

# HUMAN SALMONELLOSIS IN SINGAPORE

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## SYNOPSIS

A marked increase of hospitalised patients for salmonellosis was noted in 1971. A study was done on 118 cases and 133 carriers admitted to Middleton Hospital in 1975. 60.2 per cent of the cases were below 5 years of age. The commonest clinical manifestation was gastroenteritis; a few cases presented with septicaemia and typhoid-like illnesses. *S. typhimurium*, *S. derby* and *S. weltevreden* were the predominant serotypes isolated. More than half of the *S. typhimurium* isolates were resistant to ampicillin, tetracycline, "triple sulfa" and streptomycin. Similar serotypes were isolated from poultry and pigs, in view of which, the need for closer cooperation between the medical and veterinary services in the control of salmonellosis in Singapore was stressed.

## INTRODUCTION

*Salmonella* infection in man results in three types of clinical disease: enteric fever, gastroenteritis and septicaemia. In this paper salmonellosis refers to infection other than typhoid and paratyphoid.

In 1971, a sudden increase in *Salmonella* isolates (other than *S. typhi* and *S. paratyphi*) was reported by the Government Department of Pathology. In that year, there were 617 isolates compared with an average of 236 between 1968 and 1970 (Fig. I). This increase was due mainly to *S. typhimurium* isolates which accounted for 61.8 per cent of the total isolates compared to 5.6 per cent — 25.9 per cent between the years 1968 and 1970. There was a corresponding increase in the number of patients admitted to Middleton Hospital for salmonellosis (Fig. II). In 1972 and 1973 the number of hospital admissions for *Salmonella* gastroenteritis exceeded admissions for typhoid fever. In 1975, *Salmonella* gastroenteritis ranked next to typhoid fever in the hospital admission for gastrointestinal illnesses (Table I). The mortality rate of salmonellosis was low, between 0 — 1.96 per 100 admissions in the

