衞生防護中心
Centre for Health Protection

Scientific Committee on Enteric Infections and Foodborne Diseases

Review of Nontyphoidal *Salmonella* Food Poisoning in Hong Kong

Purpose

This paper reviews the latest global and local epidemiology of nontyphoidal foodborne salmonellosis and examines the public health measures for prevention and control of nontyphoidal *Salmonella* food poisoning in Hong Kong.

Background and Bacteriology

2. Nontyphoidal salmonellosis is caused by *Salmonella* species other than *Salmonella* Typhi and *Salmonella* Paratyphi. The epidemiology and prevention of typhoid fever have been reviewed in a separate SCEIFD Paper 1/2011 (ñEpidemiology and Prevention of Typhoid Fever in Hong Kongò). Nontyphoidal salmonellosis is one of the leading foodborne illnesses and accounted for a considerable morbidity and mortality in both developed and developing areas. For instance, in the United States it was estimated that nontyphoidal salmonellosis accounted for 11% (rank number two) of foodborne illness, 35% (rank number one) of foodborne-associated hospitalisation, and 28% (rank number one) of foodborne-associated death[1, 2].

3. *Salmonella* are motile Gram-negative facultative anaerobic bacteria in the family of Enterobacteriaceae[3]. The *Salmonella* genus consists of two species, *Salmonella enterica* and *Salmonella bongori*[4]. Most pathogenic species of *Salmonella* causing illness in human belong

to the *Salmonella enterica* species[5]. This species is further divided into 6 subspecies: *Salmonella enterica* subspecies *enterica, Salmonella enterica* subspecies *salamae, Salmonella enterica* subspecies *arizonae, Salmonella enterica* subspecies *diarizonae, Salmonella enterica* subspecies *houtenae* and *Salmonella enterica* subspecies *indica*.

4. Under the *Salmonella* genus, more than 2,500 serotypes (also called serovars) have been described based on the differences in the somatic (O) and flagellar (H) antigens according to the Kauffman and White scheme[4]. Names were maintained only for serotypes in the subspecies *enterica*, which account for more than 99.5% of isolated *Salmonella* strains. These names (e.g. Typhimurium) are not italicized and the first letter is a capital letter. Serovars of other subspecies of *Salmonella enterica* and those of *Salmonella bongori* are designated only by their antigenic formula. For *Salmonella enterica* subspecies *enterica*, the subspecies name (subspecies *enterica*) does not need to be indicated as only serovars of this subspecies bear a name. This paper will follow this convention and therefore serotype like *Salmonella enterica* subspecies *enterica* serovar Typhimurium will be written as *Salmonella* Typhimurium or simply *S.* Typhimurium.

5. *Salmonella* lives in the intestinal tract of its host. Some *Salmonella* serotypes are host-specific while some have a more generic host range. Serotypes that cause no symptoms in animal can result in infection in human, and vice versa[6]. For instance, asymptomatic egg-laying hens can produce *Salmonella*-infested eggs that cause human salmonellosis. The most common serotypes are *S.* Enteritidis and *S.* Typhimurium, as reflected by the fact that 24.1% and 6.6% of foodborne outbreaks were attributable to these two serotypes respectively in an international study[7].

6. It was estimated that globally around 86% of salmonellosis cases are foodborne[8]. Yet, other routes of transmission such as contact with pets (e.g., reptiles and birds) or pet foods, direct personal contact, nosocomial transmission, waterborne transmission, and contaminated drugs, are also important[9-11].

7. The growth and survival properties of each serotype differ[12]. In general, *Salmonella* grows optimally at 35-37°C, with growth greatly reduced below 15°C or above 45°C. Its viability can be maintained for a long period of time under refrigeration. Its growth is only slightly retarded in the absence of air. It is well known to survive well in food and on food surfaces. For instance, it can survive for more than 10 weeks in butter at -23 and 25°C, and for 28 days on the surface of refrigerated vegetables. It also survives well in dry environment, for example, for months in chocolate.

8. The most common foods associated with salmonellosis are food of animal origin, such as egg[13-17], poultry, pork[18], beef, and raw dairy

products[11]. Food of vegetable origin, such as vegetables, fruits, and juices, are also of increasing concern[19]. These foods which are usually eaten without cooking could be contaminated during production, storage, or in retail outlets. Food handlers that are in carrier state or having an acute infection could also be a potential source of infection.

9. Some food vehicles are known to associate strongly with a certain serotypes of *Salmonella.* The most famous pair would be egg and *S.* Enteritidis, as indicated by the fact that 73.7% of egg-related foodborne outbreaks in a study were caused by *S.* Enteritidis[7]. Half of the bakery-associated outbreaks in the same study were also caused by *S.* Enteritidis.

10. Large scale studies using foodborne outbreak data indicate that the most common contribution factors associated with foodborne salmonellosis are: cross-contamination, inadequate cooling or refrigeration, inadequate heat treatment or contamination from food handlers[20-22].

Clinical Presentation, Laboratory Diagnosis and Patient Management

11. *Salmonella* does not produce any toxin in food. Ingested *Salmonella* surviving the gastric acidity and bile salts lysis in the upper small intestine will colonise the intestine and cause inflammation[23]. Therefore, individuals with gastric hypoacidity are more at risk of salmonellosis[9]. Other people at risk include infants, elderly, and immunocompromised persons.

12. The incubation period ranges from 6 to 72 hours (usually 12-36 hours), and is dependent on size of the inoculum and host factors[5,24]. Salmonellosis cannot be reliably distinguished clinically from other enteric bacterial infections. The most common presentation includes fever, nausea, diarrhoea, cramping, and sometimes vomiting. Stools are usually non-bloody. Other symptoms include chills, myalgia, and headache.

13. The disease is usually self-limiting with recovery within three to seven days[9]. Hospitalisation may be required (22% of cases) in cases with severe diarrhoea and dehydration[25]. On average, patients may carry *Salmonella* in their intestinal tract for around four weeks after acute infections. This period may be as long as seven weeks for infants and children. In about 0.5% of salmonellosis cases, the patient becomes a chronic carrier.

