A COST ANALYSIS OF CLEARING TUBERCULOSIS FAMILY CONTACTS

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TUBERCULOSIS case-finding is considered at the present time to be one of the most logical measures for the control of the disease. It involves not only finding the case, but the problem of examining all members of the family in contact to that case. Further, it is generally conceded that a similar clearing of family contacts should be undertaken in all those families in which a child is found to have a positive reaction to tuberculin. Theoretically this may be a desirable procedure, but practically some serious questions may be raised as to its value. In other words, from an administrative angle it would be worth while to know the cost involved in visiting nurse and dispensary or clinic service to secure reasonable examination of all family contacts.

There is considerable data available on the frequency of finding infection and new disease among family contacts to known open pulmonary tuberculosis. Also experience suggests that a positive tuberculin in a preschool child is much more likely to lead to undiagnosed cases in the family or close contacts than is the case with a positive tuberculin in the teen age. (1), (2), (3), (4), (5), (6), (7).

If in our widespread tuberculin testing programs in the schools we can, with reasonable safety, feel that exhaustive studies of family contacts are productive of only an occasional case, we can at once free a considerable amount of service and funds to apply to more productive fields.

In order to get some concrete idea of this problem, it is necessary to make cost analyses of a number of families in

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which all members have been examined and diagnosed under comparable conditions. The cost involved would be estimated on the nursing visits required to get the individuals into the clinic to the point of a definite diagnosis, and the dispensary service in visits and X-rays required to make that diagnosis.

The data to be presented from New Haven is drawn from existing material that has been, and, for the most part, still is considered a responsibility of both the New Haven Visiting Nurse Association and the New Haven Dispensary.

New Haven has a population of 162,692 as of July 1, 1933. On April 1, 1934, there were 1,589 diagnosed cases of tuberculosis (all forms) on the roster of the Bureau of Tuberculosis. Approximately 250 were known to have some degree of clinical activity, the remainder were supposedly inactive. The diagnoses go as far back as 1915, but the majority were made within the past five to ten years.

It is estimated that there are in New Haven (April, 1934) about 1,503 families in which there is a tuberculosis problem falling in one of the following categories:

1. Families with a diagnosed case of tuberculosis, (all forms) now living, and in an active, quiescent, or arrested stage.
2. Families in which a member has died of tuberculous disease, including all such in the past three years, and many preceding 1930 which are now on our records.
3. Families which have been exposed to some known extrafamilial case of tuberculosis.
4. Families in which a member, usually a child, has been found positive to tuberculin.

Twelve hundred of these families have been known to the Visiting Nurse Association at some time, the majority still being under active care. This group likewise has been known

to the New Haven Dispensary. At present we have complete family charts for this group, which show for each member of the family, name, age, all available data on previous examinations, tuberculin tests, X-rays, diagnoses, and hospitalization.

RESULTS OF "CLEARING" CONTACTS

The analyses to follow are taken from the group of families under the Visiting Nurse Association and dispensary care in which we have a reliable diagnosis of every member. There is a total of 213 such families which may be grouped according to the first manifestation of tuberculosis in the family:

I. Those in which the first known source of infection was a pulmonary case. The case may have been a member of the family, or at least, a known intimate contact.

II. Those in which the first indication of tuberculosis was manifested by a positive tuberculin in a child.

III. Those in which the first indication of tuberculous disease was a death from tuberculous meningitis.

The major distribution of these families, and the individuals comprised are shown in Table 1.

Table 1. Number of contacts examined in families presenting a tuberculosis problem.

Classification of Families	Number of Families	Total Contacts	Age and Sex					
			Adults[1]			Children[2]		
			Total	Male	Female	Total	Male	Female
ALL GROUPS	213	964	346	137	209	618	317	301
Group I	162	673	226	85	141	447	231	216
Group II	42	241	99	42	57	142	71	71
Group III	9	50	21	10	11	29	15	14

[1]Individuals 16 years or over at time of first diagnosis in family.
[2]Individuals under 16 years at time of first diagnosis in family.

