

1969

# Effects of changing criteria on the diagnostic identification of chronic pulmonary disease

Ellen B. Milstone  
*Yale University*

Follow this and additional works at: <http://elischolar.library.yale.edu/ymtdl>

---

## Recommended Citation

Milstone, Ellen B., "Effects of changing criteria on the diagnostic identification of chronic pulmonary disease" (1969). *Yale Medicine Thesis Digital Library*. 2939.  
<http://elischolar.library.yale.edu/ymtdl/2939>

This Open Access Thesis is brought to you for free and open access by the School of Medicine at EliScholar – A Digital Platform for Scholarly Publishing at Yale. It has been accepted for inclusion in Yale Medicine Thesis Digital Library by an authorized administrator of EliScholar – A Digital Platform for Scholarly Publishing at Yale. For more information, please contact [elischolar@yale.edu](mailto:elischolar@yale.edu).

T113  
+Y12  
2994



EFFECTS OF CHANGING CRITERIA ON THE DIAGNOSTIC  
IDENTIFICATION OF CHRONIC PULMONARY DISEASE

ELLEN B. MILSTONE

1969

MUDD  
LIBRARY  
Medical

YALE




MEDICAL LIBRARY

YALE



MEDICAL LIBRARY





Digitized by the Internet Archive  
in 2017 with funding from  
The National Endowment for the Humanities and the Arcadia Fund

<https://archive.org/details/effectsofchangin00mils>





EFFECTS OF CHANGING CRITERIA ON THE DIAGNOSTIC IDENTIFICATION  
OF CHRONIC PULMONARY DISEASE

Ellen B. Milstone

A.B. University of Pennsylvania

A thesis presented to the  
Department of Medicine  
in partial fulfillment of  
the requirements for the  
degree of  
Doctor of Medicine

Yale University School of Medicine

1969





### ACKNOWLEDGMENT

I wish to express my thanks to Dr. Alvan R. Feinstein for the impact he has made on my ability to collect, analyze and interpret data, and, specifically, for his help with this study.



TABLE OF CONTENTS

|                                         | <u>PAGE</u> |
|-----------------------------------------|-------------|
| INTRODUCTION .....                      | 1           |
| Problems in Diagnostic Criteria         | 2           |
| 1. Tuberculosis                         | 2           |
| 2. Carcinoma of the Lung                | 4           |
| 3. Emphysema                            | 5           |
| MATERIALS AND METHODS .....             | 8           |
| A. Clinical Material                    | 8           |
| B. Extraction and Coding                | 9           |
| C. Method of Analysis                   | 10          |
| 1. Consideration of Supportive Evidence | 10          |
| 2. Criteria for "Justified Diagnoses"   | 12          |
| RESULTS .....                           | 14          |
| A. Types of Available Evidence          | 14          |
| B. Justified Diagnoses                  | 15          |
| C. Other Pulmonary Diseases             | 15          |
| DISCUSSION .....                        | 17          |
| SUMMARY .....                           | 20          |
| <br>TABLES                              |             |
| APPENDIX                                |             |
| REFERENCES                              |             |



According to annual national mortality statistics, there has been a fall in the death rate for pulmonary tuberculosis, and a rise in death rates for carcinoma of the lung and emphysema.<sup>1</sup> The cause of these trends is uncertain. They may reflect alterations in the actual nature of these diseases, but the trends may also be due to improved methods of prevention and therapy, and/or changes in diagnostic certification. The purpose of this research was to explore the third of these possibilities -- the role of changes in diagnostic tactics.

The mortality data of vital statistics have traditionally been used for assessing rates of disease, because the data are epidemiologically complete; a death certificate is prepared whenever someone dies. On the other hand, the use of death certificates as a source of data creates significant questions about the reliability of the data. The contents of the certificates will be affected by the variability of individual clinicians, by variations in nomenclature and coding, and by changes in diagnostic standards.<sup>2</sup> Although individual clinicians may apply the same diagnostic standards differently, a change in the standards themselves can affect the rates of disease more profoundly than any vicissitudes of the people who use the standards.

To analyze these events, this investigation was concerned with the diagnostic criteria and rates of occurrence of three major pulmonary



diseases -- tuberculosis, cancer, and emphysema -- during a span of 40 years at the New Haven Hospital.

### PROBLEMS IN DIAGNOSTIC CRITERIA

A clinician's diagnosis is based (1) on his ability to recognize and accurately identify clinical signs and symptoms, (2) on paraclinical aids -- including x-ray and laboratory data -- available at the time of diagnosis, and (3) on the standards used for interpretation of this information. Although a physician may precisely identify the clinical phenomena, the latter factors may alter his accuracy in diagnosis. The sections that follow are devoted to the refinements in paraclinical aids and the changes in diagnostic standards that have occurred for the three pulmonary diseases under survey.

#### 1. Tuberculosis

Tuberculosis provides a classic example of change in diagnostic standards. In 1920, the official Diagnostic Standards of the National Tuberculosis Association contained a section itemizing "minimum standards" for diagnosis of pulmonary tuberculosis in adults with negative sputum:

1. When constitutional signs and symptoms and definite past history are absent or nearly so, there should be demanded definite signs in the lungs, including persistent rales at one or both apices. By "persistent" it is meant that the rales must be present after cough at two or more examinations, the patient having been under observation at least one month.
2. In the presence of constitutional signs and symptoms such as loss of weight and strength, etc.,...there should be demanded some abnormality in the lungs, but not necessarily rales. X-ray evidence of apical infiltration may be of importance.





3. Usually a process at the apices should be considered tuberculous and a process at the base to be non-tuberculous until the contrary is proved, excepting when a clear history of pleurisy is present.

4. A hemorrhage [defined elsewhere as "expectorated blood, with or without sputum...when of one or two teaspoonsful"] is evidence of active pulmonary tuberculosis until the contrary is proved. [Publication notes that "blood streaks, blood spots, etc., may or may not mean tuberculosis."]

5. One should consider a typical pleurisy with effusion as presumptive evidence of tuberculosis....<sup>3</sup>

Later editions of this publication illustrate the increasing specificity of evidence demanded for diagnosis of this disease. In 1940:

If sputa and gastric washings are carefully and repeatedly examined,...negative results are of distinct diagnostic value. It can be safely said, that a patient with a demonstrable parenchymal infiltration in the lung that is apparently active, in whom tubercle bacilli cannot be demonstrated, probably has a non-tuberculous lesion.<sup>4</sup>

In 1961:

The demonstration of tubercle bacilli in clinical specimens is the one essential criterion in the definite diagnosis of active tuberculosis.<sup>5</sup>

These different statements show a change in the demands for demonstration of the tubercle bacillus. Moreover, the diagnostic criteria of 1920 would have permitted a designation of tuberculosis to be given to many respiratory diseases that would receive other diagnoses today. For example, hemoptysis, i.e., "hemorrhage", is no longer considered to be presumptive evidence of active pulmonary tuberculosis, but may be a symptom of many other diseases, including bronchogenic carcinoma. The more extensive modern availability and



use of radiographic techniques, cytologic and histologic evaluation, and other laboratory methods have helped traverse the gap between the clinical picture and the morphologic nature of disease, and thereby increase accuracy in diagnosis.

## 2. Carcinoma of the Lung

Ever since 1887, when Hampeln reported establishing the diagnosis of primary carcinoma of the lung in a patient five months before the diagnosis was verified post-mortem, the importance of microscopic diagnosis of the disease has been frequently investigated and verified.<sup>6, 7</sup> In 1935, Dudgeon and Wrigley, using a wet film method, demonstrated malignant cells in the sputa of patients with carcinoma of the lung or larynx.<sup>8</sup> In 1946, Papanicolaou applied his smear technique to sputa,<sup>9</sup> and the value of cytodiagnosis was verified soon after in controlled studies.<sup>10</sup>

Cytologic and roentgenologic methods complement each other in the diagnosis of lung cancer. A carcinoma less than one centimeter in diameter cannot be visualized with standard x-ray methods.<sup>11</sup> Although "...there is no characteristic roentgenographic picture of carcinoma of the lung which clearly distinguishes it invariably from other pulmonary lesions,"<sup>12</sup> radiography often discovers peripheral clinically silent lesions and, in general, provides precise localization of lesions.<sup>13</sup> Cytology is of particular value in diagnosis of centrally located lesions, which are often hidden on x-ray by hilar shadows.<sup>14</sup>

Histologic methods also aid in accurate diagnosis of pulmonary disease. Diagnostic lung puncture was first reported by Leyden in 1883, after he used this technique to obtain bacteriologic diagnosis



from a pneumonic lung.<sup>15</sup> Martin and Ellis later applied the procedure to diagnosis of neoplastic disease.<sup>16</sup> Since the development of alternative methods of obtaining histologic specimens, such as bronchoscopy and scalene node biopsy,<sup>17</sup> needle biopsy is much less frequently used, but is still advocated for "undiagnosed pleural effusions and peripheral bronchogenic tumors fixed to or invading the chest wall."<sup>18</sup>

Medical science has thus progressed to the point where many procedures are available to help determine the presence of lung cancer. But there is at present no one procedure which can be satisfactorily applied to all cases of suspected carcinoma of the lung. "A complete study may include bronchoscopy, bronchography, exfoliative cytology, scalene node biopsy, or early exploratory thoracotomy if doubt persists as to the diagnosis."<sup>19</sup>

### 3. Emphysema

Unlike demonstration of the tubercle bacillus in tuberculosis or the malignant cell in carcinoma of the lung, no single criterion is available to assure accurate clinical diagnosis for emphysema. Emphysema itself is defined in morphologic terms<sup>20</sup> yet, in most cases, the clinician must rely on radiographic examination and pulmonary function tests as guides to the presence of this morphologic entity.