14. The bacteria may spread beyond the intestinal mucosa into the draining mesenteric lymph nodes, and continue to the liver, spleen, and systemically, via the blood stream[5]. Bacteremia, which could be fatal, occurs in 5% of salmonellosis cases, and this is more common in

immunocompromised patients[9]. Even worse is the development of infectious endarteritis, particularly if it involves the abdominal aorta.

15. In 5-10% of bacteremic cases, other tissues could also be infected hematogenously and develop local infection even the bacteremia is treated. Such local infections include meningitis, endocarditis, pneumonia, empyema, abscess formation, osteomyelitis, and septic arthritis.

16. The clinical outcomes differ substantially by serotype. In a study using data from the United States FoodNet, it was shown that in general, 22% of cases required hospitalisation, 6.7% resulted in invasive infections (defined as the isolation of *Salmonella* from normally sterile site), and death occurred in 0.5%[25]. However, some serotypes such as *S.* Dublin had a significantly higher rate of hospitalisation (67%), invasive infections (64%), and death (3%) compared to the average figures of all serotypes.

17. Laboratory diagnosis of salmonellosis is typically by isolation of *Salmonella* from fresh stool sample[5]. Rectal swabs are less sensitive. Invasive infection can be diagnosed by isolation of *Salmonella* from clinical specimen from normally sterile sites such as blood. In an outbreak investigation, molecular typing tests such as pulsed-field gel electrophoresis (PFGE) can provide evidence for epidemiological linkage among cases.

18. Treatment of salmonellosis cases depends on the severity and risk of developing complications[5]. Gastroenteritis is usually self-limiting and the focus is on hydration and electrolyte replacement. Antibiotic treatment is not recommended in uncomplicated gastroenteritis as it may prolong the faecal excretion of *Salmonella*[26] by suppressing the normal protective endogenous flora[9, 27]. Antidiarrhoeal treatment is also not recommended as this may extend the gastrointestinal transit time and delay recovery.

19. However, antibiotics treatment is recommended for patients at risk of developing bacteremia and other complications[5]. These patients include those at the two age extremes, those immunosuppressed, those with vascular abnormalities (such as prosthetic valves or grafts), and those with prosthetic joints.

Overseas epidemiology

20. *Salmonella* infection represents a considerable burden in both developing and developed areas. It was estimated that 93.8 million cases of nontyphoidal salmonellosis occur globally each year, with 155,000 deaths[8]. Around 80.3 million cases (85.6%) were foodborne. The predominant serotypes, the foods associated with nontyphoidal salmonellosis, and the trends of nontyphoidal salmonellosis are different in different region of the world. Below we will review the epidemiology in several areas.

21. There are differences in the most commonly isolated serotypes between different areas. A study analysing serotypes isolated from human from 2001 to 2007 showed that in Australia, New Zealand and North America, *S.* Typhimurium was the most common serotype reported, followed by *S.* Enteritidis[28]. A similar study on foodborne outbreaks from 1988 to 2007 showed that outbreaks due to *S.* Typhimurium are more common in Australia and New Zealand relative to Canada, Europe, and the United States, and there is no outbreak due to *S.* Enteritidis[7]. Another study showed that, in Australia, *S.* Enteritidis infections seem to be mainly due to travelling aboard[29]. The proportion of *S.* Typhimurium in developed countries decreased from 26.4% in 2001 to 18.8% in 2007[28]. On the other hand, *S.* Enteritidis was more common in Europe than in United States. *S.* Enteritidis infection due to egg consumption has been a major food safety issue in Europe for a long time. In United States, there was an uptrend in *S.* Enteritidis cases in the 80s and 90s, until the implementation of quality assurance programs for eggs[13]. The proportion of *S.* Enteritidis in developing countries also decreased from 73.9% in 2001 to 55% in 2007[28].

22. Many countries maintain a foodborne disease reporting network[30]. For instance, the FoodNet of the United States conducts surveillance for causative agents of foodborne diseases, including *Salmonella*. According to latest FoodNet data covering 1996 to 2010, despite broad declines in several foodborne infections, infections caused by *Salmonella* have not declined and actually have increased slightly since 2006-2008[31]. The incidence was nearly three times the 2010 national health objective target. *Salmonella* was the most commonly reported pathogen (43.4%), and had the largest proportion of hospitalisation (53.9%) and death (42.6%) in FoodNet in 2010. Incidence was highest in children aged less than five years. Also, contrary to previous report, *S.* Enteritidis became the most common serotype (22% of serotyped isolates) in 2010, following by *S.* Newport (14%) and *S.* Typhimurium (13%)[31].

23. It was estimated that in the United States 29 nontyphoidal *Salmonella* infections occur for every one that is laboratory confirmed[1]. Following from this, nontyphoidal *Salmonella* caused an estimate of 1 million (11%) foodborne infections and caused $365 million (USD) in direct medical expenditures annually. In terms of foodborne outbreak, in 2008 *Salmonella* accounted for 23% of them and 31% of the affected persons[32]. *Salmonella* was also the most common cause of foodborne outbreak-related hospitalisation. Among the 22 foodborne outbreak-related deaths, *Salmonella* accounted for 13. *S.* Enteritidis was also the most common serotypes in *Salmonella* outbreak with serotype reported. Nine out of the 17 multistate outbreaks in 2008 were caused by *Salmonella*. These outbreak data also indicated that *Salmonella* associated strongly with poultry, and this finding is in line with another estimate with mathematical modelling which showed that the top three foods that contributed to *Salmonella* foodborne illness were chicken (48%), ground beef (28%), and turkey (17%)[33].

