

# Infectiousness of the "Closed Case" in Tuberculosis

MARGERIE BLAHD, ELEANOR I. LESLIE, AND  
SOL ROY ROSENTHAL

*Tice Laboratory and Clinic, Chicago Municipal Tuberculosis Sanatorium, and  
the College of Medicine, University of Illinois, Department of  
Bacteriology and Public Health, Chicago, Ill.*

AN inquiry into the adequacy of public health criteria for classifying a case of tuberculosis as "closed" (interpreted by many physicians to mean non-infectious) was indicated by an analysis of the statistics of 1,080 children of the Tice Clinic of the Chicago Municipal Tuberculosis Sanatorium. This study is unique in that all of the children under consideration were followed since birth and the tuberculosis status of the households was checked by the standard laboratory methods. In this regard it differs from clinical surveys, which are reviewed.

The experiment of the Tice Laboratory and Clinic, which is organized primarily for the purpose of studying the efficacy of BCG vaccination, is divided into two sections: one concerned with children from homes free of tuberculosis as confirmed by x-ray of all household members; the other with children from homes with tuberculous cases. Both groups come generally from the poorer and more crowded districts of Chicago, where mortality rate of tuberculosis and the tuberculin reactivity are high.

The index cases in the contact groups are cases of pulmonary tuberculosis but established as presumably "closed" immediately before and during the period of this study. That fact was ascertained at the onset by concentra-

tion, direct smears and cultures of 24 hour sputum specimens, and subsequently by monthly sputum concentration and direct smears. In the event tubercle bacilli are isolated the patient is separated from children under 16 in accordance with Illinois State Law.<sup>1</sup> All cases in which a positive sputum has been shown must by Illinois law be considered open for a period of at least three months and thereafter until three successive specimens of sputum, collected at intervals of one week, contain no tubercle bacilli. The sputum examinations must be made by a laboratory approved by the Illinois Department of Public Health. Furthermore, physical examination of the patient must indicate that the type of disease could be such as to coincide with a negative sputum.

Alternate children of both contact and non-contact groups are vaccinated with BCG at birth or within three months. The other children are registered as controls at the same time. All are given semiannual physical examinations, x-rays and tuberculin tests. The Vollmer patch test is used, and where there is a questionable reading, it is checked by the Mantoux test (O.T. 1-100 dilution or 1 mg.). All contact children are maintained in foster homes from birth until 6 weeks to 3 months of age depending on the

relationship and the severity of the disease in the index case. Approximately 60 per cent of these children are colored.

This report is concerned with a comparison only of the controls in the contact and non-contact groups with respect to the tuberculin reactivity. Table 1 shows that among the children 1 year of age 2.24 per cent of the non-exposed, and 21.6 per cent of the group in contact with tuberculosis presumably closed, were positive to tuberculin. At 2 years of age the percentages were respectively 9 per cent and 52.7 per cent (Table 1).

negative admittedly may have been positive at times. The then current accepted techniques of sputum examination were apparently employed by Brailey as well as by Mac Phedran and Opie whose work appeared in 1935. In neither case was there any mention of lavage. Brailey's study shows the following results among white children in the 0-4 age group: positive reactions to 1 mg. or less of tuberculin were found in 57.8 per cent of 199 children exposed to open tuberculosis, 18.4 per cent of 38 children exposed to "closed" tuberculosis, and 3.2 per cent of 158 non-contacts. Although the chance of

TABLE 1

*Results of Tuberculin Reaction in Non-contact Children and Children in Contact with "Closed" Cases of Tuberculosis*

Age in Months	Non-contacts			Age in Months	Contacts		
	No. Tested	No. Positive	Per cent Positive		No. Tested	No. Positive	Per cent Positive
3-7	1,025	2	.19	3-7	55	4	7.3
8-12	939	21	2.24	8-12	37	8	21.6
13-18	849	40	4.07	13-18	32	10	31.3
19-24	776	70	9.00	19-24	19	10	52.7

There is a great discrepancy between the sizes of the two groups because of the relative incidence of tuberculosis and because the work with the contact cases was not begun until 1940—three years after the non-contact study was initiated. Because of this discrepancy the results can indicate only a trend—one, however, that is definite.\*

Surveys reported by Brailey<sup>2</sup> and Mac Phedran and Opie<sup>3</sup> have disclosed that contacts to "closed" cases although showing a lower tuberculin reactivity than contacts to open cases, have a higher rate of positivity than non-contact children living in similar neighborhoods.

