21]

The consequences of delaying or failing to exercise transfer rights means that most miners who are identified through

Table I

Percentage Distribution of Participants in Rounds 1, 2, and 3, by Tenure Group. 1970–1981

Years in Mining	Round 1 (1970-73)	Round 2 (1973-78)	Round 3 (1978-81)
0-4	42.1	68.7	51.9
5-9	9.8	11.4	24.8
10-19	13.1	7.5	12.9
20-29	18.4	6.5	4.6
30+	16.6	5.9	5.8

(reproduced from reference 19)

the screening program as having CWP continue to be exposed to higher levels of coal mine dust than necessary.

IMPAIRMENT DEVELOPMENT

Despite the mandate of the MSHAct to eliminate occupationally-induced health impairments, miners continue to develop dust related disease. The extent to which this is happening is not currently measured. However, data from the surveillance program indicates that miners continue to demonstrate CWP on X-ray.[21]

Indirect evidence from the Black Lung Benefits program supports concern that some miners are developing severe pulmonary impairment in part or in whole from their workplace exposures. In fact, the number of retired miners who are awarded benefits for permanent and total pulmonary disability arising from coal mine employment is greater than the number of active miners being offered transfer rights. (see Table II) Even with a significant tightening of eligibility standards in 1981, over five hundred awards of disability benefits have been made each year to miners who applied after March 1, 1978.[22]

DISCUSSION

The surveillance and screening program for US coal miners was designed almost twenty years ago with a narrow focus on coal workers' pneumoconiosis. With minor modification, the program regulations have remained constant since its inception. The success of the surveillance component of the program is limited, in large measure, by poor participation and incomplete data. Nevertheless, the program has developed an invaluable data base through effective use of limited resources and the strong commitment of involved researchers. However, the surveillance activity has not yet been tied to the institution of primary exposure control measures.[23]

With almost twenty years' experience, it may be time to modify the program. Additional demographic data on both participants and non-participants should be collected. Also, efforts should be made to develop improved exposure information and to tie the surveillance program more directly to exposure control. The causes of non-participation in the program merit serious study. Attempts to overcome these should be continued.

The screening component of the program is more troublesome. It has operated in the shadow of the CWP surveillance activity maintaining the same narrow focus. The overall legislative mandate to identify miners with material health impairment from their workplace exposures and aid them in exposure elimination has remained largely unfulfilled. The current screening program relies exclusively on X-ray-diagnosable abnormalities and excludes consideration of dust induced functional derangement. Miners at greatest risk for the development of asymptomatic disease are least frequently screened. Only a limited number of miners avail themselves of the preventive intervention that is offered. At the same time, the number of miners qualifying for total disability benefits far exceeds the number participating in preventive options.

The screening component of the activity would improve to some extent with expanded participation in the current X-ray program. Nevertheless, until the medical screening focus is broadened to include efforts at early identification of other dust diseases in miners, the impact on overall health status will be quite limited. Part or all of the screening activity should be disaggregated from the surveillance program and new regulations developed. These would require consideration of the range of lung diseases caused by coal mine dust exposure, the methods available to detect them, and interventions that would prevent their progression. Each area presents difficult scientific issues which must be resolved. Nevertheless, it is not too soon to begin to fulfill the promise of the Mine Safety and Health Act of 1977 to "assure that no miner will suffer material impairment of health or functional capacity even if such miner has regular exposure to the hazards for the period of his working life."

Table II

Numbers of Miners Awarded Total Pulmonary Disability Benefits for Claims Filed After March 1, 1978, and Miners Offered Transfer Option. 1981–1985

Year	Awarded Benefits	Transfer Option Offered
1981	5148	245
1982	1145	119
1983	763	94
1984	556	271
1985	570	79

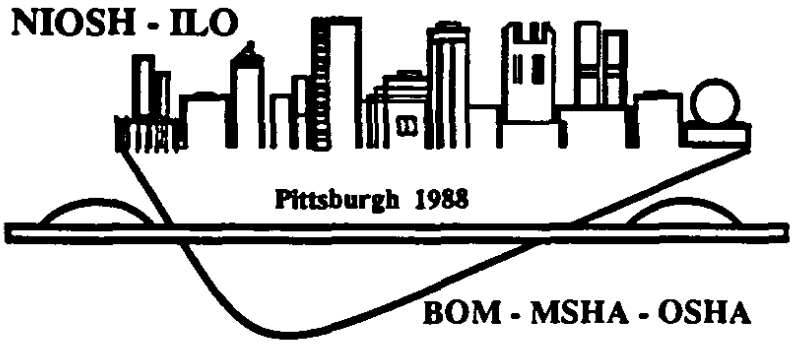
(source: references 21,22)