24. The latest report produced by European Food Safety Authority, which received data in 2009 from 27 European Union Member States, showed that the number of salmonellosis cases continued to decrease in a statistically significant manner, and that cases caused by *S.* Enteritidis decreased markedly[34]. The decrease is assumed to be attributed to successful implementation of national *Salmonella* control programmes in fowl populations. *Salmonella* was most often detected in fresh broiler (5.4%), turkey (8.7%), and pork (0.7%). *Salmonella* was rarely detected in dairy products, fruit, and vegetables. Of the 5,550 foodborne outbreaks in 2009, *Salmonella* accounted for 31.0 %, followed by viruses (18.8 %), bacterial toxins (10.1 %) and *Campylobacter* (6.0 %). The number of reported *Salmonella* outbreaks has decreased over the past three years in 2009. Half of these outbreaks were *S.* Enteritidis outbreaks caused by eggs and egg products, but these outbreaks have decreased as well. Yet, *S.* Enteritidis remained the predominant serovar associated with the *Salmonella* outbreaks, accounting for 59.6 % of all verified *Salmonella* outbreaks.

25. In a separate report by European Food Safety Authority, the laying hen reservoir was estimated to be the most important source of salmonellosis, contributing with 43.8%, followed by pigs (26.9%)[35]. Based on the outbreak data, eggs were also estimated to be the most important source of salmonellosis, followed by pork, chicken, and the general category ñmeat and poultryò[17, 35].

26. In another study of foodborne outbreaks in England and Wales by the Health Protection Agency of the United Kingdom, it was shown that from 1992 to 2008 there was a downward secular trend of outbreaks due to *Salmonella*[20]. In this study period, *Salmonella* accounted for 46.7% of the outbreaks, and also the highest number of people affected, hospitalisations, and deaths. *S.* Enteritidis was the most common serotype (77.1%). *Salmonella* outbreaks were strongly associated with the consumption of poultry meat (54.2%), desserts (89.9%), and eggs (98.3%), and were most commonly implicated in outbreaks linked to food service (42.5%), residential (45.5%) and private establishments (70.4%), defined as private functions involving more than one household. The two most common contributing factors were cross contamination and inadequate heat treatment.

27. OzFoodNet of Australia, which monitors diseases that are commonly transmitted by food, reported 27,037 notifications in 2009[29]. *Salmonella* is the second most common causative agent following *Campylobacter* (59%) and accounted for 35% of the cases. The most affected are those aged one or below. The most common serotype was *S.* Typhimurium (41% of all notified infections). *S.* Enteritidis is not endemic in Australian egg laying flocks. Of the 163 foodborne outbreaks in 2009, *Salmonella* was most common and accounted for 59 outbreaks. Eighty percent of these 59 outbreaks

were caused by *S.* Typhimurium. Also, of the 18 outbreaks associated with eggs, 14 of them were caused by *S.* Typhimurium.

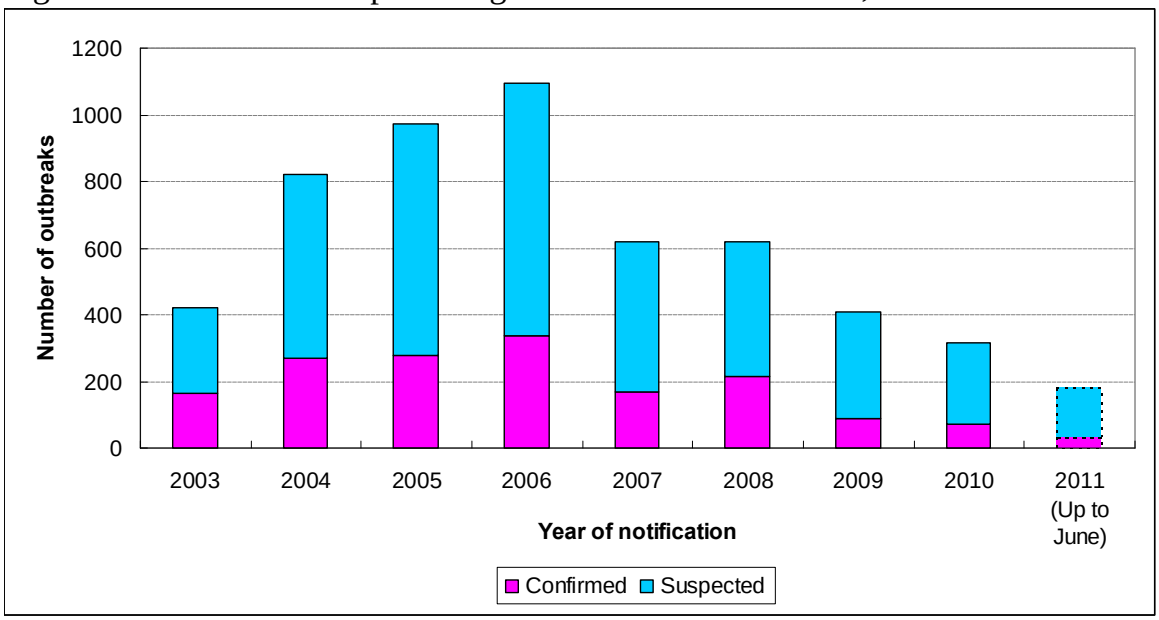
28. Large scale foodborne outbreaks of *Salmonella* happened from time to time. The Centers for Disease Control and Prevention of the United States maintain a list of *Salmonella* outbreaks investigated by them on their *Salmonella* homepage[36]. Intermittent or unpredictable food processing failures could result in large scale outbreak. For example, in 1994, an estimated 224,000 persons throughout the United States were infected with *S.* Enteritidis after eating contaminated ice cream[37, 38]. Investigation revealed that the ice cream was contaminated by a premix that had been transported by tanker trailers that had carried nonpasteurised eggs immediately before. The ice cream product was recalled.

Local epidemiology

29. In Hong Kong, food poisoning of various causes, including those caused by nontyphoidal *Salmonella*, is a statutory notifiable disease under the Prevention and Control of Disease Ordinance (Cap 599). In this paper, we reviewed the local epidemiology of food poisoning outbreaks attributed to nontyphoidal *Salmonella* reported to the Department of Health (DH) from 2003 to June 2011.