The ambiguity of the clinical diagnosis of emphysema is illustrated by differing viewpoints about which radiologic findings -- including depression and flattening of diaphragms, blunting of costophrenic angles, irregular radiolucency of lung fields, enlarged chest cage, overinflation, and abnormal retrosternal space -- best



correlate with the anatomic findings.<sup>21-23</sup> According to one official statement on diagnostic standards, "except when bullae are present, roentgenologic examination cannot reliably distinguish between pulmonary emphysema and overinflation due to other causes."<sup>20</sup> Clinical manifestations of emphysema vary, and some patients may be asymptomatic with no abnormal physical signs, yet have morphologic evidence of emphysema upon examination of their lungs.<sup>20</sup>

In general, a reasonably good correlation has been found between pulmonary structure and function, and pulmonary function tests have been useful for diagnostic purposes.<sup>24</sup> There is no single function which definitively determines the presence of emphysema; however, certain ventilatory measurements, including forced expiratory volume per unit of time (usually FEV<sub>1</sub> sec.), forced expiratory flow (FEF<sub>200-1200</sub>, previously called maximum expiratory flow rate, MEF<sub>R</sub>), and pulmonary nitrogen washout curves correlate best with the presence of disease. Measurements of vital capacity and diffusing capacity are not as reliable.<sup>25-28</sup> Although the presence of airway obstruction generally correlates well with the presence of emphysema at necropsy, and although emphysema is usually associated with reduction in expiratory air flow, airway obstruction may exist without emphysema.<sup>26, 27, 29</sup> Thus, emphysema today remains a presumptive and recently popularized<sup>2</sup> clinical diagnosis, but it "...should only be applied to those cases in which, in the observer's opinion, the defined morbid anatomical changes of emphysema can confidently be asserted to be present."<sup>30</sup>

\* \* \*

From these statements, one can anticipate that diagnostic standards for tuberculosis, carcinoma of the lung, and emphysema





would be different today from what they were at various times in the past. This study seeks to determine how different these standards have been, and how these differences have been applied in the evaluation of patients.



MATERIALS AND METHODSA. CLINICAL MATERIAL

The study initially included all patients discharged from New Haven Hospital, during 1921, 1941, and 1961, with the diagnosis of pulmonary tuberculosis, carcinoma of the lung, or emphysema. The year 1921 was chosen for survey because it was the first year for which a cross-index system based on discharge diagnoses was established at the hospital; 1941 was selected because it occurred 20 years later while still preceding the advent of antibiotic therapy; 1961 was chosen because it marked the end of another twenty-year period, and because antibiotics were then available.

A search through the cross-index files of the hospital revealed 648 patients discharged during the survey years with the appropriate diagnoses. The details of the solicited and acquired case records are presented in Table 1.

Of these 648 cases, four records from 1921, 11 records from 1941, and 21 records from 1961 could not be located by the record room staff despite repeated searches between June 1967 and April 1968. Other case records were, after review, excluded from further analysis for the following reasons:

1. Several charts had apparently been cross-indexed incorrectly in the diagnostic file, and contained either no mention of hospital discharge during the survey years, or the patient was discharged after hospital admission for an illness unrelated to those under survey. One case from 1921, 43 cases from 1941, and 14 cases from 1961 were excluded on this basis.

2. Several patients with tuberculosis or carcinoma were



excluded because of uncertain diagnoses in which the disease was specified only as probable or suspected: the cases of questionable tuberculosis were 12 in 1921, four in 1941, and six in 1961; the cases of questionable cancer were two in 1941 and seven in 1961.

3. Several cases of inappropriate forms of emphysema were excluded. These were: one case of subcutaneous emphysema following trauma, 1921; one case of compensatory emphysema secondary to obstructive atelectasis, 1961; and two cases of "emphysema" in newborns, 1961.

The remaining 519 cases defined the study population.

#### B. EXTRACTION AND CODING

In each case record, the patient's entire clinical course was thoroughly reviewed. The review included all data obtained before and during the patient's hospitalization for the year under survey. The available diagnostic evidence was extracted on a special form according to a set of criteria established for the extraction (Appendix 1). An open-type form was used, in order to avoid omission of any clinical or ancillary paraclinical diagnostic evidence. The form used for the extraction of data is shown in Appendix 2. Critical diagnostic evidence obtained at any time before the survey admission, or after it but during the same year, was included and its source specifically identified.

After all the records were extracted, criteria were established (Appendix 3) for coding the extracted data onto eighty-column Hollerith coding sheets. All the extractions and coding were done and checked by the author. Hollerith (IBM) cards were then punched according to



the code, and the punched cards were then verified. The punching and verifying were done by two different people. A print-out of the coded data was then spot-checked by the author. After these verifications, the data were analyzed with an IBM Card Sorting Machine, according to procedures described in the next section.

In addition to analysis of data available to establish diagnosis of these three pulmonary diseases, a tabulation was made, for each index year, of the total number of hospital admissions and the number of admissions of other pulmonary diseases that might present a clinical picture similar to those of the three diseases under study. The latter included all the cases cited in the cross-index file of discharge diagnoses for a variety of pulmonary diseases (listed in Table 4).

### C. METHOD OF ANALYSIS

#### 1. Consideration of Supportive Evidence

Each diagnosed disease was analyzed separately for each survey year. Certain data were regarded as supportive evidence of diagnosis. When these findings were present, the evidence was marked "positive". The criteria for positive supportive evidence in each disease were as follows:

#### Tuberculosis:

##### a. Clinical evidence - presence of symptoms and/or signs.

- (1) Symptoms - included pulmonic or infectious symptoms, and/or systemic symptoms. (Pulmonic or infectious symptoms are those indicated in coding criteria columns 16-19, 21-23, Appendix 3. Systemic symptoms are anorexia, weakness and/or fatigability, significant malaise, and weight loss





of ten pounds or more.)

- (2) Signs - included intrapulmonic and/or extrapulmonic signs (see coding criteria columns 26-33, Appendix 3).
- b. Demonstration of tubercle bacillus - in sputum, bronchial secretions, gastric washings, pleural fluid, swab of lesion or biopsy specimen or histologic specimen itself.
- c. Positive chest x-ray - included identification of lesion and/or pleural effusion.
- d. Positive skin test.

Primary Carcinoma of the Lung:

- a. Clinical evidence - presence of appropriate symptoms and/or signs, as for tuberculosis.
- b. Positive histologic evidence - included bronchoscopic biopsy, lymph node (supraclavicular, axillary, paratracheal, or cervical), aspiration biopsy of mediastinum, needle biopsy of lung, or biopsy of lung or pericardium.
- c. Positive cytologic evidence - included sputum pap smear, pleural fluid or bronchoscopic cytology.
- d. Positive chest x-ray - included identification of lesion and/or pleural effusion.

Emphysema:

- a. Clinical evidence - presence of appropriate symptoms and/or extrapulmonic signs.
  - (1) Symptoms - as for tuberculosis.
  - (2) Extrapulmonic signs - included clubbing of nails, use of accessory muscles of respiration, cyanosis, or



increased A-P diameter of the chest.

- b. Positive chest x-ray - included x-ray report with statement of "emphysema" or "findings consistent with emphysema" or "grossly emphysematous configuration of the lung fields" or "probable emphysema" or mention of presence of bullae.
- c. Positive pulmonary function tests - at least "moderate" dysfunction, as indicated with standardized qualitative description found in all cases in which complete pulmonary function studies were done.

