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CHRONIC PULMONARY DISEASE IN AN
INDUSTRIAL POPULATION

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U. S. A.

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INTRODUCTION

In previous studies chronic pulmonary disease has been identified as a relatively frequent cause of sickness absenteeism and of permanent incapacity for certain kinds of work. A review of all such cases was undertaken in order to improve our understanding of the epidemiology and the early clinical manifestations as well as the effect of such disease on job performance and life expectancy. This added information might suggest better methods for coping with similar cases in the future.

METHOD OF STUDY

The study population totaled 23,142 males engaged in refining and marketing petroleum in 18 of the eastern and southern United States. Climatic conditions varied, as did the distribution between rural and urban environments. Diagnoses selected for study were restricted to the following: (a) bronchiectasis, (b) bronchitis, (c) asthma, and (d) emphysema, pulmonary fibrosis, and cystic disease of the lung. Pul-

monary tuberculosis and cancer of the lung were excluded, since they have different etiologic backgrounds and clinical courses than the groups under discussion and, therefore, are the subjects of other studies by our group.

Three major sources were used in case finding:

1. All deaths and retirements occurring during the period 1950-1958.
2. Sickness absences during the period 1954-1958.
3. Periodic examinations performed during the same period.

Cases were accepted as "chronic" where the clinical course of the disease was one of progressive deterioration, where findings of wheezes, rhonchi, or impaired ventilation were detected at the time of periodic examination or x-ray evidences of increased aeration or fibrosis were noted.

RESULTS

Epidemiology

PREVALENCE—Three hundred and twenty-eight em-

ployee-patients were identified as belonging in the chronic pulmonary disease category. Twenty-two of these retired or died prior to 1954. Since we were unable to survey all the milder forms of chronic pulmonary disease in the pre-1954 period, we restricted our prevalence studies to the 306 patients who were active employees at any time during the 1954-1958

Prevalence varied, however, with occupation. Employees in the dusty trades (masons, insulators, and sandblasters) had a prevalence of 23.8. Metal-trades workers (welder-burners, pipefitters, and boiler-makers) were next, with a prevalence of 20.7. Chemical products operators, helpers, and resident mechanics engaged in the manufacture of alcohols, solvents,

employees were in six prevalence rate of 7.6 clerical group.

Those occupational either full or part its prevalence (16.5 and prevalence was only the same in the sever

ETIOLOGIC FACTORS—etiologic factors of clinical studies involving cultures, bronchoscopy were not available. Findings, and routine tions, however, we as group into four categories: Allergy and Inf

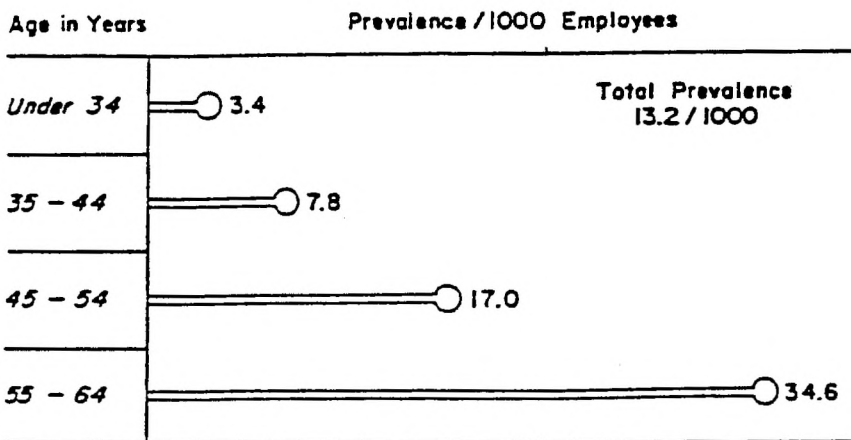


FIGURE 1—Prevalence by Age Groups, 306 Employees

study period. Based on an employee population of 23,142, the total prevalence was 13.2 per 1000.