30. A total of 5,452 food poisoning outbreaks were notified to DH from 2003 to June 2011. The number of food poisoning outbreaks increased steadily from 2003 to 2006 and then decreased afterwards (Figure 1). Among these outbreaks, epidemiological investigation indicated that 77.6% were associated with bacteria, 10.9% with viruses, and 8.3% with biochemicals.

Figure 1. Number of food poisoning outbreaks notified to DH, 2003-June 2011



31. During 2003 to June 2011, 763 food poisoning outbreaks associated with nontyphoidal *Salmonella,* affecting 3,250 persons, were notified to DH (Figure 2). Of these, 369 were confirmed outbreaks, affecting 1,906 persons. For a more meaningful interpretation, only these confirmed outbreaks will be included for analysis in the following sections. These outbreaks accounted for 28.1% of confirmed food poisoning outbreaks attributed to bacteria causes, ranking nontyphoidal *Salmonella* the second most common food poisoning outbreaks bacterial agent (Figure 3).

Figure 2. Food poisoning outbreaks associated with nontyphoidal *Salmonella*, 2003-June 2011

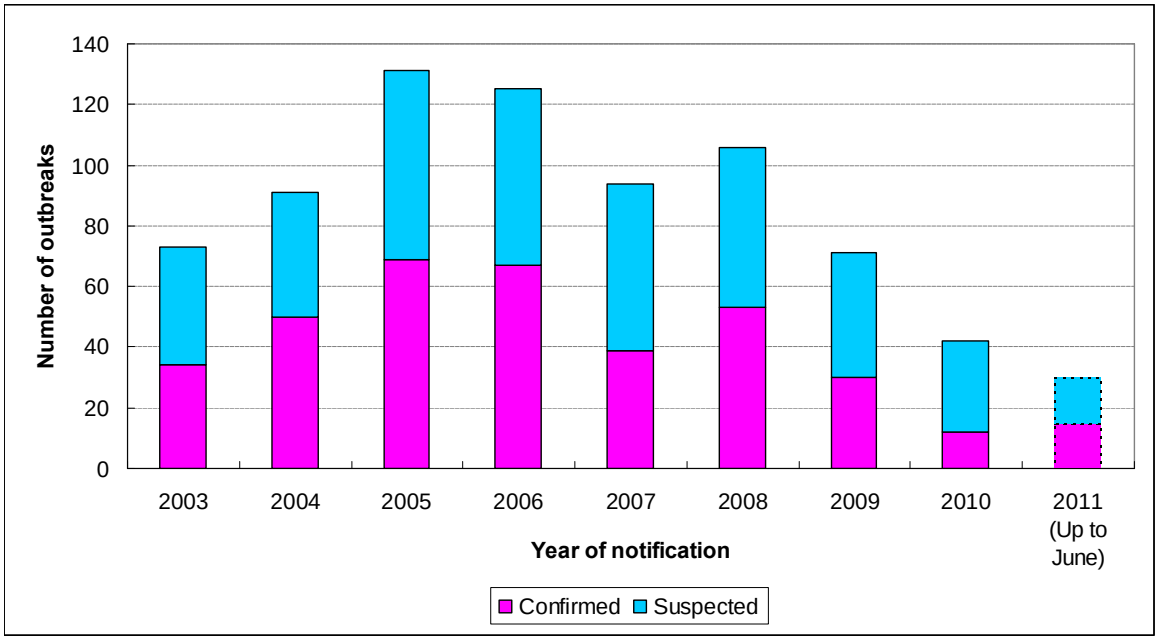
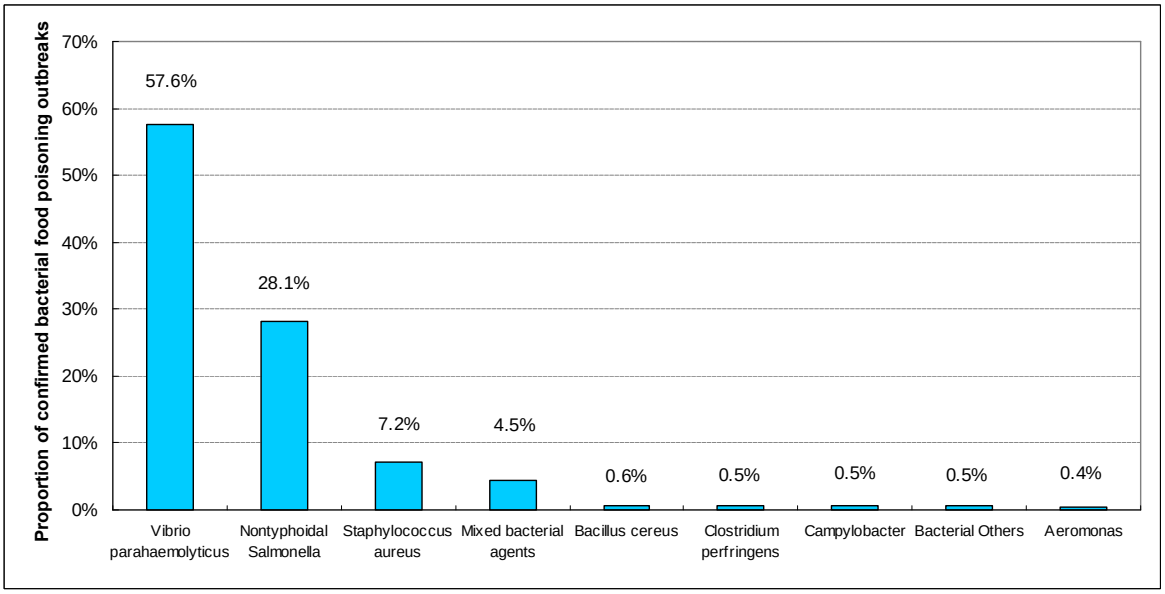


Figure 3. Causative agents of the confirmed bacterial food poisoning outbreaks, 2003-June 2011



32. The seasonal pattern of nontyphoidal *Salmonella* food poisoning outbreaks is shown in Figure 4. Most (90.1%) outbreaks were reported from April to October. Most (77.2%) of the outbreaks affected 5 persons or below and 3% of the outbreaks affected more than 20 persons (Figure 5). Although the number of nontyphoidal *Salmonella* food poisoning outbreaks has been decreasing over the past few years, large food poisoning outbreaks (more than 20 persons affected) still occurred occasionally.

