衞生防護中心
Centre for Health Protection

Scientific Committee on Enteric Infections and Foodborne Diseases

Review on the Global and Local Epidemiology of Food Poisoning

Purpose

Food poisoning results from consumption of contaminated food or water containing various bacteria, viruses or toxins of biochemical or chemical nature. The paper aims to provide an update on the global and local epidemiology of food poisoning. In particular, local epidemiology of food poisoning caused by nontyphoidal *Salmonella* species will be examined as it has replaced *Vibrio parahaemolyticus* as the most common bacterial causative agent among confirmed cases of food poisoning in Hong Kong since its last review in 2011. Local public health measures for its prevention and control will be examined as well.

Background

2. Food poisoning may manifest as different clinical presentations (Table 1). Acute gastroenteritis, presenting with any combinations of the key symptoms of abdominal pain, vomiting and diarrhoea in at least two patients who shared a common meal, can be readily related to the suspicion of a food poisoning episode. Many bacterial agents as well as viral agents can cause acute gastroenteritis.

Bloody diarrhoea may be the presentation of bacterial agents known to attack lower intestinal tracts through breaching of mucosal barriers. Biochemical or chemical agents in food, such as ciguatoxin and pesticides, could cause neurological symptoms. Most patients may experience transient symptoms but fatal complications can occur.

Table 1. List of causative agents for food poisoning according to the clinical presentation

Clinical presentation	Causative agents	
Acute gastroenteritis	*Vibrio parahaemolyticus* Non-typhoidal *Salmonella* species *Staphylococcus aureus*	*Bacillus cereus* *Clostridium perfringens* Norovirus
Bloody diarrhoea	*Campylobacter*	
Neurological involvement	Ciguatoxin Shellfish poisoning Scombroid fish poisoning Puffer fish poisoning	Mushroom poisoning Clenbuterol Pesticides

Global epidemiology

3. Foodborne illness is an important cause of morbidity and mortality worldwide. Migration, international trade and travel and globalisation of food production and market have posed greater risk of cross-border transmission of foodborne and other infectious diseases. Worldwide, increases in the incidence of foodborne illnesses continue to be reported, often associated with outbreaks and food contamination that raise international concern[1]. Global epidemiology of food poisoning will be reviewed in the following sections.

4. In 2015, the World Health Organization (WHO) published its first estimates of global foodborne disease incidence, mortality and disease burden in terms of Disability Adjusted Life Years (DALYs) caused by 31 agents (including bacteria, viruses, parasites and chemicals)[2]. It was estimated that globally 600 million people (almost 1 in 10) fell ill in 2010 from eating food contaminated by these agents, resulting in 420 000 deaths. 30% of all

deaths from foodborne diseases are children under 5 years of age.

5. 550 million of the estimated 600 million cases of illness were caused by foodborne diarrhoeal disease agents, in particular norovirus (120 million cases) and *Campylobacter* species (96 million cases). Foodborne diarrhoeal disease agents also caused 230 000 of the 420 000 deaths due to foodborne hazards. Of these, 59 000 deaths were caused by non-typhoidal *Salmonella enterica*, 37 000 by enteropathogenic *E. coli* (EPEC), 35 000 by norovirus and 26 000 by enterotoxigenic *E. coli* (ETEC).

6. The global burden of foodborne disease caused was estimated to be 33 million DALYs. Diarrhoeal disease agents were accountable for 18 million DALYs (54%) of this burden. In particular, non-typhoidal *Salmonella enterica* was responsible for 4.0 million DALYs. Five bacterial diarrhoeal disease agents (*Campylobacter* species, EPEC, ETEC, *Vibrio cholerae* and *Shigella* species) each has caused a foodborne disease burden of 1–3 million DALYs.

7. Apart from the estimation of burden of foodborne diseases by WHO, health authorities worldwide have also established various surveillance systems to detect, monitor and control foodborne diseases. These systems may involve both active and passive surveillance, as well as case-based and laboratory-based reporting system.

I. United States

8. In the United States (US), the Centers for Disease Control and Prevention (CDC) used data from active and passive surveillance to estimate the number of foodborne illness, hospitalisations, and death that were caused by major known pathogens in the US[3]. It was estimated that 9.4 million episodes of foodborne illness, 55 961 hospitalisations and 1 351 deaths were caused by some major pathogens acquired in the US each year. Among these, 5.5 million (58.7%) foodborne illnesses were caused by viruses and 3.6 million (38.8%) by bacteria. Bacterial agents that caused the most illneses were non-typhoidal *Salmonella* species (10.9%), *Clostridium perfringens* (10.3%)

and *Campylobacter* species (9.0%). In hospitalised cases, most were caused by bacteria (64.0%), followed by viruses (27.3%). In death cases caused by bacterial agents, the leading causes were non-typhoidal *Salmonella* species (28.0%), *Listeria monocytogenes* (18.9%) and *Campylobacter species* (5.6%).