Brailey's survey was made on families registered between 1928 and 1937. Sputum was examined as often as practical. Those index cases considered

infection is 18 times greater for those exposed to open tuberculosis than non-contacts, it is still 6 times greater for "closed" case contacts than non-contacts. These statistics for the non-contacts were compiled by Frobisher.<sup>4</sup>

In the same age group, Mac Phedran and Opie found 79.3 per cent of 145 exposed to open tuberculosis positive to 1 mg. or less of tuberculin, 28.7 per cent of 108 in contact with "closed" tuberculosis, and 18.1 per cent of 210 non-exposed children.

Since children in contact with so-called "closed" tuberculosis have a higher tuberculin reactivity than control children of the same neighborhoods but without household exposure, the "closed" index case in the home must be the source of infection. Therefore, the question arises: Are our methods for determining a case of tuberculosis as closed sufficiently precise and reliable?

\* Note at end of article.

Does the doctor instruct the family to guard against the constant hazard of infection or does he foster a false sense of security because the case is "closed"? The regulations observed by the U. S. Public Health Service conform with those formulated by the committee on diagnostic standards of the National Tuberculosis Association.<sup>5</sup> These can be considered typical of the regulations in general public health usage.

According to these regulations a specimen of sputum is considered negative if no bacilli are disclosed on concentration. Following observation or treatment, a patient in order to be classified as "apparently arrested" must have one adequate specimen of sputum or gastric lavage reported negative. It is mentioned as desirable to call a specimen of sputum negative only after examination by all available methods—culture and animal inoculation as well as smear of the sputum; and culture and animal inoculation of stomach washings. However, according to *Diagnostic Standards*, "such rigid standards cannot be applied at present because many tuberculosis institutions are not equipped for this work. For the time being, it is therefore suggested that minimal standards be applied."

The recent literature has demonstrated the importance of gastric lavage in determining the presence of tubercle bacilli; Robinson and Dunn<sup>6</sup> in 1943 compiled all results of gastric washings in the available literature. A total of 12,040 stomach lavages were done on apparently closed subjects with 36.8 per cent positive results; 6,843 were on children with 36.6 per cent positive and 5,197 on adults with 37.1 per cent positive. In the first thousand lavages in their laboratory in "no sputum" cases and on patients with smears negative on concentration, 30.3 per cent were positive; 3.9 per cent were posi-

tive on smear of concentrate, and the rest on culture and/or guinea pig inoculation. More than one-third had had negative sputum cultures previously

Foley and Andosca,<sup>7</sup> reporting on 639 cases with no bacilli on direct smear or by concentration methods, found 29.2 per cent were positive by direct smear of lavage material. Of 60 stomach specimens, 25 per cent were positive by direct smear, 65 per cent by guinea pig inoculation.

The value of gastric lavage in cases with no sputum is demonstrated by Decker, Ordway, and Medlar.<sup>8</sup> By repeated examination of sputum and stomach washings, through culture and guinea pig inoculation, 67 of 97 cases of minimal tuberculosis were found positive during the five years 1936–1940, with 41 of 56 no sputum cases showing tubercle bacilli. From 1930 to 1935 only 24 of 172 minimal cases were positive. During the earlier period, no gastric lavages were done and only cases with sputum were tested by culture and guinea pig inoculation.

A recent study by Koons<sup>9</sup> re-emphasizes the generally known superiority of guinea pig inoculations over smears of concentrate. Of 590 specimens of sputum, pleural fluid, gastric washings, and other questionably tuberculous fluids, 6.1 per cent were positive on direct smear after concentration, while 21.8 per cent were positive on guinea pig inoculation.

The importance of more refined and scanning laboratory procedures is indicated by a study by Ordway, Medlar, and Sasano<sup>10</sup> of 99 cases without sputum or with sputum negative to smear on concentration. Seventy-six were positive by culture or guinea pig inoculation on monthly tests one or more times over a period of one year. Gastric lavage specimens were employed in the absence of sputum. However, 62 of the 76 positive individuals showed bacilli only on 72 hour sputum samples

or after two consecutive gastric washings. Only one of 12 patients with thoracoplasties and 9 of 28 patients with pneumothorax were consistently negative.

