FATE OF 424 PATIENTS WITH PNEUMONIA AND BRONCHITIS

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Each year about one million persons in Great Britain suffer from an acute chest infection (College of General Practitioners, 1956). Who are these people, and what eventually happens to them? How many recover completely, and how many remain permanently disabled? On these very pertinent and important questions we have relatively little information.

An attempt to answer these questions is made in this survey and review of 424 patients in a general practice who suffered from pneumonia or acute bronchitis during 1949-54. In 1959, 5 to 10 years later, an assessment was made of the situation in respect of their health in general and their respiratory function in particular.

Methods

In general practice a long-term follow-up presents no serious difficulties, because the doctor is working constantly in the static community of his own practice and is able to see the great majority of his patients (or their relatives) at least once a year and can keep in close contact with all that goes on. There is bound to be a loss of patients owing to removal, and 38 of those with an acute chest infection who were seen during the period of observation subsequently moved out of the practice. The remaining 424 patients, who were followed up until 1959 (or until they died), represent 92% of the possible total.

The methods employed were simple yet effective. A card index was kept of all the patients in the practice who suffered from acute bronchitis or pneumonia during 1949-54. In addition to clinical details, a record was made of the past history, smoking habits, and social class. These patients were followed up, notes being kept of any further incidents; and in 1959 all the survivors still in the practice were seen for any residual disabilities.

Patients were regarded as suffering from pneumonia or acute bronchitis when the following three criteria were present: a sudden *onset* or a sudden worsening of an established chronic respiratory condition; a *fever* of over 100° F. (37.8° C.) on at least one occasion during the illness; and *abnormal physical signs* in the chest on clinical examination. All cases coming within this definition were included—both sexes, of all ages, and those with and without previous chest troubles.

There is no readily acceptable nomenclature for these conditions, but that used was as follows:

Lobar pneumonia was diagnosed when there were definite physical signs of consolidation in the chest—that is, dullness and bronchial breathing.

Segmental pneumonia was diagnosed when the abnormal physical signs consisted of a local area of moist sounds on one side of the chest.

Acute bronchitis (or bronchopneumonia) was diagnosed when the physical signs in the chest (wheezes and moist sounds) were diffuse and bilateral.

Although 315 of the 424 patients were examined radiologically, the findings were not taken into account in the analysis, as this study was intended to be a clinical one in a general practice.

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Classification of *social class* was based on the occupation of the wage-earner in the household, either the patient or the husband or father.

Smoking habits were simply classified. A "smoker" was considered to be any person who had smoked more than five cigarettes daily and regularly for more than one year at any time during his or her life. No distinction was made between the actual amounts being smoked or whether the person was an "ex-smoker." Only adults over the age of 15 were asked about their smoking habits, and the results expressed are percentages of those over this age.

The *grading* of patients was based on an assessment of function and on the degree of residual symptoms. Five grades were recognized:

1. No respiratory illness or symptoms requiring medical attention since the recorded episode.

2. No residual respiratory symptoms, but there was a record of attendance for a minor respiratory illness during the follow-up period.

3. *Some persistent residual symptoms*—that is, cough and sputum for at least four weeks in any year. No major interference with daily routine and little time lost from school or work on account of respiratory illnesses during the follow-up period.

4. *Serious After-effects*.—Residual symptoms—that is, cough, sputum, and dyspnoea present for most of the time. Considerable interference with normal routine—that is, more than four weeks away from work or school in any year.

5. *Complete Invalids*.—Severe residual symptoms. Unable to do any work at home or at usual occupation. *Deaths* were included in this grade.

Disability was considered to be present in grades 3, 4, and 5. This "grading" was applied to the functional state of the patients both *before* the chest infection under consideration and also to the situation *after* the follow-up period. In this way it was possible to assess the degree of deterioration that might have occurred.

The Practice

The basic information on this practice in a south-eastern suburb of London is shown in Tables I and II.