II. Canada

9. The Public Health Agency of Canada estimated that 4 million episodes of foodborne illness occur each year in Canada due to 30 known pathogens and unspecified agents[4]. It is estimated that each year there are 11 632 hospitalisations and 238 deaths associated with domestically acquired foodborne illness in Canada. The bacterial pathogens that are estimated to cause the greatest number of hospitalisations each year are non-typhoidal *Salmonella* species (23.5%), Campylobacter species (14.3%) and Verocytotoxin-producing *E coli* O157 (6.2%) accounting for 44% of all hospitalisations related to known pathogens.

III. United Kingdom

10. In the United Kingdom (UK), foodborne disease outbreaks are monitored by the Electronic foodborne and non-foodborne gastrointestinal outbreak surveillance system (eFOSS). Information obtained by eFOSS is provided to the Food Standard Agency (FSA) and the Department of Health to support public health policies and foodborne disease reduction strategies.

11. The FSA of the UK commissioned the Second Study of Infectious Intestinal Disease (IID) in the Community (IID2 study) from April 2006 to March 2012 to investigate the incidence of IID in the UK and their causes, and to find out if the situation had changed since a similar study conducted in England in the mid-1990s (IID1). It was estimated that the age- and sex-standardised rate of IID in the community in the UK was 274 per 1 000 person-years (around 1 in 4 members of the population) with up to 17 million cases annually[5,6]. The most commonly identified microorganisms in stool samples from those with IID in the community was norovirus (16.5%) accounting for around 3 million cases, followed by sapovirus (9.2%),

Campylobacter species (4.6%) and rotavirus (4.1%). When compared with mid-1990s, the rate of IID in the community in England was 43% higher in 2008-2009.

IV. European Union

12. In the European Union (EU), the monitoring and control of foodborne diseases is regulated by EU legislation on zoonoses and communicable diseases. A system for collection and analysis of data from the EU Member States on the number of human cases and the prevalence of zoonotic microorganisms in different foodstuffs and animal populations was set up in the EU. The data were utilised to develop, monitor and implement control measures for prevention and reduction of microorganisms in the food chain.

13. The European Food Safety Authority and European Centre for Disease Prevention and Control (ECDC) reported a total of 5 251 food-borne outbreaks, including water-borne outbreaks, in 32 European countries in 2014[7]. The 5 251 reported outbreaks involved a total of 45 665 human cases, 6 438 hospitalisations and 27 deaths. The evidence supporting the link between human cases and food vehicles was strong in 592 outbreaks. The largest number of reported foodborne outbreaks was caused by viruses (20.4% of all outbreaks), which overtook *Salmonella* (20.0% of all outbreaks) as the most common cause of outbreaks in the EU. Bacterial toxins accounted for 16.1% of the outbreaks and *Campylobacter* for 8.5% of the outbreaks. For 29.2% of the outbreaks the causative agent was unknown. From 2008 to 2014, there has been a markedly decreasing trend in the annual total number of *Salmonella* outbreaks within the EU by 44.4%, whereas the number of outbreaks caused by viruses has more than doubled since 2011 (525) and reached in 2014 the highest level yet reported (1 072). The most important food vehicles in the strong-evidence outbreaks were ‘eggs and egg products’, followed by ‘mixed food’, ‘crustaceans, shellfish, mollusks and products thereof’ and ‘vegetables and juices’.

V. Australia

14. In Australia, OzFoodNet was established by the Australian Government in 2000 with an aim to provide better understanding of the causes and incidence of foodborne disease in the community. It studies the epidemiology of foodborne diseases by enhancing surveillance, coordinating foodborne diseases outbreak investigation and conducting special studies on foodborne pathogens. It also identifies foods and commodities that cause human illness and collaborates with food safety agencies for risk assessment.

15. It was estimated that circa 2010, 4.1 million cases of foodborne gastroenteritis occurred in Australia[8]. In 2011, OzFoodNet sites reported 1 719 outbreaks of gastrointestinal illness, of which 151 were suspected or confirmed to be foodborne, affecting 2 104 persons and resulted in 231 hospitalisations and five deaths[9]. This number of outbreaks was higher than the 5-year mean (2006-2010) of 137 outbreaks. The most common causative agent of these outbreaks was *Salmonella Typhimurium* (37%), followed by *Clostridium perfringens* (11%) and *Campylobacter* (6%). 31% of these outbreaks were of unknown etiology, which was similar to 2010 (36%).

