

# A Five Year Follow-up of Discharges from Maryland Tuberculosis Sanatoria\*

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THE study of the fate of persons who have received treatment for pulmonary tuberculosis in sanatoria is of considerable importance to the clinician and also to the epidemiologist. Definite knowledge of what happens following discharge from a sanatorium is necessary not only to evaluate the results of sanatorium treatment and to advance a prognosis, but such knowledge can also be of value as an index in comparing the characteristics of the disease in different areas.

Attempts to obtain exact knowledge of events subsequent to discharge by relying upon the patient's coöperation either in reporting at specified intervals or in replying to questionnaires, are prone to yield results which contain bias because of the inability of fatal cases to report and a tendency for those who have improved to coöperate more readily. Only by a systematic follow-up through personal canvas can the percentage lost from observation be lowered and bias reduced to a minimum.

In Maryland a systematic follow-up of sanatorium discharges has been conducted on a state-wide basis since January 1, 1935. This has been possible through the coöperative efforts of the Tuberculosis Sanatoria, the Maryland State Department of Health, the Baltimore City Health Department, and all of the local city and county health units throughout the state. Every year a visit is made by some member of the local health department (usually the nurse) to each person living within the area who has been discharged from any sanatorium in Maryland since January 1, 1934. These visits are so scheduled that they are made each year in the same month as that in which the discharge occurred, and are for the purpose of recording the history of the year elapsing since the last record. The information recorded at the time of the visit is quite simple and is not difficult to obtain—the date, place, and cause of

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all deaths; the residence of the living, at home, again in sanatorium, or out of the state; the patient's capacity to work, and the amount of time, if any, confined to bed or in the sanatorium. The data thus collected by the local health departments are forwarded for assembly to the State Department of Health, except in Baltimore City where they are assembled in the City Health Department. The analysis of the records to date has been undertaken by the Department of Epidemiology of the School of Hygiene and Public Health, Johns Hopkins University. This is the first report to be made of this investigation, and since the study is still in progress, it is essentially of a preliminary nature.

The data available for analysis at present are on all persons discharged from the various sanatoria throughout the state between January 1, 1934, and December 31, 1938—a period of 5 years. The records include the information obtained by all visits up to the close of 1939. The maximum period of observation is 5 years from the time of discharge, and the minimum period may be only a few days, as in the case of those who die or emigrate from the state soon after discharge. The state-wide nature of this investigation has the advantage that the mortality among these discharges can be readily compared with the mortality among the general population of the state. On the other hand, it has the disadvantage of being unable to follow patients after emigration from the state, and this has resulted in a loss from observation of a considerable number of persons.

Throughout the analysis, time has been counted in years from the initial discharge during the study period and not in calendar years. The status of the individuals at annual intervals, dating from the time of discharge, has been determined and will be shown

graphically for the various racial and clinical groups. The results are expressed as the number of individuals out of 1,000 discharges who are dead or living 1, 2, 3, 4, and 5 years from the time of discharge. The living are further subdivided into whether they are living at home, are again in the sanatorium, or have been lost from observation either by emigration from the state or in some other way. As the majority of the persons in the study were observed for less than the full 5 years, two assumptions were necessary to express the findings in these terms. The first is that persons observed in any one year (*i.e.*, dating from discharge, are, with respect to that year, an unselected sample of the whole. The second assumption is that persons leaving observation because of emigration or loss in some other way are unselected with respect to subsequent mortality. Inasmuch as the analysis is made by race, age, and stage of the disease, it is felt that these assumptions are not unreasonable. The biometrics of the study are rather complex and will be discussed in a later paper. They are based upon the use of the modified life-table method of analysis as developed by the late Dr. Frost and his collaborators. A discussion of the methodology involved must form the basis of a separate article.

