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The changing epidemiology of salmonellosis in Singapore

Introduction

Salmonellosis is one of the most common and widely distributed foodborne diseases. It constitutes a major public health burden in many countries[1]. Salmonellosis is caused by the bacterium *Salmonella*. Over 2,500 different *Salmonella* serotypes have been identified so far. *Salmonella* Enteritidis and *Salmonella* Typhimurium are two of the most commonly reported serotypes in countries with a salmonellosis surveillance programme[2].

Salmonella infection in humans is generally acquired via consumption of contaminated food items of animal origin (meat, poultry, eggs and milk). Direct or indirect contact with farm animals, reptiles, and chicks are also potential sources of infection[3].

Emergence of *Salmonella* strains resistant to one or more types of antimicrobials has also become a growing public health problem since the early 1990s, limiting the effective treatment of infections[1].

All laboratory confirmed salmonellosis cases are administratively notified to the Ministry of Health. The *Salmonellae* isolated were routinely serotyped for *S* Enteritidis and *S* Typhimurium. A review was carried out on the epidemiology and disease trends of *Salmonella* infections in Singapore between 2000 and 2005. Epidemiological information such as age, gender and ethnicity was analysed.

Results

A total of 1,259 laboratory-confirmed salmonellosis cases were notified during the study period. *S.* Enteritidis was the predominant

serotype comprising two-thirds of the cases. Infection by *S.* Typhimurium consisted of only 1.4% of all cases.

The annual incidence rate of salmonellosis increased from 2.5 per 100,000 population in 2000 to 6.8 per 100,000 population in 2005, with a peak in 2004 (8.1 per 100,000 population). The annual incidence rate of salmonellosis caused by *S.* Enteritidis showed a similar trend, from 2.1 per 100,000 population in 2000 to 5.2 per 100,000 population in 2005, with a peak of 6.0 per 100,000 population in 2004 (*Fig. 1*).

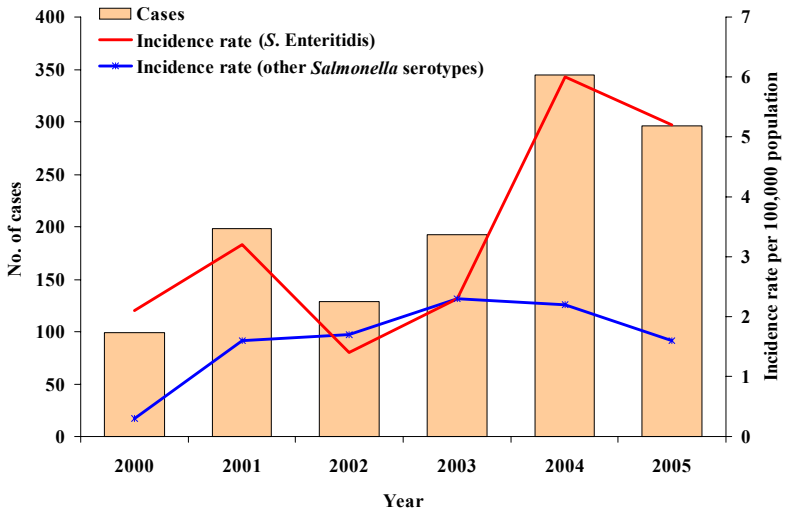
The annual incidence of *S.* Enteritidis was highest in children below five years old, followed by adults aged 55 years and above. However, the incidence of adults aged 55 years and above increased by five-fold, from 2.3 per 100,000 population in 2000 to 11.7 per 100,000 population in 2005. This increase was statistically significant over the 6-year period ($p<0.05$).

The incidence of adolescents and adults (15–54 years) also showed an increasing trend during the study period. In contrast, the incidence of children aged 5–14 years decreased from 1.6 and 2.5 per 100,000 population in year 2000 and 2001, respectively, to 0.8 per 100,000 population in 2005 (*Fig. 2*).

Although the annual incidence of children below 5 years remained the highest during the study period, this age group represented a decreasing proportion of annual disease notifications in recent years; i.e. from 43.5% in 2000 to 11.6% in 2005 (*Fig. 3*).

In contrast, the incidence of adults over 55 years increased from 2.3 per 100,000 population in 2000 to 11.7 per 100,000 population in 2005 (*Fig 2*); almost reaching the level of the 5 years and below age group. The burden of disease contributed by the infection in this age group also increased from 14.1% in 2000 to 35.1% in 2005 (*Fig 3*).

Figure 1
Annual incidence of reported salmonellosis cases in Singapore, 2000 – 2005



Among the major ethnic groups, Malays had the highest incidence rates, followed by Chinese and Indians. The male to female ratio was 1.5 to 1.

Comments

The incidence of salmonellosis in Singapore is relatively low, in comparison with other developed countries (*Fig. 4*). The Agri-Food & Veterinary Authority of Singapore (AVA) maintains stringent control on food safety and supply, through surveillance and testing of food products[4]. It conducts inspection and accreditation of overseas farms and establishments. It also carries out extensive public education programme on food safety.

However, both sporadic cases and outbreaks of salmonellosis continue to be reported. In view of the increasing disease trend, the public should be further reminded to practise good personal hygiene as well as proper handling, preparation and storage of food items. An in-depth analysis of risk factors affecting the older adults would be beneficial in directing future prevention and control measures.