## 2. Criteria for "Justified Diagnoses"

After analysis of the different supportive evidence available for diagnosis of these diseases, criteria were established for a "justified diagnosis". A diagnosis was considered to be "justified" whenever any one of the conditions cited below was fulfilled:

### Pulmonary Tuberculosis:

- a. Positive x-ray and demonstration of tubercle bacillus; or
- b. Demonstration of tubercle bacillus and positive skin test; or
- c. Autopsy: pulmonary tuberculosis -- if patient died during survey admission.

### Primary Carcinoma of the Lung:

- a. Positive x-ray and either histologic or cytologic evidence, regardless of site; or
- b. Negative x-ray and primary site evidence (histologic or cytologic).

Note: Primary site = sputum cytology, bronchoscopic biopsy or cytology, or biopsy of lung or part, including needle biopsy.



Emphysema:

- a. Positive x-ray; or
- b. Positive pulmonary function tests.

Although the criteria cited for a diagnosis of pulmonary tuberculosis refer to active tuberculosis, there was no clear indication in most records whether the diagnosis of "pulmonary tuberculosis" referred to active or inactive disease. Those cases considered to have "unjustified diagnoses" according to the above criteria were, therefore, divided into two groups: those managed as if they had active tuberculosis, and those who did not receive antituberculosis therapy. For these purposes, "antituberculosis therapy" or "active management" consisted of any one of the following procedures: antituberculosis drug therapy; patient sent to sanatorium or sanatorium advised; recommendation of prolonged bed rest at home or outdoor employment in the country. Patients who had no "active management" were further subdivided into cases in which the diagnosis of tuberculosis was used to explain the clinical picture, and those in which it was not. If the patient was not treated as though he had active tuberculosis, and if this diagnosis was not used to explain the clinical picture, his diagnosis was removed from the final "unjustified" group. The final group of "unjustified diagnoses" of tuberculosis thus included those cases of the original "unjustified" group who received antituberculosis treatment or in whom the diagnosis of tuberculosis was used to explain the clinical picture.



## RESULTS

### A. TYPES OF AVAILABLE EVIDENCE

The different evidence available at time of diagnosis of tuberculosis, primary carcinoma of the lung, and emphysema is summarized in Table 2.

Of particular note is the frequency with which clinical evidence alone was used to establish diagnosis of tuberculosis and emphysema in 1921, and the increasing use of paraclinical evidence thereafter. In 1921, 40% of tuberculosis diagnoses were made on the basis of clinical evidence alone, as compared with only 2% and 6% of cases in 1941 and 1961. Although diagnosis of emphysema in a purely clinical manner also declined from 86% of cases in 1921 to 48% in 1941, 36% of diagnoses were still being made on this basis in 1961. In contrast, carcinoma of the lung was never diagnosed only with purely clinical evidence during these years.

The data also indicate an increased use of chest x-ray for diagnosis of tuberculosis and emphysema since 1921. Although 44% of diagnosed cases of tuberculosis in 1921 apparently had no chest x-ray taken, roentgenographic examination was done in nearly all cases in the more recent years, and the percentage of patients with positive x-rays also increased sharply. Diagnosis of emphysema without the aid of x-ray also decreased after 1921, although less dramatically than for tuberculosis. The rate of positive x-rays in cases diagnosed as emphysema also rose, from 14% in 1921 to 52% in 1941, but fell to 41% in 1961.

Carcinoma of the lung was nearly always diagnosed after x-ray, which was usually positive, during all three years. Cytologic and





histologic evidence have been used increasingly for this diagnosis since 1941. Forty-six per cent of cases during that year were diagnosed from positive x-ray, without supplementary histologic or cytologic verification; only 7% of cases were thus diagnosed in 1961.

In diagnosis of tuberculosis, demonstration of the tubercle bacillus increased, although to only 53% of cases in 1961. The incidence of administration of skin tests did not rise greatly, and the rate of positive skin tests rose only 7% to 23%.

#### B. JUSTIFIED DIAGNOSES

According to the criteria given previously for justified diagnosis of tuberculosis, carcinoma of the lung, and emphysema, accuracy of their diagnosis has increased during the survey period (Table 3). The frequency with which justified diagnoses of pulmonary tuberculosis were made rose steadily, from 24% of cases in 1921 to 50% in 1941 and 77% in 1961. Excluding the single case of carcinoma of the lung in 1921, which was apparently correctly diagnosed, accuracy in diagnosis of that disease has also increased, from 64% in 1941 to 94% in 1961. In contrast, although the percentage of justified diagnoses of emphysema rose from 14% in 1921 to 52% in 1941, accuracy improved only slightly to 57% in 1961. Indeed, if more stringent criteria are applied, i.e., bullae seen on x-ray and/or at least moderate expiratory resistance, only 16% of diagnoses in 1961 were justified.

#### C. OTHER PULMONARY DISEASES

Tabulation of the number of admissions to the same hospital



during 1921, 1941, and 1961 for diagnosed diseases that could present overlapping clinical pictures is given in Table 4. In Table 5, these numbers are divided by the total number of hospital admissions to provide the occurrence rates of hospitalization with respiratory illnesses during each year. Of interest is the decreasing annual incidence of tuberculosis, bronchitis and bronchiectasis, lung abscess and empyema, and pleurisy, as compared with the rise in occurrence of carcinoma of the lung, asthma, congestive heart failure and pulmonary edema, and Hodgkin's disease and lymphosarcoma. The diagnostic frequency of emphysema was highest in 1921, with a fall in 1941, and a later rise in 1961. This change in the "hospitalization" rate of emphysema is in marked contrast to its rising annual "mortality" rate, as noted in the data of the United States Vital Statistics reports.<sup>1, 2</sup>

Of particular note is the sharp decline after 1921 in total incidence of hospitalizations with any form of respiratory illness. The rate in 1921 was 1697 per 10,000 admissions; the rate of 570 in 1941 is similar to that in 1961.



## DISCUSSION

These results demonstrate, according to current standards, that accuracy in diagnosis of pulmonary tuberculosis, primary carcinoma of the lung, and emphysema has increased significantly since 1921.

As exemplified by tuberculosis, changes in diagnostic standards have been a key factor in more accurate diagnosis. Demonstration of the tubercle bacillus is crucial for diagnosis of active disease today, but was not in 1921, when clinical presumptive evidence alone was considered sufficient for diagnosis. The same signs and symptoms that are now known to indicate the presence of one or more of several other diseases, could thus be considered diagnostic of tuberculosis in 1921. Although a history of contact with active cases of tuberculosis was not analyzed as a variable in this study, it seems likely that such an epidemiologic history was an important factor at that time.

Advances in technology have helped produce more accurate diagnosis and diagnostic standards. Increased reliance on cytology and histology have reduced the instances in which carcinoma of the lung is diagnosed by x-ray and clinical evidence alone. Use of multiple diagnostic procedures, especially in cancer diagnosis, has compensated for the relative insensitivity of an individual biopsy and/or cytology specimen.

The literature indicates the variability and unreliability of clinical evidence and x-ray -- except when bullae are identified -- as indicators of the presence of emphysema. Pulmonary function tests are recognized as a valuable adjunct in correlating pulmonary structure and function in this disease. Yet by 1961, such tests were applied to only 20% of suspected cases. These data exemplify the way in which the incidence of diseases can "fluctuate with their fashions in clinical



diagnostic popularity."<sup>2</sup> Although official diagnostic standards have been established to provide fairly good correlation between the presumptive clinical diagnosis of emphysema and its morphologic existence, many clinicians utilize their own separate diagnostic standards, which rely on clinical evidence alone.

This study is limited by its approach. It considers only cases of diagnosed tuberculosis, lung cancer, and emphysema. It does not include all missed cases of these diseases. The one reported case in 1921 of carcinoma of the lung would probably be considered the same disease today. It seems likely, however, that other diagnoses of this disease were missed during that year, perhaps because the patients were asymptomatic, or perhaps because they presented with clinical pictures similar to other respiratory illnesses and were then misdiagnosed.

One can only guess as to what the many "unjustified" diagnoses of tuberculosis, carcinoma of the lung, and emphysema in the past would be called today. It is important to realize that the changing incidence rates of hospital diagnoses shown in Table 5 are distorted to the extent that hospitalizations during these different years were the result of varied iatrotropic stimuli. Thus, what brought people to the hospital in 1921 may not have caused them to be hospitalized in 1941 and 1961. Having noted these qualifications, one can at best speculate as to the true nature of misdiagnosed illnesses, and wonder only at such examples as the increasing annual incidence of asthma, congestive heart failure and pulmonary edema, and the decrease of pleurisy. The marked decline after 1921 in incidence of hospitalization for the cited respiratory diseases cannot be attributed to the advent of antibiotics; antibiotics were not yet available in 1941. The





decline may represent changes in diagnostic standards, altered hospital admission policies, or both.