The present analysis is confined to a consideration of the fate of persons discharged one or more times from the Tuberculosis Sanatoria of Maryland during the years 1934–1938. It is concerned with the experience of those who were treated in the sanatoria for pulmonary tuberculosis of the adult or reinfection type and is limited to adolescents and adults. No minimal cases under 15 years of age were included because of the possibility of confusion with the childhood type of pulmonary infiltration. The composition of the study group by age, color, and

TABLE 1

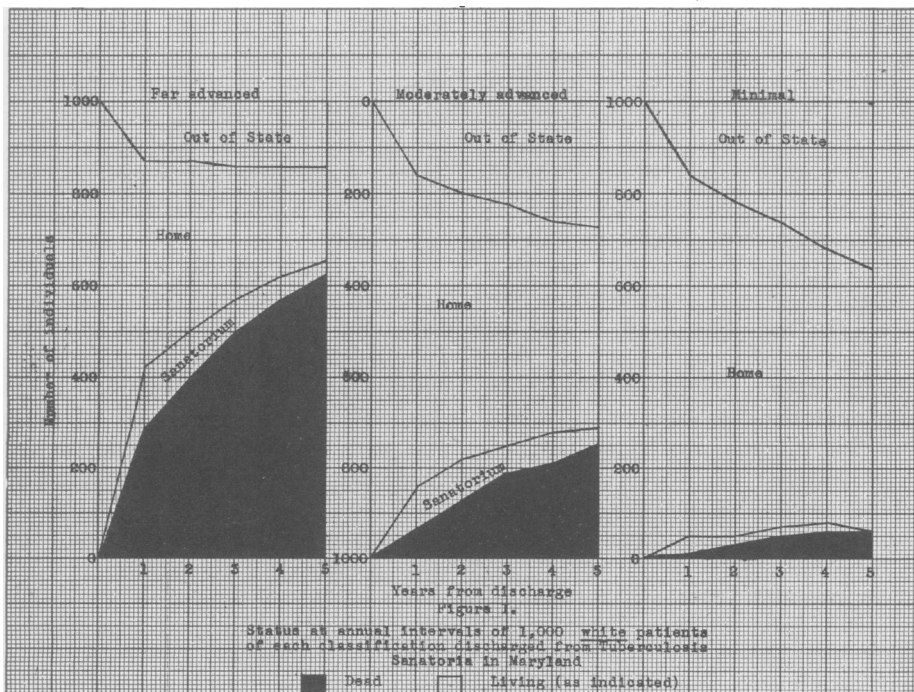
*Distribution by Race, Age at Discharge, and Clinical Classification of 4,149 Individuals with Pulmonary Tuberculosis of the Adult Type Discharged from the Tuberculosis Sanatoria of Maryland, 1934-1938*

| Clinical Classification | Age at Discharge |       |     |         | Total |
|-------------------------|------------------|-------|-----|---------|-------|
|                         | Under 20         | 20-44 | 45+ | Unknown |       |
| <i>White</i>            |                  |       |     |         |       |
| Far advanced            | 73               | 782   | 332 | 10      | 1,197 |
| Moderately advanced     | 129              | 1,085 | 363 | 10      | 1,537 |
| Minimal                 | 154              | 457   | 104 | 8       | 723   |
| Total                   |                  |       |     |         | 3,507 |
| <i>Colored</i>          |                  |       |     |         |       |
| Far advanced            | 62               | 222   | 37  | 1       | 322   |
| Moderately advanced     | 26               | 91    | 14  | ..      | 131   |
| Minimal                 | 56               | 121   | 10  | 2       | 139   |
| Total                   |                  |       |     |         | 642   |

classification according to the extent of the lesion at the time of admission to the sanatorium, is shown in Table 1. The clinical classification used is that of the National Tuberculosis Association.

The fate of the patients discharged from the sanatoria has been studied

according to classification on admission to the sanatorium, and their subsequent history is shown graphically in Figure I, which indicates the fate of 1,000 *white* discharges of each clinical class over a period of 5 years following discharge. In this graph the height of the vertical lines, spaced at yearly intervals, repre-