TABLE I.—Population at Risk in 1952*

Age:	0-	10-	20-	30-	40-	50-	60-	70+	Total
Males	410	221	308	409	389	298	189	95	2,319
Females	347	227	379	411	375	273	196	146	2,354
Total	757	448	687	820	764	571	385	241	4,673

* 1952 was taken to represent the average for the whole period.

TABLE II.—Social Class Distribution of the Practice

	Social Class					Students and Not Known	Total
	I	II	III	IV	V		
No. ..	225	1,036	2,744	223	272	173	4,673
% ..	5	23	61	5	6	—	100

The smoking habits of the practice adult population were not worked out, but reliance has been placed on figures collected by Todd (1959), who states that, in London in 1956, 76% of all men were smokers and 48% of all women (these rates being applied to subjects aged 15 and over).

Results in the Series as a Whole

Incidence.—Over the observation period (1949-54) 462 individual patients suffered 553 episodes of pneumonia or acute bronchitis. Eventually 424 were

followed up and reviewed 5 to 10 years later. The annual incidence in this practice was therefore approximately 20 per 1,000.

Age and Sex.—The distribution of patients who suffered from pneumonia or acute bronchitis at various ages is shown in Table III.

TABLE III.—*Age Incidence of Acute Chest Infections (1949–54)*

Age:	0–	10–	20–	30–	40–	50–	60–	70+	Total
Males ..	84	8	10	13	24	41	26	26	232
Females	54	4	9	16	32	23	25	29	192
Total	138	12	19	29	56	64	51	55	424
%	180	30	29	40	73	102	132	271	92

It is evident that acute chest infections predominantly tend to affect the young and the old. There were no striking sex differences.

Recurrences.—During the period of observation no fewer than 44% (188) of these patients had a recurrence of their acute chest infection. Nearly twice as many males (120) as females (68) had a recurrence. The liability to recurrent attacks also varied with age, and Table IV shows the proportion of the patients in each age-group who suffered a recurrence.

TABLE IV.—*Recurrences at Various Ages Expressed as Percentage of Those in Each Age-group*

	0–	10–	20–	30–	40–	50–	60–	70+	Total
Males ..	62	22	10	13	33	53	61	73	52%
Females	38	20	20	26	40	31	48	31	35%

It is interesting to note that the excessive liability of males to suffer recurrent attacks was apparent only in boys under 10 and in men over 50.

Functional Grading.—Grades 3, 4, and 5 were taken as evidence of disability. The functional grading of the patients before and after their chest infections are shown in Table V.

TABLE V.—*Grades Before and After Acute Chest Infection*

Grade	Before		After	
1	262	62%	120	28%
2	70	17%	124	29%
3	80	19%	125	30%
4	11	2%	17	4%
5	1	—	38	9%
Total ..	424	100%	424	100%

It is evident that twice as many patients were disabled at follow-up than had been before suffering infection. While the infection itself must have contributed to this deterioration, other possible factors, such as age, chronic bronchitis, atmospheric pollution, and smoking habits must also be considered.

During the period of observation, 24 of these patients died from the effects of their chest infection.

Social Classes.—Compared with the social grouping in the practice as a whole there was a greater tendency for those in the lower social classes (IV and V) to suffer from these acute chest infections (Table VI).

TABLE VI.—*Social Class Distribution (Percentages)*

Social Class:	I	II	III	IV	V	Total
Acute chest infections ..	3	6	49	32	10	100
Practice as a whole	5	23	61	5	6	100

Smoking Habits.—The proportion of smokers and non-smokers in the group of adult patients did not vary

greatly from the figures for the area as a whole. Thus, while there were more male smokers in the group with chest infections, there were relatively fewer female smokers in those affected (Table VII).

TABLE VII.—*Percentages of Smokers among Those with Acute Chest Infections and the General Population (Expressed as Rates of Population at Risk Aged 15 and Over)*

	Male		Female	
	Chest Infections	Population	Chest Infections	Population
Smokers ..	83%	76%	31%	48%
Non-smokers ..	17%	24%	69%	52%

Previous History of Chest Illness.—182 (43%) persons (125 males, 57 females) had a past history of chest illness.

