

## REVIEW ARTICLE

## Epidemics of Tuberculosis in Canada in the Sixties

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Data on 24 localized tuberculosis epidemics occurring in Canada from January 1960 to March 1965 have been analyzed. In a population of about 13,000 at some degree of risk 308 new cases of active tuberculosis occurred—an incidence of 2.3%. In individual outbreaks, however, the incidence was as high as 31%. Epidemics occurred under a wide variety of circumstances—in schools, homes, communities, an army camp and a hockey team. Detected source cases included parents, school teachers, a cook, a hired man and a “den mother”.

Because of the involvement of children, about four out of 10 new active cases were primary tuberculosis. Approximately two out of 10 were moderately or far advanced pulmonary cases. The findings suggest the need to reconsider BCG vaccination of the younger age group as a means of raising the level of herd immunity.

**A**FTER increasing for centuries, the incidence of tuberculosis, one of the most obstinate diseases known to man, has shown a slow decline in many countries since the early 19th century. In Great Britain the early “Bills of Mortality” confirm that 15-20% of all deaths in London were recorded under the heading “consumption”. However, the disease in Britain, as distinct from many other well-known infectious diseases such as smallpox and plague, has never been “epidemic” in the sense of being much more prevalent at one time than at another.<sup>1</sup>

In Canada dramatic progress has been achieved in the control of tuberculosis since the introduction of chemotherapy for its treatment. Since 1950, mortality rates per 100,000 population have declined from 26.8 to 4.0 at the end of 1963, a reduction of 85%. Reported rates of new active cases have decreased from 84.5 per 100,000 in 1950 to 30.2 at the end of 1963, a reduction of 64%. The reduced period of stay in hospital and the conversion of existing sanatoria to other uses have misled the public and some physicians to believe that this disease is conquered. This is not so!

In 1963, there were almost 6000 reported new cases of active tuberculosis for the country as a whole. The sources of infection for these new cases obviously constitute a considerable reservoir of unknown “open” cases in the community

L'auteur a analysé des renseignements sur 24 épidémies de foyers localisés de tuberculose ayant éclaté au Canada de janvier 1960 à mars 1965. Dans une population d'environ 13,000 âmes, représentant un certain degré de risque, 308 nouveaux cas de tuberculose active ont été découverts, soit une proportion de 2.3%. Toutefois, parmi les épidémies individuelles la fréquence est montée jusqu'à 31%. Les épidémies sont apparues dans des circonstances très diverses: dans des écoles, des foyers domestiques, des collectivités, dans un camp de l'armée et dans une équipe de hockey. Parmi les personnes contaminantes qui ont pu être découvertes, figuraient des parents, des institutrices, un cuisinier, un domestique et une surveillante.

Etant donné que des enfants figuraient parmi les malades, près de quatre des 10 nouveaux cas actifs étaient des cas de tuberculose pulmonaire modérée ou très avancée. Ces constatations portent à croire qu'il faudrait reconsidérer la nécessité de la vaccination au BCG des sujets jeunes, de façon à relever le niveau d'immunité de la collectivité.

at large. In some areas a resurgence of the disease with a considerable increase in reported cases occurred, while in others a formidable threat remained in the form of smouldering or endemic foci which occasionally erupted among the population.

Before proceeding with this discussion some definitions are in order. The word “epidemic” is a very loose term. It literally means “disease upon the people”. Of course some 6000 new active cases of tuberculosis (1963) constitute an epidemic in the truest sense. However, this paper will not be concerned with the incidence and trends of the disease across the country, but rather with the analysis of data collected from purely local outbreaks. The definition of “epidemic” which has been adopted is the following: “an unusual prevalence of the disease in an area as indicated by an abrupt deviation from the normal levels for the location”.

## METHODOLOGY

Few of the localized epidemics which have occurred in Canada in recent years have been reported in the literature.<sup>2-5</sup> Through the cooperation of provincial tuberculosis control directors it has been possible to secure details on standard forms of 24 tuberculosis epidemics which have occurred in this country since 1960.