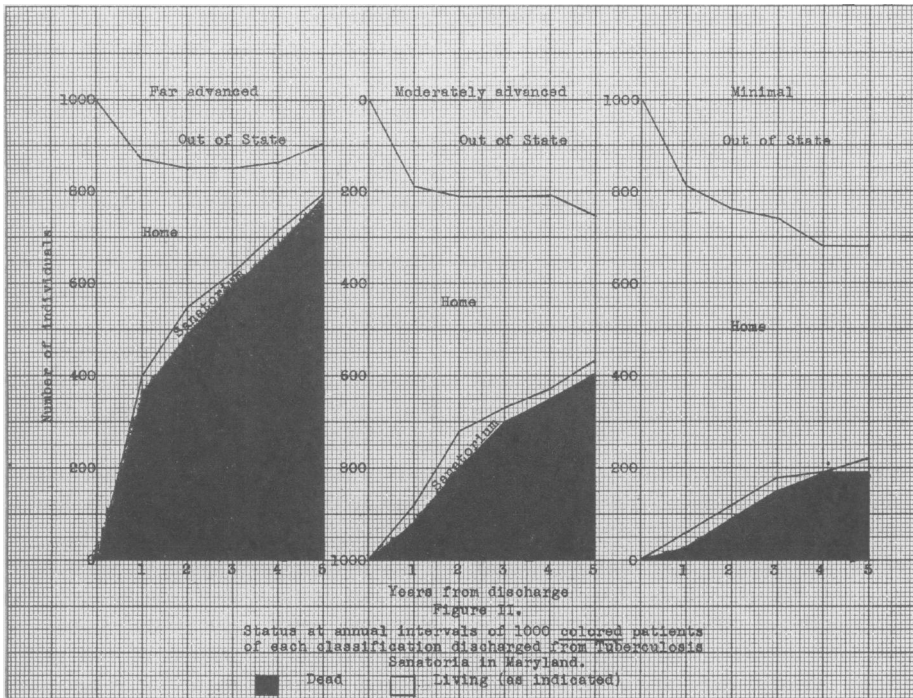
sents 1,000 discharges. The shaded portion of each line represents the number of persons dead from all causes at the end of each given year and should not be interpreted as tuberculosis deaths alone. The number thus represented is cumulative and includes all deaths whether under observation or occurring subsequent to their loss from observation from emigration or from some other cause. The unshaded portion of each line represents the living at the end of the indicated year, and this decreases as the number of deaths increase. This portion of the line has been subdivided according to the residence of the living at the time indicated—at home, in the sanatorium, or out of the state. The number falling into each status is thus represented by the length of the line between the horizontal sectors. This figure demonstrates clearly the relationship which the extent of the lesion has to the subsequent prognosis. The mortality was by far the greatest among those with far advanced lesions. A year following discharge 289 out of 1,000, or 29 per cent, of these white patients were dead, and with the passage of time the number of deaths increased to 622, or 62 per cent, at the end of 5 years. Contrasted with this, of every 1,000 minimal white cases discharged 15, or 1.5 per cent, died within 1 year, and 58, or approximately 6 per cent, died within 5 years. The mortality of those with moderately advanced lesions was such that 67, or 7 per cent, died within a year, and 251, or 25 per cent, within 5 years from discharge. The number of deaths in this group of discharges is somewhat less than found by Hartley, Wingfield, and Thompson<sup>1</sup> among the discharges of Brompton Hospital, England, for the years 1905–1914. Using their basic data, Hilleboe<sup>2</sup> in his comparative study of mortality from different sanatoria calculated the percentage dead at the end of successive

years from discharge. His results are given for each sex but can be readily calculated for both sexes combined. The percentages dead at the end of 5 years in the Brompton study were: far advanced 79, moderately advanced 40, minimal 10. It should be noted, however, that many of the discharges in the Brompton study were observed during the war years and the influenza epidemic of 1918.

In considering the prognosis it should also be noted that the proportion of discharges readmitted to and again resident in the sanatorium at the end of each year was greater among those with the more advanced lesions.

It would appear at first glance that fewer persons emigrated or were otherwise lost from observation among those with the more advanced lesions. In interpreting this section of the graphs marked "Out of State" it is necessary to keep in mind that it represents the proportion of the original 1,000 discharges which have emigrated and are assumed to be still living. The group is made up at any one time of those who have emigrated minus the deaths which would be expected to occur among them at the rates prevailing among those under observation. The force of mortality affects its size in two ways—where the mortality is high the number of potential additions is decreased because fewer survive to emigrate. In addition, with a higher mortality, a greater proportion die after emigration. A calculation based on the proportion of living who are lost from observation shows no difference between the numbers in the various clinical classes. This would indicate that the amount of emigration was not different between the advanced cases and the minimal.