There was a distinct difference in prevalence by age groups, as shown in Figure 1. With each decade beyond age 35 the prevalence doubled. This pattern was consistent in each of the four groups: Bronchiectasis, Bronchitis, Asthma, and Emphysema.

specialty oils, additives, synthetic rubber, etc., were third, with a prevalence of 19.3. Petroleum products workers engaged in the distillation and purification of various petroleum fractions and mechanical department employees other than those in the dusty and metal trades groups had similar prevalence rates (16.5 and 16.3, respectively). Outdoor sales em-

In the 27 patients recognized as a likely Among the 61 cases of were present in sidered the major eti- of the asthmatics, ar present in another 50 considered the respon per cent fell into the

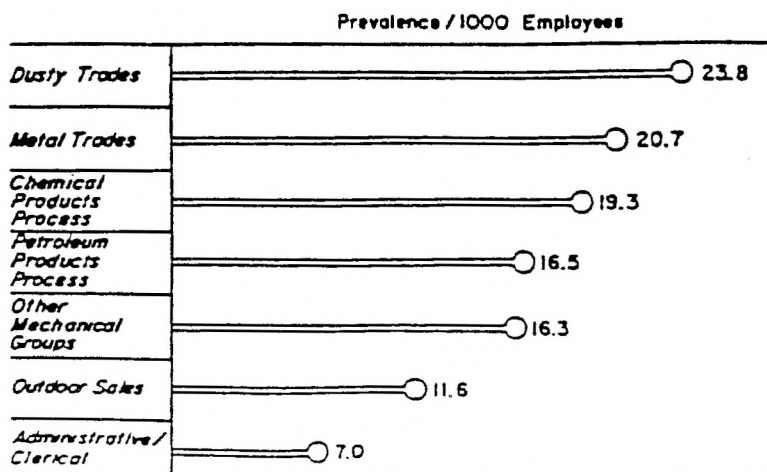


FIGURE 2—Prevalence by Occupational Groups, 306 Employees

Dusty Trades
Metal Trades
Chemical Products Process
Petroleum Products Process
Other Mechanical Groups
Outdoor Sales
Administrative / Clerical

insulators, and
8. Metal-trades
s. and boiler-
20.7. Chemical
mechanics
vents.

proved were in main part, with 11.3, the lower prevalence rate of 7.0 occurred in the administrative-clerical group.

Those occupational groups working out of doors either full or part time, had approximately the same prevalence (16.5 and 17.1), whereas the indoor group prevalence was only 7.0. Prevalence was essentially the same in the several major geographical areas.

Etiologic Factors—Accurate identification of the etiologic factors of each case would require detailed clinical studies involving allergenic testing, sputum cultures, bronchoscopy, bronchography, etc. Such data were not available. On the basis of history, physical findings, and routine laboratory and x-ray examinations, however, we categorized members of the study group into four categories: Allergy, Infection, Combined Allergy and Infection, and Unknown (Table I).

phymema group of 101 patients. Allergy and Combined etiologic factors accounted for 2 per cent and 5 per cent respectively; 25.8 per cent had a history suggesting repeated episodes of pulmonary infection. In 67.2, however, there was no antecedent history of febrile pulmonary disease or allergic manifestations but merely an insidious onset of dyspnea and cough with x-ray changes of increased aeration of the lungs. Although a majority of the emphysema patients regressed slowly in their downhill course, there were a few who deteriorated rapidly from apparent vigorous health to complete invalidism within a period of several months. The relationship of the four possible etiologic factors (Allergy, Infection, etc.) to the occupational groups shown in Figure 2 was reviewed.

The findings are not remarkable except for the absence of Allergy in the dusty trades group and its

TABLE I
POSSIBLE ETIOLOGIC FACTORS, 328 EMPLOYEES

	Bronchiectasis		Bronchitis		Asthma		Emphysema		Total	
	=	%	=	%	=	%	=	%	=	%
Allergy	—	—	—	—	36	23.9	2	2.0	38	11.6
Infection	20	74.1	56	92.0	17	12.5	26	25.8	119	36.4
Combined	1	3.7	1	1.6	70	50.0	5	5.0	77	23.5
Unknown	6	22.2	4	6.4	16	11.6	68	67.2	94	28.5
Total	27	100.0	61	100.0	139	100.0	101	100.0	328	100.0

In the 27 patients with bronchiectasis, infection was recognized as a likely etiologic factor in 74 per cent. Among the 61 cases of bronchitis, evidences of infection were present in 95 per cent. Allergy was considered the major etiologic factor in 25.9 per cent of the asthmatics, and allergy plus infection was present in another 50 per cent. Infection alone was considered the responsible factor in 12.5 per cent. 11.6 per cent fell into the unknown category. In the em-

physema group, infection was present in about a quarter of the administrative-clerical group. This may represent some degree of job-selection on the part of those patients with allergic rhinitis or asthma predating employment.