Local situation

16. Food poisoning is a notifiable infectious disease in Hong Kong and doctors are required to report food poisoning cases to the Centre for Health Protection (CHP) of the Department of Health (DH). A food poisoning case generally refers to an incident in which two or more persons experience a similar illness after ingestion of a common food, and epidemiological analysis implicates the food as the source of the illness. One person having chemical poisoning or biochemical poisoning after consuming of food also constitutes a food poisoning case. With epidemiological investigations, the sources of infection may be traced in some cases, which may require immediate public health control.

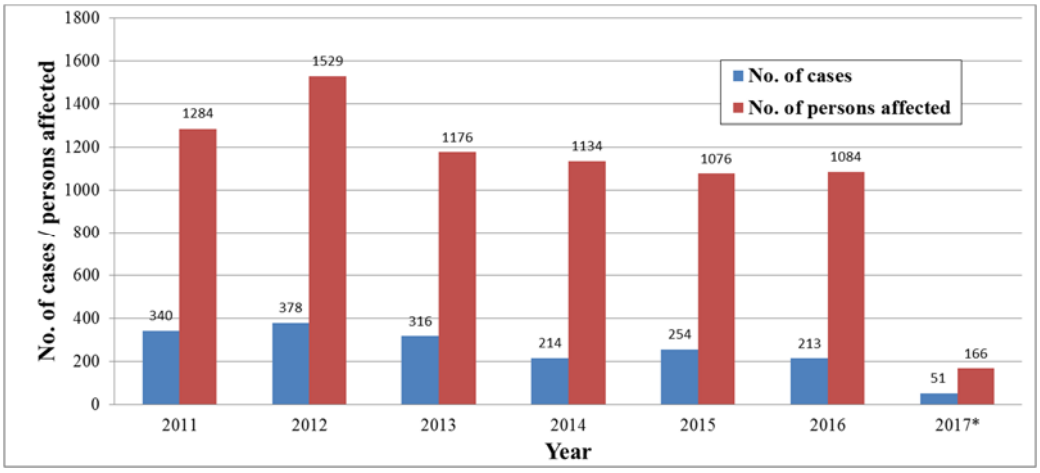
17. Upon notification, CHP will confirm the occurrence of the case, determine the causative agent based on information including clinical symptoms, incubation period and type of food consumed, collect clinical

specimens for laboratory investigation and implement control measures if needed. Cases suspected to be associated with food premises may be referred to the Centre for Food Safety (CFS) of the Food and Environmental Hygiene Department (FEHD) for further investigation and appropriate follow up actions. Upon notification, the FEHD conducts investigation and implements prompt control measures to prevent further outbreaks. These include providing health advice to food handlers and initiating enforcement actions such as prosecution and closure of the incriminated food premises.

I. Overall pattern

18. From 2011 to 31 March 2017, CHP recorded 1 766 food poisoning cases, affecting a total of 7 449 persons, of which 432 were hospitalised. The male to female ratio was 1:1.3. The median number of persons affected was 3 per case (range 1 to 149, mean = 4). From 2011 to 2016, both the annual number of cases and the number of persons affected remained stable†. The annual number of cases ranged from 213 to 378, while the number of persons affected ranged from 1 076 to 1 529. (Figure 1). A seasonal pattern of recorded food poisoning cases in Hong Kong was also noted with peaks in January to February and July to August (Figure 2).