Figure 2
Trends of reported salmonellosis cases caused by *S.* Enteritidis by age group, 2000 – 2005

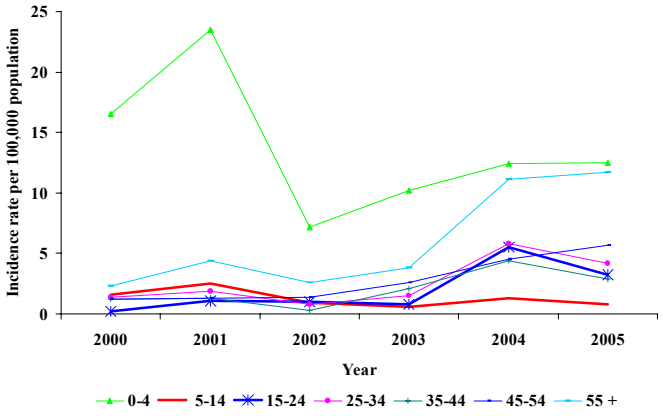


Figure 3
Percentage of reported salmonellosis cases caused by *S.* Enteritidis by age group, 2000 & 2005

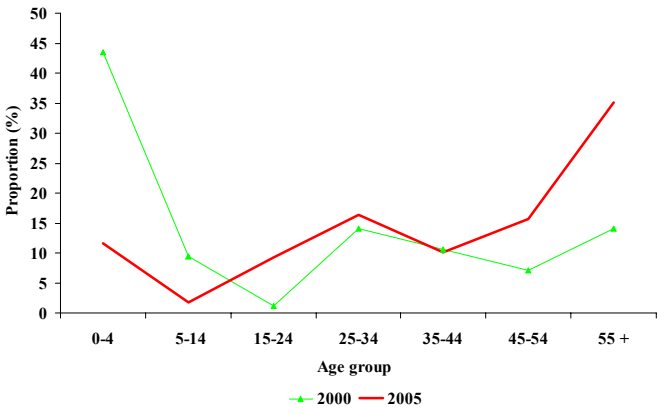
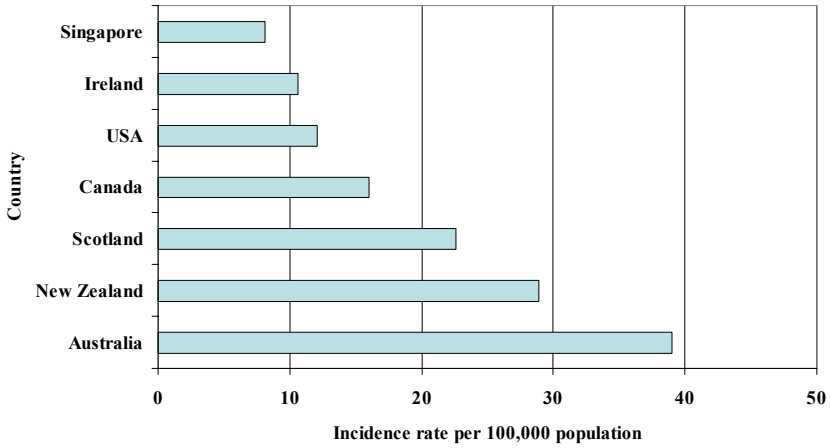


Figure 4
Incidence rate of reported salmonellosis cases by country, 2004[5-11]



[Reported by Kita Y, Ye T, Chow A, Ang LW, Chew SK, Communicable Diseases Division, Ministry of Health]

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Staphylococcus aureus and bacterial contamination in hawker ice products

Introduction

Ice products are capable of preserving the viability of inoculated food-borne bacterial pathogens and cause food poisoning[1]. While ice cream is a well-documented vehicle for food-borne disease outbreaks worldwide[2], studies on local hawker ice products such as iced drinks and desserts which constitute an integral part of our daily diet are limited. In 2005, a survey on Singaporean eating habits revealed an association between diarrhoeal illness and regular consumption of these ice products. Analysis of food poisoning incidents in 2004-5[3] further showed that majority (44.5%) of the incidents were attributed to causative agents with incubation periods of 1-7 hours, implying the presence of fast-acting toxin-producing bacterial agents such as *Staphylococcus aureus*. The pathogen was also the most commonly-isolated organism, accounting for two-thirds (67.9%) of the positive food and environmental samples within the same time period[3].

The aim of this study was to evaluate the prevalence of *S. aureus* and bacterial contamination in iced drinks and desserts sold in hawker centres in Singapore.

Materials and methods

The sampling method was based on a two-stage cluster sampling design. From the universe of 124 hawker centres subject to licensing by the National Environment Agency and regulated under its Environmental Public Health Act, 31 hawker centres were randomly selected based on a sampling fraction of 25%. We then attempted to select a cluster of two stalls selling both iced drinks and desserts from each hawker centre for a total of 62 stalls. In the field survey, not all stalls were found to fulfill the criteria of selling both iced drinks and desserts, and we had to settle with the final tally of 29 hawker stalls. Each hawker stall was visited and one sample of 400g of ice cubes/blocks for use in drinks only, one sample of 400g of ice shavings used in making desserts and a pair of environmental swabs from the blades of the ice shaving machines were taken. These samples were collected in sterile bags which were then placed in cooler bags and transported within two hours to the Food and Water Laboratory, Singapore General Hospital.

In the microbiological analysis, the ice cubes/blocks, ice shavings and environmental swabs were tested for the presence of *S. aureus* and its enterotoxins. In addition, the samples were tested for four common indicators of hygiene and sanitation; viz. standard plate count (SPC), total coliform count, faecal coliform count and presence of *Escherichia coli*. The SPC was derived by the pour plate method and measured in colony-forming units (cfu per ml) of ice water. The membrane filtration method was used for the analysis for total coliform count and *S. aureus,* measured in cfu per 100ml of ice water and cfu per 250ml of ice water, respectively. Colonies from the total coliform plate were subsequently confirmed for the presence of faecal coliforms and *E. coli*, measured in cfu per 100ml of ice water. Results indicated as 'too numerous to count with detectable hygiene

indicator/ pathogen' or 'confluent growth with detectable hygiene indicator/ pathogen' were taken to be qualitatively positive.