The course of events among the colored discharges is portrayed in Figure II. The picture is in general similar to that shown for the white



discharges, but the mortality from all causes is greater among the colored than among the corresponding white cases. Out of 1,000 colored discharges classed as far advanced there were 360, or 36 per cent, dead 1 year, and 779, or 78 per cent, dead 5 years after discharge. The moderately advanced had 85 deaths, or 8.5 per cent, within 1 year cumulating to 399, or 40 per cent, dead within 5 years, while out of 1,000 minimal discharges 30, or 3 per cent, died in the first year, and 188, or 19 per cent, died within 5 years of discharge.

These comparisons show graphically the relative risk of death among the discharges according to the severity of the lesion but they fail to compare the risk of death among these persons with that prevailing in the general population. In order to make this comparison it is necessary to calculate the deaths which would be expected to occur in a group of 1,000 individuals of the same

race and age composition at the mortality rates from all causes prevalent in the general population of Maryland. This has been done using the Maryland age-specific mortality rates for 1937 to calculate the expected deaths, and a summarized comparison of the observed and expected deaths within 5 years of discharge is shown in Table 2. The observed deaths as compared with the expected are expressed as a ratio, and give an indication of how much greater is the risk of death among these persons than among the general population. It will be noted that among the white the ratio of observed to expected deaths is 13-1 for the far advanced, 7-1 for the moderately advanced, and 1.8-1 for the minimal. These ratios compare with those reported by Hilleboe<sup>3</sup> from Minnesota of 8.7 times the expected for the far advanced, 4.6 times for the moderately advanced, and 1.8 times among the minimal cases. It should be noted, however, that Hilleboe did not

TABLE 2

*Comparison of the Mortality Occurring Over a 5 Year Period Among Patients Discharged from the Tuberculosis Sanatoria in Maryland and that Prevailing in the General Population of the State, by Race and Clinical Stage of Disease*

| Clinical Classification | White                                        |            |       | Colored                                      |            |       |
|-------------------------|----------------------------------------------|------------|-------|----------------------------------------------|------------|-------|
|                         | No. of Deaths in 1,000 Discharges in 5 Years |            |       | No. of Deaths in 1,000 Discharges in 5 Years |            |       |
|                         | Observed                                     | Expected * | Ratio | Observed                                     | Expected * | Ratio |
| Far advanced            | 622                                          | 47         | 13-1  | 779                                          | 61         | 13-1  |
| Moderately advanced     | 251                                          | 38         | 7-1   | 399                                          | 60         | 7-1   |
| Minimal                 | 58                                           | 33         | 1.8-1 | 188                                          | 52         | 3.6-1 |

\* Expected deaths calculated from 1937 mortality rates for Maryland and are age adjusted

include any patients who were subsequently readmitted to sanatoria, and also excluded those discharges with less than 9 months residence in the sanatorium.

Two features of this table are worthy of passing reference. The smaller number of expected deaths estimated for the minimal cases is due to the fact that they are on the whole younger and hence have a more favorable age distribution. The fact that the ratios among the far advanced and moderately advanced is the same for the white and colored is also of some interest. This is in all probability fortuitous and does *not* mean that tuberculosis affects both races equally. The fact that there is in each clinical class a higher mortality among the colored would clearly indicate that the colored race is affected to a greater extent than the white by this disease.