This study is not intended to condemn past diagnosis with the aid of a knowledgeable "retrospectoscope". Clinicians of the past did not have the paraclinical tests now available to help convert bedside evidence into accurate diagnosis. Indeed, forty years from today, when there may exist a more satisfactory way of diagnosing emphysema, a reviewer of the 1968 diagnoses of this disease will probably pity the poor clinician who had to rely on presumptive clinical evidence for diagnosis.

This study emphasizes the dangers of comparing the incidence rates of chronic pulmonary disease -- in particular tuberculosis, carcinoma of the lung, and emphysema -- diagnosed at different times and with different diagnostic standards. The results suggest that a substantial part of the reported change in incidence of these diseases may merely reflect a change in diagnostic standards.



SUMMARY

This study explores the effects of changing criteria on the diagnosis of pulmonary tuberculosis, carcinoma of the lung, and emphysema during a span of 40 years at the New Haven Hospital.

The data available to establish diagnosis were analyzed for 519 cases discharged with one or more of these diagnoses in 1921, 1941, or 1961. The results indicate decreasing reliance on clinical signs and symptoms alone to establish diagnosis of tuberculosis and emphysema. The diagnostic evidence was exclusively clinical for tuberculosis in 40% of cases in 1921, in 2% in 1941, and in 6% in 1961; for emphysema, in 86% of cases in 1921, 48% in 1941, and 36% in 1961. In contrast, cancer of the lung was usually diagnosed after positive x-ray during all three survey years; however, 46% of diagnoses in 1941 were made without supplementary histologic or cytologic verification, whereas only 7% of cases were thus diagnosed in 1961. For tuberculosis, the tubercle bacillus was demonstrated with increasing frequency during the survey period, rising from 16% in 1921 to 53% of cases in 1961.

After analysis of the different supportive evidence available for diagnosis of these diseases, criteria were established for a "justified diagnosis". According to these criteria, accuracy in diagnosis has increased: for tuberculosis, from 24% of cases in 1921 to 50% in 1941, and 77% in 1961; for carcinoma of the lung -- excluding the single "justified" case in 1921 -- 64% in 1941, and 94% in 1961; for emphysema, 14% in 1921, 52% in 1941, and 57% in 1961.

In order to obtain clues as to the true nature of these "unjustified diagnoses" of tuberculosis, cancer of the lung, and emphysema, tabulation was made of the total hospitalizations and the number of



admissions to the same hospital with diagnosed illnesses that could present a clinical picture similar to those of the diseases under study.

The results of this study thus suggest that a substantial part of the reported change in incidence of pulmonary tuberculosis, carcinoma of the lung, and emphysema may be a consequence of change in diagnostic standards.



TABLE 1

CLINICAL MATERIAL

|                          | <u>1921</u> | <u>1941</u>                | <u>1961</u>                 |
|--------------------------|-------------|----------------------------|-----------------------------|
| PULMONARY TUBERCULOSIS   |             |                            |                             |
| No. of cases listed      | 65          | 146                        | 91                          |
| No. of cases missing     | 3           | 3                          | 2                           |
| No. of cases excluded    | 12          | 21                         | 10                          |
| no. of cases studied     | 50          | 122                        | 79                          |
| CARCINOMA OF THE LUNG    |             |                            |                             |
| No. of cases listed      | 1           | 50                         | 105                         |
| No. of cases missing     | 0           | 8                          | 13                          |
| No. of cases excluded    | 0           | 18                         | 9                           |
| No. of cases studied     | 1(1° Ca)    | 24(22=1° Ca)<br>(2=2° Ca)† | 83(68=1° Ca)<br>(15=2° Ca)† |
| PULMONARY EMPHYSEMA      |             |                            |                             |
| No. of cases listed      | 17          | 36                         | 125                         |
| No. of cases missing     | 1           | 0                          | 6                           |
| No. of cases excluded    | 2           | 10                         | 11                          |
| No. of cases studied     | 14          | 26                         | 108                         |
| CO-MORBIDITY*            |             |                            |                             |
| Tuberculosis & Emphysema | 0           | 1                          | 7                           |
| Tuberculosis & Carcinoma | 0           | 1(2° Ca)†                  | 1(1° Ca)                    |
| Emphysema & Carcinoma    | 0           | 0                          | 2(1° Ca)                    |
| TOTAL CASES STUDIED      |             |                            |                             |
| Tuberculosis             | 50          | 124                        | 87                          |
| Carcinoma of the lung    | 1           | 25                         | 86                          |
| Emphysema                | <u>14</u>   | <u>27</u>                  | <u>117</u>                  |
| Total                    | 65          | 174††                      | 290††                       |

\*All cases listed were studied.

†After record was obtained, these cases were discovered to have secondary (metastatic) lung cancer and were excluded from further analysis.

††Totals include multiple entries of cases with more than one of the diseases under investigation.





TABLE 2

DIFFERENT EVIDENCE USED TO DIAGNOSE  
TUBERCULOSIS, CARCINOMA, AND EMPHYSEMA

|                                                        | <u>1921</u> | <u>1941</u> | <u>1961</u> |
|--------------------------------------------------------|-------------|-------------|-------------|
| <b>TUBERCULOSIS</b>                                    |             |             |             |
| Total Cases                                            | 50          | 124         | 87          |
| Clinical Evidence Only                                 | 20 (40%)    | 3 (2%)      | 5 (6%)      |
| AFB Shown During Life                                  | 8 (16%)     | 52 (42%)    | 46 (53%)    |
| Positive Chest X-ray                                   | 25 (50%)    | 118 (95%)   | 74 (85%)    |
| Chest X-ray Not Done                                   | 22 (44%)    | 1 (1%)      | 3 (3%)      |
| Positive Skin Test                                     | 8 (16%)     | 22 (18%)    | 20 (23%)    |
| Skin Test Not Done                                     | 42 (84%)    | 94 (76%)    | 64 (74%)    |
| <b>PRIMARY LUNG CANCER</b>                             |             |             |             |
| Total Cases                                            | 1           | 22          | 71          |
| Clinical Evidence Only                                 | 0 (0%)      | 0 (0%)      | 0 (0%)      |
| Positive Chest X-ray                                   | 1 (100%)    | 21 (95%)    | 63 (89%)    |
| Chest X-ray Not Done                                   | 0 (0%)      | 0 (0%)      | 2 (3%)      |
| Histologic Evidence                                    | 1 (100%)    | 11 (50%)    | 52 (73%)    |
| Cytologic Evidence                                     | 0 (0%)      | 2 (9%)      | 30 (42%)    |
| Positive X-ray; No Histologic<br>or Cytologic Evidence | 0 (0%)      | 10 (46%)    | 5 (7%)      |
| <b>EMPHYSEMA</b>                                       |             |             |             |
| Total Cases                                            | 14          | 27          | 117         |
| Clinical Evidence Only                                 | 12 (86%)    | 13 (48%)    | 42 (36%)    |
| Positive Chest X-ray                                   | 2 (14%)     | 14 (52%)    | 48 (41%)    |
| Chest X-ray Not Done                                   | 5 (36%)     | 4 (15%)     | 7 (6%)      |
| Bullae on X-ray                                        | 0 (0%)      | 0 (0%)      | 6 (5%)      |
| Abnormal Pulmonary Fcn. Tests                          | 0 (0%)      | 0 (0%)      | 34 (29%)    |
| Pulm. Fcn. Not Tested                                  | 14 (100%)   | 27 (100%)   | 94 (80%)    |
| Bullae + Abnormal Pulm. Fcn.                           | 0 (0%)      | 0 (0%)      | 38 (32%)    |
| Bullae + Significant Expiratory<br>Resistance          | 0 (0%)      | 0 (0%)      | 19 (16%)    |



TABLE 3

OCCURRENCE RATES OF "JUSTIFIED" DIAGNOSES

|                           | <u>1921</u>    | <u>1941</u>     | <u>1961</u>     |
|---------------------------|----------------|-----------------|-----------------|
| PULMONARY TUBERCULOSIS*   | 12/50<br>(24%) | 62/124<br>(50%) | 67/87<br>(77%)  |
| PRIMARY CARCINOMA OF LUNG | 1/1<br>(100%)  | 14/22<br>(64%)  | 67/71<br>(94%)  |
| PULMONARY EMPHYSEMA       | 2/14<br>(14%)  | 14/27<br>(52%)  | 67/117<br>(57%) |

Numerators = number of cases with "justified" diagnoses.  
Denominators = total number of cases with indicated diagnosis.