Statistical analysis of the findings was performed using SPSS Version 14.0. Chi-square and Fisher's exact tests were used to compare the difference in proportion of the samples positive for specific bacterial pathogens, while the paired sample t-test was used to compare the difference in mean cfus. Odds ratios with 95% confidence intervals were derived for the proportions and a p-value of less than 0.05 was considered to be significant.

Results

The 29 stalls sampled were located in 18 hawker centres distributed geographically throughout the island. Six were graded A, 19 graded B, two graded C while the remaining two were ungraded.

S. aureus was found in 55.2% of the ice shavings, 44.8% of the ice cubes/blocks and 17.2% of swabs of the ice shaving machines (*Table 1*). The ice shavings showed a higher proportion with *S. aureus* compared to swabs of the ice shaving machines (p=0.048, OR=2.2, 95% CI = 1.41–3.37) and the ice cubes/blocks (p=0.008; OR=12.1, 95% CI=1.92-76.23), respectively. *E. coli* was about three times more prevalent in ice shavings (24.1%) compared to the ice cubes/ blocks (6.9%) and swabs of ice shaving machines (6.9%). For faecal coliforms, 100% of the ice shavings samples tested positive, compared to 93.1% of ice cubes/blocks samples and 27.6% swabs from ice shaving machines. The prevalence of total coliforms was 100% in samples of ice cubes/blocks and ice shavings but lower in swabs of the ice shaving machines (65.5%). There were no significant differences in distribution of total coliforms, faecal coliforms and *E.coli* in the different types of samples taken.

The mean SPC of the ice shavings was significantly higher compared to that of the ice cubes/blocks (p<0.05) (*Table 2*). However, there was no significant difference between the mean SPCs of ice shavings and swabs of ice shaving machines.

Table 1

Prevalence of food pathogens and hygiene indicators in ice cubes/blocks, ice shavings and swabs of ice shaving machines

Pathogen tested	Ice cubes/ block (n=29)		Ice shavings (n=29)		Swabs of ice-shaving machine (n=29)	
	No. positive (%)	No. negative (%)	No. positive (%)	No. negative (%)	No. positive (%)	No. negative (%)
Total coliforms	29 (100)	0 (0)	29 (100)	0 (0)	19 (65.5)	10 (34.5)
Faecal coliforms	27 (93.1)	2 (6.9)	29 (100)	0 (0)	8 (27.6)	21 (72.4)
Escherichia coli	2 (6.9)	27 (93.1)	7 (24.1)	22 (76.9)	2 (6.9)	27 (93.1)
Staphylococcus aureus	13[*] (44.8)	16 (55.2)	16[@] (55.2)	13 (44.8)	5[#] (17.2)	24 (82.8)

[*] Of the 13 samples of ice cubes/block, 4 (30.8%) were enterotoxigenic.
[@] Of the 16 samples of ice shavings, 3 (18.8%) were enterotoxigenic.
[#] Of the 5 swabs, 1 (20%) was enterotoxigenic.

Discussion

Hawker centres make up a sizeable proportion of eating establishments in Singapore. They have a wide array of stalls selling iced products with some stalls holding mediocre hygiene grading.

Presence of S. aureus in food, particularly ready-to-eat foods which require substantial handling, indicates lapses in personal hygiene practices during the preparation and handling of the food[4]. The organism is normally found in the nasal mucosa, skin and hair follicles of the human reservoir and some 30-50% of the human population are carriers[5]. *S. aureus* has the ability to grow in temperatures as low as 5–6.1°C[6]. The significantly higher frequency of isolation of this pathogen in ice shavings compared with ice cubes/ blocks showed that handling of iced desserts was a risk factor for contamination. As observed during the sampling process, the lapses which could account for this finding included use of bare hands during handling of ice products; concurrent handling of ice products, receptacles for condiments of desserts and money; and lack of or improper usage of ice scoops for ice cubes. In addition, the higher proportion of ice shavings having the bacteria compared to the ice shaving machines suggests it did not come from these machines but rather, the machines were also contaminated through poor handling.

The presence of coliforms and *E. coli* in our samples pointed towards improper hygiene practices and environmental sanitation at the hawker stalls. The greater SPC in ice shavings compared with the ice cubes/ blocks highlighted a consistent finding that the handling of iced desserts was a risk factor for contamination. While SPC of all the samples were within the microbial standard of 100,000 cfu/ml for liquid food ready for consumption as stated under Section 56(1) of the Sale of Food Act (Cap 283), inclusion of microbial tests during the issuance of licence and routine checks on stalls would be useful. The current food stall grading system does not include microbial testing as one of the criteria for assessment.

Our study confirmed the need for all food handlers to constantly practise good food and personal hygiene to ensure that food served is safe for consumption. Other recommended practices include: (1) proper cleaning of ice shaving machines, paying close attention to the crevices and surfaces in direct contact with the ice blocks; (2) proper storage of ice blocks; and (3) refraining from concurrent handling of food items and money.

Table 2

Mean, standard deviation and range of SPC in ice cubes/blocks, ice shavings and swabs of ice shaving machines

Type of sample	Mean SPC	Standard deviation	Range
Ice shavings (cfu/ml ice water)	12,050	16,089	210 – 16,000
Ice cubes/blocks (cfu/ml ice water)	6,076	6,953	170 – 26,000
Swab of ice shaving machine (cfu/swab)	547,543	1,614,035	50 – 8,300,000

(Reported by Nur Rasidah, Low C, Lim S, Ooi PL, Disease Control Branch, Communicable Diseases Division, Ministry of Health)

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Factors affecting colonization of *Legionella pneumophila* in Singapore spa establishments

Introduction

Spas represent a new setting for *Legionella* and other bacterial infections as they are unique water systems where organic and inorganic substances are added to the pools, and extensive usage combined with inadequate maintenance could lead to contamination of the systems. Past studies have shown that usage of spas, hot tubs and whirlpools has been associated with infections by pathogens such as *Mycobacterium avium*[1] and *Pseudomonas aeruginosa*[2], and outbreaks of Legionnaires' disease reported in Japan, Netherlands and USA have been linked to whirlpool spas[3-5].

