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Salmonella serotypes isolated from man in Malaysia over the 10-year period 1973–1982

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SUMMARY

The results of serotyping of 10953 salmonella isolates from humans over a 10-year period, 1973–82 at the Bacteriology Division, Institute for Medical Research, Malaysia are presented. A total of 104 serotypes from 22 'O' groups were encountered; 95 isolates were considered untypable. The three most predominant serotypes, namely *Salmonella typhi*, *S. typhimurium* and *S. weltevreden* together accounted for 54·1 % of all isolates whilst the 25 most frequent serotypes accounted for 93·6 % of the total. Whilst the commoner serotypes occurred regularly throughout the study period, the rarer ones tended to appear only in one year, when they might be associated with an outbreak, and never again.

The pattern of serotypes, though quite similar to the one seen in neighbouring Singapore, is different from those experienced in other places such as Hong Kong, Jakarta, Bangladesh and Manchester.

INTRODUCTION

Salmonellosis is becoming an increasing public health problem in many countries and seems to be associated with development. It appears to be on the increase while other gastrointestinal diseases such as typhoid and shigellosis are decreasing.

Serotyping of salmonella is a useful tool which assists in understanding the epidemiology of the disease. Nearly 2000 serotypes are recognized, and their varied distribution in different geographical and zoological situations allows some epidemiological tracking to be done.

As the traffic of people, livestock and foodstuffs across national boundaries expands, so does the risk from importation/exportation of salmonellosis. In this regard the knowledge of the prevalent serotypes in a country will be indispensable in understanding the mechanism of transmission from country to country.

This paper attempts to provide a picture of the pattern of salmonella serotypes in Malaysia based on the findings of serotyping activity at the Bacteriology Division of IMR, Kuala Lumpur for the 10-year period 1973–82. This division started serotyping strains of salmonella isolated from the various laboratories in the country in 1965 when 15 serotypes were encountered (IMR, 1965).

MATERIALS AND METHODS

Salmonella strains isolated in the division as well as those submitted by the government pathology laboratories in the various states of Malaysia and the departments of medical microbiology at the University of Malaya and the Universiti Kebangsaan were included in the study. The strains were first confirmed to be salmonella by conventional biochemical techniques and then serotyped by slide agglutination using Burroughs Wellcome 'O' and 'H' antisera. Strains were ascribed to serotypes by their reaction to group and specific antisera according to the scheme of Kauffmann and White (Edwards & Ewing, 1972).

Doubtful cases and strains encountered for the first time were despatched to the Salmonella Reference Laboratory at the Institute for Medical and Veterinary Science, Adelaide, Australia for serotyping and confirmation.

RESULTS

During the 10-year period 1973–82, a total of 10953 strains were serotyped. Of these 2290 were isolated at the Division of Bacteriology, Institute for Medical Research itself while 8663 were received from the referring laboratories.

Most of the strains were from stool specimens, a much lesser number from blood and a few from unusual specimens such as cerebrospinal fluid, pleural fluid, pus, urine and high vaginal swab.

Of the strains isolated at the division 1317 were from stools of cases of diarrhoea, which for the study period totalled 23738. This gives an isolation rate for salmonella from diarrhoea cases of 5·5%.

Another 784 isolates at the division were obtained from the stools of asymptomatic persons – food handlers and contacts of cases who numbered 34255, giving an isolation rate of 2·3%.

The total number of strains serotyped each year has been on the increase, perhaps partly due to improved laboratory services, increased awareness and improved surveillance.

A total of 104 serotypes were encountered. They were from 22 Kauffmann–White groups, namely A, B, C_1, C_2, C_3, D_1, E_1, E_2, E_4, F, G_1, I, J, K, M, N, O, P, Q, U, V and Y.

Ninety-five strains were considered untypable both by this laboratory and the reference laboratories. Four of these were from group B, 21 from C_1, 11 from C_2, one from C_3, 21 from D_1, 10 from E_1, four from E_4, one from F, 14 from I, four from Y and four could not be ascribed to any 'O' group.

Table 1 lists the 25 most frequently encountered serotypes over the 10-year study period and also gives their occurrence for each 2-year interval. These 25 serotypes are all in the Kauffmann–White groups A to E, a pattern commonly found worldwide.

The three serotypes *Salmonella typhi*, *S. typhimurium* and *S. weltevreden* alone account for 54·13% of the total, while the 25 most frequent serotypes account for 93·6% of the total. The remaining 79 serotypes together with the untypable strains only account for 6·4%.