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TABLE I.—EPIDEMIC TUBERCULOSIS, CANADA, 1960-1964

Province	Location	Total at risk	Total new active T.B. cases	Total pos. reactors treated	Total hospitalized	Comments
Nfld. 1960-62	Harbour Grace	2650	29	—	?	Village epidemic possibly of multiple origin. BCG vaccination program since late 1940's, but only two of the newly reported new active T.B. cases had received previous BCG vaccination.
P.E.I. 1960-62	St. Charles	46	10	10	9	Home and school affected
	Montague	400	6	6	6	Home and school
	Abram's Village	107	4	4	4	Home and village
	Grand Tracadie	51	8	8	8	Home and village
	Borden	187	4	4	4	Village
	Souris	394	8	7	7	Town
	Little Harbour	45	7	7	7	Village
	Morell	97	5	5	5	Village
N.S. 1960	Hants County	32	10	2	10	Negro population with poor housing
N.B. 1964	Dalhousie	1699	7	—	?	School epidemic with seven new cases discovered. Twenty-five per cent of school population reacted to tuberculin. Source case possibly a Chinese school girl.
Que. 1962	Petit Cap	119	3	5	5	School epidemic with 31 additional reactors under radiological control. No cases had received BCG previously.
	Beauport	580	5	—	5	Four hundred and thirty-three pupils tuberculin-tested of whom 320 were positive. Two hundred and ninety-one of the latter had been previously BCG vaccinated. Of the five new cases, two had been previously BCG vaccinated.
1963	Quebec City	5	5	—	5	Family outbreak. All affected, one of whom was previously BCG vaccinated.
Ont. 1963-64	Wheatley	2400	9	65	7	Village and school (hockey team). Source case a "den mother". Seven of 12 "pee-wees" infected.
	London	400	12	10	12	School. Source undetected despite intensive examination of over 2000 people.
Man. 1963-64	Thicket Portage	275	28	—	28	Village. Experiment in home therapy carried out.
	Trentham	400	7	12	6	Survey carried out before detection of the epidemic with only 50% attendance and normal tuberculin reactor rate. All cases were later discovered among the 50% not radiographed in the original survey. 10,353 total patient days.
Sask. 1964	Harris and Rocanville Rural Municipality No. 11	800	24	1	23	No cases of T.B. for 10 years before present outbreak. Outbreak detected when infant 10/12 admitted with primary T.B. A "hired man" was found to be source case.
		130	11	—	11	Rural high school outbreak. Teacher source case. Ninety-two school children and 13 teachers converted to positive reaction during a nine-month period.
B.C. 1962-63	Prince Rupert	650	4	11	3	Discovered through tuberculin surveys carried out in successive years. Source case an Indian boy whose disease reactivated between surveys. He infected seven pupils in a school bus, of whom three developed active disease, and in his own classroom an additional four, of whom one became active. Three additional converters were found in his other contacts.
1964-65	Camp Chilliwack (Army camp)	971	9	18	9	Army camp. Spread by case-to-case contact. Source case a cook.
N.W.T. 1962-63	Eskimo Point	329	80	—	80	4 BCG vaccinated before epidemic. No cases in this group. Outbreaks of virus diseases and poor home conditions believed to be predisposing factors.
		16 White	Nil	—	—	

This paper is based on an analysis of this information.

RESULTS

Table I lists the location of reported epidemics. It will be noted that every province as well as the North West Territories is represented. In a population in excess of 13,000 at some degree of risk in these epidemics, 308 new active tuberculosis cases occurred, a rate of about 2.4%. In individual outbreaks the risk was considerably higher; 31% among the Negroes in the Hants County epidemic, 24% among the Eskimos of Eskimo Point, and 10% among the residents of Thicket Portage, Manitoba. Of the 308 new active cases discovered at least 267 were hospitalized. An additional 175 persons whose tuberculin tests, previously negative, became positive (tuberculin converters) were given prophylactic treatment with isoniazid.