Figure 4. Number of food poisoning outbreaks attributed to nontyphoidal *Salmonella* by the month of notification, 2003-2010

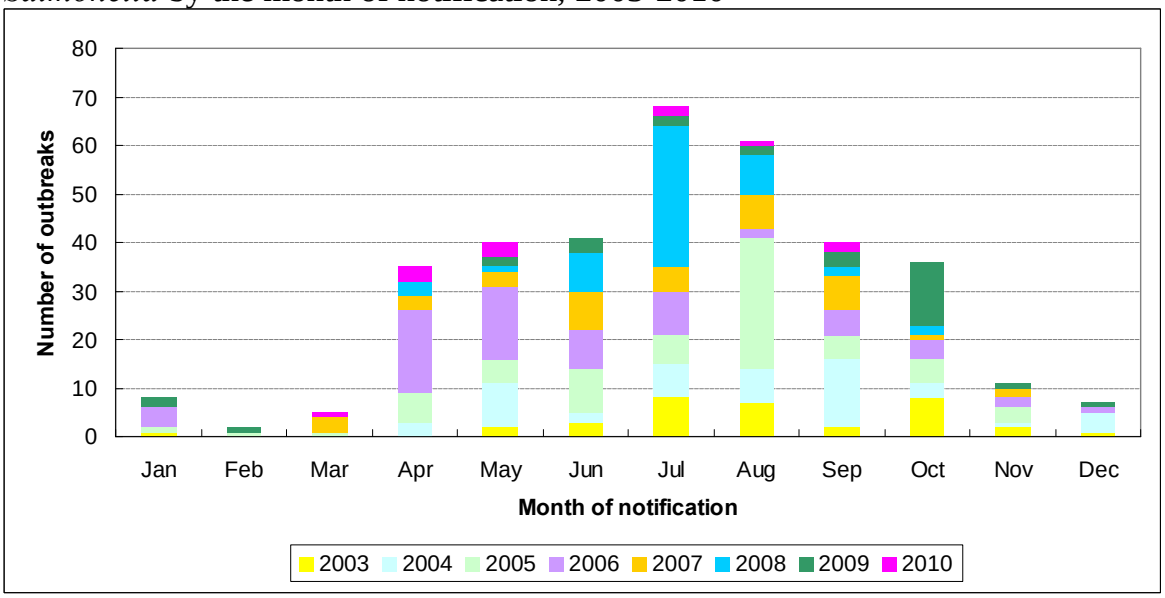
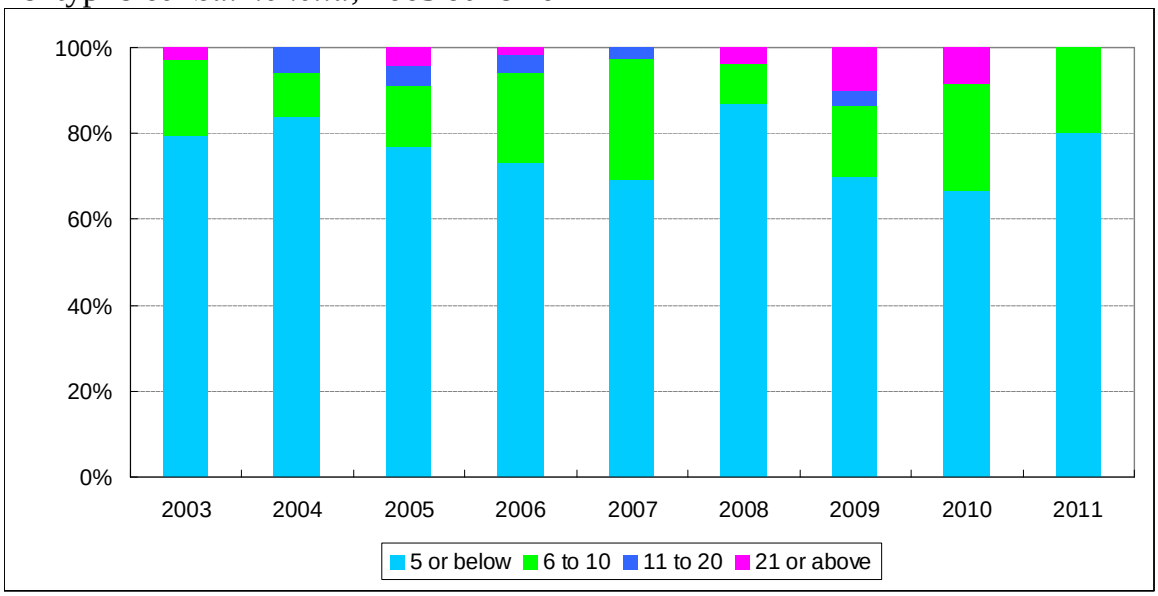