The aims of our study were to investigate the prevalence of *L. pneumophila* in accredited local spa establishments; evaluate the associated risk factors; and suggest possible applications of the findings on the regulation of spas.

Materials and methods

We defined a spa establishment as a business entity containing spa pools in its premises for the provision of spa services. The spa pool is any structure containing a body of water for recreational or therapeutic use. It usually contains a water jet or aeration

system. The pool water should not be treated with chemicals like chlorine and it is drained, cleaned or refilled after each use. These structures are also referred to as tubs or whirlpools but are generically referred to as spa pools in this study[6].

A total of 22 out of 30 establishments accredited by the Spa Association of Singapore (SPA) were systematically sampled (SPA represents the professional spa operators in Singapore and is supported by the Singapore Tourism Board. The accreditation process is based on the facilities, equipment and services available, and the business practices and staff development of the establishment). Of the remaining eight establishments, six had no spa pools that fulfilled our definition (as they were treated with chlorine) while two opted against participating in the study. In establishments with four spa pools or more, a maximum of three pools in each establishment were randomly selected for sampling. For establishments with three spa pools or less, all the pools were sampled. In each spa pool, one environmental swab was taken from the faucet. If jets were present, one environmental swab was taken from a randomly selected jet as well.

Invasive sterile EUROTUBO® collection swabs were used for sampling. The swabs were removed from their sleeves, moistened with a small amount of water from the faucet to be sampled and inserted into the faucet/ jet as far as it could reach. The swab was then rotated around the inside of the faucet/jet four times and returned to its sleeve immediately. The swabs were stored in cooler bags and transported within two hours to the Food and Water Laboratory, Singapore General Hospital, for testing of *Legionella*. The bacteria were cultured for an average of two weeks on *Legionella* selective agar plates and the number of colony forming units per swab counted in accordance with the British Standard (BS)/International Organisation for Standardisation (ISO) Standard method.

During each spa establishment visit, the general cleanliness and conditions of the spa pool were observed and the spa operator interviewed on the maintenance, cleaning regime of the spa pools and the types of ingredients used in the spa pools to assess for possible risk factors (*Table 3*).

All results were tabulated and analysed using the statistical software SPSS Version 14.0. Chi-square and Fisher's exact tests were used to compare differences in the proportion of spa establishments with specific risk factors. Odds ratios (OR) and 95% confidence intervals (CI) were derived for the comparisons, and a p-value of less than 0.05 was considered to be significant.

Results

A total of 66 swabs comprising 35 from faucets and 31 from jets were taken from 35 spa pools and sent for microbial testing. The number and type of swabs taken, and distribution of spa pools, are provided in *Fig. 5* and *Fig. 6*, respectively.

Legionella was detected in seven (31.8%) of the 22 spa establishments, of which four (18.2%) were positive for *L. pneumophila*. Nine (13.6%) out of 66 swabs tested positive for *Legionella,* of which five (7.6%) were positive for *L. pneumophila* and four (6.1%) were positive for other *Legionella* species. The bacterial count ranged from 10 cfu/swab to 2400 cfu/swab, with a median of 180 cfu/swab. *Table 4* details the bacteriological results of the five samples positive for *L. pneumophila*.

Table 3

Checklist on possible risk factors for the presence of *L. pneumophila* in spa pools

Possible risk Factors	Remarks
General cleanliness	The overall premise is tidy and clean Spa surfaces are free of algae, slime and physical defects
Cleaning regime	Type of staff performing cleaning: • In-house staff • Contracted vendor Frequency of cleaning Type of cleaning solution used: • Antiseptic or disinfectant • Detergent • Manufacturer's solution
Maintenance programme	Presence of regular maintenance programme
Spa treatment	Ingredients added into spa pools: • seaweed • salt • oils • milk • flowers and herbs • mud
Miscellaneous	Food and drinks allowed in spa pools