Clinical Groups.—The proportions of the various clinical groups in the series were as follows:

	No.	%
Lobar pneumonia ..	72	15
Segmental ..	192	41
Acute bronchitis ..	200	43
Others ..	5	1
	469*	100

* Some patients suffered from more than one type during the period of observation.

The fate of the patients in each of these groups is shown below.

Lobar Pneumonia

There were 72 patients (34 males, 38 females) with lobar pneumonia, or 15% of the total. The age incidence (Table VIII) showed a rise with age.

TABLE VIII.—*Age Incidence of Lobar Pneumonia*

Age:	0–	10–	20–	30–	40–	50–	60–	70+	Total
Males ..	—	2	2	4	1	14	3	8	34
Females	3	1	4	2	8	6	7	7	38
Total	3	3	6	6	9	20	10	15	72
%	4	7	8	7	11	35	26	62	15

The social class distribution (Table IX) showed that there was an increased tendency for the lower groups to suffer from lobar pneumonia.

TABLE IX.—*Social Class Distribution in Lobar Pneumonia*

Social Class:	I	II	III	IV	V
Lobar pneumonia ..	3	9	56	26	6
Practice ..	5	23	61	5	6

Investigation of the smoking habits of patients with lobar pneumonia showed that 90% of men were smokers and only 25% of women, compared with approximate figures of 76% and 48% for the local population.

Assessment of functional grades at follow-up revealed that 42% of these 72 patients were disabled (four had died during their illness)—that is, grade 3, 4, or 5, compared with 21% so graded prior to the pneumonia. This disability grading was related to age, sex, social class, and smoking habits.

There were 30 patients (42%) classified as grades 3, 4, or 5, and 26 of these were over the age of 40. In this disabled group there were 17 (out of 34) males and 13 (out of 38) females. The numbers of disabled in the five social classes were small, but they did show rates that rose inversely with the social group—thus 33% of those in social class II were classified as disabled, 40% in class III, 43% in class IV, and 100% in class V. Among the smokers 50% of male smokers were disabled at follow-up and 33% of the non-smokers. The figures

for women were 30% for smokers and 33% for non-smokers.

A history of previous chest illness had adverse effects on the later assessment: 92% males with such a history were disabled and 60% of females.

Segmental Pneumonia

Segmental pneumonia occurred in 192 patients in this series (41% of total). The age distribution was quite different from lobar pneumonia and acute bronchitis (Table X), young children being more likely to suffer from segmental pneumonia than any other age-group.

TABLE X.—Age Incidence of Segmental Pneumonia

Age:	0-	10-	20-	30-	40-	50-	60-	70+	Total
Males ..	48	5	6	7	15	7	5	3	96
Females ..	36	2	6	13	16	10	6	7	96
Total	84	7	12	20	31	17	11	10	192
%	112	16	17	24	40	30	28	40	41

There was no difference in the two sexes. The social class pattern was almost the same as in lobar pneumonias, and its comparison with the population at risk is shown in Table XI.

TABLE XI.—Social Class Distribution of Segmental Pneumonias

Social Class:	I	II	III	IV	V
Segmental pneumonia	2	7	54	32	5
Practice	5	23	61	5	6

Here again there was a tendency for segmental pneumonia to occur most frequently in classes III and IV.

The smoking habits of the adults with segmental pneumonia showed that in males 74% were smokers and in females only 28% were smokers, compared with figures of 76% and 48% for the population at risk.

Functional grading at follow-up revealed a disability rate (grades 3, 4, and 5) of only 16%—that is, 31 out of 192 patients. Only one old man of 82 died during his illness. However, this figure of 16% was more than twice that of 6% who were so classified before the illness. Of the 31 patients who were classified as disabled, only 14 (45%) were over the age of 40. The two sexes were equally disabled—16 males and 15 females. Social class had some bearing on the proportions disabled; thus the rates were 21% in those belonging to social class II, 13% in class III, 20% in class IV, and 33% in class V. There was a tendency for smokers to suffer more from disability, the rates in men being 30% in smokers and 25% in non-smokers; and of women smokers 35% were disabled against only 12% of non-smokers. Those with a previous history of chest illness were much more likely to be disabled than those without such a history, the figures being 47% and 7% respectively.

