

ENTERIC FEVER SURVEILLANCE IN SINGAPORE

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SYNOPSIS

A 5 year-review of enteric fever in Singapore showed that an average of 200 cases were notified annually. The morbidity rate varied from 7—13.6 per 100,000 and the case fatality 0.45—5.19%. The highest attack rate was in the 5—24 years age group. There were 3 electoral constituencies with high morbidity rates. Most localised outbreaks were traced to public food handlers. Epidemiological investigation and control measures and the special problems of public food handlers were described. Various control strategies have been and would be implemented to reduce the endemicity of the disease. These include identifying the pool of carriers in the community, through screening of past cases, follow up of current acute cases, bucket latrine survey, screening of food handlers in schools and in high endemic areas; the vaccination of public food handlers and health education of the public.

EPIDEMIOLOGY

Enteric fever is endemic in Singapore. About 200 cases were notified annually. The morbidity rate varied from 7 per 100,000 to 13.6 per 100,000 during the 5 year-period 1970-1974. The mortality rate was low, 0.05 to 0.37 per 100,000. The case fatality rate was between 0.45 to 5.19%. (Table I).

Most of the enteric fevers were typhoid cases; 3.6% were paratyphoid fever cases. (Table II).

The morbidity rate was highest in the 5-24 years age groups. (Table III).

Males constituted about 55% of the cases.

Table IV gives an analysis of the notified cases by electoral constituencies with highest morbidity rates. Most enteric fever cases occurred during the first quarter of the year. (Fig. I).

EPIDEMIOLOGICAL INVESTIGATION AND CONTROL

Notifications of enteric fever cases were received from medical practitioners and clinical laboratories. Early notifications are essential for rapid investigations and implementation of control measures. All contacts with signs and symptoms suggestive of the disease were screened as outpatients at Middleton Hospital. Food handlers implicated from the food history were also screened for the carrier state. The screening consisted of daily examination of urine and a purged specimen of stool for 3 consecutive days. A blood sample was also taken on the first day of screening for serology ('Vi', 'O', 'H' titres).

All enteric fever cases were isolated and treated

at Middleton Hospital. Acute cases were initially treated with chloramphenicol at 50 mgm/Kg B.W./day in divided doses and the dosage was reduced to 30 mgm/Kg B.W./day when the temperature fell. The usual duration of chemotherapy was 2 weeks. "Bactrim" (trimethoprim 80 mg/tab. and sulfamethoxazole 400 mg/tab.) at a dosage of Tab II tds. and reduced to Tab II bd. when the temperature fell, given for 12 days, was the next drug of choice. Three days after completion of the full course, stool and urine samples were taken daily for 7 consecutive days for culture. If all cultures were negative, the case was followed up 3 months later. If any of these cultures were positive (the case is termed a "convalescent" typhoid carrier), cholecystogram was taken to exclude gallbladder disease. Surgery and/or antibiotics would be offered to the patient with gallbladder disease. Three months after discharge, if any of the 3 urine and stool cultures, blood clot culture and serology were positive (the case is termed a "temporary" typhoid carrier), he is further investigated, treated and followed up at 6 months and 1 year. If any of the cultures were again positive at 1 year (the case is termed a "chronic" typhoid carrier), he is further investigated and treated. Treatment of chronic carrier consisted of surgery and/or antibiotics. This consisted of oral ampicillin at 4 g/day (75-100 mgm/Kg B.W./day) in 4 divided doses for 4 weeks or i/v ampicillin at 1g tds. (50-75 mgm/Kg B.W./day) for 2 weeks or oral "Bactrim" Tab II tds. for 4 weeks. All chronic typhoid carriers were followed-up yearly for life to ensure that they did not become public food handlers. Their particulars were recorded in a Chronic Typhoid Carrier Register.

Environmental control measures included fly control, "impact cleansing" and sanitation of latrines and wells. In the low-lying endemic areas where there is a possibility of cross-contamination of piped water supply with sewer lines, regular samples of potable water were taken for bacteriological analysis.