Figure 5
Number & type of swabs taken from 22 spa establishments

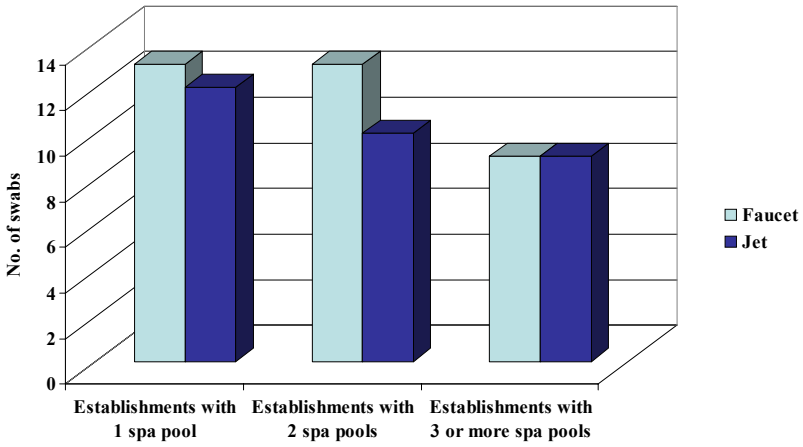

Figure 6
Number of spa pools in 22 spa establishments

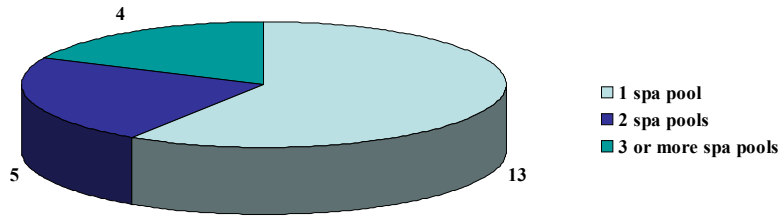

Table 4

***L. pneumophila* and bacterial count detected among 5 positive samples by spa establishment and location of swab**

Establishment	Location of swab	*Legionella* detected*	Bacterial count (cfu^/swab)
A	Jet	*L. pneumophila*	10
A	Faucet	*L. pneumophila*	10
B	Jet	*L. pneumophila*	180
C	Jet	*L. pneumophila*	270
D	Faucet	*L. pneumophila* and other *Legionella* species (not *L. pneumophila*)	400

* Detection limit = 10 cfu/swab
^ cfu = colony forming units
Note: Acceptable bacteriological standards for *Legionella* count is < 10 cfu/ml

Differences in the number of swab samples that tested positive for *L. pneumophila* among spa establishments with various risk factors were analysed (*Table 5*). Use of seaweed as an ingredient in spa pools was significantly associated with the presence of *L. pneumophila* in the establishments (p = 0.046, OR = 15.0, CI = 1.14 – 198.04).

Discussion

The current incidence of Legionnaires' disease in Singapore is relatively low at 0.4 per 100,000 population. However, spa establishments would be an area of emerging environmental health concern as the popularity of spa treatment increases and the client profile shifts towards older persons due to an ageing population.

Our results showed that spa pools are capable of harbouring *L. pneumophila*, especially in those using seaweed. The role of this spa ingredient is uncertain because little is known about it as a suitable nutrient source or how its extraction process could result in an affiliation with *Legionella*. Alternatively, use of the seaweed in spa pools could have introduced protozoa or supported their growth, which in turn may lead to an increase in *Legionella* within the spa pool water system. The other organic ingredients available

Table 5

Analysis of risk factors among four spa establishments positive for *L. pneumophila*

Risk factor	No. of *L. pneumophila*-positive establishments with risk factor (%)	No. of *L. pneumophila*-positive establishments without risk factor (%)	p value	Odds ratio	95% confidence interval
Overall premises not tidy and clean	0 (0.0%)	4 (100.0%)	-	-	-
Spa pools not in clean or good condition	0 (0.0%)	4 (100.0%)	-	-	-
Contracted vendor performing cleaning	0 (0.0%)	4 (100.0%)	-	-	-
Spa pool not cleaned after every use	0 (0.0%)	4 (100.0%)	-	-	-
Antiseptic or disinfectant used for cleaning	3 (21.4%)	1 (12.5%)	1.000	1.91	0.16-22.20
Detergent used for cleaning	2 (16.7%)	2 (20.0%)	1.000	0.80	0.09-7.00
Manufacturer's solution used for cleaning	1 (50.0%)	3 (15.0%)	0.338	5.67	0.27-117.45
No regular maintenance programme in place	2 (11.8%)	2 (40.0%)	0.210	0.20	0.02-2.03
Seaweed added into spa pools	**3 (50.0%)**	**1 (6.3%)**	**0.046**	**15.0**	**1.14-198.04**
Salts added into spa pools	3 (30.0%)	1 (8.3%)	0.293	4.71	0.41-54.83
Oils added into spa pools	1 (9.1%)	3 (27.3%)	0.586	0.27	0.02-3.08
Milk added into spa pools	1 (10.0%)	3 (25.0%)	0.594	0.33	0.03-3.84
Flowers and herbs added into spa pools	1 (11.1%)	3 (23.1%)	0.616	0.42	0.04-4.81
Mud added into spa pools	1 (25.0%)	3 (16.7%)	1.000	1.67	0.13-22.00
Food and drinks allowed in spa pools	1 (16.7%)	3 (18.8%)	1.000	0.87	0.07-10.42

as treatments in spas, such as milk and flowers, do not appear to support the multiplication of *L. pneumophila*.

High standards of general cleanliness were observed in all locations visited. Majority (86%) had only one or two spa pools in their premises, and this may have made maintenance easy. Use of different cleaning solutions (antiseptic/disinfectant, detergent or manufacturer's solution) was not significantly associated with the detection of *L. pneumophila,* probably because all the solutions were capable of remov-

ing biofilm from the surface of the spa pools. On the practice of allowing food and drinks in spa pools, contamination was minimal as two establishments had allowed their clients to consume fruit drinks, while the others were limited to tea drinks.

While the prevalence of *Legionella* in local spa establishments (31.8%) was found to be comparable to that of a recent study conducted by the Health Protection Agency in UK[7] (26.1%), this study has highlighted an interesting new finding that can contribute towards regulation of spa establishments to prevent transmission of infections. Further studies need to be conducted to investigate if the seaweed extraction process, species used, and quantities added have an effect on the growth of *Legionella*.

(Reported by Ng A, Lalitha K, Chan PP, Lim S, Ooi PL, Disease Control Branch, Communicable Diseases Division, Ministry of Health)

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Is rodent-borne disease still of public health importance in Singapore?

Introduction

With the emergence of rodent-borne diseases worldwide, diseases which are directly or indirectly transmitted by rodents cause significant public health impact in many countries[1]. Rodents can be found throughout the year in humid tropical environments, while in temperate regions, they are most common during the warm summer months.