Acute Bronchitis

This was the largest group of acute chest infections, and accounted for 43% of the total (200 patients). The age and sex distributions were quite different from the other two groups (Table XII). Males predominated

TABLE XII.—Age Incidence of Acute Bronchitis

Age:	0-	10-	20-	30-	40-	50-	60-	70+	Total
Males ..	38	2	3	2	9	26	18	18	116
Females ..	24	1	—	3	14	8	15	19	84
Total	62	3	3	5	23	34	33	37	200
%	80	7	5	6	30	60	84	154	42

by almost 3-2, and the greatest frequency was in the very young and the elderly.

The social class distribution showed a greater tendency for the lower groups to be affected than was the case in the pneumonias (Table XIII); over one-half (52%) were in social classes IV and V compared with 11% for the practice.

TABLE XIII.—Social Class Distribution in Acute Bronchitis

Social Class:	I	II	III	IV	V
Acute bronchitis	1	5	42	36	16
Practice	5	23	61	5	6

The smoking habits again showed no great differences from those of the population at large. Amongst the men 86% were smokers (76% in the population) and only 37% of women smoked (48% in the population).

When the patients were functionally graded, after 5 to 10 years, the rate of disability was 71% compared with 38% before the attack. This rate of disability did not differ much with age. Of those over 40, 68% were disabled, and in these under 40 the rate was higher still, 74%. Men were more likely to be disabled (67%) than women (60%). Socially there was an increasing disability rate rising inversely with the social class, the rates being 50% in social class II, 64% in class III, 59% in class IV, and 78% in class V. Smokers were more likely to become disabled (84% in men and 73% in women) compared with non-smokers (50% and 69% respectively).

A history of previous chest trouble was much more likely to result in subsequent disability; thus, of 77 males with such a history, 62 (80%) were classified as disabled at follow-up, and out of 42 women 32 were disabled (76%). During the period of observation 17 men and 2 women died during an attack of acute bronchitis.

Discussion

The importance of studying and knowing the fate of one million victims who each year suffer from pneumonia or acute bronchitis scarcely requires stressing, but it is even more important still if we consider that according to this study there were twice as many disabled respiratory invalids at follow-up 5 to 10 years later than before the infection. Our knowledge of these conditions is still somewhat unsatisfactory. There is still much to discover outside the basic clinical facts. More epidemiological and sociological studies are required to find out who are these persons who suffer these attacks. Why do they fall sick? How many become disabled, and for what reasons? Only when such information is available can we think of applying successful preventive measures.

This review of the material in one general practice can only be looked upon as a pilot study in a single area of south-east London, but, nevertheless, some interesting facts have emerged which merit further discussion and consideration.

Application of accepted labels such as pneumonia and bronchitis are notoriously difficult in general practice, and it has been shown by Batty Shaw and Fry (1955) that there is little correlation between such diagnostic labels and pathological and bacteriological findings. However, one has to begin somewhere, so the terms lobar and segmental pneumonias and acute bronchitis were employed as defined. The age incidence of each of these clinical conditions was quite different.

The incidence of lobar pneumonia rose with age, segmental pneumonia was most frequent in young children, and acute bronchitis was most often found in the young and the elderly. Similar facts were observed in the report of the College of General Practitioners (1956). These three clinical conditions also had quite different disability rates at follow-up. The highest disability rate was found in those who had suffered from acute bronchitis (71%), and the lowest in those with segmental pneumonias (16%); that for lobar pneumonia was in between (42%). It was also found that the lower social classes were more likely to suffer from these acute chest infections, whereas only 11% of the practice population belonged to classes IV and V; 44% of the patients with these chest infections were in these two groups.