Although the working environment of these employee-patients has been under continued scrutiny and control by the industrial hygiene staff, it is obviously necessary to consider the possible relationship of these diseases to occupational exposures—e.g., dusts.

Prevalence / 1000 Employees

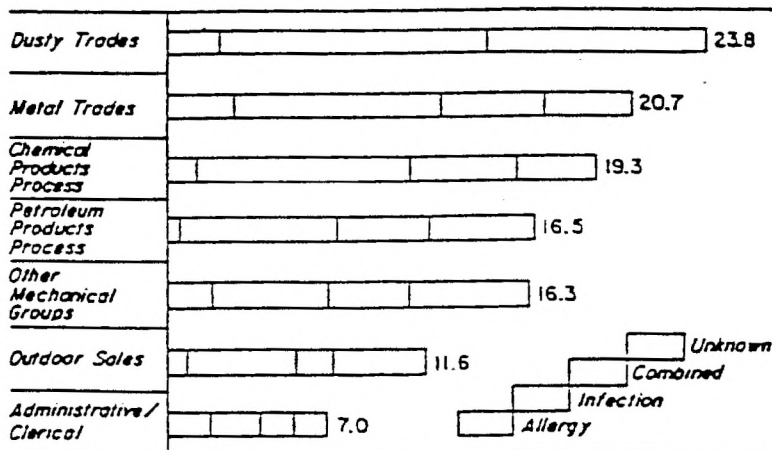


FIGURE 3—Prevalence by Occupational Groups, 306 Employees

ber, etc., were
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lar prevalence
door sales em-

silica, metal fumes, acid mists, etc. Thirty six per cent of the cases of bronchitis worked where such exposures could have occurred, but only 20 per cent of the other diagnostic groups had such a work history. About 60 per cent of the employees studied showed no unusual environmental exposure. In about 20 per cent of the cases the data were inadequate to make any judgment about their work environment.

Tobacco consumption was one of the factors studied. Information was available for the total employee population at only a single location—the Baton Rouge Refinery. Since 40 per cent of the group under study was derived from this location, the findings are probably significant. The first column in Table II outlines the tobacco consumption history of the 328 members of the total study group. The second column shows the same data for the members of the study group at Baton Rouge. The third column lists smoking data on the total plant population at that location.

The percentage of nonsmokers in the three groups

given category (Figure 4). Normal findings were reported in 26 per cent of the cases of bronchiectasis, 46 per cent of individuals with bronchitis, and 51 per cent of the asthmatics. Increased aeration alone predominated in emphysema but was also present in one-sixth of the cases with bronchitis and asthma. Increased aeration plus increased hilar markings was reported in a third of the cases of emphysema and a sixth of the employees with bronchiectasis and asthma. Increased hilar markings predominated in bronchiectasis and bronchitis. Infiltration of lung parenchyma was more common in bronchiectasis but also occurred transiently in several patients with bronchitis, asthma, and emphysema.

ELECTROCARDIOGRAM—Although electrocardiograms were done in 75 per cent of the study group, they proved to be of positive value in the interpretation of pulmonary change only in the emphysema group. About 60 per cent of the tracings in this group were normal, 7 per cent showed a pattern compatible with right ventricular hypertrophy, and 3 per cent

Normal
Incr. A
Incr. H
Incr. A
Milder
Infiltrat
Infiltr
Incr. A
Unknc

TABLE II
TOBACCO USE HISTORY

Tobacco History	Entire Study Group		Baton Rouge Ref. Study Group		Baton Rouge Ref. Gen. Population	
	N	%	N	%	N	%
None	41	12.5	24	17.7	988	19.1
Cigarettes						
Less than 1 pk./day	65	19.7	31	23.1	2811	54.4
More than 1 pk./day	140	42.9	51	38.1	839	16.2
Amount Unknown	17	5.2	6	4.5	—	—
Pipe or Cigars	28	8.6	14	10.4	520	10.3
(Singly or in Combination)						
Unknown	37	11.1	8	6.2	—	—
Total	328	100.0	134	100.0	5158	100.0

was essentially the same, but of those who smoked, 54.4 per cent of the control group smoked less than a pack of cigarettes a day, compared to 23.1 per cent of the study group at Baton Rouge and 19.7 per cent of the total study group. Conversely, 16.2 per cent of the total refinery population were in the pack or more a day group, compared to 38.1 per cent of the study group at Baton Rouge and 42.9 per cent of the general study group.