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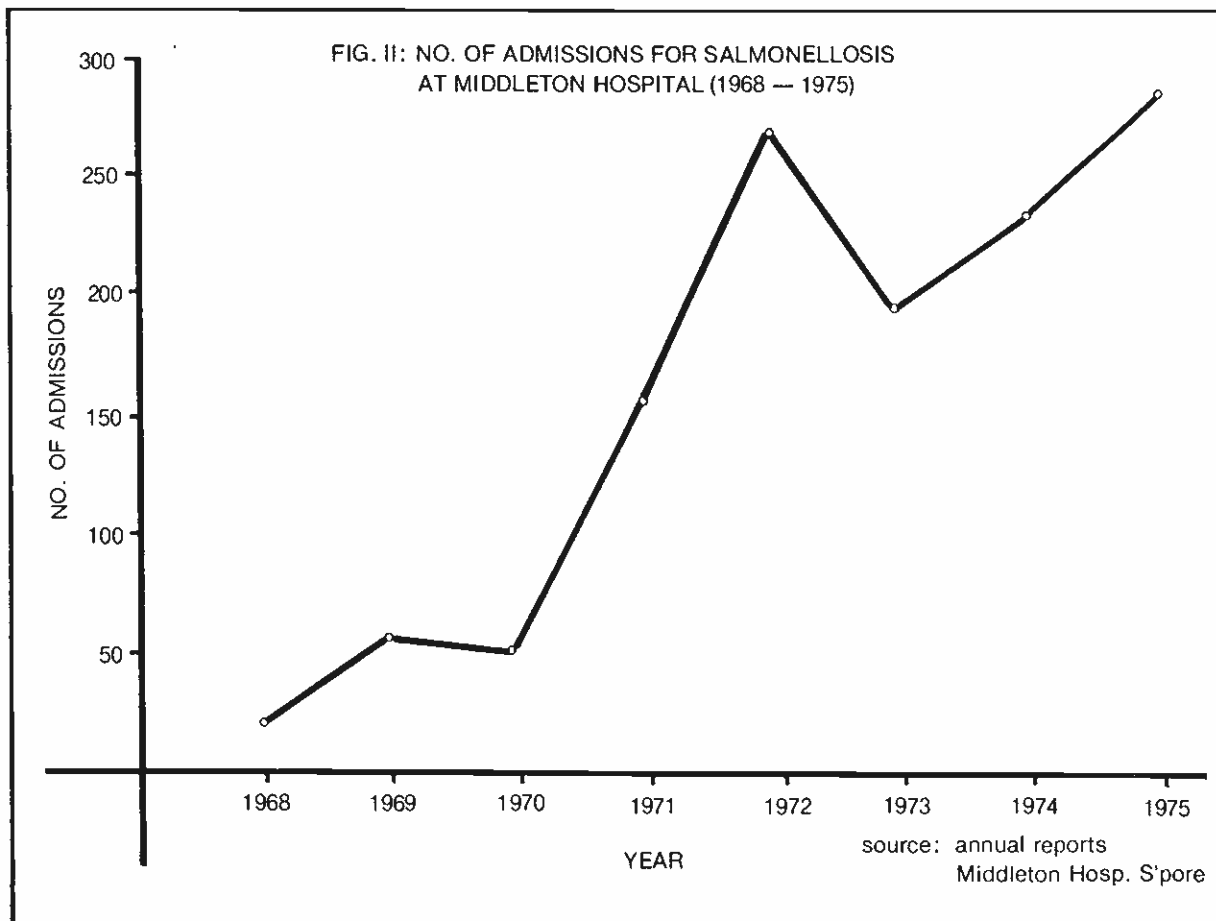
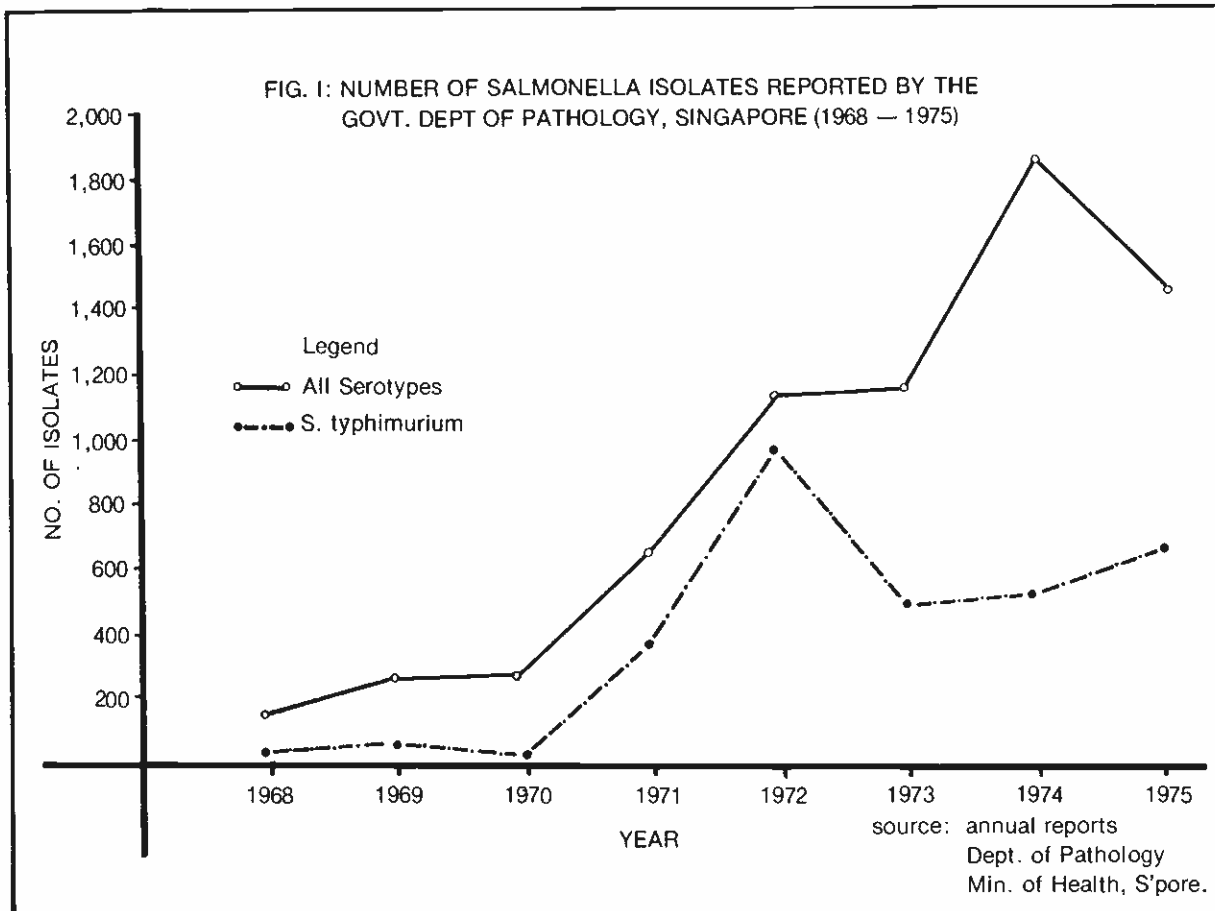


TABLE I — Admission for Gastrointestinal Illnesses at Middleton Hospital, 1975

TYPES OF GASTROINTESTINAL ILLNESSES	NO. OF ADMISSIONS
Amoebic dysentery	102 (1)
Bacillary dysentery	57
Cholera el tor	10 (1)
Clinical dysentery	72
Gastroenteritis	207
Salmonella gastroenteritis	279 (1)
Typhoid fever	508 (2)

Figures in brackets denote deaths  
Source: Annual Report, Middleton Hospital.

years 1968 — 1975.