Diagnoses	Per Cent			Number		
	Total	Adults	Children	Total	Adults	Children
TOTAL EXAM. AND DIAG.	100.0	100.0	100.1	673	226	447
Pulmonary tuberculosis	8.8	15.5	5.4	59	35	24
Childhood type tbc.	14.9	4.0	20.4	100	9	91
Glandular tuberculosis	3.1	.9	4.3	21	2	19
Bone	.1	..	.2	1	..	1
Others	2.7	.9	3.6	18	2	16
No manifest tbc.	42.3	21.2	53.0	285	48	237
Non-tuberculous	28.1	57.5	13.2	189	130	59

Table 2. Diagnoses made in the examination of 673 contacts in 162 families in which the primary case was pulmonary tuberculosis.

I. *Families in Which the Primary Case Was Pulmonary Tuberculosis.* The examination of all contacts in this group (Table 2) has resulted in 199 new diagnoses of tuberculous disease, 59 of which were pulmonary disease, and 14, or 23.7 per cent, had bacilli in their sputa. Five of the pulmonary cases were considered negative for tuberculosis at the first examination, but were diagnosed during the follow-up since that time.[3]

In 40 of the 673 individuals examined, there is record of a change in diagnosis during subsequent examination. Five were changed from a non-tuberculous diagnosis to a pulmonary tuberculosis, three of which had a positive sputum.

The incidence of positive sputa among primary cases is shown in Table 3. It is clear that in 103 of the 162 families

[3]The dispensary procedure has varied considerably during the period in which the individuals in these families were cleared. Previous to 1925 it was customary to make many diagnoses on physical examination alone, whereas since then the X-ray has been utilized more frequently, and in the past two years the fluroscope is almost routine, regardless of physical findings. Thus it is conceivable that many of the diagnoses of "non-tuberculous" made previous to 1925 might today be changed to a childhood type on X-ray study. It is fairly certain that a few diagnosed as "non-tuberculous" or "no manifest" before 1925, excepting five, were not adult pulmonary cases because more recent information on the cases indicates they are in apparent good health.

Individuals	Total No. Families	Sputum Positive	Diagnosis at Death	Pos. Sputum and Diag. at Death	Per Cent Infectious
TOTAL	162	103	29	132	81.5
Father	92	59	17	76	82.6
Mother	51	34	7	41	80.4
Child	10	4	2	6	60.0
Other intimate contacts	9	6	3	9	100.0

Table 3. The incidence of positive sputa in the primary cases in the families of Group I, and the cases diagnosed at the time of death.

one or more positive sputa were obtained. In 29 other families the primary case was diagnosed first at the time of death, and in all probability the majority had positive sputa. Thus it is reasonable to state that 132 (81.5 per cent) of the primary cases were known to be infectious.

II. *Families in Which the Primary Case Was a Child Positive to Tuberculin.* In this group of families the primary child showing a positive tuberculin was discovered in routine clinic practice and was not previously known to have been in contact to a case of tuberculosis.

The examination of 241 contacts in this group (Table 4) revealed 42 new diagnoses of tuberculous disease, two of

Table 4. Diagnoses made in the examination of 241 contacts in 42 families in which a positive tuberculin in a member was the first evidence of tuberculous infection.

Diagnoses	Per Cent			Number		
	Total	Adults	Children	Total	Adults	Children
TOTAL EXAM. AND DIAG.	100.0	99.9	100.0	241	99	142
Pulmonary tuberculosis	0.8	1.0	0.7	2	1	1
Childhood type tbc.	8.7	1.0	14.1	21	1	20
Glandular	6.2	2.0	9.2	15	2	13
Others	1.7	3.0	0.7	4	3	1
No manifest tbc.	43.6	24.2	57.0	105	24	81
Non-tuberculous	39.0	68.7	18.3	94	68	26

Diagnoses	Per Cent			Number		
	Total	Adults	Children	Total	Adults	Children
TOTAL EXAM. AND DIAG.	100.0	100.1	99.9	50	21	29
Pulmonary tuberculosis	20.0	38.1	6.9	10	8	2
Childhood type tbc.	18.0	4.8	27.6	9	1	8
Bone	2.0	0	3.4	1	0	1
No manifest tbc.	40.0	14.3	58.6	20	3	17
Non-tuberculous	20.0	42.9	3.4	10	9	1

Table 5. Diagnoses made in examination of 50 contacts in 9 families in which the primary case was tuberculous meningitis.

which were classified as pulmonary disease. One adult had bacilli in his sputa and the child so diagnosed had an apparently healed lesion. Only 17.4 per cent of the contacts in this group was found to have some manifest form of tuberculosis, compared to 29 per cent in Group I.