In Singapore, apart from the legally notifiable infectious diseases stated in the Infectious Diseases Act, the Ministry of Health (MOH) has also been receiving notifications of laboratory-confirmed murine

typhus and leptospirosis cases from hospitals and clinical laboratories administratively. These rodent-borne diseases were thoroughly investigated upon notification, followed by multi-agency response[2].

The purpose of the study was to explore the epidemiology of rodent-borne diseases and to improve the current understanding of disease transmission pattern in Singapore.

The surveillance data of rodent-borne disease notifications received at MOH during the period 2002 – 2005 were analysed. Additional information obtained from investigations of these case-patients was also reviewed.

Results

During the period 2002 – 2005, a total of 99 murine typhus and 98 leptospirosis cases were notified to MOH. The mean annual notifications of murine typhus and leptospirosis was 25 and 26 cases, respectively, which gave an average annual incidence rate of 0.58 per 100,000 population (*Fig 7*). The disease incidence had consistently remained under 1 per 100,000 population in the past four years. There had been no notification for hantavirus infection and plague for the same period.

The risk of importation of rodent-borne diseases was high, particularly for leptospirosis. About 9% of murine typhus and 38% of leptospirosis cases were classified as imported after investigation.

Majority of the cases were in the age group 15 – 44 years (94% for murine typhus & 76% for leptospirosis). There was a male predominance (95% for murine typhus & 90% for leptospirosis). No cases were reported in children below 15 years of age (*Figs 8* and *9*).

Foreigners (i.e. work permit holders, student pass holders and visitor pass holders) represented approximately 81% – 96% of murine typhus and 43% – 60% of leptospirosis cases.

Figure 7
Annual notifications and incidence rates of murine typhus and leptospirosis cases, 2002–2005

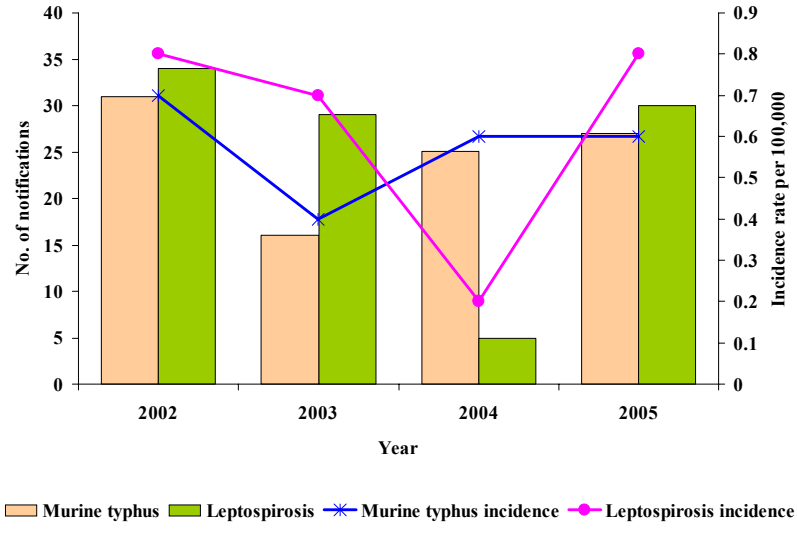


Figure 8
Reported murine typhus cases by age and gender, 2002-2005

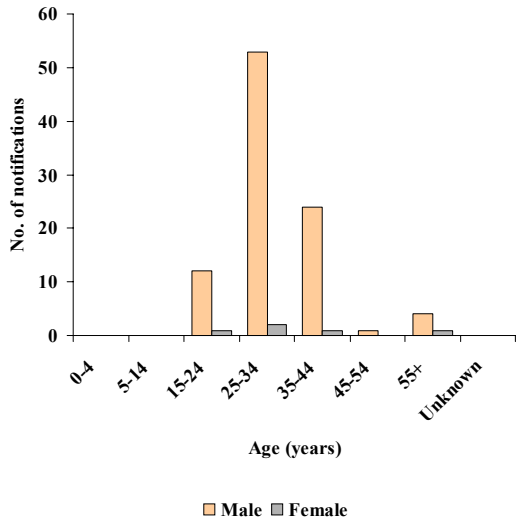
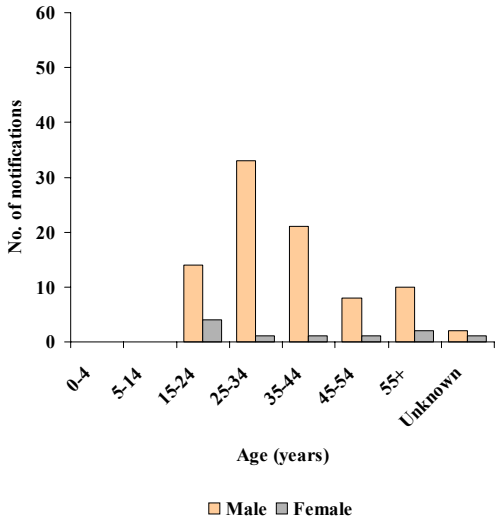


Figure 9
Reported leptospirosis cases by age and gender , 2002–2005



In 2005, the incidence of murine typhus among Singapore residents and foreigners was 0.1 and 2.9 per 100,000 population, respectively. The corresponding figures for leptospirosis was 0.5 and 1.4 per 100,000.

During the past four years, 51 (52%) of 98 leptospirosis cases were Singapore residents. Among resident cases, 25 (49%) were imported. For the same period, only 12 (12%) of 99 murine typhus cases occurred among local residents and of these residents, 2 (17%) were classified as imported.