The types of epidemics reported are of some interest. They include epidemics in homes, schools, villages, an army camp and a "pee-wee" hockey team. The source cases include parents in the home, school teachers, a cook, a hired man and a "den mother" who infected the hockey team. In the London, Ontario, school epidemic the source case was never found despite a most intensive search for every possible contact among school personnel, school visitors and employees of neighbourhood stores totalling altogether some 2000 persons. The onset of many of these epidemics may be sudden and dramatic or may be discovered during the course of tuberculin and/or radiographic surveys. It is of concern that in a number of instances routine surveys had been conducted in the area shortly before the onset of the epidemic without revealing any unusual findings. In the Edmonton rural high school outbreak, for example, tuberculin

TABLE II.—EPIDEMIC TUBERCULOSIS, CANADA, 1960-64: NEW ACTIVE CASES BY STAGE AND TYPE OF DISEASE

Province	Location	Primary	Pleural effusion	Minimal	Moderately advanced	Far advanced	Others
<i>Nfld.</i>	Harbour Grace.....	10	3	7	6	2	1
<i>P.E.I.</i>	St. Charles.....	6	1	1	1	—	1
	Montague.....	—	1	3	—	1	1
	Abram's Village.....	2	—	1	—	1	—
	Grand Tracadie.....	4	1	1	1	1	—
	Borden.....	2	—	1	1	—	—
	Souris.....	3	—	2	2	1	—
	Little Harbour.....	—	1	1	4	1	—
	Morell.....	—	1	1	2	1	—
<i>N.B.</i>	Dalhousie.....	—	—	2	1	1	3
<i>N.S.</i>	Hants County.....	6	—	1	—	2	1
<i>Ont.</i>	Wheatley.....	—	—	7	1	1	—
	London.....	12	—	—	—	—	—
<i>Que.</i>	Petit Cap.....	—	—	1	1	—	1
	Beauport.....	—	—	—	—	—	5
	Quebec City.....	3	—	1	—	1	—
<i>Man.</i>	Thicket Portage.....	18	—	6	2	2	—
	Trentham.....	1	1	1	—	3	1
<i>Sask.</i>	Harris and Rocanville.....	—	—	2	2	—	20
	R.R.M. No. 11.....	8	—	2	1	—	—
<i>Alta.</i>	Edmonton area.....	8	1	3	1	—	—
<i>B.C.</i>	Camp Chilliwack.....	—	1	5	2	—	1
	Prince Rupert.....	2	1	—	1	—	—
<i>N.W.T.</i>	Eskimo Point.....	49	9	6	4	4	8
Totals.....		134	21	55	33	22	43

testing of the school was carried out in the spring of 1961. Retesting some nine months later in January 1962 after the source case was detected revealed over 100 tuberculin converters. Among these were 13 cases of demonstrable active pulmonary disease.

In Table II the stages and types of disease of the reported new active cases are provided. Because of the number of children involved, 134 out of 308 reported (43.5%) were cases of primary infection. Fifty-five (17.8%) were cases of moderately or far advanced pulmonary disease. The column "others" includes cases of miliary tuberculosis as well as extrapulmonary disease, e.g. tuberculous meningitis.

Table III delineates "epidemic" cases by age and sex. The male to female ratio is 1.3 to 1.0. In all age groups in which the numbers are significant males predominate, the one exception being the 10- to 14-year age group in which females outnumber males (ratio: 1.6 to 1.0).