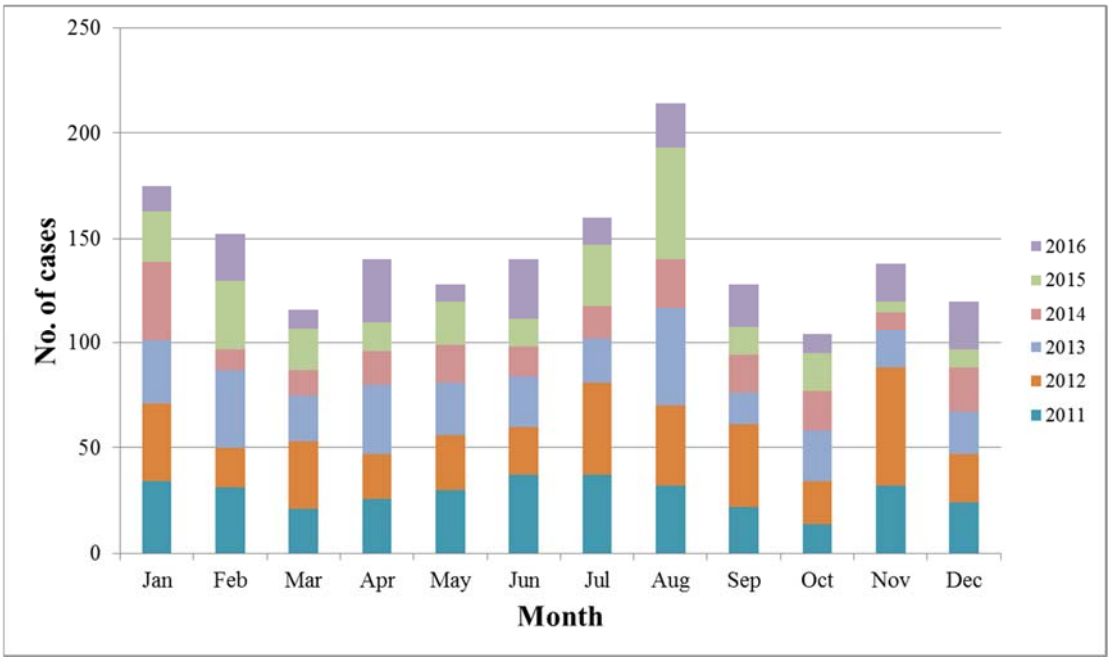
Figure 1. Number of food poisoning cases and persons affected, 2011 – 2017 (up to 31 March)



*Provisional figures as of 23 June 2017

† For comparison, the annual number of some other notifiable foodborne diseases and enteric infections recorded by CHP are shown in Annex 1

Figure 2. Number of food poisoning cases by year and month, 2011 – 2016



19. The different groups of causative agents of food poisoning cases are shown in Table 2. Among the 1 766 cases recorded, causative agent(s) could be confirmed in 459 (26.0%) of them. For the majority of food poisoning cases, the causative agent could not be confirmed because no specimen was available for laboratory investigation or the specimen was tested negative for causative agents.

Table 2. Number of cases and number of persons affected by different groups of causative agents, 2011 – March 2017 (as of 23 June 2017)

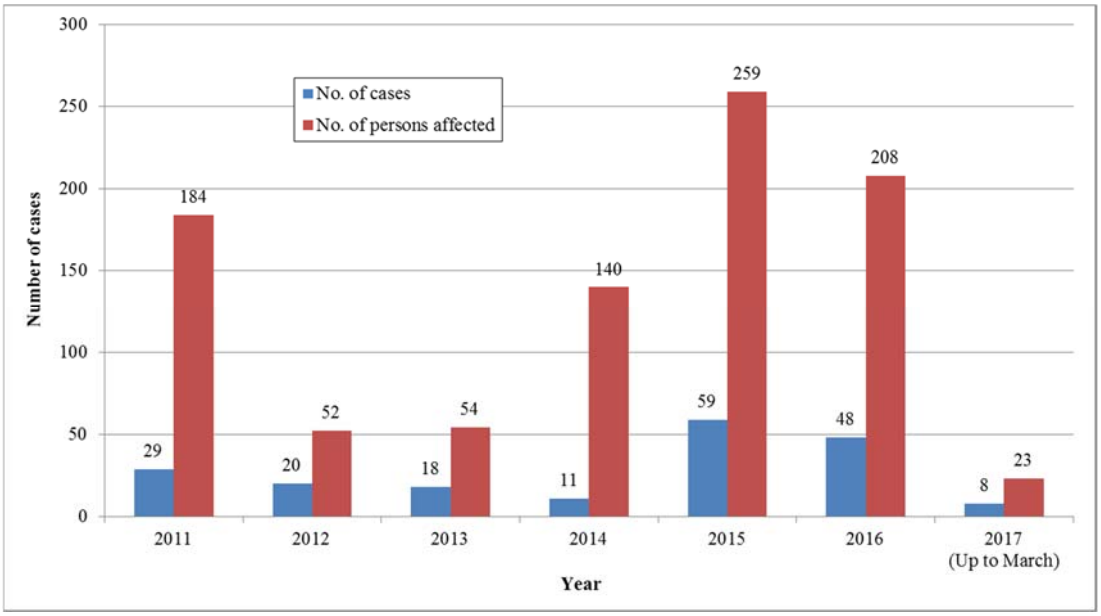
Group of causative agents	No. of cases		No. of persons affected	
	Confirmed	Probable / Suspected	Confirmed	Probable / Suspected
Bacteria	301	1 017	1496	4 211
Virus	63	188	451	885
Biochemical	82	76	196	114
Chemical	12	16	15	41
Others	1	10	2	38
Subtotal	459	1 307	2 160	5 289
Total	1 766		7 449	

II. Food poisoning cases due to Salmonella

20. Nontyphoidal *Salmonella* has replaced *Vibrio parahaemolyticus* as the most common bacterial causative agent among confirmed cases of food poisoning. Clusters of epi-linked cases involving nontyphoidal *Salmonella* were also recorded recently. In the following sections, we reviewed the local epidemiology of food poisoning cases attributed to nontyphoidal *Salmonella* recorded by the CHP from 2011 to March 2017.