The occupations of locally-acquired murine typhus and leptospirosis cases are shown in *Figs 10* and *11*. Majority of foreigners were construction labourers and related workers. The commonly reported occupations of Singapore residents with locally acquired leptospirosis were construction labourers, fishery workers, food handlers and domestic helpers/cleaners. In the case of murine typhus, the more common occupations were construction labourers, ship/ shipyard cleaners and electricians.

Comments

In Singapore, the incidence of rodent-borne diseases had sharply declined when compared to the incidence in the 1970s. For example, in 1973, 198 leptospirosis cases were reported. The disease incidence has remained at a low level with only sporadic cases reported in recent years.

The individual's risk of acquisition of these diseases is largely associated with the living conditions such as housekeeping and environmental sanitation at worksites and exposures to infectious sources while travelling to other endemic countries.

Stringent control measures against rodent infestations in and around residential areas and workplaces should be continued to prevent transmis-

Figure 10
Occupations of locally-acquired murine typhus cases , 2002–2005

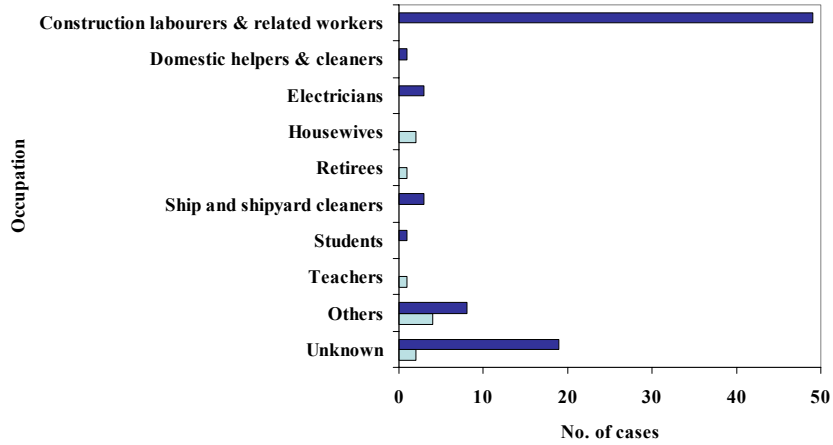
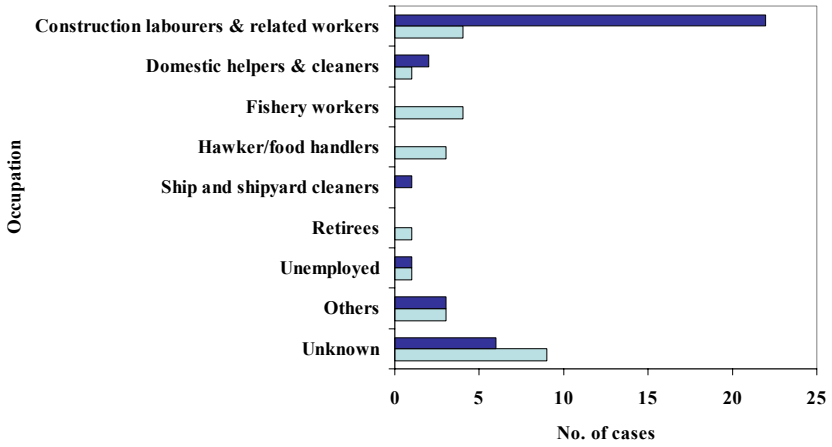


Figure 11
Occupations of locally-acquired leptospirosis, 2002–2005



sion. of infection. Regular monitoring of the rodent situation and community-led intervention activities such as the 'RAT Attack Plus' programme conducted by the National Environmental Agency also contributed to the maintenance of a low rodent population in Singapore.

(Reported by Toh HY, Ye T, Chow A and Chew SK, Communicable Disease Division, Ministry of Health)

References

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Notifications of avian influenza in Singapore

Introduction

In mid-2003, the highly pathogenic H5N1 influenza virus began to circulate widely in poultry in different parts of South-east Asia, spreading within months to affect 8 countries in an outbreak unprecedented in its geographical extent.[1] Since 2003, 228 laboratory-confirmed human cases of avian influenza A (H5N1) with 130 fatalities had been reported to WHO (*Fig 12*).[2]

In Singapore, the notification of suspected avian influenza (AI) was made mandatory under the Infectious Diseases Act on 12 December 2005.

A study was conducted to examine the epidemiological and clinical characteristics of notified cases of suspected AI during the period 15 Dec 2005 - 30 April 2006, and to compare the findings with the current clinical case definition for suspected AI (*Fig. 13*).

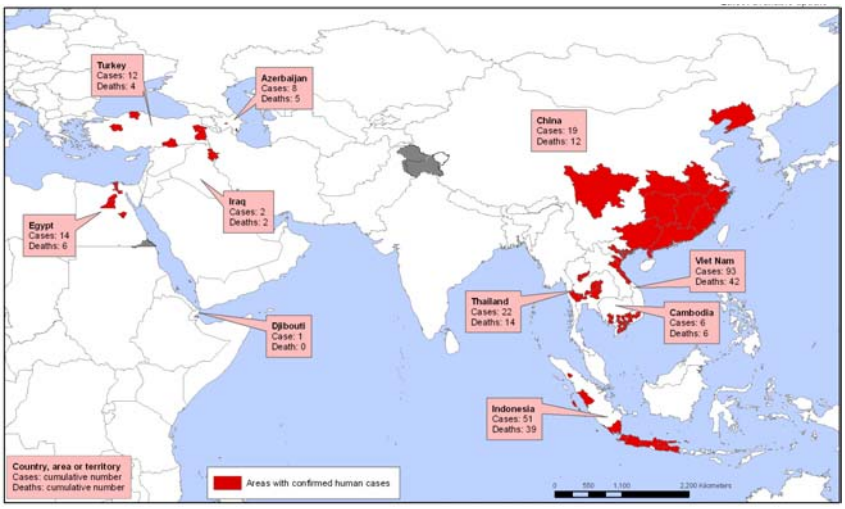
Notifications were made by medical practitioners to the Communicable Diseases Surveillance Branch, Ministry of Health (MOH), using the routine notification form (MD131) and/or electronic case reporting form (CRF).