Pipe, cigar, and miscellaneous tobacco consumption was essentially the same in the three population groups.

Clinical Observations

HISTORY AND PHYSICAL SIGNS—Despite the predominance of certain symptoms and signs in each diagnostic group, these tended to overlap. Cough was a common denominator in all. Hemoptysis was noted most often in bronchiectasis, occurring in about 25 per cent of cases. Fever was most common in bronchitis. Dyspnea was the characteristic symptom of asthma and emphysema, whereas the distinctive finding in asthma.

CHEST X RAY

demonstrated the high peaked P-waves frequently associated with cor pulmonale.

Work Experience

ABSENTEEISM—Two hundred ninety-seven of the 306 employees with chronic pulmonary disease lost time due to respiratory illness, on the average, 1.2 times per year during the period 1954-1958. Other employees averaged only 0.59 absences per year due to respiratory illness. There was no significant difference in absence pattern of the four diagnostic groups studied.

The average number of days lost due to all respiratory disease in this selected group was 12.7 days per employee, while the average number of days lost per employee due to all causes in the entire Esso population for 1954 was 8.7 days, of which only 1.6 days was for respiratory disease.

PARTIAL DISABILITY: JOB RESTRICTION—Of the individuals with chronic pulmonary disease, 22.6 per cent had or developed some degree of permanent disability during the follow-up period. In a number of instances the job demands did not exceed the physical capacity of the partially disabled employees. Since this fortunate group was made up of normal

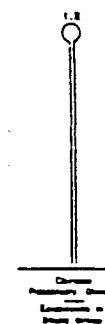


FIGURE 5—Average

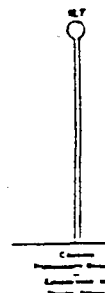
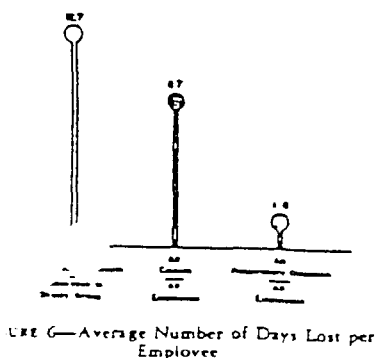
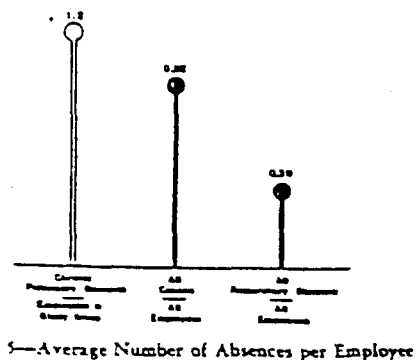


FIGURE 6—Average

each case in terms of have been imposed upon in work.

	Bronchiectasis	Bronchitis	Asthma	Emphysema
Normal	25.9%	46.0%	51.0%	9.9%
Incr. Aeration	7.4%	18.1%	16.5%	42.5%
Incr. Hilar Markings	25.9%	23.0%	10.7%	4.0%
Incr. Aeration & Hilar Markings	14.8%	8.1%	15.1%	33.6%
Infiltration	18.6%	4.8%	2.9%	4.0%
Infiltration & Aeration	—	—	1.4%	3.0%
Unknown	7.4%	—	2.2%	3.0%

FIGURE 4—Radiologic Findings, 328 Employees



and, disabled employees were classified as to the degree of work restriction which would have been necessary were they to work at one of these jobs. Of the entire group, 77.4 per cent had no significant limitation in their work capacity. Major limitations regarding climbing, carrying and walking were necessary most frequently among the emphysema group and a small number of the asthmatics. Minor restrictions pertaining mainly to exposure to inclement weather, dusts, fumes, and very heavy effort were fairly common in all groups.