III. *Families in Which the Primary Case Was Tuberculous Meningitis.* Tuberculous meningitis constitutes only about 4 per cent of tuberculosis deaths. It is most frequent in infants and preschool children, but its importance as a lead to significant tuberculosis is clearly indicated in Table 5. Forty per cent of all contacts showed evidence of tuberculous disease, half of which were pulmonary. It is most likely that the infection of the primary case in this group occurred within the family, as in eight of the nine families the primary case was in an infant, and 7 of the 10 pulmonary cases found among contacts were known to have positive sputa.

ESTIMATING THE COST IN EXAMINATION OF CONTACTS

The cost of clearing a family has been based on two factors offering a reasonable basis of cost accounting: (1) Visiting Nurse Association visits and (2) dispensary visits.[4]

[4]Visiting Nurse Association visits are based upon the number of visits made in order to get the contact into the clinic to the point that a reasonably definite diagnosis could be made.

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Table 6.

THE COST OF CLEARING 964 CONTACTS IN 213 FAMILIES CLASSIFIED ACCORDING TO TYPE OF PRIMARY CASE IN FAMILY

Age Groups	Number of Contacts	V. N. A.		Dispensary		X-Rays		Total	Unit Costs		
		Number of Visits	Cost $1.00 Per Visit	Number of Visits	Cost $1.00 Per Visit	Number X-Rayed	Cost $3.00 Per X-Ray	Costs	Contacts	New Diagnosis Tuber-culosis	New Diagnosis Pul. Tbc.
TOTAL FOR 213 FAMILIES											
All Ages	964	7,367	$7,367.00	2,306	$2,306.00	508	$1,524.00	$11,197.00	$11.62	$42.90	$157.70
Less than 16 years	618	6,336	6,336.00	1,773	1,773.00	392	1,176.00	9,285.00	15.02	47.13	343.89
16 years and over	346	1,031	1,031.00	533	533.00	116	348.00	1,912.00	5.53	20.88	43.45
I—162 FAMILIES—PRIMARY CASE—PULMONARY TUBERCULOSIS											
All Ages	673	5,613	$5,613.00	1,627	$1,627.00	350	$1,050.00	$8,290.00	$12.32	$41.66	$140.51
Less than 16 years	447	4,921	4,921.00	1,252	1,252.00	274	822.00	6,995.00	15.65	46.32	291.45
16 years and over	226	692	692.00	375	375.00	76	228.00	1,295.00	5.73	26.98	37.00
II—42 FAMILIES—PRIMARY CASE—A CHILD POSITIVE TO TUBERCULIN											
All Ages	241	1,102	$1,102.00	593	$593.00	144	$432.00	$2,127.00	$8.80	$50.64	$1,063.50
Less than 16 years	142	807	807.00	451	451.00	106	318.00	1,576.00	11.09	45.02	1,576.00
16 years and over	99	295	295.00	142	142.00	38	114.00	551.00	5.56	78.71	551.00
III—9 FAMILIES—PRIMARY CASE—TUBERCULOUS MENINGITIS											
All Ages	50	652	$652.00	86	$86.00	14	$42.00	$780.00	$15.60	$39.00	$78.00
Less than 16 years	29	608	608.00	70	70.00	12	36.00	714.00	24.62	64.90	357.00
16 years and over	21	44	44.00	16	16.00	2	6.00	66.00	3.14	7.33	8.25

The Visiting Nurse Association quotes $1.00 as the average cost of a tuberculosis visit. Visits were counted as nearly as possible by the tuberculosis supervisor to indicate only those visits in which the nurse endeavored to encourage clinic attendance.