TABLE III.—EPIDEMIC TUBERCULOSIS, CANADA 1960-64: NEW ACTIVE CASES BY AGE AND SEX

Age	Male	Female	Total	Distribution (%)
0 - 4.....	28	24	52	16.9
5 - 9.....	39	28	67	21.7
10 - 14.....	18	29	47	15.3
15 - 19.....	40	21	61	19.8
20 - 39.....	36	24	60	19.5
40 - 59.....	13	3	16	5.2
60+.....	2	3	5	1.6
Totals.....	176	132	308	100.0

This may be related in some way to the increased susceptibility of females around puberty. The age distribution of the disease is also of interest. Almost three-quarters of the patients were under 20 years of age. Each five-year age group up to the age of 19 years shows a high proportion of cases varying from 15.3 to 21.7% of the total and the age group 5-9 years shows the highest proportion of all (21.7%). Figures are not available for five-year age groups after the age of 20 years, but it would appear that there is a rapid decline within the age group 20-39 years.

Table IV compares the number and percentage distribution of the "epidemic cases" for 1960-1964 with reported new active cases of tuberculosis in Canada for the middle year 1962. The age distributions of the two groups are obviously dissimilar. Approximately 73% of the epidemic cases occurred in persons under 20 years of age as compared with about 27% of the new active cases reported routinely in the same age group.

## DISCUSSION

It is apparent from the data presented that the epidemiological characteristics of "epidemic" cases of tuberculosis differ from those cases detected during the course of routine survey and control programs. In view of the significant number of epidemics which have occurred during the period 1960-64, a relatively short time, certain questions naturally arise. Has the epidemiology of tuberculosis entered a new phase?

TABLE IV.—NUMBER AND PER CENT DISTRIBUTION BY AGE, REPORTED NEW ACTIVE CASES, CANADA, 1962,\* AND EPIDEMIC CASES, CANADA, 1960-64

	Total	Age					Age unknown
		0 - 9	10 - 19	20 - 39	40 - 59	60+	
New active cases (1962).....	3845 100%	608 15.8	447 11.6	1169 30.4	912 23.7	699 18.2	10 0.3
Epidemic cases (1960-64).....	308 100%	119 38.6	108 35.1	60 5.2	16 19.5	5 1.6	— —

\*Quebec cases omitted (2439) as age not given.

Can we expect increasing numbers of such epidemics? The answers to these questions may be found in the underlying causes of the epidemics. Conventionally we search for these causes in three areas—the agent, the host and the environment. As far as the agent is concerned, one might postulate increased virulence of the organism or increased resistance of the organism to anti-tuberculous drugs. Sultan's study of the variability of aerial infectivity of patients with drug-resistant tuberculosis suggests the latter as one possibility.<sup>6</sup> In a separate study, I have reviewed approximately 100 tuberculosis epidemics occurring during the past century, and I have been unable to find reports of such changes occurring during epidemics. These aspects appear to have received little attention and would benefit from further investigation.

Environmental conditions which are considered to contribute to an increased incidence of tuberculosis—poverty, overcrowding, poor housing—appear to have improved greatly in recent years. Certainly incomes continue to rise while family size is decreasing. Despite this increasing affluence it has been suggested that poor living conditions, nutritional factors, etc., may have been contributory in one or two of the reported outbreaks. In the Eskimo Point outbreak, for example, these factors received considerable emphasis. However, additional factors must have played a part in this epidemic because the conditions the authors describe are not unique to any one Eskimo community.<sup>7, 8</sup>

Another factor which may predispose to epidemics is the high level of susceptibility of our population—a by-product of the control programs of recent years. Tuberculin skin testing in the population at large has demonstrated that the positive rate for Mantoux tests has fallen to a very low figure in persons under the age of 20 years and will continue to fall even lower. This undoubtedly helps to explain the peculiar age distribution of the epidemic cases. Almost three-quarters of the total cases were in the age group under 20 years.

Experimental evidence has shown that pulmonary tuberculosis is an airborne infection.<sup>9, 10</sup>

Small droplets, containing a single bacterium or a few bacteria (droplet nuclei), are required to produce pulmonary infection. Small particles are inhaled, traverse the smaller bronchioles and are retained in the alveoli, where they may produce separate tubercles. Large particles containing viable bacilli fail to do so and are wafted to the surface by ciliary action. Because of the comparative rarity of tuberculosis epidemics one can infer that rarely do circumstances exist which are favourable to the production and maintenance of aerosols capable of transmitting infection.