REFERENCES

1. P.L.91-173, Federal Coal Mine Health and Safety Act of 1969, Title II: Interim Health Standards.
2. Millar, J.D.: Screening and Monitoring: Tools for Prevention. *J. Occup. Med.* 28:544-546 (1986).
3. P.L.91-173 as amended by p.L. 95-164, Federal Mine Health and Safety Act of 1977, Section 101(a)(7).
4. 30 C.F.R. part 90, Subpart C.
5. Morgan, W.K.C.: Coal Workers' Pneumoconiosis, in *Occupational Lung Diseases*, pp. 149-215. W.C.K. Morgan and A. Seaton, Eds. W.B. Saunders Co., Philadelphia (1975).
6. Seaton, A.: (editorial) Coal and the Lung. *Thorax*. 38:241-243 (1983).
7. Ruckley, V.A., Gauld, S.J., Chapman, J.S., Davis, J.M.G., Douglas, A.N., Fernie, J.M., Jacobsen, M., Lamb, D.: Emphysema and Dust Exposure in a Group of Coal Workers. *Am. Rev. Respir. Dis.* 129:528-532 (1984).
8. Leigh, J., Outhred, K.G., McKenzie, H.I., Glick, M., Wiles, A.N.:. Quantification of Pathology of Emphysema, Pneumoconiosis and Chronic Bronchitis in Coal Workers. *Br. J. Indus. Med.* 40:258-263 (1983).
9. Lyons, J.P., Ryder, R.C., Seal, R.M.E., Wagner, J.C.: Emphysema in Smoking and Non-smoking Coalworkers with Pneumoconiosis. *Bull. Europ. Physiopath. Resp.* 17:75-85 (1981).
10. Kibelstis, J.A., Morgan, E.J., Reger, R., Lapp, N.L., Seaton, A., Morgan, W.K.C.: Prevalence of Bronchitis and Airway Obstruction in American Bituminous Coal Miners. *Am. Rev. Resp. Dis.* 108:886-893 (1973).
11. Hurley, J.F., Soutar, C.A.: Can Exposure to Coalmine Dust Cause a Severe Impairment of Lung Function? *Br. J. Ind. Med.* 42:150-7 (1986).
12. Marine, W.M., Gurr, D., Jacobsen, M.: Clinically Important Respiratory Effects of Dust Exposure in British Coal Miners. *Am. Rev. Resp. Dis.* 137:106-112 (1988).
13. Ames, R.G., Trent, R.B.: Respiratory Impairment and Symptoms as Predictors of Early Retirement With Disability in US Underground Coal Miners. *Am. J. Pub. Health.* 74:837-838 (1984).
14. Love, R.G., Miller, B.G.: Longitudinal Study of Lung Function in Coal-Miners. *Thorax*. 37:193-197 (1982).
15. Attfield, M.D.: Longitudinal Decline in FEV_1 in United States Coalminers. *Thorax*. 40:132-137 (1985).
16. Nemery, B., Veriter, C., Brasseur, L., Frans, A.: Impairment of Ventilatory Function and Pulmonary Gas Exchange in Non-Smoking Coalminers. *Lancet*. 1987ii:1427-1430.
17. Rasmussen, D.L.: Impairment of Oxygen Transfer in Dyspneic and Non-Smoking Soft Coal Miners. *J. Occup. Med.* 13:300-305 (1971).
18. Rockett, H.: *Mortality Among Coal Miners Covered by the UMWA Health and Retirement Funds*. DHEW (NIOSH) Publication No. 77-155, U.S. Government Printing Office, Washington, D.C., 1977.
19. Althouse, R.: Ten Years' Experience with The Coal Workers' Health Surveillance Program, 1970-1981. *MMWR*. 34:33SS-37SS (1985).
20. Personal communications from West Virginia coal miners.
21. Personal communication from Joseph M. Hoffman, Mine Safety and Health Administration, prepared November 25, 1987.
22. *Black Lung Benefits Act: Annual Report on Administration of the Act during Calendar Year 1981, 1982, 1983, 1984, 1985*. U.S. Department of Labor, Employment Standards Administration. U.S. Government Printing Office, Washington, D.C., 1982-1986.
23. Althouse, R., Attfield, M., Kellie, S.: Use of Data from X-ray Screening Program for Coal Workers To Evaluate Effectiveness of 2 mg/m^3 Coal Dust Standard. *J. Occup. Med.* 28:741-745 (1986).

Proceedings of the VIIth International Pneumoconioses Conference | *Part*
Transactions de la VIIe Conférence Internationale sur les Pneumoconioses | *Tome*
Transaciones de la VIIa Conferencia Internacional sobre las Neumoconiosis | *Parte*

I



Pittsburgh, Pennsylvania, USA—August 23–26, 1988
Pittsburgh, Pennsylvanie, Etats-Unis—23–26 aout 1988
Pittsburgh, Pennsylvania EE. UU—23–26 de agosto de 1988

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control
National Institute for Occupational Safety and Health

CDC
CENTERS FOR DISEASE CONTROL

Sponsors

International Labour Office (ILO)
National Institute for Occupational Safety and Health (NIOSH)
Mine Safety and Health Administration (MSHA)
Occupational Safety and Health Administration (OSHA)
Bureau of Mines (BOM)

September 1990

DISCLAIMER

Sponsorship of this conference and these proceedings by the sponsoring organizations does not constitute endorsement of the views expressed or recommendation for the use of any commercial product, commodity, or service mentioned.

The opinions and conclusions expressed herein are those of the authors and not the sponsoring organizations.

DHHS (NIOSH) Publication No. 90-108 Part I