The New Haven Dispensary until 1933 has not attempted cost accounting for the various special services. A fair estimate can be reached by using the known salary items and supplies. This averages about $1.00 per visit. X-ray charges are an additional item of cost, and are estimated at $3.00 per case. In the majority of instances children received a series of X-rays, consisting of stereo of chest, and postero-anterior view of neck and abdomen. The cost of fluoroscopic examinations has not been estimated in dispensary costs.

The cost of clearing contacts in the 213 families in Groups I, II, III is shown in Table 6. The unit cost of contact examination and the discovery of tuberculous disease with one exception is decidedly lower among those individuals 16 years and over. The exception occurs in Group II families. It is common experience to encounter more difficulty in securing cooperation from adults than children, and this difficulty is increased where the only incentive for routine examination is a child with a positive tuberculin. The discovery of new pulmonary tuberculosis in all groups is strikingly lower in those 16 years and older than among the children.

DISCUSSION

It is immediately obvious that in those families in which we find a case of tuberculous meningitis we are most likely

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Dispensary visits are based upon the number of visits made to the dispensary by the contact before a definite diagnosis was made. The diagnosis may be "no manifest disease," but if in the course of time it is changed to "pulmonary tuberculosis" or some other form, the first diagnosis is the one used in this study.

to find the highest percentage of undiscovered significant tuberculosis. Tuberculous meningitis comprises only a small fraction of our tuberculosis deaths, but those families warrant prompt attention. In this study three of the ten pulmonary cases discovered died of tuberculosis subsequent to the discovery of the original case.

Families in which we find a case of pulmonary tuberculosis are also valuable sources of undiscovered pulmonary tuberculosis among contacts. The experience at Gaylord Farm as reported by Haywood *et al* (6) is almost a duplicate of the New Haven experience. Even though the cost of clearance is twice that of tuberculous meningitis families, it is unquestionably worth while, particularly in those families in which a member has a positive sputum.

The routine examination of family contacts to children with positive tuberculins in this study proved to be unreasonably expensive. The one case of significant tuberculosis, in all probability, would have been discovered along routine channels because the sputum was positive and the individual had clinical symptoms. It is interesting to note, however, that about 24 per cent of the children in this group had evidence of some form of manifest tuberculosis, chiefly the primary infection type. Thus the importance of casual infection is emphasized.

The study of this group, then, confirms the question originally raised: Is it administratively sound to spend the time and effort necessary to clear such families? The answer seems to be in the negative, unless we can place more significance on the discovery of primary type lesions.

Recently in New Haven we analyzed 155 cases originally diagnosed as childhood type tuberculosis. It was found that only 9, or 5.8 per cent, later developed an adult form of pulmonary tuberculosis. It was significant that in the 9 families

in which these cases were found there had been one or more cases (primary) diagnosed as pulmonary tuberculosis, and one as tuberculous meningitis. There were 12 pulmonary cases and one meningitis case known before the childhood type case was discovered, and 9 of the 12 pulmonary cases were known to have positive sputa.

Our experience then indicates that we can expect to find a very limited amount of significant tuberculosis in the routine examination of contacts to positive tuberculin reactors. In view of the excessive cost involved which is perhaps somewhat understated, our efforts can be placed elsewhere to better advantage.

SUMMARY

A cost analysis was made of 213 families in New Haven in which all members had been examined one or more times, and in which the visiting nurses had made visits to secure these examinations.

The families are divided into three groups: I. Primary case, pulmonary tuberculosis, (162); II. Primary case, a child with a positive tuberculin, (42); and III. Primary case, tuberculous meningitis, (9).

Pulmonary tuberculosis of the adult type was considered to be the significant finding in each group. The cost for each diagnosed case, including nursing visits, dispensary service and X-rays, according to family groups was as follows: I. $140.51; II. $1,063.50; III. $78.00.

From the standpoint of the dollar invested there is justification for the routine clearing of Group III families, and Group I families, particularly those with a positive sputum case. Group II families in our experience do not warrant such intensive study.

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