An epidemiological study was carried out on 251 patients admitted to Middleton Hospital in 1975. A total of 118 salmonellosis cases and 133 *Salmonella* carriers (other than typhoid and paratyphoid carriers) was admitted in that year.

## EPIDEMIOLOGY

### Salmonellosis Cases

60.2 per cent of the cases were below 5 years of age and 44.6 per cent were infants (Table II). The male

TABLE II — Age Distribution of 118 Salmonellosis Cases admitted to Middleton Hospital, 1975

Age groups	Cases	%
Under 1	55	46.61
1 — 4	16	13.56
5 — 14	4	3.39
15 — 24	15	12.71
25 — 34	13	11.02
35 — 44	3	2.54
45 — 54	6	5.08
55 — 64	4	3.39
65 — 74	2	1.69
TOTAL	118	100

to female ratio was 1.36 : 1.

The predominant serotype isolated was *S. typhimurium* (57.72 per cent). In those under 5 years of age, *S. typhimurium* accounted for 84.72 per cent (Table III).

### Salmonella Carriers

These carriers were detected on routine screening of public food handlers of various food establishments; e.g. school canteens, army canteens, hawker stalls and food factories. These carriers were found in various age groups (Table IV). The male to female ratio was 1.33 : 1.

Majority of the strains isolated from carriers were *Salmonella Group E* (39.36 per cent) and *Salmonella Group B* (38.52 per cent), as shown in Table V.

### Time Distribution

Salmonellosis cases were reported throughout the year with no marked seasonal pattern (Fig III), as compared with typhoid fever which usually shows a peak during the first quarter of the year.

### Geographical Distribution

Salmonellosis cases were reported sporadically from all over Singapore. *Salmonella* carriers had a similar but wider distribution (Fig. IV).

TABLE III — Distribution of *Salmonella* strains isolated from 118 cases admitted to Middleton Hospital, 1975

STRAINS	CASES	
	All Age groups (%)	Under 5 years (%)
<i>S. typhimurium</i>	71 (57.72)	61 (84.72)
Group B	17 (13.82)	6 (8.33)
Group C	11 (8.94)	2 (2.78)
Group D	2 (1.63)	—
Group E	19 (15.45)	2 (2.78)
Group G	1 (0.81)	—
Not stated	2 (1.63)	1 (1.39)
TOTAL	123*(100)	72+ (100)

\*5 patients with 2 different strains  
+ 3 patients with 2 different strains

**TABLE IV — Age distribution of 133 Salmonella Carriers admitted to Middleton Hospital, 1975**

Age groups	No. of Carriers	%
5 — 14	4	3.01
15 — 24	32	24.06
25 — 34	25	18.8
35 — 44	21	15.79
45 — 54	23	17.29
55 — 64	23	17.29
65 — 74	4	3.01
75+	1	0.75
TOTAL	133	100

**TABLE V — Distribution of Salmonella strains isolated from 133 Carriers admitted to Middleton Hospital, 1975**

Strains	Number	%
Group B	57	42.22
Group E	53	39.36
Group C	13	9.63
Group G	7	5.19
Group D	1	0.74
<i>S. typhimurium</i>	3	2.22
Not stated	1	0.74
TOTAL	135*	100

\*2 carriers with 2 different strains.

**Clinical Features**

The cases presented with the following clinical manifestations: **Salmonella** gastroenteritis, **Salmonella** food poisoning, **Salmonella** bacteraemia and other manifestations.

**Salmonella gastroenteritis**

This was the commonest manifestation. Diarrhoea of varying frequency was the predominant symptom. In those under 5 years of age, 56.3 per cent had blood with or without mucus in stools; 22.5 per cent had vomiting; and 77.5 per cent had fever (37.5°C to 39.5°C). 9.9 per cent of them also com-

plained of febrile fits. 57.7 per cent of those under 5 years of age were noted to have some degree of dehydration (Table VI).