\*According to modified diagnostic criteria cited in text.



TABLE 4NUMBER OF HOSPITALIZATIONS WITH VARIOUS  
RESPIRATORY ILLNESSES AT NEW HAVEN HOSPITAL

| <u>DISEASE GROUP</u>                                                                                               | <u>1921</u> | <u>1941</u> | <u>1961</u> |
|--------------------------------------------------------------------------------------------------------------------|-------------|-------------|-------------|
| Pneumonia, Aspiration Pneumonia,<br>Bronchopneumonia                                                               | 9           | 246         | 548         |
| Bronchitis, Bronchiectasis                                                                                         | 14          | 169         | 203         |
| Actinomycosis, Hydatid Cyst,<br>Amebiasis, Paragonimiasis,<br>Blastomycosis, Histoplasmosis,<br>Coccidioidomycosis | 1           | 2           | 1           |
| Pulmonary Infarction, Pulmonary<br>Embolism                                                                        | 16          | 41          | 66          |
| Lung Abscess, Empyema                                                                                              | 18          | 62          | 20          |
| Pleurisy (Nontuberculous)                                                                                          | 12          | 25          | 25          |
| Pneumothorax                                                                                                       | 6           | 10          | 35          |
| Asthma                                                                                                             | 0           | 0           | 99          |
| Hodgkin's Disease, Lymphosarcoma                                                                                   | 0           | 5           | 41          |
| Pneumoconioses, Farmer's Lung                                                                                      | 0           | 10          | 11          |
| Pulmonary Sarcoidosis                                                                                              | 0           | 0           | 1           |
| Congestive Heart Failure,<br>Pulmonary Edema                                                                       | 1           | 21          | 154         |
| Pulmonary Tuberculosis                                                                                             | 50          | 124         | 87          |
| Carcinoma of Lung (All Types)                                                                                      | 1           | 25          | 86          |
| Pulmonary Emphysema                                                                                                | 14          | 27          | 117         |



TABLE 5

INCIDENCE RATES OF HOSPITALIZATION WITH  
VARIOUS RESPIRATORY ILLNESSES AT NEW HAVEN HOSPITAL

|                                                                                                                    | <u>1921</u>  | <u>1941</u> | <u>1961</u> |
|--------------------------------------------------------------------------------------------------------------------|--------------|-------------|-------------|
| TOTAL NUMBER OF HOSPITALIZATIONS                                                                                   | 836          | 13,106      | 28,439      |
| DISEASE GROUP (Incidence/10 <sup>4</sup> Adm.):                                                                    | <u>RATES</u> |             |             |
| Pneumonia, Aspiration Pneumonia,<br>Bronchopneumonia                                                               | 108          | 188         | 193         |
| Bronchitis, Bronchiectasis                                                                                         | 167          | 129         | 72          |
| Actinomycosis, Hydatid Cyst,<br>Amebiasis, Paragonimiasis,<br>Blastomycosis, Histoplasmosis,<br>Coccidioidomycosis | 12           | 2           | <1          |
| Pulmonary Infarction, Pulmonary<br>Embolism                                                                        | 191          | 31          | 23          |
| Lung Abscess, Empyema                                                                                              | 215          | 47          | 7           |
| Pleurisy (Nontuberculous)                                                                                          | 144          | 19          | 9           |
| Pneumothorax                                                                                                       | 72           | 8           | 12          |
| Asthma                                                                                                             | 0            | 0           | 35          |
| Hodgkin's Disease, Lymphosarcoma                                                                                   | 0            | 4           | 14          |
| Pneumoconioses, Farmer's Lung                                                                                      | 0            | 8           | 4           |
| Pulmonary Sarcoidosis                                                                                              | 0            | 0           | <1          |
| Congestive Heart Failure,<br>Pulmonary Edema                                                                       | 12           | 16          | 54          |
| Pulmonary Tuberculosis                                                                                             | 597          | 95          | 31          |
| Carcinoma of Lung (All Types)                                                                                      | 12           | 19          | 30          |
| Pulmonary Emphysema                                                                                                | <u>167</u>   | <u>20</u>   | <u>41</u>   |
| TOTAL INCIDENCE RATES OF ABOVE<br>RESPIRATORY ILLNESSES                                                            | 1697         | 570         | 527         |





Criteria for Extraction: Diagnostic Evidence Study

Age: as recorded in admission note, or by calculation from Date of Birth & Zero Time.

Race: as recorded in diagnostic sheet or adm. note.

Year: Index year. If Zero Time occurred in previous year, put that year in parenthesis. Zero Time = date of first discharge at which the target diagnosis was recorded.

Dx: TBC, EMPH, or CA -- or combinations. Specify whether 1° Ca lung or 2° Ca.

Iatrotropic Stimulus: Record only if it is not one of the symptoms. Use "→" to point to the symptom(s), cited in the next section, that acted as iatrotropic stimulus.

Symptoms: Respiratory or allied complaints cited in "Present Illness" or in progress notes. "Allied complaints" = fever, weight loss, sweats, etc. Severity of disease = total effect on patient's ability to work or to perform acts of daily life.

Signs: Omit pulmonary findings except location. Record location as RUL (R. upper lobe), RLFP (R. lower field, posteriorly) or other appropriate abbreviations. [Keep track of abbreviations.] Clubbing, ↑A-P diam., use of access. muscles: Record only if unequivocal.

Other: Includes cyanosis, etc.

Chest X-Ray: Location of lesion: use lobes or fields (e.g., RUL, LLF), or other designations as appropriate. Cavity, abscess, empyema, effusion: Use ± if equivocal (otherwise no symbol), and cite location.

Evidence for TBC

Skin Test: Circle the preparation (TbcIn or PPD) that was used; record strength; indicate results as positive (⊕), equivocal (⊕±), negative (⊖), or not done (ND). Sputum smear and sputum culture for TBC: record only the result, using symbols as above. Gastric washing: is usually injected in a guinea pig. Note if done otherwise, or if some other substance was injected in the guinea pig.

Other Skin Tests: Record only the reaction as ⊕, ⊖, ⊕±, or ND. Note appropriately if some other test (e.g., complement fixation) was used.

Sputum Pap Smear: Record number positive per number done. E.G., 2/6 means 2 pos. and 4 neg. tests. Use a middle section for equivocals, e.g., 0/4/6 means 0 pos., 4 equivocal and 2 neg. tests.



- 2 -

Bronchoscopy: Record as ND, Neg., or location of observed lesion.  
(Don't describe lesion unless it was a mass; if so, record "mass").  
Enter results, if available, of Bronchial washings (for TBC or CA)  
or of biopsy.

Pleural Fluid: When available (otherwise "NA"); describe as bloody,  
serosanguinous, amber, or purulent, according to gross description.  
Record any pertinent smears, cytologic tests, or cultures.  
"Pertinent" - in regard to TBC or CA.

Biopsy: Record results of biopsy of any structure other than bronchus.  
If not pos. for TBC, EMPH, or CA, record as ⊖ .

Resp. Fcn. Tests: Record degree (slight, moderate, severe) of respiratory  
impairment for each of categories cited in chart:

Pulmonary distention  
Pulmonary restriction  
Impaired dynamic function  
Impaired respiratory gas mixing  
Impaired oxygenation  
Venous admixture  
Hyperventilation  
Expiratory resistance

Disposition: Record anti-tuberculous Rx by name (not dose), e.g., Strep.  
& INH. If pt. had surgery, note what was done (e.g., R. upper  
lobectomy) and the diagnostic finding in the removed specimen  
(e.g., TBC granuloma & pos. AFB smear).



DIAGNOSTIC EVIDENCE STUDY

---

|      |     |     |      |      |    |
|------|-----|-----|------|------|----|
| Name | Age | Sex | Race | Year | Dx |
|------|-----|-----|------|------|----|

---

Iatro. Stim.:

Symptoms:

Chest X-ray

Location of Lesion:

Cavity:

Empyema:

Abscess:

Effusion:

Other:

---

Evidence for TBC

Skin Test TbcIn PPD:

Sputum Smear:

Sputum Culture:

Gastric Washing:

Other:

Severity of Disease

Other Skin Tests

Histoplasmin:

Coccidoidin:

Other:

---

Signs: Location:

Clubbing:

↑A-P diam:

Access. Muscles:

Other:

Sputum Pap Smear:

Bronchoscopy:

Pleural Fluid:

---

Other:

Smoking:

Biopsy:

Resp. Fcn. Tests:

---

Disposition (Rx., etc.)