These, with their numbers isolated over the 10-year period, are listed below:

Table 1. *The most frequently isolated serotypes salmonella over the period* 1973–1982

Serotype	Years						Percentage isolates
	1973–4	1975–6	1977–8	1979–80	1981–2	1973–82	
S. typhi	323	513	932	876	1190	3834	35·0
S. typhimurium	636	249	52	60	94	1091	10·0
S. weltevreden	123	101	138	317	325	1004	9·2
S. paratyphi B	74	87	95	138	151	545	5·0
S. lexington	65	55	57	111	154	442	4·0
S. stanley	22	24	43	77	158	424	3·9
S. bareilly	45	61	51	96	101	354	3·2
S. haifa	1	26	113	117	62	319	2·9
S. blockley	7	12	72	128	44	263	2·4
S. derby	62	51	67	43	2	225	2·1
S. bovis-morbificans	43	17	48	69	44	221	2·0
S. agona	0	0	11	96	105	212	1·9
S. newport	36	33	14	53	69	205	1·9
S. paratyphi A	9	19	31	28	82	169	1·5
S. javiana	27	16	27	25	48	143	1·3
S. anatum	48	22	11	28	23	132	1·2
S. krefeld	—	—	—	81	39	120	1·1
S. heidelberg	5	4	26	30	21	86	0·8
S. enteritidis	7	11	10	15	42	85	0·8
S. typhimurium var. *copenhagen*	1	34	26	10	0	71	0·6
S. virchow	—	—	6	28	30	64	0·6
S. give	9	19	7	21	7	63	0·6
S. infantis	16	15	6	14	10	61	0·6
S. emek	3	2	11	14	26	56	0·5
S. oslo	7	4	32	8	1	52	0·5
All remaining serotypes	85	86	90	199	252	712	6·4
Total	1654	1461	1976	2682	3180	10953	100

S. bredeney (43), *S. kentucky* (38), *S. choleraesuis* (35); *S. havana* (33), *S. senftenberg* (30), *S. braenderup* (28), *S. lomita* (26), *S. litchfield* (24), *S. london* (24), *S. muenchen* (20), *S. raus* (20), *S. rubislaw* (19), *S. ohio* (19), *S. saintpaul* (19), *S. thompson* (18), *S. hvittingfoss* (17), *S. montevideo* (14), *S. singapore* (13), *S. paratyphi B* var. *odense* (13), *S. potsdam* (11), *S. sofia* (10), *S. chincol* (9), *S. othmarschen* (9), *S. schwarzengrund* (8), *S. albany* (8), *S. meleagridis* (7), *S. paratyphi B* var. *java* (5), *S. chester* (5), *S. augustenborg* (5), *S. cerro* (5), *S. dublin* (4), *S. poona* (4), *S. mbandaka* (3), *S. jamaica* (3), *S. seremban* (3), *S. eastbourne* (3), *S. orion* (3), *S. chingola* (3), *S. tennessee* (3), *S. abony* (2), *S. indiana* (2), *S. livingstone* (2), *S. choleraesuis* var. *kunzendorf* (2), *S. oritamerin* (2), *S. nienstedten* (2), *S. hadar* (2), *S. pullorum* (2), *S. enteritidis* var. *chaco* (2), *S. nchanga* (2), *S. gaminara* (2), *S. mgulani* (2), *S. wandsworth* (2), *S. cairo* (1), *S. oranienburg* (1), *S. djugu* (1), *S. eimsbuettel* (1), *S. isangi* (1), *S. kottbus* (1), *S. wangata* (1), *S. enteritidis* var. *danysz* (1), *S. lanka* (1), *S. newington* (1), *S. manila* (1), *S. binza* (1), *S. taksony* (1), *S. aberdeen* (1), *S. cubana* (1), *S. okotie* (1), *S. arizonae* (1), *S. berlin* (1), *S. blukwa* (1), *S. pomana* (1), *S. matopeni* (1), *S. godesberg* (1), *S. adelaide* (1), *S. alachua* (1), *S. houten* (1), *S. lohbruegge* (1), *S. djakarta* (1).

S. typhi is still very commonly isolated in this country and the figures given in

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this study probably underestimate its real frequency of isolation as many of the laboratories are able to identify it and do not send all their strains for serotyping. This same reason also explains the drop in number of *S. typhimurium* isolates in the second half of the study period, during which the development of the laboratory services in this country has seen the establishment of more competent state laboratories. It is now quite usual for many of these laboratories to identify *S. typhi*, *S. paratyphi A* and *B* and *S. typhimurium* and only send the others for serotyping.

Apart from these serotypes, *S. weltevreden* can be considered to be the leading serotype in this country and has been in positions two to four in each of the 10 years of the study.

S. derby has dropped in frequency in the last 3 years while *S. stanley*, *S. haifa*, *S. blockley* and *S. agona* have become more prominent.

S. krefeld, which was first isolated here in 1979 and reached a peak in 1980 when it was associated with hospital infection outbreaks in paediatric wards, tailed off in the later years of the study.