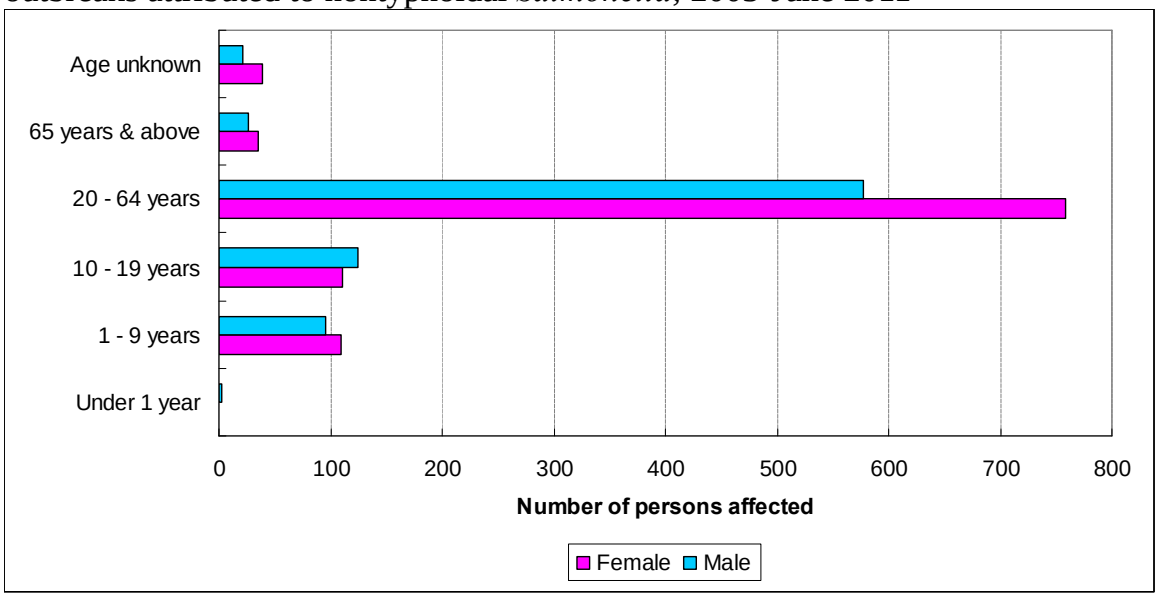
Figure 5. Number of persons affected in food poisoning outbreaks attributed to nontyphoidal *Salmonella*, 2003-June 2011



33. Among the affected persons, age groups of the two age extremes were less commonly affected (Figure 6). There was no obvious sex preference (male-to-female ratio was 1:1.24). One hundred and ninety-six affected

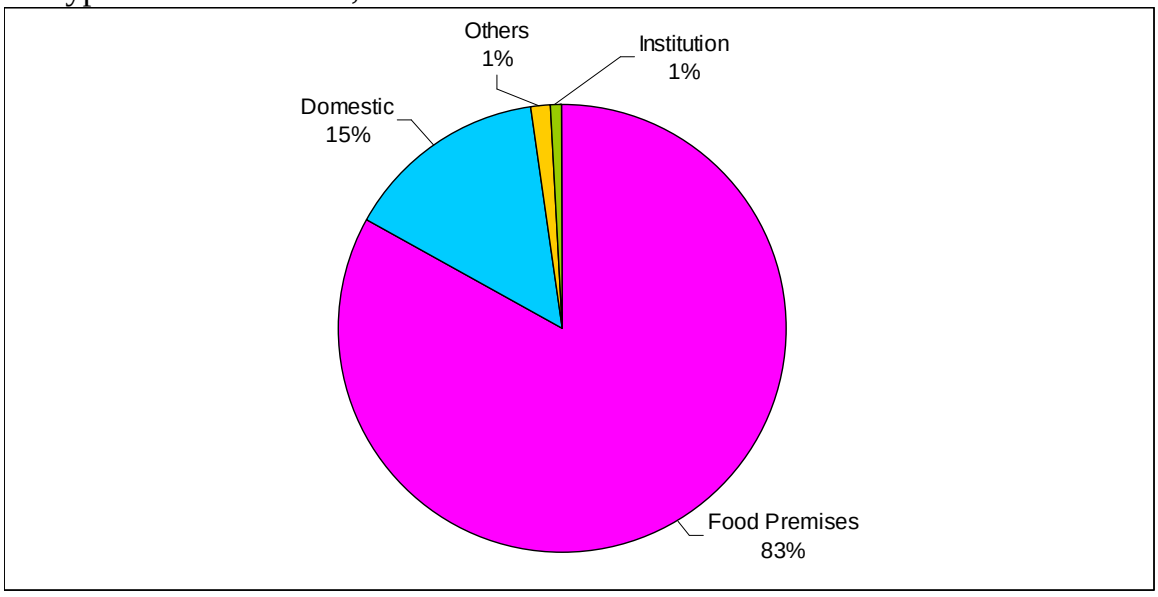
persons (10.3%) required hospitalisation. One patient developed bacteremia. There was no fatal case.

Figure 6. Age and sex distribution of persons affected in food poisoning outbreaks attributed to nontyphoidal *Salmonella*, 2003-June 2011



34. More than 80% of food poisoning outbreaks attributed to nontyphoidal *Salmonella* occurred at food premises (Figure 7). Domestic outbreaks accounted for 15% and only 1% (three outbreaks) of the outbreaks occurred at institutions.

Figure 7. Place of consumption of food poisoning outbreaks attributed to nontyphoidal *Salmonella*, 2003-June 2011