CODING CRITERIA

(For Hollerith Card)

(1), (2), (3): CODING NUMBER

(4), (5): AGE

Years as of last birthday

00 = unknown

01 = one year or less

(6): SEX AND RACE

1: male, white

2: male, Negro

3: male, race unknown or other

4: female, white

5: female, Negro

6: female, race unknown

(7): DIAGNOSIS

Tuberculosis - 1

Emphysema - 2

Carcinoma Lung - 4

(For combinations of above, add numbers.)

(8): SURVEY YEAR

1: 1921

2: 1941

3: 1961

(9): ZERO TIME

0: same as survey year

1: 0-1 year preceding survey year

2: >1 year and <5 years preceding

3: >5 years and <10 years preceding

4: >10 years preceding

5: "chronic"

6: unknown

(10): SOURCE OF DIAGNOSTIC EVIDENCE CITED

0: survey year admission only (or <2 weeks preceding admission)

1: survey year adm. + zero time

2: survey year + within one year previous (hosp. or clinic)

3: survey year + time between then and zero time





- 2 -

SMOKING STATUS AND HABITS

- (11): 0: inapplicable or no mention of change in status  
 1: stopped smoking before \* event (\* event = symptoms related to tbc., emph., or Ca.)  
 2: changed smoking before \* event but continued smoking  
 3: stopped smoking after onset of \* event  
 4: changed smoking after \* event but continued smoking  
 5: stopped smoking in past; when?

- (12): customary cigarettes (most common mode prior to \* event)  
 0: none or rare  
 1: <1/2 pack/day  
 2: 1/2 - 1  
 3: 1  
 4: 1-2  
 5: 2  
 6: >2  
 7: unknown

- (13): other tobacco habits
- |                                   |     |
|-----------------------------------|-----|
| no mention of other habits        | - 0 |
| pipes                             | - 1 |
| cigars                            | - 2 |
| snuff or chewed                   | - 4 |
| uses tobacco but category unknown | - 9 |

(14): COMPLAINANT STATUS

- 0: not applicable; autopsy discovery  
 1: Complaints due to pulm. symptoms.  
 2: Pulm. symptoms; complaints due to other situation.  
 3: Pulm. symptoms; complaints due to these + other situation.  
 4: No pulm. symptoms; complaints due to other situation.  
 5: Complaints of ? attribution. (Pt. may or may not have other symptoms attributed to lung.)  
 6: Symptoms of ? attribution or ? existence; complaints due to other situation.  
 7: Complaints not clearly determined.

(15): IATROTROPIC STIMULUS

- 0: not applicable (0, 1, 7 above)  
 1: Sx. of other disease; probably unrelated to T.E.C. (tuberculosis, emphysema or carcinoma)  
 2: Sx. of other disease; relation to T.E.C. unclear.  
 3: Sx. of other disease; probably related to T.E.C.  
 4: regular follow-up of a chest disease  
 5: abnormal finding on chest x-ray



- 3 -

SYMPTOMS

- (16): DOE - 1  
 PND or dyspnea - 2  
 orthopnea - 4
- (17): cough (not otherwise specified) - 1  
 cough, nonproductive - 2  
 cough, productive - 4
- (18): gross hemoptysis - 1  
 blood-streaked sputum - 2  
 foul-smelling sputum - 4
- (19): pleuritic chest pain - 1  
 nonpleuritic chest pain - 2  
 unknown re pleuritic character - 4  
 "tightness", "pressure" or "vague ache" in chest - 5
- (20): anorexia - 1  
 weakness and/or fatigability - 2  
 significant malaise - 4
- (21): night sweats - 1  
 chills, fever or sweats - 2  
 cyanosis - 4
- (22): "chronic bronchitis" - 1  
 "asthma" - 2  
 subjective wheezing - 4
- (23): "URI" or "cold" - 1  
 unresolving "pneumonia" - 2  
 "flu" or "grippe" - 4
- (24): hoarseness - 1  
 dysphagia - 2
- (25): involuntary weight loss  
 0: none or unk. (unknown)  
 1: <10 lb.  
 2: 10-19 lb.  
 3: 20 lb.  
 4: >20 lb.  
 7: amount not indicated



SIGNS

LOCATION

(26): right side

- 0: not applicable (lungs clear or no specified location)
- 1: right lung, next digit = lobe
- 2: right lung, next digit = field
- 3: rales, wheezes or rhonchi - diffuse (next digit = 0)
- 4: rales, wheezes or rhonchi - next digit = field
- 9: no data-P.E. (+) at zero time or since (next 3 digits = 0)

(27): lobe code

- 0: not applicable or unk.
- 1: upper
- 2: middle
- 3: upper and middle
- 4: lower
- 5: upper and lower
- 6: middle and lower
- 7: all 3 lobes

field code

- 0: not applicable or unk.
- 1: apex
- 2: upper
- 3: middle
- 4: lower
- 5: base
- 6: apex and base

(28): left side

- 0: not applicable
- 1: left lung, next digit = lobe
- 2: left lung, next digit = field
- 3: rales, wheezes or rhonchi - diffuse (next digit = 0)
- 4: rales, wheezes or rhonchi - next digit = field

(29): lobe code

- 0: not applicable or unk.
- 1: upper
- 2: lower
- 3: both lobes

field code

- 0: not applicable or unk.
- 1: apex
- 2: upper
- 3: lower
- 4: base
- 5: apex and base

(30): CLUBBING

- ND (no data) - 0
- (+) - 1
- (-) or (±) - 2

(31): accessory muscles - 1  
cyanosis - 2

(32): A-P DIAMETER

- ND or not increased - 0
- ↑A-P diameter or "barrel-shaped chest" - 1
- "emphysematous chest" - 2



(33): LYMPHADENOPATHY

none or ND - 0  
 axillary - 1  
 cervical - 2  
 supraclavicular - 4

CHEST X-RAYLOCATION OF LESION(34): right side

0: not applicable (no specified location)  
 1: right lung, next digit = lobe  
 2: right lung, next digit = field  
 3: mediastinum only (next digit = 0)  
 4: No x-ray done this adm.; data from zero time or since.  
 8: No x-ray done this adm.; x-ray at or since zero time,  
     reading unk. (next five digits = 0)  
 9: X-ray not done (next five digits = 0)

(35): lobe code

0: not applicable or unk.  
 1: upper  
 2: middle  
 3: upper and middle  
 4: lower  
 5: upper and lower  
 6: middle and lower  
 7: all 3 lobes

field code

0: not applicable or unk.  
 1: apex  
 2: upper  
 3: middle  
 4: hilum or mediastinum  
 5: lower  
 6: base  
 7: apex and hilum

(36): left side

0: not applicable  
 1: left lung, next digit = lobe  
 2: left lung, next digit = field  
 3: mediastinum only  
 4: no x-ray done this adm.; data from zero time or since.

(37): lobe code

0: not applicable or unk.  
 1: upper  
 2: lingula  
 3: upper and lingula  
 4: lower  
 5: upper and lower  
 6: lingula and lower  
 7: all lobes  
 9: middle lobe (anomalous)

field code

0: not applicable or unk.  
 1: apex  
 2: upper  
 3: middle  
 4: hilum or mediastinum  
 5: lower  
 6: base  
 7: apex and hilum





- (38): cavity - 1
  - abscess - 2
  - empyema - 4
  - primary Ghon focus (in cases not diagnosed as tbc.) - 8
  - healed or fibrotic apical tbc. (in cases not dxed. as tbc.) - 9
  
- (39): effusion
  - 0: none or unk.
  - 1: right
  - 2: left
  - 3: both

X-RAY EVIDENCE FOR EMPHYSEMA (inapplicable, = 0, in all cases not diagnosed as emphysema, unless "emphysema" is stated in x-ray)

- (40): 0: inapplicable (no dx. of emph. or no mention of emph. in x-ray)
- 1: X-ray not done.
- 2: X-ray negative for "emphysema" (i.e., x-ray diagnosis or conclusion thereof).
- 3: X-ray positive for "emphysema".
- 6: X-ray negative for "emphysema"; bronchogram done.
- 7: X-ray positive for "emphysema"; bronchogram done.
- 9: "Findings consistent with emphysema"  
or "grossly emphysematous configuration of the lung fields"  
or "probable emphysema"
  
- (41): bullae - 1
  - flattened diaphragms - 2
  - ↑A-P diameter - 4
  
- (42): fibrosis - 1
  - "chronic lung disease" or  
"chronic bronchopulmonary disease" - 2
  - "area of focal emphysema" - 4

TUBERCULOSIS EVIDENCE

SKIN TEST

- (43): type
  - none indicated - 0
  - old tuberculin - 1
  - PPD - 2
  - unk. type - 4
  
- (44): PPD - test strength
  - 0: not applicable
  - 1: not listed
  - 2: 1st
  - 3: intermediate
  - 4: 2nd



- 7 -

- (45): O.T. - test strength  
 0: not applicable  
 1: 1/10 mg.  
 2: 1/50  
 3: 1/100  
 4: 1/500  
 5: 1/1000  
 6: 1/10,000  
 9: unk.
- (46): reading (If positive - weakest dilution positive.  
 If negative only - strongest dilution negative.)  
 0: not applicable  
 1: (+) 48 hrs.  
 2: (-) 48 hrs.  
 3: (±) 48 hrs.  
 4: reading not recorded  
 5: (+) in past; ND this adm.  
 6: (-) in past; ND this adm.