In those over 5 years of age, the signs and symptoms were diarrhoea (100 per cent), fever (83.7 per cent), vomiting (44.2 per cent) and abdominal cramp (41.9 per cent). Only 9.3 per cent of the cases complained of blood and mucus in stools and 4.7 per cent presented with mild degree of dehydration from prolonged and frequent bouts of diarrhoea.

**S. typhimurium** was the commonest serotype giving rise to blood-stained diarrhoea in children under 5 years of age (Table VII).

**Salmonella food poisoning**

3 patients were admitted for **Salmonella** food poisoning. This incident was investigated and it was found that in fact, 14 (70 per cent) of a group of 20 nurses who attended a party on 19.12.75 became ill. The clinical symptoms were diarrhoea (92.9 per cent), abdominal cramp (85.7 per cent),

**TABLE VI — Clinical features of Salmonella Gastroenteritis**

Signs and Symptoms	CASES (%)	
	Under 5 years	Over 5 years
Diarrhoea	71 (100%)	43 (100%)
Blood-stained diarrhoea	40 (56.3%)	4 (9.3%)
Fever	55 (77.5%)	36 (83.7%)
Vomiting	16 (22.5%)	19 (44.2%)
Abdominal cramp	—	18 (41.9%)
Febrile fits	7 (9.9%)	—
Dehydration	41 (57.7%)	2 (4.7%)
TOTAL	71	43

**TABLE VII — Salmonella strains isolated from patients with blood-stained Diarrhoea**

Strains	CASES (%)	
	Under 5 years	Over 5 years
<i>S. typhimurium</i>	37 (92.5%)	—
Group B	2 (5%)	1 (25%)
Group E	1 (2.5%)	3 (75%)
TOTAL	40 (100%)	4 (100%)

fever (78.6 per cent), headache (71.4 per cent), nausea (57.1 per cent) and vomiting (42.9 per cent). The median incubation period was 20 hours. The food incriminated was coconut jelly (Chi-square 5.079;  $p < 0.025$ ) which was kept uncovered in the refrigerator and probably contaminated by drips from raw meat. **Salmonella Group E** were isolated from all the 3 patients hospitalised; one of the iso-

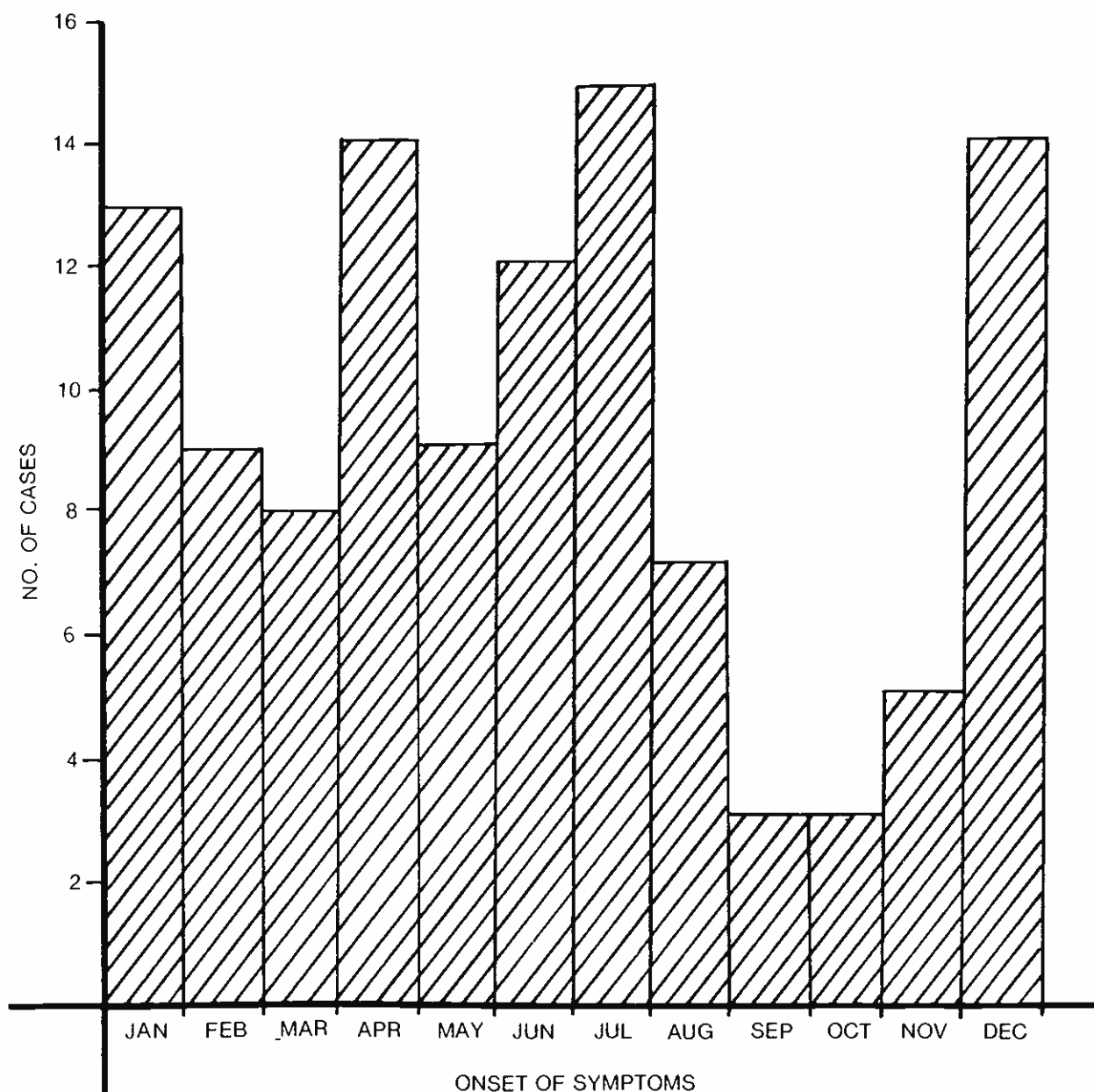
lates was serotyped and found to be **S. weltevreden**.