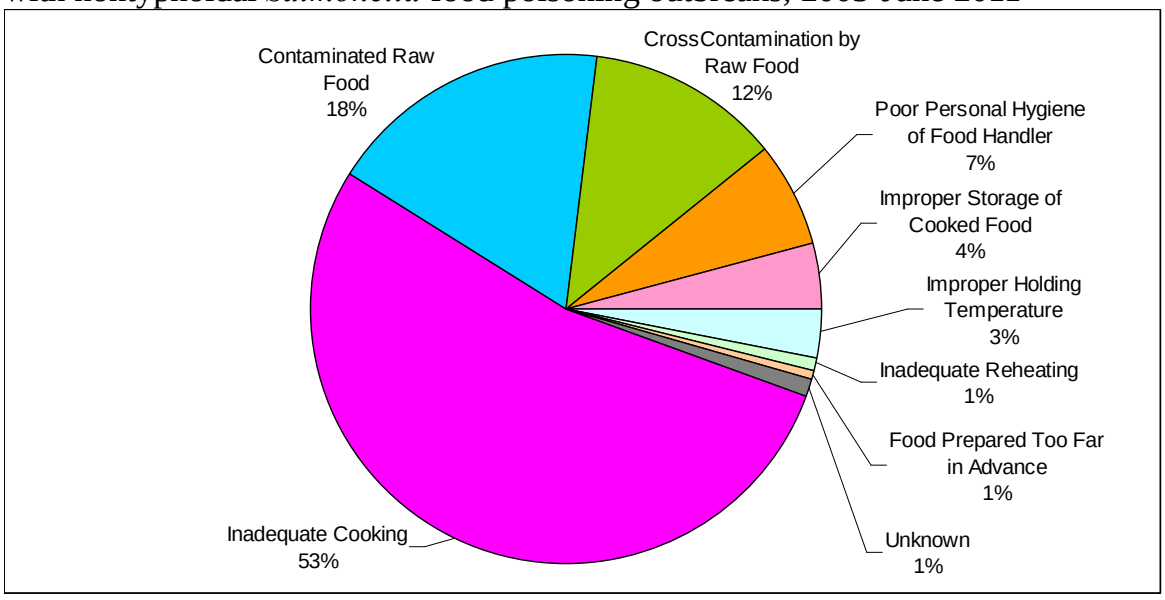


35. Among the 369 confirmed food poisoning outbreaks attributed to nontyphoidal *Salmonella*, a single food vehicle was implicated in 248 outbreaks. Furthermore, 53 of the foods implicated in these 248 outbreaks

were complex foods of which the epidemiological investigation cannot identify the relevant food ingredients causing the salmonellosis. The remaining 195 outbreaks were used for the analysis of contributing factors and foods most commonly associated with nontyphoidal *Salmonella* food poisoning.

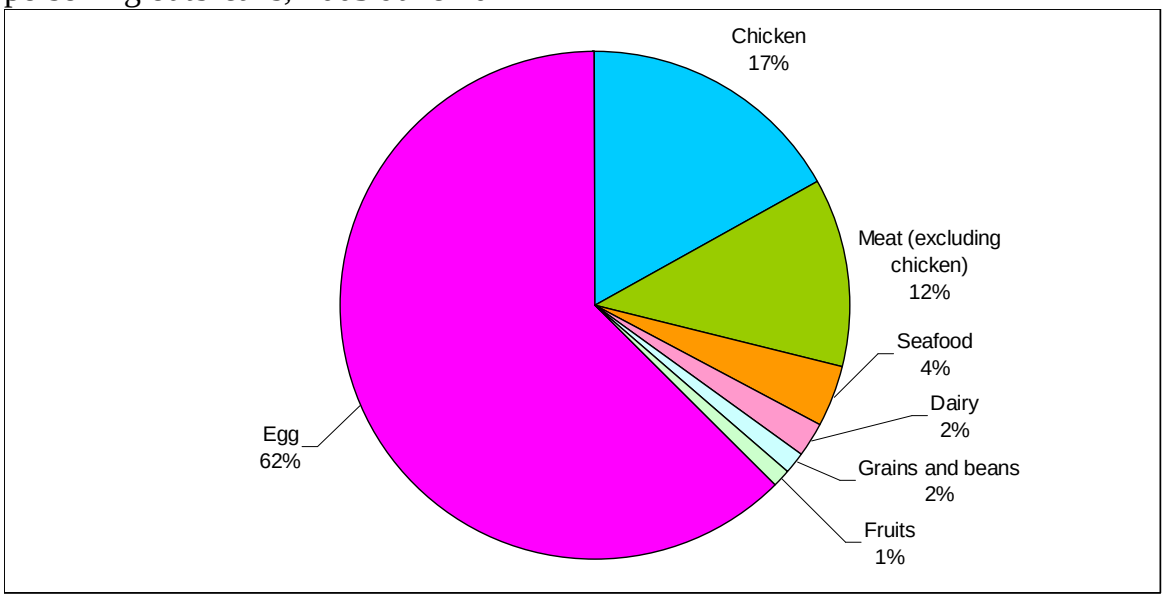
36. The contributing factors of the 195 outbreaks with a single implicated food vehicle identified were shown in Figure 8. Inadequate cooking accounted for half of the outbreaks. Together with contaminated raw food, these two contributing factors indicated that in most of the nontyphoidal *Salmonella* food poisoning outbreaks, the raw food ingredients are carrying *Salmonella*.

Figure 8. Implicated contributing factor for identified food vehicles associated with nontyphoidal *Salmonella* food poisoning outbreaks, 2003-June 2011



37. Following the results of the analysis of contributing factors, the food ingredients of the 195 outbreaks with a single implicated food vehicle were regrouped according to literature and were shown in Figure 9[17]. The most commonly associated food ingredients were egg (62.6%), chicken (16.9%) and meat (11.8%). Almost all (92%) of the egg containing food items can be accounted by either inadequate cooking (66%) or contaminated raw food (26%), and this dominated the overall analysis of contributing factors.

Figure 9. Food ingredients associated with nontyphoidal *Salmonella* food poisoning outbreaks, 2003-June 2011



38. Large-scale food poisoning outbreaks attributed to nontyphoidal *Salmonella* did occur. The largest outbreak, which occurred in 2008 affecting 128 persons, was related to a school fair. The incriminated food item was inadequately cooked pancake. Twenty-two patients were hospitalised and all were discharged in stable condition. Both stool specimens and food remnant of pancake from the school fair grew *Salmonella* group D.

39. In summary, nontyphoidal *Salmonella* is the second most common bacterial food poisoning outbreak agent in Hong Kong. Most of the outbreaks affected less than 5 persons but occasionally large outbreaks occurred. The most common associated food vehicles were egg, chicken, and meat. Most of the confirmed outbreak involved food consumption at food premises. Inadequate cooking, contaminated raw food, and cross contamination by raw food were the most commonly identified contributing factors in causing these outbreaks.