To account for acute outbreaks occurring in a restricted period of time it is necessary to postulate group exposure under special circumstances that yield unusually fine aerosols. The character of the sputum from the source case, its fluidity, the presence in it of bacilli visible on smear, as distinct from growth by culture, and the duration of exposure to such sputum may be of importance. There is general agreement that sputum positive for tubercle bacilli on direct smear, is more infectious than sputum in which tubercle bacilli can only be grown by culture.<sup>11</sup> Also possibly of importance in each case are: (a) the character of the cough and its frequency; (b) sneezing, which produces a fine aerosol; and (c) the simple matter of protection of the mouth during such acts. Singing has been incriminated in other epidemics and appears to be an effective generator of fine aerosols.<sup>12</sup> These aspects should be given greater attention in future studies of outbreaks. The source case should be investigated meticulously. With experience, proper control measures may follow.

The data recorded here about these recent epidemics demonstrate that at this time we cannot rely exclusively on an intensive system of case finding (tuberculin-testing and radiographic chest surveys), isolation and drug treatment for the control of tuberculosis. In view of the high incidence in the younger age groups, we should consider the benefits to be gained by the creation of active immunity with BCG vaccine in this highly susceptible segment of our population.<sup>13</sup>

## SUMMARY AND CONCLUSIONS

Despite great progress in combating tuberculosis in recent years the disease is still a formidable threat in this country. The resurgence of tuberculosis in some areas, with a significant increase in active cases and reports of epidemics, has implications for the individual and the community at large.

The age distribution of cases reported for 24 epidemics which have occurred during the past five years (73% under 20 years of age) suggests that our young population has had fewer opportunities for exposure to the organism in the recent past and may be highly susceptible at the present time.

The occurrence of this considerable number of epidemics during a relatively short period of time also suggests that we should not rely exclusively on the present methods used for the control of this disease. The benefits of a BCG immunization program should also be considered.

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## CASE REPORTS

## Avoidance Therapy: Its Use in Two Cases of Underwear Fetishism

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**D**URING the past decade several attempts have been made to treat fetishism by aversion therapy.<sup>8-10, 12</sup> Fetishism like alcoholism<sup>4</sup> may be considered as a learned response, which by the time of treatment is an habitual response. Support for this contention may be seen in the finding that conventional therapy has little effect in the treatment of this malady, while aversion therapy has proved more successful. The treatment pattern to be reported here was designed to further increase the potency of aversion therapy. The regimen is the result of a critical review of earlier methods and recent findings in learning theory.

## CASE HISTORIES

**CASE 1.**—G.W., a 16-year-old Protestant, Canadian male, was first seen in February 1966. He was suffering from a fetish to female underwear,

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namely brassieres and panties. An only child of middle-class parents, he was adopted at the age of 21 months. Nothing is known of his genetic antecedents, but it is interesting that he was a hyperkinetic child. The boy had always been rather "cold", withdrawn and odd, but was not considered psychotic. It was thought that he demonstrated a character disorder invariably found in sexual deviates. The boy was of average intelligence but his scholastic record was poor, as he was apathetic and without ambition. Physical examination was negative. His fetishistic activities began at the age of 11 and he had been "acting out" on the average of twice monthly since that time. His technique was to raid clothes lines at a distance from his home. At first he stole the articles and hid them some distance from the scene; he did not don them or masturbate with them. Of late he had taken to tearing up the objects, often on the spot, and this change in behaviour seemed to be activated by aggressive sexual fantasies. He alleged that he had never masturbated, thus lacking the normal history of masturbation for a boy of his age.

His fantasies were heterosexual and fetishistic, and he showed no evidence of other deviations. His father was rather obsessive and domineering, the