21. During 2011 to March 2017, 378 food poisoning cases associated with nontyphoidal *Salmonella*, affecting 1 687 persons, were recorded by CHP. Of these, 193 were confirmed cases, affecting 920 persons (Figure 3). Such confirmed cases will be included for analysis in the following sections. The median number of persons affected was 3 per case (range 1 to 62, mean = 5). These cases accounted for 64% of confirmed food poisoning cases of bacterial causes, ranking nontyphoidal *Salmonella* the most common food poisoning bacterial agent.

Figure 3. Confirmed food poisoning cases associated with nontyphoidal *Salmonella*, 2011- March 2017 (as of 23 June 2017)



22. The seasonal pattern of nontyphoidal *Salmonella* food poisoning cases is shown in Figure 4. Despite a cluster of 15 epi-linked cases recorded in November and December 2016, more cases were recorded in warmer months in general. Although the number of nontyphoidal *Salmonella* food poisoning cases has been decreasing during 2011 - 2014, large food poisoning cases (more than 20 persons affected) have occurred in recent two years. Majority (84.5%) of the cases affected 5 persons or below and 3.1% of the cases affected more than 20 persons (Figure 5).

Figure 4. Number of confirmed food poisoning cases attributed to nontyphoidal *Salmonella* by the month of notification, 2011 – 2016