#### **Salmonella bacteraemia**

Although 11 patients presented with septicaemic-like illnesses, **Salmonella** organisms were isolated from blood cultures of only 3 patients.

The first patient was a 25 year-old male with

FIG. III: MONTHLY DISTRIBUTION OF SALMONELLOSIS CASES ADMITTED TO MIDDLETON HOSP., 1975 (BASED ON DATES OF ONSET)



Epidemiology unit

Unknown: 6 Cases

acute myeloid leukaemia. He developed gastroenteritis and septicaemia. *S. typhimurium* and *Salmonella Group C* were isolated from blood culture on separate occasions (but not from stools). He died subsequently.

The other two patients, aged 20 and 22 years, presented with gastroenteritis, hepatosplenomegaly and swinging temperature. *Salmonella Group C* were isolated from blood cultures (but not stool) in one and from both blood and stool cultures in the other patient.

### Other manifestations

In 2 female patients, aged 62 and 31 years, the only symptom was fever. *S. cholerae-suis* var *kurzendorf* and *S. typhimurium* respectively were isolated from their stool cultures.

3 patients aged 16 — 21 years, presented with typhoid-like illnesses but stool cultures were repeatedly negative for *S. typhi* and *paratyphi*. However, *Salmonella Group C, B* and *S. bovis-morbificans* were subsequently cultured from their respective stools.

Focal manifestations were suspected in 2 patients. One of them, a 1 year-old patient with gastroenteritis, developed osteomyelitis of left

femur. *Salmonella Group C* and *E* were repeatedly isolated from stools. The other patient, a 62 year-old diabetic developed a swinging temperature and an abdominal mass. At laparotomy, he was found to have a ruptured splenic abscess and a left sub-phrenic abscess. *S. typhimurium* were isolated from stool, but not from blood and pus cultures.

### Treatment

All cases were given symptomatic and supportive treatment. Antibiotics were prescribed only when there was septicaemia. The types of antibiotics used were based on the antibiotics sensitivity pattern of the organisms. Most patients stopped excreting *Salmonella* organisms within a month, with a few exceptions. In a 16 year-old boy with agammaglobulinaemia, and in a 32 year-old woman with metastatic nasopharyngeal carcinoma, *S. meleagridis* and *S. typhimurium* respectively were repeatedly isolated from their stool cultures for more than 3 months. The median duration of hospitalisation was 18 days for those under 5 years of age and 14 days for those above 5 years of age.

Carriers were not treated with antibiotics and became culture negative subsequently. They were discharged when 3 — 6 consecutive stool cultures