Of the 104 serotypes encountered, 67 were known in Malaysia at the start of the study in 1973 while 37 were seen for the first time during the study period. Of these 29 were seen only in any one year and never again. An example of the latter is *S. rubislaw*, which made its appearance in 1977 when it was implicated in a common-source foodborne outbreak and then completely disappeared.

DISCUSSION

The pattern of serotypes of salmonella encountered in Malaysia is presented. The different serotypes can be seen to fit into three categories.

The first group comprises those that appear to be firmly established in one place and are in high prevalence throughout long periods. Examples are *S. typhimurium*, *S. weltevreden*, *S. lexington* and *S. stanley*. The second group comprises those that seem to be involved in particular situations when conditions are right for them and are associated with outbreaks. Examples of this group are *S. krefeld* and *S. agona*.

The third group comprises those that are isolated only sporadically and never really get a good foothold. There are many examples of this in our series.

The increasing traffic of people, animals and foodstuffs across national boundaries gives ample opportunity for the introduction of new serotypes into a country. This could explain in part the gradual increase in number of serotypes encountered in this country from 15 in 1965 to 104 by 1982. Once introduced into a country a serotype can behave in one of the three ways described above. One example of a presumably imported serotype which adapted and proliferated in its new habitat is *S. johannesburg*; this was first isolated in Hong Kong in 1971 with four isolates, but by the following year the number of isolations increased rapidly and it soon became the most prevalent serotype found (Chau and Huang, 1977).

The leading serotypes in Malaysia (other than the enteric fever organisms) are *S. typhimurium*, *S. weltevreden*, *S. lexington*, *S. stanley*, *S. bareilly*, *S. haifa*, *S. blockley* and *S. derby*. It would be interesting to compare this with the findings in some other places to illustrate the geographical variation of serotype prevalence.

In neighbouring Singapore, the common serotypes for the period 1975–6 were *S. typhimurium*, *S. weltevreden*, *S. derby*, *S. havana* and *S. lexington* (Goh, Lam & Monteiro, 1977). All of these with the exception of *S. havana* also featured prominently in Malaysia over the same two-year period. Both these countries have close economic, social and cultural connections.

Comparison with places further afield shows a different picture. A 6-year study in Hong Kong from 1969 to 1974 (Chau & Huang, 1977) revealed the 10 most prevalent serotypes to be *S. johannesburg*, *S. derby*, *S. typhimurium*, *S. anatum*, *S. london*, *S. manhattan*, *S. newport*, *S. stanley*, *S. potsdam* and *S. meleagridis*. Its most prominent serotype, *S. johannesburg*, has yet to be isolated in Malaysia although there is a lot of exchange of traffic in both people and foodstuffs between the two places.

Similarly, *S. oranienburg*, of which only one isolate was found in this country over the 10-year period, is said to be the most frequently isolated serotype from hospitalized diarrhoea patients in Jakarta, Indonesia (Cobet *et al.* 1981).

In Bangladesh, a study showed that *S. java* and *S. virchow* accounted for 64% of all isolates (Blaser *et al.* 1982) and in the Manchester area of the United Kingdom during the period 1976–80 the predominant serotypes were found to be *S. typhimurium*, *S. hadar*, *S. virchow* and *S. agona* (Barrel, 1982).

It is thus quite clear that different serotypes of salmonella have different properties which influence their prevalence in a particular place, probably in interaction with geographical, climatic, socio-economic and cultural factors existent there. Studies into these properties may lead to better understanding of the worldwide epidemiology of salmonellosis and the formulation of better control measures for this increasingly troublesome problem.

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REFERENCES

Blaser, M. J., Imdadul Huq, M., Glass, R. I., Zimicki, S. & Birkness, K. A. (1982). Salmonellosis at rural and urban clinics in Bangladesh. Epidemiological and clinical characteristics. *Journal of Epidemiology* **116**, 266–275.

Barrel, R. A. E. (1982). Isolations of salmonellas from human, food and environmental sources in the Manchester area: 1976–1980. *Journal of Hygiene* **88**, 403–411.

Chau, P. Y. & Huang, C. T. (1977). Salmonellosis in Hong Kong. *Public Health* **91**, 83–89.

Cobet, A. B., Gershman, M., Asril Moechtar, M., Sumarmo & Sunoto (1981). Salmonellosis in Indonesia: phage type of *Salmonella oranienburg* obtained from hospitalised patients in Jakarta, Indonesia. *Journal of Hygiene* **86**, 227–236.

Edwards, P. R. & Ewing, W. H. (1972). *Identification of Enterobacteriaceae*, 3rd ed. Minneapolis: Burgess Publishing Company.

Goh, K. T., Lam, S. & Monteiro, E. S. (1977). Human salmonellosis in Singapore. *Singapore Medical Journal* **18**, 44–52.

Institute for Medical Research (1965). Division of Bacteriology. Annual Report, pp. 8–14.