Thus far the analysis has dealt with broad classifications based upon the findings of the examination made in the sanatorium at the time of admission, and no consideration has been given to the condition of the patients at the time of discharge. A further analysis has, therefore, been made of the course of events in *white* persons following discharge in which the extent of the lesion is qualified by a statement as to whether or not the patient improved

under sanatorium care. Such a classification places together in one group all those whose condition at the time of discharge was arrested, quiescent, or improved. It is recognized that the prognosis is different in the case of a person whose lesion has been arrested and one who has improved but where the tuberculous process may still be active. Unfortunately the number of discharges in each group did not warrant separate tabulations, and the comparison is, therefore, much less definitive, being simply between those white persons who did not benefit from sanatorium care and those who showed varying degrees of improvement. This comparison is shown in Figure III, where it will be noted that the number of deaths which occurred over a period of 5 years among the unimproved is twice that which occurred among the improved. Among the far advanced 82 per cent of the unimproved were dead at the end of 4 years as compared with 42 per cent at the end of 5 years among the improved. The improved cases among the moderately advanced showed 20 per cent dead at the end of 5 years compared with 53 per cent among the unimproved, while 10 per cent of the minimal unimproved were dead as compared with 5 per cent of the improved.

The number of deaths occurring over

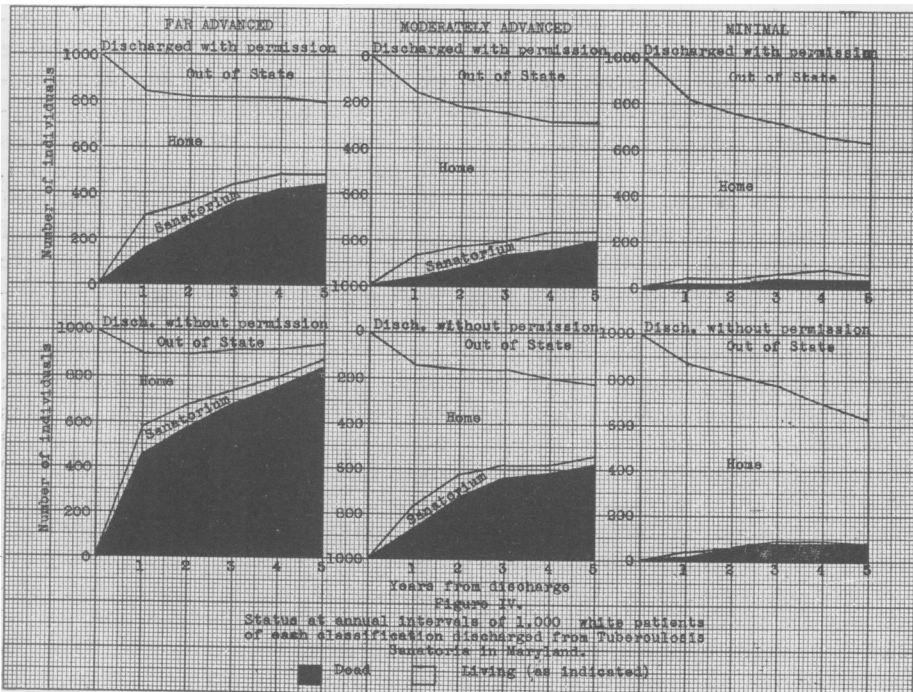
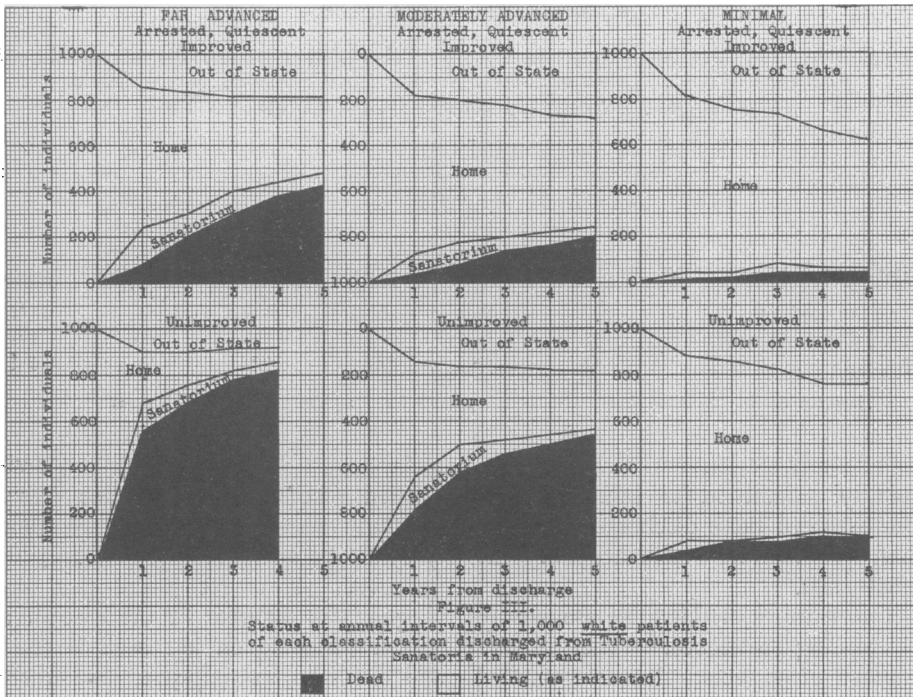