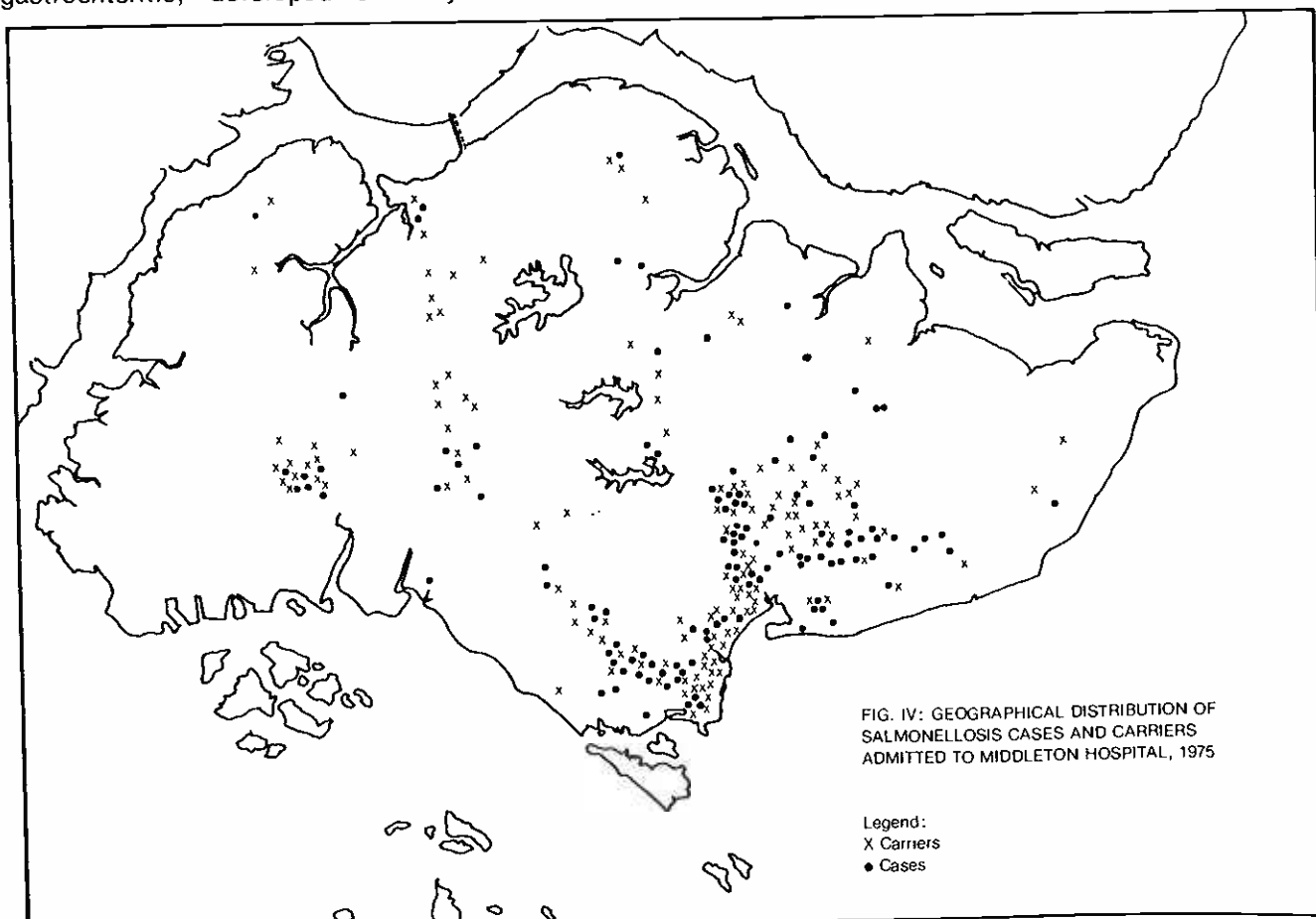


FIG. IV: GEOGRAPHICAL DISTRIBUTION OF SALMONELLOSIS CASES AND CARRIERS ADMITTED TO MIDDLETON HOSPITAL, 1975

Legend:  
 X Carriers  
 ● Cases

were negative for *Salmonella* organisms. The median duration of hospitalisation for carriers was 8 days (range 3 — 43 days).

### Antibiotics Sensitivity Pattern

Based on the tests carried out in 1975 at the Government Department of Pathology, it was found that *S. typhimurium* was resistant to most drugs frequently prescribed by some medical practitioners for gastroenteritis (Table VIII). 83.87 per cent were resistant to streptomycin; 68.56 per cent to "triple sulfa", 60.79 per cent to tetracycline, 59.75 per cent to ampicillin and 27.48 per cent to neomycin. All the *S. typhimurium* isolates tested were sensitive to chloramphenicol and only 4.7 per cent resistant to "septrin". Over half of the *Salmonella* Group E and Group C isolates tested were resistant to "triple sulfa".