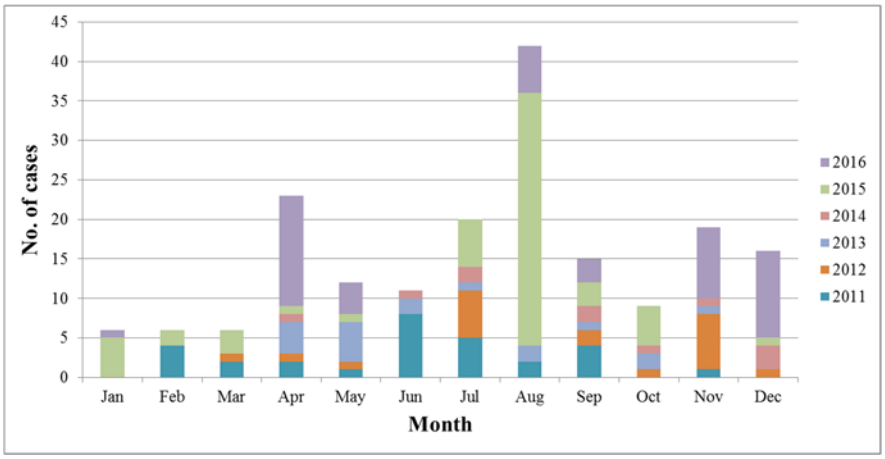
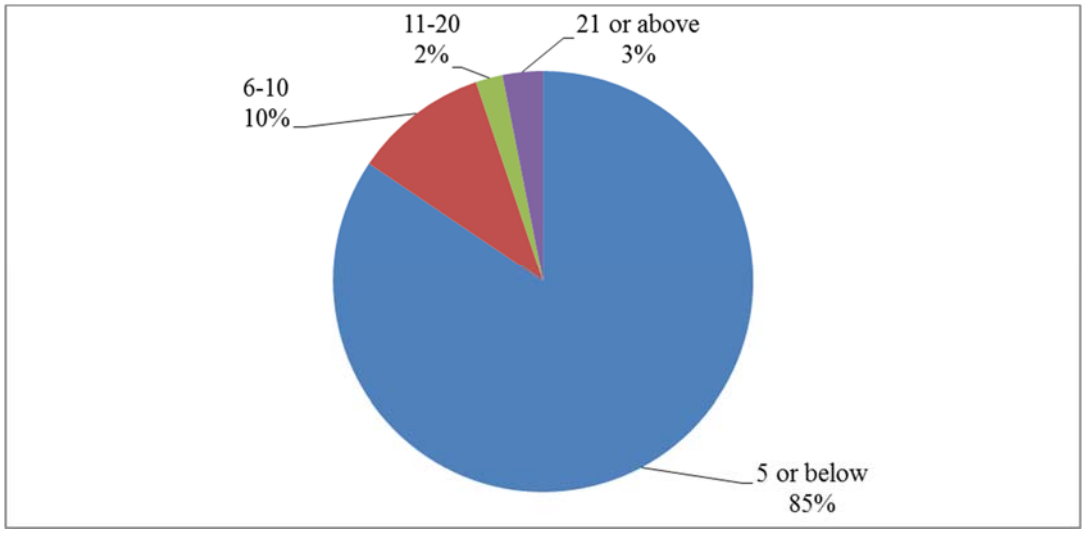
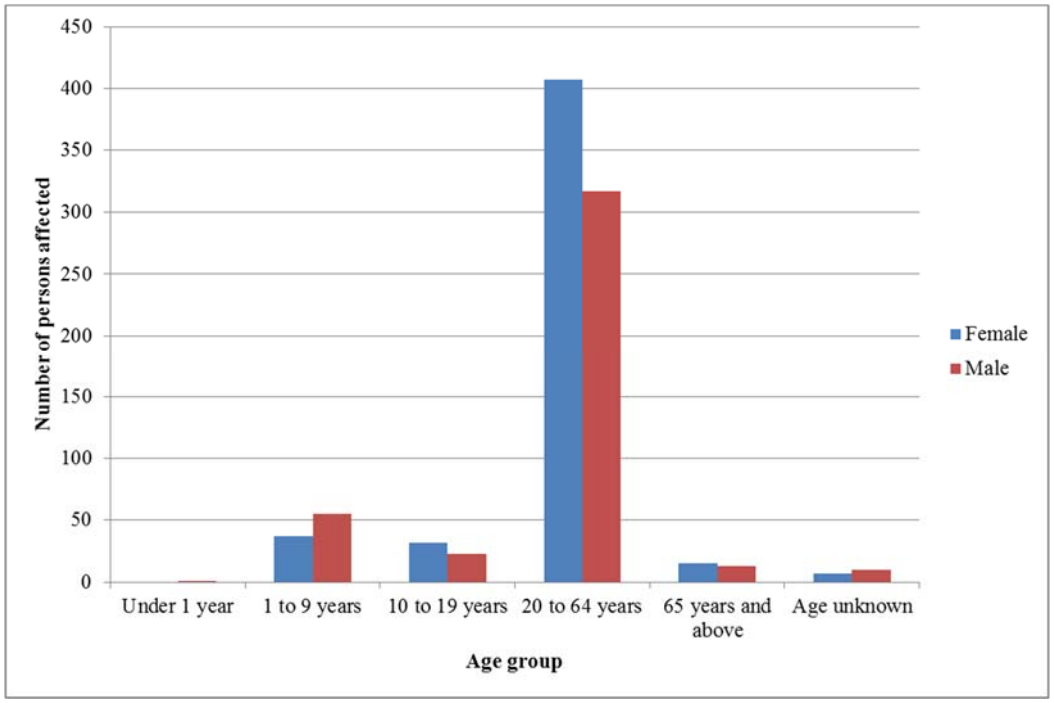


Figure 5. Number of persons affected in confirmed food poisoning cases attributed to nontyphoidal *Salmonella*, 2011 - March 2017 (as of 23 June 2017)



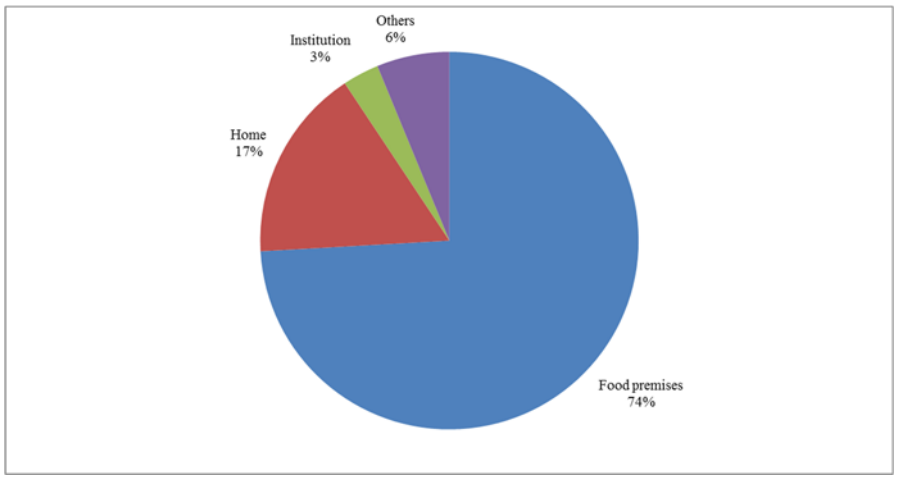
23. Among the 920 affected persons, age groups of the two age extremes were less commonly affected (Figure 6). There was no obvious sex preference (male-to-female ratio was 1:1.2). One hundred and forty-nine persons out of the 920 affected persons (16.2%) required hospitalisation. There was no fatal case recorded.