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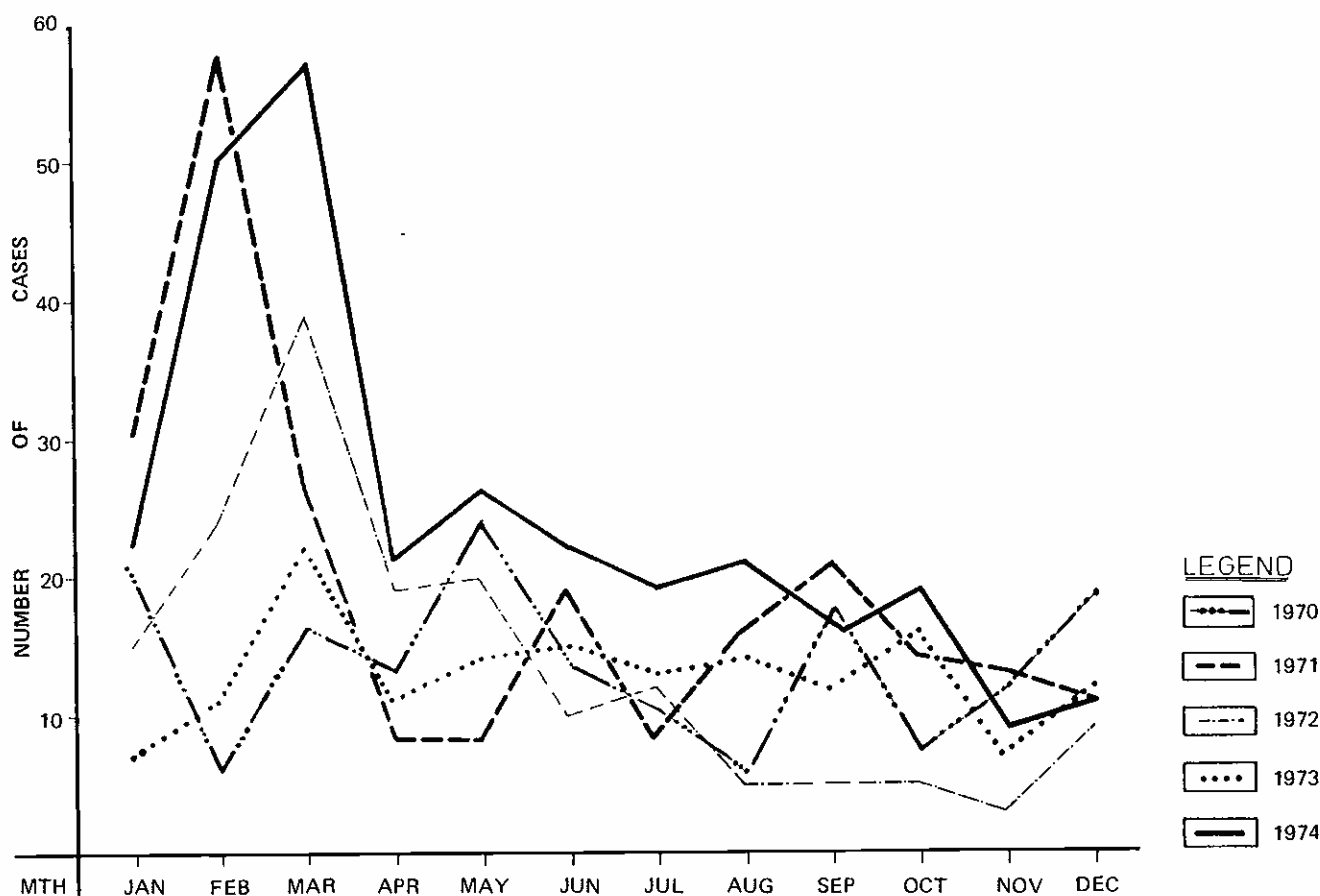


Fig. 1. Monthly Distribution of Enteric Fever Cases in Singapore 1970-1974 (Based on date of notification).

TABLE I
ENTERIC FEVER CASES IN SINGAPORE
1970-1974

Year	No. of cases Notified	Morbidity Rate (per 100,000)	Mortality Rate (per 100,000)	Case Fatality Rate (%)
1970	158 (3)	7.61	0.14	1.90
1971	224 (1)	10.61	0.05	0.45
1972	167 (4)	7.77	0.14	2.40
1973	154 (8)	7.04	0.37	5.19
1974	301 (4)	13.56	0.18	1.33

Figures in brackets indicate death cases, and included in the total. Rates based on projected mid-year population, except for 1970 which was based on population census, obtained from the Department of Statistics, Singapore.