SPUTUM

- (47): mode of collection  
 not done - 0  
 unspecified - 1  
 Ad. Hoc. - 2  
 24 hour - 4
- (48): mode of concentration  
 unspecified - 1  
 not concentrated (direct) - 2  
 conc. - 4  
 mode of collection unspecified; result = atypical AFB - 9  
 (Note: 09 implies ND this adm., atypical AFB at zero time)  
 [There was no occurrence of combinations of 9 with 1, 2 or 4]
- (49): result  
 0: not done or ND (no data)  
 1: 0/1 tests positive  
 2: 0/many  
 3: 1/1  
 4: 1/many  
 5: >1/many  
 6: results?  
 7: (+) in past; not done this adm.  
 8: (+) in past; (-) this adm.  
 9: (-) in past; not done this adm.



(50): GASTRIC WASHING

- 0: not done or ND
- 1: inoculated into guinea pig (GP); results (+)
- 2: inoculated into GP; results (-)
- 3: not specified re GP; results (+)
- 4: not specified re GP; results (-)
- 5: results?
- 6: (+) in past; not done this adm.
- 7: (+) zero time or since; (-) this adm.
- 9: (-) in past; not done this adm.

(51): BRONCHIAL SECRETIONS

- 0: ND
- 1: (+) AFB
- 2: (-) AFB
- 5: results?
- 6: (+) in past; not done this adm.
- 7: (-) in past; not done this adm.

(52): PLEURAL FLUID

- 0: ND
- 1: (+) AFB
- 2: (-) AFB
- 5: results?
- 6: (+) in past; not done this adm.
- 7: (-) in past; not done this adm.

(53): URINE

- 0: ND
- 1: (+) AFB
- 2: (-) AFB
- 5: results?
- 8: (-) in past; not done this adm.
- 9: (+) in past; not done this adm.

(54): STOOL

- 0: ND
- 1: (+) AFB
- 2: (-) AFB
- 5: results?
- 8: (-) in past; not done this adm.
- 9: (+) in past; not done this adm.



(55): SWAB FROM LESION OR BIOPSY SPECIMEN

- 0: ND
- 1: (+) AFB
- 2: (-) AFB
- 5: results?

OTHER SKIN TESTS

(56): HISTOPLASMIN

- 0: not done or ND
- 1: (+) 48 hrs.
- 2: (-) 48 hrs.
- 5: results?
- 6: ND; (+) in past
- 7: ND; (-) in past

(57): COCCIDIOIDIN

- 0: not done or ND
- 1: (+) 48 hrs.
- 2: (-) 48 hrs.
- 5: results?
- 6: ND; (+) in past
- 7: ND; (-) in past

(58): BLASTOMYCIN

- 0: not done or ND
- 1: (+) 48 hrs.
- 2: (-) 48 hrs.
- 5: results?
- 6: ND; (+) in past
- 7: ND; (-) in past

(59): SPUTUM PAP SMEAR

- 0: not done or ND
- 1: none positive
- 2: none positive; at least one equivocal
- 3: only one positive
- 4: two or more positive
- 5: results?
- 7: (-) this adm. - (+) in past
- 8: ND this adm. - (+) in past
- 9: ND this adm. - (-) in past





- 10 -

BRONCHOSCOPYGROSS FINDINGS

## (60): location

|                    |     |
|--------------------|-----|
| ND or not done     | - 0 |
| trachea or carina  | - 1 |
| main stem bronchus | - 2 |
| other              | - 4 |
| negative           | - 8 |
| done, results?     | - 9 |

## (61): description

|                        |     |
|------------------------|-----|
| none or not applicable | - 0 |
| mass                   | - 1 |
| bleeding or friable    | - 2 |
| other lesion           | - 4 |

(62): PATHOLOGIC FINDINGS

- 0: Test(s) done, none positive.
- 1: Positive biopsy and cytology.
- 2: Positive biopsy; cytology not positive, but done.
- 3: Positive biopsy; cytology not done.
- 4: Biopsy not done; cytology positive.
- 5: Biopsy not positive; cytology positive.
- 7: No tests done or tests unsatisfactory.
- 8: Results unk.
- 9: Biopsy negative; positive at zero time.  
     or Biopsy not done; positive at zero time (if 60=0).

PLEURAL FLUID

## (63): gross description

- 0: none noted or no thoracentesis performed
- 1: "yellow", "straw-colored", "amber", "serous" or  
     "normal" in appearance
- 2: serosanguinous
- 3: bloody
- 4: purulent
- 7: Specimen removed but not described.

## (64): cytology - cell block (pleural fluid)

- 0: none positive
- 1: none positive; at least one equivocal
- 2: only one positive
- 3: two or more positive
- 7: unk. or not done



BIOPSYLOCATION

(65): supraclavicular or scalene node - 1  
 axillary node - 2  
 paratracheal node - 4  
 aspiration biopsy - mediastinum - 9

(66): cervical node - 1  
 pleura - 2  
 lung or lobe (or part) - 4  
 pericardium - 8  
 needle biopsy - lung - 9

(67), (68): HISTOLOGY CODE

- 10: epidermoid (squamous-cell) carcinoma  
 (Use if Ep. Ca. is not further specified.)  
 11: highly differentiated; "well differentiated"  
 12: mod. diff. or differentiated  
 13: slightly differentiated; poorly diff.; mod. undifferentiated  
 14: "anaplastic Ep. Ca."; pleomorphic epidermoid Ca.  
 15: undifferentiated; dedifferentiated Ep. Ca.  
 19: Biopsy not done this adm.; (+) for Ep. Ca. at zero time.
- 20: small-cell carcinoma  
 21: oval-cell structure ("oat cell Ca.")  
 22: polygonal cell structure
- 30: adenocarcinoma (mucinous adenocarcinoma)  
 31: acinar; scirrhous adeno Ca.  
 32: papillary (alveolar cell); bronchiolar Ca.  
 33: chiefly "large cells"  
 34: "anaplastic adeno Ca."  
 35: "undiff. adeno Ca."; "poorly diff. adeno Ca."  
 38: adeno Ca. + bronchiolo-alveolar Ca.  
 39: Biopsy not done this adm.; (+) for adeno Ca. at zero time.
- 40: large-cell undifferentiated carcinoma  
 41: giant-cell anaplastic  
 42: pleomorphic  
 43: plexiform
- 50: combined epidermoid and adenocarcinoma  
 51: combined small-cell and adenocarcinoma  
 55: "anaplastic Ca."; poorly diff. Ca.; undiff. Ca.  
 56: "bronchogenic carcinoma"  
 57: "carcinoma" (type unspecified); malignant tumor cells  
 (type unspecified)  
 59: Biopsy not done this adm.; (+) for undiff. Ca. at zero time.



- 60: bronchial adenoma (type unspecified)
  - 61: carcinoid type
  - 62: cylindroid type
  - 69: Biopsy not done this adm.; cylindroid type (+) at zero time.
- 70: mesodermal tumor (type unspecified)
  - 71: fibroma
  - 72: fibrosarcoma
- 76: cancer other than Ca. lung
- 77: "metastatic cancer"
- 80: tuberculosis
  - 81: tuberculoma
  - 82: partial lobectomy in past for tbc.; path. unk.
- 90: Biopsy neg. for tbc.