Figure 6. Age and sex distribution of persons affected in food poisoning cases attributed to nontyphoidal *Salmonella*, 2011 - March 2017 (as of 23 June 2017)



24. More than 70% of food poisoning cases attributed to nontyphoidal *Salmonella* occurred at food premises (Figure 7). Domestic cases accounted for 17% (32 cases) and only 3% (six cases) occurred at institutions.

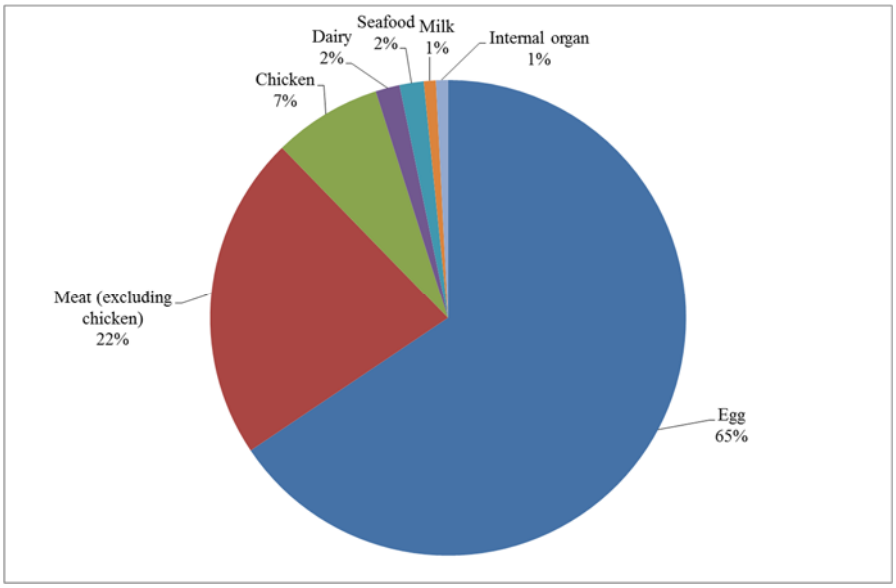
Figure 7. Place of consumption of confirmed food poisoning cases attributed to nontyphoidal *Salmonella*, 2011 - March 2017 (As of 23 June 2017)



25. Among the 193 confirmed food poisoning cases attributed to nontyphoidal *Salmonella*, a single food item was implicated in 154 cases. Furthermore, 32 of the foods implicated in these 154 cases were complex foods of which the epidemiological investigation could not identify the relevant food ingredients causing the salmonellosis. The remaining 122 cases were used for the analysis of contributing factors and foods most commonly associated with nontyphoidal *Salmonella* food poisoning.

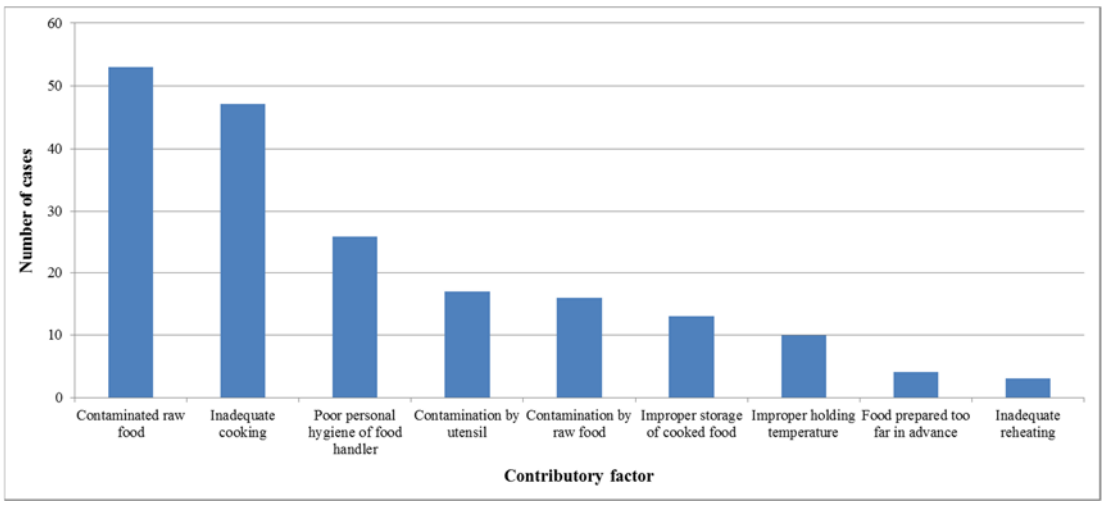
26. The food ingredients of the 122 cases with a single implicated food item were analysed and shown in Figure 8. The most commonly associated food ingredients were egg (65.6%), meat (excluding chicken) (22.1%) and chicken (7.4%).