TABLE II
CLASSIFICATION OF THE ENTERIC FEVER CASES

Year	Typhoid Cases	Paratyphoid Cases			
		A	B	C	Total
1970	150	6	2	0	8
1971	218	2	3	1	6
1972	161	3	3	0	6
1973	145	5	4	0	9
1974	294	4	2	1	7
All Years	968	20	14	2	36

TABLE III
AGE-SPECIFIC MORBIDITY RATE OF ENTERIC FEVER

Age Groups	Year									
	1970		1971		1972		1973		1974	
	C	MR	C	MR	C	MR	C	MR	C	MR
0—4	9	3.8	15	6.4	6	2.6	12	5.1	22	9.3
5—14	52	9.1	91	16.0	73	12.8	55	9.7	110	19.3
15—24	61	13.6	57	12.7	39	8.7	44	9.8	96	21.3
25—34	14	5.2	33	12.3	26	9.7	19	7.7	39	14.5
35—44	10	4.7	14	6.6	14	6.6	12	5.6	22	10.3
45—54	7	4.6	6	3.9	4	2.6	9	5.9	7	4.6
55—64	2	1.8	6	5.3	4	3.5	3	2.6	3	2.6
65—74	3	5.7	1	1.9	1	1.9	0	0	2	3.8
75+	0	0	1	5.9	0	0	0	0	0	0

C = Cases

MR = Morbidity rate per 100,000 population, based on projected mid-year population, except for 1970 which was based on population census, obtained from the Department of Statistics, Singapore.

TABLE IV
MORBIDITY RATES OF ENTERIC FEVER IN
7 ELECTORAL CONSTITUENCIES

Constituency	Year					All years 1970-1974	Morbidity* Rates per 100,000
	1970	1971	1972	1973	1974		
Kg. Kembangan	8	41	22	7	25	103	214.3
Kg. Ubi	6	34	12	4	9	65	152.5
Tg. Pagar	12	1	6	10	2	31	150.7
Kg. Chai Chee	1	4	13	5	12	35	93.1
Geylang Serai	8	11	3	0	1	23	66.6
Jurong	2	1	2	4	10	19	38.6
Havelock	1	4	0	1	1	6	29.2

* Based on estimated population in 65 electoral constituencies in 1970.

In epidemic situations, control measures were intensified. Vaccinations of the population at risk were also offered.

LOCALISED TYPHOID OUTBREAKS (1970-1974)

Localised typhoid outbreaks occurred from time to time. Most of these outbreaks were traced to typhoid carriers or cases amongst public food handlers.

In the Geylang Serai outbreak in January/March 1971 (Koh T.S. *et al*, 1971), involving 76 cases, 4 carriers were detected from mass screening of over 600 hawkers and food handlers in the area. These 4 carriers were selling food and cold drinks to residents in the area.

In the Kelantan Lane/Jalan Besar Outbreak in February/March 1974, there were 50 cases. This out-

break was traced to a cold drink stall selling "Ice Kachang", ice water and "ice ball". This itinerant hawker was assisted by his 2 daughters who were found to be carriers.

In another outbreak at Tanah Rata in April 1974, 13 persons came down with typhoid fever after taking "Nasi Lemak" from a neighbouring house.

In a small outbreak at Pachitan Empat in October 1974, a 14-year-old female carrier who sold "Rojak" and "Ayer Batu Malaysia" was responsible for 4 cases. In another small outbreak at Alexandra Hill Integrated Primary School in October 1974, 3 school children and 1 teacher were infected by a canteen food handler (a typhoid carrier) selling "Nonya" cake, "Otak-otak", "Tau-suan", "Chai-tua-kueh" and red and green bean soup.

Although no typhoid organisms have been iso-

lated from the food samples, more than 50% were contaminated with *E. coli*, reflecting poor hygienic practices amongst the food handlers.

THE PUBLIC FOOD HANDLERS AND THEIR CONTROL

There are 500 restaurants and 1,500 various other categories of eating establishments in Singapore. All food establishments, including food factories, are subject to licensing and control to ensure that the premises are maintained in a state of cleanliness and that sufficient number of functional water closets, washing facilities and anti-pollution measures are provided.

In addition, there are 31,000 hawkers, 11,000 of whom sell cooked food and drink. They do their trade in markets, hawker centres, on public side walks, at street pitches or as itinerant hawkers moving from place to place. These hawkers have to comply with basic health requirements.

There is a comprehensive system of food control in Singapore. This control extends right from the time of preparation and manufacture of food, including handling and serving, to the final food product for sale. There is control of the hygiene and sanitation of the food premises, a code of conduct of hygienic practices and habits and microbiological standards for food.

Typhoid cases with no evidence of the carrier state after clinical recovery (all stool and urine cultures negative) are allowed to resume as food handlers. They are routinely screened 3 months after discharge. Cases with intermittent or persistent positive stool or urine cultures after clinical recovery are treated as carriers. They constitute a health hazard, and therefore are prohibited from food handling.