When the disabled group was analysed in an attempt to answer the questions *who* was disabled and *why*, some pointers emerged. Of those disabled 63% (118 out of 187) were over the age of 40. The disability rate for males (47%) was only a little higher than that for females (40%). It was very difficult to interpret the role of smoking because while 90% of disabled men were smokers (but then more than 76% of men in the London area are smokers) only 40% of the disabled women were smokers (in London 48% of women are smokers). It may well be that men were more susceptible to the effects of smoking and that they smoked more, or that women found it easier to give up once symptoms developed. More studies are obviously necessary to clear up this point.

The disabled group contained 53% in social classes IV and V, whereas only 11% of the practice were in these two classes. It seems fairly definite that the lower social groups are more likely to suffer disability after pneumonias and acute bronchitis. A previous history of chest trouble also had a marked adverse effect on the prognosis. The disability rate in those with such a history was 71%—almost twice that for the whole series, which was 40%.

A picture thus builds up that those *most* likely to develop disabilities from chest infections are men over 40 who smoke, who belong to social classes IV and V, and who have a previous history of chest troubles. There are also other factors which have not been taken into account here, but which must be considered—the environmental effects, such as atmospheric pollution, and occupational risks and genetic and familial influences. The treatment given may also play a part in influencing the ultimate course of the condition. All these facts require further assessment by planned long-term studies before prevention can be attempted.

Summary

424 patients who suffered from pneumonia or acute bronchitis in 1949–54 were followed up for 5 to 10 years and reassessed functionally in 1959.

As many as 43% were considered to be disabled according to the method of grading used, 9% were complete invalids, and 24 had died during the acute illness. This rate of disability was more than twice that present (21%) before the infection 5 to 10 years earlier.

Three distinct clinical conditions were recognized—lobar pneumonia, segmental pneumonia, and acute bronchitis.

Lobar pneumonia accounted for 15% of the whole series. The age incidence rose with age. The sex dis-

tribution was equal. It was more frequent in lower social groups, in male smokers, and in those with a previous history of chest illness. There was a disability rate of 42%, compared with 21% before the episode.

Segmental pneumonias were much the most frequent in young children. There was a disability rate at follow-up of only 16%, and some relations were noted with social classes and smoking; even this rate was much higher than the 6% before the infection.

Acute bronchitis had the unusual age incidence of being frequent in the young and the old. Disability at follow-up had occurred in 71%, and there were close associations with smoking, social classes, and previous chest illnesses. The initial disability rate had been 38%.

The importance of acute chest illnesses is evident from the fact that one million persons are affected each year and that 43% appear to be left with some disability, which is twice the initial figure. Preventive measures must take into account the associations between disability and age, sex, social class, smoking habits, past history, and environmental and genetic influences.

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HYPOXIA AND THORACIC SCOLIOSIS

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It has been recognized for many years that thoracic deformity predisposes to the development of hypoxia and respiratory failure, but the mechanism by which these are brought about is not fully understood. Gray (1956) studied 22 patients with kyphoscoliosis, and concluded that the abnormalities in pulmonary function found in this condition were similar to those occurring in emphysema. This implies that the primary cause for the hypoxia in patients with a chest deformity is uneven distribution of air and blood within the lungs (Bates, Knott, and Christie, 1956). However, after investigating 16 patients, Schaub, Bühlmann, Kälin, and Wegmann (1954) reported that the main factor was alveolar hypoventilation. Fishman, Bergofsky, Turino, Jameson, and Richards (1956) and Hanley, Platts, Clifton, and Morris (1958) reached similar conclusions, and suggested that patients with thoracic deformities underventilated owing to restriction of the chest bellows.

The common association of chronic bronchitis with deformities of the chest tends to obscure the effect of the latter upon pulmonary function. Other difficulties in interpreting the results of pulmonary function studies in this condition are the variety of types of deformity and the lack, until recent years, of a satisfactory technique for measuring the relationship of ventilation to blood-flow within the lungs. The present study was

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