40. Other than monitoring the notification of food poisoning outbreaks, the DH also maintained a Salmonella Surveillance Programme (SSP). It is a laboratory-based surveillance system established since 1974, aiming at monitoring the situation of *Salmonella* infection in Hong Kong. The main purposes of this programme are primarily to delineate the pattern of circulating strains of *Salmonella* species in the local community, to monitor emerging serotypes, and to detect large outbreaks associated with *Salmonella*. In 2010, a total of 1494 isolates were analysed. Among these, the top five serotypes were *S.* Enteritidis (475 isolates, 31.8%), *S.* Typhimurium (240 isolates, 16.1%), *S.* Stanley (96 isolates, 6.4%), *S.* Derby (89 isolates, 6.0%), and *S.* Agona (38 isolates, 2.5%). The proportion of *S.* Enteritidis was increasing since 2006 but decreased after 2008. The seasonal pattern of these

serotypes closely followed that of the nontyphoidal *Salmonella* food poisoning outbreaks.

Public Health Prevention and Control Measures

Surveillance and food poisoning investigation

41. In Hong Kong, food poisoning is a statutory notifiable disease under the Prevention and Control of Disease Ordinance (Cap 599). Upon notification of food poisoning outbreaks, CHP will initiate prompt epidemiological investigation. Nontyphoidal *Salmonella* food poisoning outbreaks can usually be differentiated by their longer incubation period and higher proportion of cases with fever. Outbreaks associated with food premises would be referred to the Food and Environmental Hygiene Department (FEHD) for further investigation.[45] FEHD collects food and environmental specimens as well as clinical specimens from food handlers for laboratory investigation, provides specific advice on food hygiene, conducts source tracing and takes actions against any irregularities identified during the course of investigation at food premises. Health education on food hygiene and food safety will be stressed. Sale and distribution of incriminated food items may be suspended as appropriate. Closure order would be issued if food premises pose an immediate health hazard to the public[46]. On the other hand, in case the clinical specimen from a food handler is positive for *Salmonella*, one on one health education on personal, food and environmental hygiene including demonstration of hand washing technique would be arranged. Both food premises inspection and food surveillance will be stepped up at the concerned food premises.

Food surveillance and risk assessment studies

42. Food surveillance programme and risk assessment studies have been put in place by the Centre for Food Safety (CFS) of FEHD. Currently, food surveillance including routine, targeted and seasonal programmes[47]. Health inspectors take samples at import, wholesale and retail levels for microbiological and chemical testing. Laboratory testing covers chemicals, viruses and bacteria including *Salmonella*. The results would be released regularly to promote public awareness.

43. FEHD has also conducted risk assessment studies targeted on high risk foods such as eggs and eggs products, poached chicken, siu-mei, and lo-mei. In a study evaluating the local situation of *Salmonella* food poisoning from 1998 to 2002, it was shown that the eggs and egg products (including desserts) food group is the most common incriminated food in terms of number of confirmed cases[15]. Within this food group, 61% of the outbreaks were due

to desserts with egg as an ingredient. For these egg containing desserts related food poisoning outbreaks, the three most common contributing factors were contaminated raw food / raw food consumed (90%), poor personal hygiene of food handler (20%), and improper holding temperature (13%). It was concluded that it would be prudent for the caterers and manufacturers to avoid using raw unpasteurised eggs in preparing desserts, and that good hygiene practice should always be adhered by food handlers. Avoiding cross contamination from raw unpasteurised eggs is also important. A detailed set of advice is available in the report[15].

44. In a study by CFS in assessing the microbiological quality of poached chicken for sale in retail outlets, a total of 247 poached chickens and 70 sauces were collected in 2007, *Salmonella* was not detected in any samples[48]. In another risk assessment study published in 2001, *Salmonella* was detected in the steamed plain chicken sample. This study tested for 406 samples of siu-mei and 190 samples of lo-mei collected in 2000[49]. *Salmonella* was also detected in two siu-mei (roasted pork and BBQ pork) samples. In both cases, post-cooking contamination and prolonged storage at inappropriate temperature might be the main contributing factors.

45. *Salmonella* was also detected in several ready-to-eat food items or food items that use ready-to-eat ingredients. These includes cold dishes[50] (2 out of 114 samples, a bean curd with lime preserved eggs sample and a liquor-saturated chicken sample), salads[51] (4 out of 573 samples), sandwiches[52] (3 out of 1023 samples), Snowy Moon Cake[53] (3 out of 107 samples), and sashimi[54] (1 out of 906 samples). *Salmonella* could have been introduced into these food items through contaminated raw food, insufficient cooking, cross contamination, or introduction by food handlers.

Education to trade and consumers

46. FEHD not only has prepared a variety of education materials (including pamphlet, posters, videos, exhibition boards), but also has been conducting series of food safety talks throughout the year covering various topics of food poisoning and food safety for food handlers and the public. Thorough cooking, separation of raw and cooked food and avoid using raw unpasteurized eggs to make pastry cakes and desserts are important measures in preventing *Salmonella* food poisoning[55]. Food should be consumed immediately or refrigerated and not kept at room temperature to avoid proliferation of *Salmonella*. In addition, a trilingual telephone hotline on food safety and environmental hygiene has been operated by FEHD.

Recommendation

47. *Salmonella* is an important causative agent for food poisoning outbreaks worldwide. In Hong Kong, it is the second most common food poisoning outbreak agent. The most common implicated food is egg or egg containing dishes, and most confirmed nontyphoidal *Salmonella* food poisoning outbreaks involved food consumption at food premises. The number of food poisoning outbreaks associated with nontyphoidal *Salmonella* has been decreasing since 2006. This may be due to better food hygiene practices of the trade and consumers, as well as more targeted food surveillance programmes. Nevertheless, the followings are suggested to further prevent *Salmonella* food poisoning in Hong Kong:

(a) Food handlers and the public should be encouraged to ensure good personal hygiene practices and proper cooking/food handling procedures through various trainings and education.
(b) Since egg and other foods high risk for *Salmonella* would continue to be part of our diet, it is important to educate the trade and the general public to cook high risk foods thoroughly, and to avoid using raw unpasteurised eggs in preparing dishes that would not be subject to the heat treatment step.

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