PULMONARY FUNCTION STUDIES

- (69): 0: not done or ND
  - 1: slight resp. impairment (if no categories more than slight)
  - 2: moderate resp. impairment (if no categories more than mod.)
  - 3: marked resp. impairment (if only one function is severe)
  - 4: severe resp. impairment (if at least two parameters are severe)
  - 7: abbreviated study - before thoracic surgery
- (70): expiratory resistance
  - 0: ND or not done
  - 1: none
  - 2: slight
  - 3: moderate
  - 4: severe
  - 7: present but to unknown degree

THERAPY

- (71): antineoplastic or antituberculous procedures
  - surgery to lung - 1
  - radiation to lung - 2
  - cytotoxic agent - 4
- (72): other therapy
  - none indicated - 0
  - INH - 1
  - PAS - 2
  - streptomycin - 4

(73): DISPOSITION

- none indicated or "home" - 0
- PMD - 1
- return to clinic - 2
- sanatorium - 4
- Pt. died - 9



(74): AUTOPSY

- 0: inapplicable - Pt. alive at discharge.
- 1: Pt. died. Autopsy revealed no evidence of T.E.C.
- 2: Pt. died. Autopsy: tuberculosis.
- 3: Pt. died. Autopsy: Ca. lung.
- 4: Pt. died. Autopsy: emphysema.
- 5: Autopsy: tbc. + Ca. lung
- 6: Autopsy: tbc. + emphysema
- 7: Autopsy: Ca. lung + emphysema
- 9: Pt. died - no autopsy or autopsy findings unk.

(75): If diagnosis is Ca. lung:

|                                                                                   |     |
|-----------------------------------------------------------------------------------|-----|
| inapplicable                                                                      | - 0 |
| primary Ca.                                                                       | - 1 |
| secondary Ca. - primary known                                                     | - 2 |
| secondary Ca. - primary unk.                                                      | - 4 |
| secondary Ca. - primary uncertain but there is<br>diagnosed primary Ca. elsewhere | - 7 |
| "probably primary"                                                                | - 9 |

(80): SPECIAL COMMENTS

- 0: negative cytology - bronchoscopy report: "changes characteristic of chronic emphysema" (Dx. apparently established with ↑A-P diameter, bronchoscopy report, (+) smoking history, x-ray - no mention of emphysema)
- 1: CSF (+) for AFB
- 2: "lung puncture" - cytology negative
- 3: thoracoscopy - negative
- 4: intratracheal lipiodal with bronchography  
diagnosis: "peripheral primary Ca. RUL"
- 5: diagnosis = senile emphysema
- 6: CSF (-) for AFB
- 7: craniotomy done; biopsy: metastatic Ep. Ca.
- 8: needle biopsy, ileum or ischium: metastatic undiff. Ca.
- 9: pulmonary function studies - ND this adm.; results in 69, 70  
from previous adm.





## REFERENCES

1. National Center for Health Statistics, Division of Vital Statistics, U.S. Dept. of Health, Education, and Welfare. Vital Statistics of the United States. Data from the annual mortality reports issued by the U.S. Bureau of Vital Statistics, 1909-1965.
2. Feinstein, A.R. Clinical epidemiology. II. The identification rates of disease. *Ann. Int. Med.* 69: 1037-1061, 1968.
3. National Tuberculosis Association. Diagnostic Standards of the National Tuberculosis Association -- Pulmonary Tuberculosis, Tuberculous Cervical Adenitis (4th edition). Prepared by the Diagnostic Standard Committees of the Framingham Community Health and Tuberculosis Demonstration. New York: 4-8, 1920.
4. National Tuberculosis Association. Diagnostic Standards and Classification of Tuberculosis. Prepared by the committee on diagnostic standards. New York: 28, 1940.
5. National Tuberculosis Association. Diagnostic Standards and Classification of Tuberculosis. Prepared by the committee on revision of diagnostic standards. New York: 19, 1961.
6. Grunze, H. A critical review and evaluation of cytodagnosis in chest diseases. *Acta Cytologica* 4: 175-198, 1960.
7. Rosenblatt, M.B. and Lisa, J.R. Diagnostic progress in lung cancer: historical perspective. *J. Am. Geriatrics Soc.* 16: 919-929, 1968.
8. Dudgeon, L.J. and Wrigley, C.H. On the demonstration of particles of malignant growth in the sputum by means of the wet film method. *J. Laryng. and Otol.* 50: 752-762, 1935.
9. Papanicolaou, G.N. Diagnostic value of exfoliated cells from cancerous tissue. *J.A.M.A.* 131: 372-378, 1946.



10. Liebow, A.A., Lindskog, G.E. and Bloomer, W.E. Cytological studies of sputum and bronchial secretions in the diagnosis of carcinoma of the lung. *Cancer* 1: 223-233, 1948.
11. Goldmeier, E. Limits of visibility of bronchogenic carcinoma. *Am. Rev. Resp. Dis.* 91: 232-239, 1965.
12. Burdette, W.J. Diagnosis of carcinoma of the lung. *Postgrad. Med.* 17: 432-437, 1955.
13. Lerner, M.A. et al. Radiologic localization and management of cytologically discovered bronchial carcinoma. *New Eng. J. Med.* 264: 480-485, 1961.
14. Umiker, W.O. Relative accuracy of various procedures in the diagnosis of bronchogenic carcinoma. *J.A.M.A.* 195: 658-661, 1966.
15. Leyden, E. *Deutsche med. Wchnschr.* 9: 52, 1883. Cited in Craver, L.F. and Binkley, S. Aspiration biopsy of tumors of the lung. *J. Thoracic Surg.* 8: 436-462, 1938.
16. Martin, H.E. and Ellis, E.B. Biopsy by needle puncture and aspiration. *Ann. Surg.* 92: 169-181, 1930.
17. Daniels, A.C. A method of biopsy useful in diagnosing certain intrathoracic diseases. *Dis. Chest* 16: 360-366, 1949.
18. Shields, T.W. Current concepts in the surgical diagnosis and treatment of bronchogenic carcinoma. *Surg. Clin. N. Am.* 43: 109-123, 1963.
19. American Thoracic Society. The diagnosis and treatment of bronchogenic carcinoma. A statement of the subcommittee on surgery and the committee on therapy. *Am. Rev. Resp. Dis.* 88: 277-278, 1963.



20. American Thoracic Society. Chronic bronchitis, asthma, and pulmonary emphysema. A statement by the committee on diagnostic standards for nontuberculous respiratory diseases. Am. Rev. Resp. Dis. 85: 762-768, 1962.
21. Nicklaus, T.M. et al. The accuracy of the roentgenologic diagnosis of chronic pulmonary emphysema. Am. Rev. Resp. Dis. 93: 889-899, 1966.
22. Katsura, S. and Martin, C.J. The roentgenologic diagnosis of anatomic emphysema. Am. Rev. Resp. Dis. 96: 700-706, 1967.
23. Sutinen, S. et al. Roentgenologic criteria for the recognition of nonsymptomatic pulmonary emphysema. Correlation between roentgenologic findings and pulmonary pathology. Am. Rev. Resp. Dis. 91: 69-76, 1965.
24. Thurlbeck, W.M. et al. The correlation between pulmonary structure and function in chronic bronchitis, pulmonary emphysema and asthma. Medicina Thoracalis 22: 295-303, 1965.
25. Suprenant, E.L. and Vance, J.W. Evaluation of methods for the early detection of chronic obstructive ventilatory diseases. Dis. Chest 52: 760-766, 1967.
26. Jenkins, D.E. et al. Correlation of morphologic emphysema with pulmonary function parameters. Transactions of the Assoc. of Am. Physicians 78: 218-230, 1965.
27. Mitchell, R.S. et al. Clinical and morphologic correlations in chronic airway obstruction. Am. Rev. Resp. Dis. 97: 54-62, 1968.
28. Hanson, J.S. and Tabakin, B.S. Correlation of vital capacity with other indices of disease in obstructive emphysema. Dis. Chest 49: 52-56, 1966.



29. Tomashefski, J.F. and Pratt, P.C. Pulmonary emphysema: pathology and pathogenesis. Med. Clin. N. Am. 51: 269-281, 1967.
  
30. Ciba Guest Symposium. Terminology, definitions, and classification of chronic pulmonary emphysema and related conditions. Thorax 14: 286-299, 1959.













YALE MEDICAL LIBRARY

Manuscript Theses

Unpublished theses submitted for the Master's and Doctor's degrees and deposited in the Yale Medical Library are to be used only with due regard to the rights of the authors. Bibliographical references may be noted, but passages must not be copied without permission of the authors, and without proper credit being given in subsequent written or published work.

This thesis by \_\_\_\_\_ has been used by the following persons, whose signatures attest their acceptance of the above restrictions.

---

---

NAME AND ADDRESS

DATE