Follow-up

Of the 306 employees with chronic pulmonary disease who were working at the beginning of the five-year period, 55.9 per cent continued at work at the end of that time, 6.2 per cent in a restricted capacity and 49.7 per cent carrying out regular jobs. Premature medical retirement due to pulmonary disease were necessary in 10.8 per cent of the group over the five-year period. Deaths due to pulmonary disease totaled two or 0.7 per cent. The remainder, or 32.6 per cent, listed as "Other" were lost for follow-up due to nonpulmonary medical retirement, non-medical retirement, layoff, resignation, or nonpulmonary death.

DISCUSSION

On reviewing this group of patients with chronic pulmonary disease, we were most impressed by the fact that a clearcut diagnosis was made infrequently and a satisfactory response to treatment was rarely obtained. In a few instances, localized bronchiectasis was identified and extirpated surgically. In approximately a fourth of the asthmatic patients the major cause was identified as allergic in nature, and some of them were helped by desensitization or removal of the specific allergen from the environment. These allergens were rarely associated with the work environment. Emphysema appeared as a primary or secondary diagnosis in approximately one-third of the group.

in terms of the job demands which would be imposed had each of the men been re-employed as a refinery mechanic, etc. (Table 1)

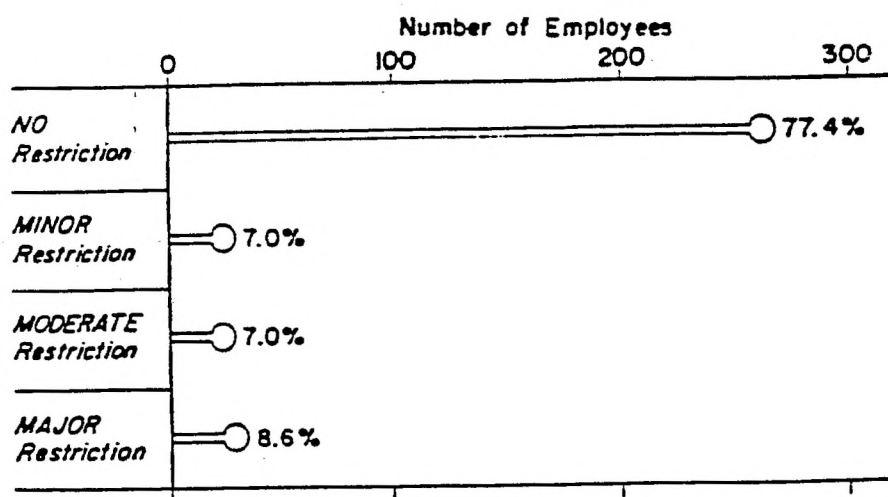


FIGURE 7—Partial "Disability"—Job Restriction
328 Employees

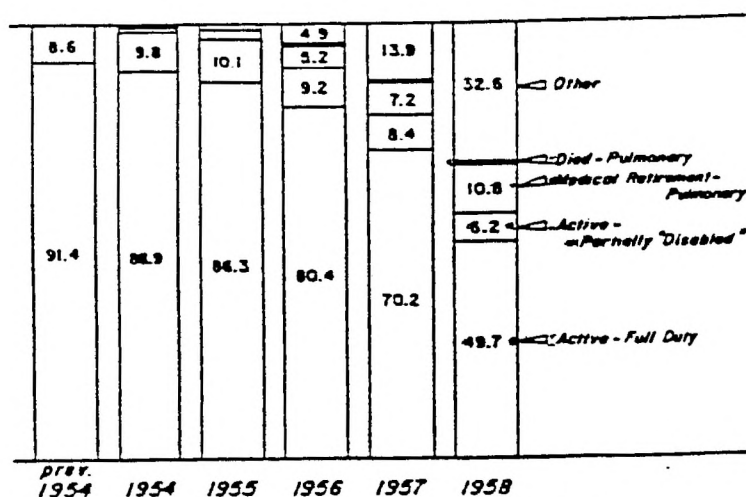


FIGURE 8—Follow-up Experience, 1954-58, 306 Employees

older age groups leads us to expect that the number of cases of emphysema and pulmonary insufficiency will increase in any group such as this with the passage of time. None of these patients had the usual finding of pneumoconiosis. We believe, however, that in the working population studied approximately 1 per cent have a lower respiratory tract susceptible to chronic disease.