### Salmonella Serotypes

The majority of the *Salmonella* strains isolated were from faecal specimens received by the Public Health

and Routine Laboratories with a few from non-faecal specimens. The specimens were directly inoculated into blood agar, MacConkey agar and selenite broth. Secondary subcultures from the selenite broth were done on eosin methylene blue and desoxycholate citrate agar. Overnight incubation at 37°C was employed. All watery stools were also inoculated onto T.C.B.S. (thiosulphate citrate bile salts sucrose) to check for *Vibrio* organisms. The *Salmonella* organisms were identified according to the Kauffman-White Schema; uncommon ones were serotyped by the *Salmonella* Reference Laboratory, Institute of Medical & Veterinary Science, Adelaide. The distribution of the *Salmonella* serotypes from 585 cases in Singapore during the 1 1/2 year period from March 1975 to August 1976 is shown in Table IX.

### DISCUSSION

Salmonellosis is a zoonotic disease of public health importance in Singapore in which animal infections are communicated to man. Sporadic cases of *Salmonella* gastroenteritis have been increasing annually since 1971 and more and more food poison-

TABLE VIII — Antibiotics resistance pattern of *Salmonella* organisms tested at the Government Department of Pathology, 1975

STRAINS	PERCENTAGE OF SALMONELLA RESISTANT TO						
	Ampicillin	Tetracycline	Chloramphenicol	Septrin	Neomycin	Triple Sulfa	Streptomycin
<i>S. typhimurium</i>	59.75% (405)	60.79% (403)	0% (243)	4.70% (404)	27.48% (404)	68.56% (353)	83.87% (62)
Group E	3.33% (150)	9.33% (150)	1.68% (119)	2.0% (150)	2.01% (149)	52.03% (148)	—
Group B	16.82% (107)	14.95% (107)	1.06% (94)	3.74% (107)	2.86% (105)	44.90% (98)	50% (10)
Group C	21.82% (55)	16.67% (54)	4.88% (41)	3.64% (55)	9.09% (55)	66.67% (51)	44.44% (9)
Group G	9.52% (21)	38.09% (21)	0% (9)	0% (21)	0% (20)	33.33% (21)	—
Group D	0% (15)	0% (15)	0% (13)	20% (15)	0% (15)	41.67% (12)	0% (3)

Figures in brackets denote number of isolates tested.

All strains were tested by Kirby-Bauer method using discs with ampicillin (100 mcg), tetracycline (30 mcg), chloramphenicol (30 mcg), septrin (trimethoprim 1.25 mcg, sulfamethoxazole 23.75 mcg), neomycin (30 mcg), triple sulfa (250 mcg) and streptomycin (10 mcg).

TABLE IX — *Salmonella* serotypes (other than *S. typhi* and *S. paratyphi*) isolated at the Government Department of Pathology from 585 cases (March 1975 to August 1976)

SALMONELLA		MAR — DEC 1975		JAN — AUG 1976	
GROUPS	SEROTYPES	No. of Cases	%	No. of Cases	%
B	<i>S. typhimurium</i>	198	70.1	91	30.0
	<i>S. derby</i>	15	5.3	43	14.1
	<i>S. agona</i>	1	0.4	0	0
	<i>S. stanley</i>	1	0.4	0	0
	<i>S. java</i>	0	0	4	1.3
C	<i>S. blockley</i>	0	0	3	1.0
	<i>S. bovis-morbilicans</i>	12	4.2	11	3.6
	<i>S. cholerae-suis v. kunzendorf</i>	3	1.0	0	0
	<i>S. cholerae-suis</i>	0	0	1	0.3
	<i>S. virchow</i>	2	0.7	4	1.3
	<i>S. singapore</i>	1	0.4	0	0
	<i>S. muenchen</i>	1	0.4	0	0
	<i>S. albany</i>	1	0.4	5	1.7
	<i>S. oslo</i>	0	0	2	0.7
	<i>S. newport</i>	0	0	2	0.7
	D	<i>S. enteritidis</i>	6	2.1	2
<i>S. javiana</i>		2	0.7	5	1.7
E	<i>S. anatum</i>	5	1.8	3	1.0
	<i>S. give</i>	0	0	1	0.3
	<i>S. lexington</i>	6	2.1	23	7.6
	<i>S. meleagridis</i>	5	1.8	13	4.3
	<i>S. weltevreden</i>	16	5.6	45	14.9
	<i>S. senftenberg</i>	1	0.4	13	4.3
G	<i>S. havana</i>	5	1.8	32	10.5
K	<i>S. cerro</i>	1	0.4	0	0
TOTAL		282	100	303	100

ing outbreaks have been or are suspected to be caused by the *Salmonella* group of food poisoning organisms. In previous years, the number of *S. typhimurium* cases was usually fewer than 20 per year until in 1971 when a sudden sharp increase in the cases, especially among infants, was recorded in September (Tan and Tan, 1972). This sudden increase in incidence of *S. typhimurium* infections in 1971 has been attributed to the importation of a virulent strain which had since been shown to have also infected the local domestic animal population (Epidemiological News Bulletin, 1975). Many public food handlers are also known *Salmonella* carriers; e.g. 2.7 per cent of the 996 public food handlers screened by Epidemiology Unit in 1975 were posi-

tive for *Salmonella* organisms.