Results

Patient characteristics

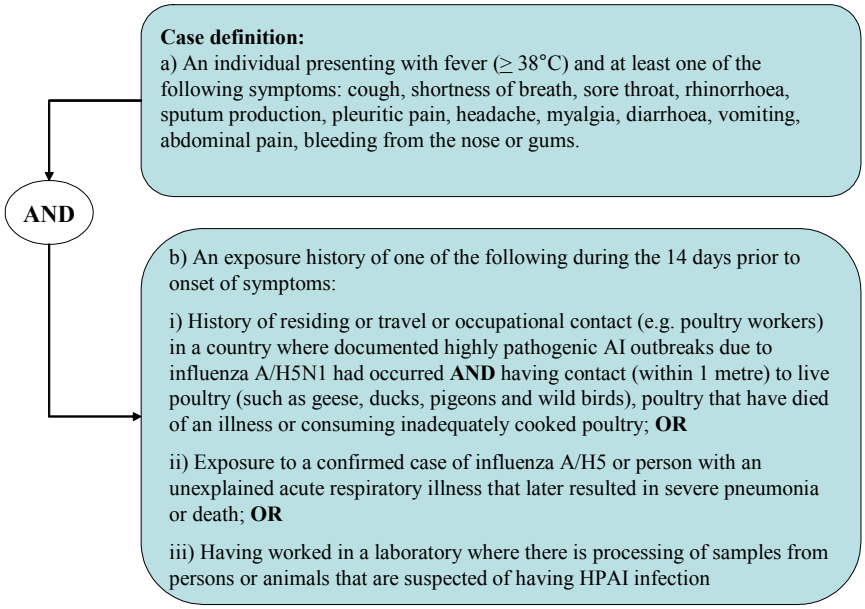
During the study period, a total of 68 patients were notified as suspected AI cases based on clinical presentations and travel history to countries with known influenza A/H5N1 outbreaks.

Figure 12
Affected areas with confirmed human cases of H5N1 avian influenza since 2003



Source: World Health Organization (status as of 20 June 2006)

Figure 13
Suspected AI case definition



The mean age of the patients was 35 years (range 1year – 77 years) and those aged 15 to 44 years accounted for 60.3% of the total cases reported (*Table 6*). The male to female ratio was 0.9:1.

The majority (73.5%) were Singaporeans and of the 18 (26.5%) foreigners notified, two came to Singapore to seek medical care.

Clinical presentations

The main clinical presentations were fever and respiratory symptoms such as cough, runny nose and sore throat. Other clinical presentations included gastrointestinal symptoms.

Of 52 patients with respiratory symptoms, 42 (80.8%) had fever. However, 11 patients had fever but no respiratory symptoms. They presented with either gastroenteritis symptoms (5 cases) or other non-respiratory symptoms (6 cases). The remaining 5 cases presented with gastroenteritis but no fever (*Table 7*).

Chest radiographs were performed on 59 patients and 17 (28.8%) were found to have abnormal findings.

Of the 33 cases that required hospitalisation, polymerase chain reaction (PCR) tests were performed on 28 patients (84.8%) but none tested positive for H5N1.

Countries of travel

All cases except one had recent travel history to countries with known H5N1 outbreaks in poultry and/or humans. Majority of the cases had travelled to China, followed by Indonesia, Malaysia, Thailand and Vietnam (*Table 8*).

Table 6

Demographic characteristics of 68 suspected avian influenza cases

Characteristics	No.	%
Gender		
Male	32	47.1
Female	36	52.9
Age group (years)		
<5	2	2.9
5-14	5	7.4
15-24	13	19.1
25-34	17	25
35-44	11	16.2
45-54	8	11.8
55-64	8	11.8
≥65	4	5.9
Ethnic group		
Singapore resident		
Chinese	40	58.8
Malay	5	7.4
Indian	3	4.4
Other	2	2.9
Foreigner	18	26.5

Table 7

Clinical presentations of 68 suspected avian influenza cases

Clinical Presentations	Travel history	Exposure history#	Admission	CXR performed	CXR changes	PCR (H5N1) positive	No of patients
Fever with respiratory symptoms	41	13	25	38	13	0	42
No fever, respiratory symptoms present	10	2	2	8	0	0	10
Fever , no respiratory symptoms	11	3	5	10	4	0	11
No fever, no respiratory symptoms	5	0	1	3	0	0	5

#Includes close contact and possible contact with poultry

Table 8
Travel history of 68 suspected avian influenza cases

Countries travelled*	Number
China	20
Indonesia	10
Malaysia	10
Thailand	9
Vietnam	9
Cambodia	6
Hong Kong	6
India	4
Laos	1
Macau	1
Nigeria	1
Total	77

*Cases may have travelled to more than one country

However, only 18 (27%) patients had close contact and possible contact with live poultry and/or poultry that had died of an illness.

Comments

With the continuing AI outbreaks in poultry and humans in neighbouring countries, the risk of importation of AI cases into Singapore is high. A greater public awareness and increase in vigilance among clinicians are necessary for early detection of imported cases.

[Reported by Ng AL, Ye T, Chow A, Chew SK, Communicable Diseases Division, Ministry of Health, Singapore]

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The data in this Bulletin are provisional, based on reports to the Communicable Diseases Division, Ministry of Health. Any comments or questions should be addressed to:

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