The basic causes for this response are obscure. In some infection in the bronchial tree or accessory nasal sinuses is probably a major contributing or etiologic factor. In others an allergic response to irritants at home or at work may be primary. The observed prevalence in the occupational groups out-

containing dusts, fumes, or mists which we believe to be nontoxic or of a nuisance character may aggravate the underlying disease state, whatever the basic cause. Exposure to cold and damp environment either on or off the job also has an adverse influence.

There are more heavy smokers in the "pulmonary" group than in the general employee population. Tobacco smoke probably has an aggravating effect similar to that ascribed to other environmental smokes or fumes. Clinical manifestations in most cases are not dramatic or specific; chronic cough is often dismissed as "smoker's cough"; recurrent, prolonged episodes of bronchitis are interpreted as a tendency to chest colds; wheezing or mild dyspnea

sician specifically in like manner. x-ray areas of increased attention as clues to restrictive measures initiate to minimize cases of chronic pulmonary employees affected?

Environmental Control

In cooperation with local work environment critically. In addition recognized respiratory vapors), a continuous control exposures to Sweepings from a carpenter's bench is of us, but to the precipitate a bout of environmental control the susceptible employee necessary.

Individual Health

While control of is edly important, even given the patient's matters require his

1. EARLIER CASE F on the alert to elicit respiratory disease physical and labor long natural history

2. AVOIDANCE OF ENVIRONMENT — While

300

Indian specifically inquires about such symptoms. In like manner, x-ray findings of hilar thickening or areas of increased aeration may not be given proper attention as clues to underlying disease. What constructive measures can the physician in industry initiate to minimize the number and severity of cases of chronic pulmonary disease and to help those employees affected?

Environmental Control

In cooperation with the industrial hygienist, the local work environment should be evaluated very critically. In addition to the elimination of the well-recognized respiratory irritants (e.g., silica or acid vapors), a continuing effort should be made to control exposures to other atmospheric contaminants. Sweepings from a shop floor or sawdust from the carpenter's bench may be nuisance factors to most of us, but to the patient with asthma they may precipitate a bout of serious illness. If adequate environmental control is impossible, then removal of the susceptible employee from the environment may be necessary.

Individual Health Promotion

While control of the work environment is undoubtedly important, even greater attention should be given the patient as an individual. Many of these matters require his interest and initiative:

1. **EARLIER CASE FINDING**—The physician must be on the alert to elicit details of repeated episodes of respiratory disease and to evaluate more critically physical and laboratory findings in the light of the long natural history of the disease.

2. **AVOIDANCE OF PROLONGED EXPOSURE TO WET, COLD ENVIRONMENT**—While it is not possible to surround

every individual with an ideal milieu, many respiratory disease-prone individuals should give special attention to wearing warm dry clothing, headgear, and proper footwear when going out of doors.

3. **CONTROL OF HOME ENVIRONMENT**—Although the present day study concerns itself primarily with workers and their work environment, it was obvious in many instances that household dust, pet, and pollen exposures played an important role in accentuating symptoms of a respiratory nature.

4. **ELIMINATION OF TOBACCO**—Many victims of respiratory disease smoke in excess of those without such disease. The inhalation of all forms of tobacco smoke should be discouraged.

5. **PREVENTIVE IMMUNIZATION**—While the over-all value of prophylactic immunization against respiratory viral agents and the common bacterial agents of secondary infection may still be in doubt, we have observed enough clinical benefit in individual cases to recommend these measures to many patients with chronic, recurrent respiratory disease.

6. **EARLY ADEQUATE TREATMENT**—Many prolonged periods of illness due to bronchitis, asthma, etc., followed neglect of the early stages of a common cold. Appropriate early treatment under the guidance of an interested personal physician may mean the difference between a minor illness and a lengthy disability. A severe cold may initiate pulmonary insufficiency which is permanently disabling in patients with moderate to marked emphysema.

7. **JOB PLACEMENT**—Selective placement has been mentioned as the possible solution to the problem of certain occupational exposures. In addition, job placement is important in the later stages of chronic pulmonary disease where partial disability is still compatible with productive employment.

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