THE ENTERIC FEVER PROBLEM IN SINGAPORE

There has been no decrease in the yearly incidence of enteric fever in Singapore compared with the period 1960-1964 (K. Kanagaratnam, 1967). The incidence remained the same despite improvements in housing and environmental sanitation. 95% of the population now have access to safe water supply and 70% are served with modern sanitation. The existing surveillance and epidemiological investigation have been prompt and efficient. An effective system of control and licensing of public food handlers has been implemented. To further reduce the incidence of enteric fever in Singapore and ultimately eradicating it altogether, various control strategies have been evolved.

THE ENTERIC FEVER CONTROL STRATEGY

(a) Examination of previous carriers and past cases

The first step was to pick up carriers in the community responsible for maintaining the endemicity of the disease.

Since 1966, a list of 53 typhoid carriers was recorded. Forty of them, comprising 26 convalescent and temporary carriers and 14 symptomless excretors and chronic carriers, were re-examined in July 1973 to ascertain their present status. The screening consisted of stool and urine cultures for 6 consecutive days, blood for serology ('Vi', 'O', 'H' titres) and bile intubation if serology was positive and culture negative. They were followed up by stool and urine cultures monthly for 5 months. Ten were finally confirmed as chronic carriers with gall bladder abnormalities, and following successful treatment, they have now been cleared.

Apart from the known carriers, there were 1776 past typhoid cases between 1963 and May 1973. Theoretically 3% of these past cases would be chronic carriers (Jawetz E. *et al*, 1966). These previous cases were re-examined, starting from those in the most endemic areas. Initially, 483 (67.5%) out of 817 people contacted were screened. No case or carrier was detected amongst them. Since the results were disappointing, it was decided to screen only food handlers amongst the past cases. Of the 42 food handlers screened, 1 was confirmed as a chronic carrier.

The low pick-up rate among past cases is probably attributed to more thorough screening of all typhoid cases before discharge.

Although only 11 chronic carriers were picked up, certain diagnostic procedures were found to be useful for screening purposes.

It was found that 'Vi' and 'O' are highly sensitive in giving few false negatives, but they are not very sensitive in picking up positive cases. 'Vi' ($\geq 1/5$) is 36% reliable for screening positive cases; 'O' ($\geq 1/100$), 18%; and combined (if none reacted to both 'Vi' and 'O'), 54%. However, examination of the first purged stool samples gave better results. 91% of the carriers had positive stool cultures. Therefore examination of single specimen of purged stool was adopted to screen carriers in preference to serological technique.

(b) Follow-up of Current Cases for Carrier State

All typhoid cases were followed up at 3 months, 6 months and 1 year after discharge. *Salmonella typhi* and *paratyphi* organisms isolated from every new case and confirmed chronic carrier were sent to Colorado, U.S.A. for antibiograms and Vi phage typing to aid future epidemiological investigation of enteric fever cases in Singapore.

An evaluation of 195 cases of typhoid fever treated at Middleton Hospital during the first 10 months of 1974 showed that there was a cure rate of 90.8%, a convalescent carrier rate of 6.7%, a temporary carrier rate of 0.5% and a fatality rate of 2.1%. Laboratory diagnostic tests showed that 77% of the serological tests ('Vi' and 'O'), 53% of blood cultures, 47% of stool cultures and 2% of urine cultures were positive. A combination of laboratory tests gave a better pick-up rate than any one single test. An assess-

ment of the effectiveness of the different drug regimens used for the treatment of these patients (excluding 4 who died) showed that of the 45 patients treated with "Bactrim", the cure rate was 100%; with chloramphenicol (139 treated), the cure rate was 98%, and convalescent carrier rate 2%. Five patients were put on ampicillin; of these, 1 was cured, 4 were convalescent carriers.

(c) *Bucket Latrine Survey*

It was also decided to pick up carriers in high endemic areas by culturing stool samples taken from bucket latrines for the presence of *S. typhi* and *paratyphi*. This would give lead to the source of infection and provide a monitoring system. The latrine survey has been found to be efficient in the detection of cholera carriers in Calcutta (Renuka Sinha *et al*, 1967).