Figure 8. Food ingredients associated with nontyphoidal *Salmonella* food poisoning cases, 2011 - March 2017 (As of 23 June 2017)



27. The contributing factors of the 122 cases with a single implicated food ingredient identified were shown in Figure 9. While each case can have one or more contributing factor(s), contaminated raw food was the most commonly implicated one, followed by inadequate cooking.

Figure 9. Implicated contributing factor for identified food items associated with nontyphoidal *Salmonella* food poisoning cases, 2011 - March 2017 (As of 23 June 2017) (each case can have one or more contributing factor(s))



28. These two leading contributing factors, namely, contaminated raw food and inadequate cooking, have together been implicated in 74

(92.5%) out of 80 cases where egg was the incriminated food ingredient. This indicated that *Salmonella* was present in the raw egg in almost all of these cases and highlighted the importance of thorough cooking of eggs.

29. Despite the fact that small numbers of persons were affected in each case, a cluster of epi-linked confirmed food poisoning cases associated with an emerging source of purchase and caused by nontyphoidal *Salmonella* was recorded recently.

30. With the increasing popularity of online food sales, CHP maintains vigilance on food poisoning cases related to such purchases. Public education on ordering high-risk food online should be delivered, particularly regarding the source of food supply, the nature of foods as well as the mode of delivery and the storage temperature.

31. To safeguard food safety, the FEHD introduced in February 2016 a new set of licensing conditions for the regulation of operators without physical premises and selling restricted foods including high-risk food such as sushi, sashimi and oysters / meat to be eaten in raw state via the Internet or social media platforms. The licensing conditions mainly require that restricted foods must be obtained from lawful sources and not be tampered with during transportation to prevent cross-contamination, and that the food products shall be stored at a safe and proper temperature at all times. In addition, operators are also required to disclose on their websites information about their permit, such as the permit number, registered business address and the category of restricted food permitted to sell, for reference by consumers when they make a purchase online and enable them to verify such information by referring to the FEHD website.

32. The FEHD has stepped up public education and publicity on the sale of food online. A series of television and radio Announcements in the Public Interest (APIs) have been broadcasted since December 2015 to draw public attention to the safety issues and inherent risks of purchasing food online and advise them to check and make sure that food suppliers handle and deliver food properly before placing orders online. Besides, the FEHD launched series

of radio and television APIs in 2016 and 2017 to remind the trade of the need to obtain a licence or permit for their online food sale business and the conditions to be complied with. The FEHD has also called upon food retailers, including online shops, through different channels such as leaflets, the FEHD website and meetings with the trades to ensure that their food products are stored and delivered at a safe temperature as instructed by food manufacturers or suppliers.

33. The food safety authority enhanced public education on online food shopping for high risk food items e.g. sandwich or salad with ready-to-eat ingredients, which have been associated with large scale food poisoning outbreaks either locally or overseas. Purely relying on legislative control from the government is not enough to ensure food safety, the self-discipline of the food manufacturer / importer in ensuring the food they produced / imported are fit and safe for human consumption and the cooperation from the consumer in making a right consumer's choice and the proper storage and handling of food prior to consumption are the keys to food safety.

Conclusion

34. Food poisoning remains a common phenomenon which poses significant burden to public health. Owing to globalisation and use of the Internet, the pattern of food poisoning has been evolving and cases related to online purchase of food have recently emerged.

35. The prevention and control of food poisoning is multi-prong and comprises a number of measures, including public education, legislation, prompt investigation of outbreaks and implementation of control measures and risk communication. In view of the evolving pattern of food poisoning, health education to the relevant stakeholders, including the food industry and the general public, should be tailored to address the new challenges. In particular, with the prevalence of e-commerce, online food shopping has become more popular in recent years. To minimise food safety risk through online food trading, the public should be educated to be more discerning when ordering high-risk foods online. They should pay particular attention to the source of

food supply, the nature of foods as well as the mode of delivery in particular the storage temperature when purchasing food online because high-risk food items may contain food poisoning organisms that may cause food poisoning outbreaks if handle improperly.

Centre for Health Protection

Department of Health

December 2017

Reference

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Annex 1

Annual number of some other notifiable foodborne diseases and enteric infections recorded by CHP, 2011-2016