TABLE 3

*Comparison of the Mortality Occurring Over a 5 Year Period Among White Patients Discharged from the Tuberculosis Sanatoria of Maryland and That Prevailing in the White Population of the State, by Clinical Class and Condition at the Time of Discharge*

| Clinical Classification | Condition at the Time of Discharge | No. of Deaths in 1,000 Discharges in 5 Years |            |       |
|-------------------------|------------------------------------|----------------------------------------------|------------|-------|
|                         |                                    | Observed                                     | Expected * | Ratio |
| Far advanced            | Unimproved †                       | 818                                          | 40         | 20-1  |
|                         | Arrested                           | 423                                          | 45         | 9-1   |
|                         | Quiescent                          |                                              |            |       |
| Moderately advanced     | Improved                           | 534                                          | 41         | 13-1  |
|                         | Unimproved                         | 198                                          | 37         | 5.4-1 |
|                         | Arrested                           |                                              |            |       |
| Minimal                 | Quiescent                          | 106                                          | 30         | 3.5-1 |
|                         | Improved                           | 50                                           | 33         | 1.5-1 |
|                         | Arrested                           |                                              |            |       |

\* Expected deaths calculated from 1937 mortality rates for white population of Maryland and are age adjusted

† For 4 years only

the 5 year period (shown graphically in Figure III) has been compared with the number which would be expected in each group at the age-specific mortality rates from all causes in Maryland, and this comparison is summarized in Table 3. This table shows the ratio of risk among the discharges to that in the general population. The ratio of observed to expected deaths is greatest among the far advanced unimproved where over a period of 4 years it is 20 to 1. The moderately advanced unimproved have a ratio of 13-1 and this is higher than the 9.1 of the far advanced improved. Similarly the ratio of 3.5-1 among the minimal unimproved approaches the 5.4-1 of the moderately advanced improved. In the minimal improved group the mortality was one and one-half times that of the general population. The inference to be drawn from this table is that the prognosis can be improved by maintaining tuberculous patients in a sanatorium until they show some degree of improvement.

The course of events among those who left the sanatorium with the permission of the hospital staff is contrasted with that of those who left against advice in Figure IV. The findings in this instance are almost identical with those shown in Figure III, and would seem to indicate that the clinical condition of the patient was, in most instances, the factor which determined whether the authorities granted or withheld permission for discharge.

#### DIGEST

Since 1935 all discharges from the Tuberculosis Sanatoria have been followed up on a state-wide basis by means of an annual visit by the personnel of the local health departments. This is a preliminary report of the analysis of the data collected to date and is mainly concerned with the mortality after discharge among those who had been treated for adult type pulmonary tuberculosis. The percentage of these persons who died within 5 years of discharge was determined ac-



ording to their clinical classification, and these percentages were compared with the proportion who would have died had they been subject to the race and age-specific rates of the general population. The mortality expressed as a ratio to that prevailing in the population of Maryland (taken as 1) was:

| <i>Clinical<br/>Classification</i> | <i>White</i> | <i>Colored</i> |
|------------------------------------|--------------|----------------|
| Far advanced                       | 13           | 13             |
| Moderately advanced                | 7            | 7              |
| Minimal                            | 1.8          | 3.6            |

The mortality among the discharges who had improved under sanatorium care was only half that experienced by those who were discharged as unimproved.

## REFERENCES

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3. Hilleboe, H. E. *Nat. Tuberc. A. Tr.*, 34:149-161, 1938.