A survey of the distribution of latrines was therefore carried out. 1,213 stool samples from 1,157 bucket latrines utilised by about 8,500 people were taken. These samples were obtained by a standardised method using a stick with a pad of cotton wool at one end. The stick was used to stir the faeces and then kept in 50 ml. of selenite and peptone media. No *S. typhi* organisms were detected. However, 3.6% showed presence of other *salmonella* pathogenic organisms, esp. *Group B Salmonella*. One sample was positive for *Vibrio Cholerae* and two positive for non-agglutinating group *Vibrios (NAG Vibrios)*. All occupants in the house where *Vibrio cholerae* were detected were screened for 5 days at Middleton Hospital, but with negative results. 50% of the occupants of the other 2 houses where *NAG Vibrios* were isolated were also screened once and again with negative results. The source of these organisms remained unknown. 56 repeated samples were also taken from the latrines from which pathogenic organisms were isolated, but only 2 of these were positive for non-typhoid *salmonella* organisms different from those originally isolated. Because of the negative results, this project was discontinued.

(d) *Screening of food handlers in Schools and in High endemic areas*

As the attack rate of enteric fever was highest in the 5-24 years age group, it was decided to protect the school children by screening all food handlers and their assistants in all the schools in Singapore. It was estimated that there were 2,476 hawkers and 2,485 assistants in 493 schools in Singapore. The project was started in October, 1974 and up to 31 July 1975, 5,318 stool and urine samples were examined. Three typhoid carriers were detected. 45 other food handlers were found to have non-typhoid *salmonella* organisms and 4 with *Shigella flexneri*.

This exercise will be followed by the screening of food handlers in high endemic areas.

All food handlers in hotels, large eating establishments, food centres and others working in ice-cream factories are periodically screened.

(e) *Enteric Fever Registry*

A system to pool all existing epidemiological, clinical and laboratory data of all typhoid cases and stored in a standardised format has been worked out in 1974. The effectiveness of various treatment regimens was periodically evaluated. A computer register of all past cases was kept at the Pathology Department whereby contacts of acute cases would be matched with the register to pick out past cases amongst them. A list of patients due for follow-up at 3 months and 1 year after discharge would be automatically printed out. Addresses and occupations of these past cases would be updated from time to time. A current list of contacts would also be kept whereby those who are repeatedly contacts of acute cases would be screened.

A Chronic Typhoid Carrier Registry was established in 1974 and maintained in the Epidemiology Unit, Ministry of the Environment.

(f) *Vaccination of public food handlers*

There is no doubt that inoculation against typhoid to all persons at risk such as contacts, hospital staff, workers in water works and all those exposed in outbreaks is justified. Annual compulsory vaccination for military personnel is also justifiable as they should not suffer from enteric fever, a preventable disease, and as they are subjected to greater risk in the field where sanitation and hygienic conditions are poor. There is also a place for the inoculation of all food handlers in Singapore.

Although there is an organised system of controlling food handlers in Singapore, the personal hygiene of these food handlers is still lacking. They therefore pose a potential hazard to the consumers if they continue to indulge in poor food handling practices. Since food handlers have been repeatedly shown to be the major sources of infection, the vaccination of food handlers is considered worthwhile. Consumers will eventually benefit indirectly as the incidence of typhoid cases and carriers among food handlers are expected to fall.

One dose of heat-phenol-inactivated vaccine prepared by the Department of Pathology, Ministry of Health, will be given using "Jet-Guns" and thereafter a single booster dose every 3 years.

The degree of effectiveness of a single dose of the vaccine confers notable protection i.e. 77.5% (C.C. Nicholson, 1970). In endemic areas, besides the clinically manifest case, a symptomless inapparent form of the disease affects a considerable proportion of the population who thus acquire a certain degree of immunity. If therefore, we assume that this situation exists among our food handlers, then inoculations of these are expected to yield a higher degree of protection. The possibility of creating a larger pool of chronic carriers among food handlers due to vaccination is a theoretical possibility but there have been no studies to establish this yet.

(g) *Health Education*

The ultimate solution to the enteric fever problem in Singapore would be health education of the public to practise good personal and food hygiene. Various nation-wide campaigns have emphasised the need for food hygiene. The 1975 "Better Food for Better Health" Campaign (18.4.75-8.5.75) was aimed at promoting better nutrition, improving food hygiene and sanitation and promoting food standards and quality. Food handlers were impressed on the importance of good food hygiene and on ways to implement food hygiene practices. Extensive use was made of the mass media to project this message across—food handlers to serve clean food and the public to eat only clean food.

As a large proportion of the population rely on public food handlers for one or more of their daily meals, it is therefore imperative that these food handlers practise good food and personal hygiene. The public should also demand only clean food. Together, we hope that with the change in attitude, behaviour and habits of the food handlers, we will achieve a high standard of food hygiene, with conse-

quent reduction in the incidence of food-borne diseases in Singapore.

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