It is evident, therefore, that our minimal public health standards need revision upward—with the requirement of periodic culture and/or guinea pig inoculation of pooled sputum samples covering several consecutive days, and gastric washings from patients without sputum or with consistently negative sputum. Medlar and his colleagues recommend as minimal requirements concentrated 72 hour sputum samples or two consecutive gastric washings for the "no sputum" cases.

Although a so-called "closed" case is not as grave a source of infection as a frankly open one, it is more insidious. From the results of employment of modern and thorough methods, it is clear that most discharged patients intermittently release tubercle bacilli.<sup>10</sup> The physician too frequently assures the patient and family of the non-infectiousness of the "closed case." As segregation of potential carriers is the basic measure which can effectively eradicate tuberculosis it is suggested that until more rigid standards can be applied and more tuberculosis institutions are equipped to carry out efficiently the necessary laboratory procedures, the term "closed" be dropped.

The physician and the public must be constantly impressed to respect and treat tuberculosis as a highly contagious disease.

#### SUMMARY

1. A singularly well controlled study of 1,080 children followed since birth indicates a markedly higher rate of tuberculin positivity in children exposed to the so-called "closed" cases of tuberculosis than in non-contact controls.

2. Current public health criteria for

classifying a tuberculosis patient as "closed" are given and their adequacy is questioned.

3. It is suggested that until the rigid standards formulated by the U. S. Public Health Service and the Committee on Diagnostic Standards of the National Tuberculosis Association can be complied with, the term "closed case" be dropped.

#### REFERENCES

1. Control of Contagious Diseases. Department of Public Health. State of Illinois.
2. Brailey, M. E. Tuberculosis in Children. *Am. J. Hyg.*, Sect. A, 31:1, 1940.
3. Mac Phedran, F. M., and Opie, E. L. The Spread of Tuberculosis in Families. *Am. J. Hyg.*, 22:565, 1935.
4. Frobisher, M., Jr. A Study of the Tuberculin Reaction in Young Children in the Eastern Health District of Baltimore, Md. 1933. Unpublished; quoted by Brailey. Ref. No. 2.
5. *Diagnostic Standards and Classification of Tuberculosis*. New York, N. Y.: National Tuberculosis Association. 1940.
6. Robinson, J. L., and Dunn, W. T. Gastric Lavage and Sputum Cultures. *Am. Rev. Tuberc.*, 47:413, 1943.
7. Foley, J. A., and Andosca, J. B. Value of Examination of Gastric Contents for Tubercle Bacilli. *Ann. Int. Med.*, 19:629, 1943.
8. Dicker, W. P., Ordway, W. H., and Medlar, E. M. Demonstration of Tubercle Bacilli in Minimal Pulmonary Tuberculosis. *Am. Rev. Tuberc.*, 47: 625, 1943.
9. Koons, M. E. Laboratory Diagnosis of Tuberculosis—A Comparative Study of Animal Inoculation and Microscopic Examination. *J. Lab. & Clin. Med.*, 29:75, 1944.
10. Ordway, W. H., Medlar, E. M., and Lasano, K. T. Routine Application of Concentration, Culture and Guinea Pig Inoculation for the Demonstration of Tubercle Bacilli in Tuberculous Cases under Treatment. *Yale J. Biol. & Med.*, 15:353, 1943.
11. Lyman, D. R. Pregnancy and Tuberculosis. *Yale J. Biol. & Med.*, 15:464, 1943.

#### \* FOOTNOTE

Applying the formula of Significance of the difference between proportions,

$$\sigma D\% = \sqrt{pq \left( \frac{1}{N_1} + \frac{1}{N_2} \right)},$$

in the various age groups reveals that in the 3-7 month group there are 48 chances in 100 that the difference is a chance difference due to sampling; in the 8-12 months group it is 0.000000002 chances in 100; in the 13-18 months group 0.000000002 chances in 100, and in the 19-21 months group 0.0000002 chances in 100.