Human salmonellosis affects mainly the young. The duration of hospitalisation is relatively long and death may result from septicaemia in the debilitated and from severe dehydration and cardiovascular collapse if cases are not treated early. The hospitalised patients probably represent only a fraction of the population infected with *Salmonella* organisms. The number of isolates at the Government Department of Pathology also does not give a true picture of the prevalence of the disease in Singapore; it merely indicates those that are regularly encountered from specimens sent by hospitals and general practitioners to the laboratories for bacteriological investigations.

The importance of *Salmonella* food poisoning outbreaks was recognised when thorough epidemiological investigation was carried on all notified food poisoning cases since 1975. (Epidemiological News Bulletin, Jan, May, Aug, Sept, 1976). Epidemiological investigations have shown that the commonest cause of *Salmonella* food poisoning outbreaks is cross contamination between raw meat and ready-to-serve food. The poor personal hygiene of some public handlers and incorrect food handling practices may be responsible for some sporadic cases of *Salmonella* gastroenteritis. The handling of raw meat prior to the preparation to infant feeds seen in many households, may account for a few cases of infantile *Salmonella* gastroenteritis.

*Salmonella* organisms especially *S. typhimurium* have been found to be resistant to several common antibiotics. This is a matter of concern. The frequency of drug resistance to particular antibiotics probably reflects the indiscriminate use of the drugs concerned by medical and veterinary practitioners. Before 1971, studies carried out on non-typhoid *Salmonella* strains showed that antibiotics resistance was comparatively lower (Sng and Lam, 1971). Antibiotics resistance poses therapeutic problems and enhances epidemic potential of the strains. This is even more important because of the phenomena of transferable drug resistance in enterobacteriaceae. Antibiotics are not indicated in treatment of *Salmonella* gastroenteritis unless there is septicaemia. They do not shorten the period of diarrhoea. There is evidence to suggest that treatment with antibiotics in mild cases of gastroenteritis and in carriers prolong the period of *Salmonella* excretion by modifying the normal intestinal flora (Christie, 1973).

*Salmonella* surveillance in Singapore is not well developed because of the lack of serotyping faci-



lities which would help to trace the source of infection, especially in food poisoning outbreaks. However, several studies carried out showed that **S. typhimurium** was the most common serotype recovered from local diseased pigs (Liow, 1975) and the second most common from diseased poultry (Chew and Liow, 1974). 89(19.0 per cent) out of 469 slaughtered pigs at Jurong Abattoir examined between November 1974 and November 1975 were found to harbour **Salmonellae**; the most predominant serotype being **S. derby** and **S. weltevreden** with **S. typhimurium** ranked fifth (Liow and Loh, 1976). It was also found that **S. typhimurium**, **S. derby** and **S. weltevreden** were present in animal products, especially pig and sheep carcasses (Chua, 1976). These serotypes were also commonly isolated from human sources (Table IX). During the outbreak of human salmonellosis in 1971, a high incidence of **S. typhimurium** infection was also reported in pigs and poultry by the Veterinary Laboratory, Primary Production Department. Cultures isolated from both human and animals were sent at that time to the **Salmonella** Reference Laboratory, Colindale for phage-typing. Most of the strains were found to share a common "phage-type 193" and carrying the same resistance factors indicating the animal origin of human infections (WHO 1974; WHO 1976). The close correlation between human and animal sources of **Salmonellae** reflects the importance of the animal reservoir of **Salmonellae** in the epidemiology of human salmonellosis. Therefore, there is a need for closer liaison between the veterinary and medical services in the prevention and control of salmonellosis in Singapore.

The steps taken by the Environment and Health Ministries to control salmonellosis and other food-borne diseases include a comprehensive system of food control which extends right from the time of preparation to the final product for sale. All food establishments including hawker stalls are licensed. There is a code of conduct of hygienic practices and habits for food handlers, and microbiological standards for food (Koh and Goh, 1976). Food handlers with **Salmonella** infection are isolated at Middleton Hospital and prohibited from food hand-

ling until free from infection, so as not to pose a health hazard to others. Health education on strict personal and food hygiene is given on a personal basis and also during National Health Campaigns.

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