衞生防護中心
Centre for Health Protection

# Scientific Committee on Enteric Infections and Foodborne Diseases

## Review of Bacillary Dysentery in Hong Kong, 2003 - 2012

### Purpose

This paper reviews the recent global and local epidemiology of bacillary dysentery and examines the prevention and control of the disease in Hong Kong.

### The pathogen and the disease

2. Bacillary dysentery, also called shigellosis, is an acute enteric infection caused by a group of gram–negative, non-lactose fermenting, non-motile bacilli that belong to the genus *Shigella* under the family Enterobacteriaceae (1, 2). They are approximately 0.5 micron wide and 2 microns long. The pathogen dies rapidly in dry environment or when exposed directly to sunlight (3). There are four species of *Shigella* which are classified by the basis of differences in O antigen of their lipopolysaccharide and some biochemical reactions. They are *Shigella dysenteriae (S. dysenteriae), Shigella flexneri (S. flexneri), Shigella boydii (S. boydii)* and *Shigella sonnei (S. sonnei)*. They are also designated as serogroups A, B, C and D with 15, 6 (with 15 subtypes), 18 and 1 serotypes respectively (1, 3).

3. Disease severity and epidemiology vary across species and serotypes. *S. sonnei* is less virulent. This serotype predominantly distributes in developed countries and accounts for 77% of cases in these countries. While *S. boydii* is mainly restricted to the Indian subcontinent, it causes diarrhoeal diseases of varying severity, mostly similar to *S. sonnei* (4). *S. flexneri* is endemic in developing countries, it is the most common species isolated worldwide causing morbidity and

mortality. *S. dysenteriae* occurs frequently in less developed countries where people are living in crowded settings with poor hygiene and sanitation. *S. dysenteriae* is the most virulent and frequently reported to be associated with antimicrobial resistance which may cause extensive and prolonged endemic with high fatality rate (5) (Table 1).

Table 1: Characteristics of *Shigella spp* (3, 4).

| Species | Serogroup | Serotypes | Symptoms | Place of occurrence |
|---|---|---|---|---|
| *S. dysenteriae* | A | 1-15 | ● More severe symptoms with higher fatality rates<br>● In most cases, it causes inflammation and ulceration of the lower part of the bowel that causes bloody stools | ● Less developed countries<br>● Cause vicious outbreaks in confined populations, especially in refugee camps (6) |
| *S. flexneri* | B | 1-6 (with 15 subtypes)<br>2a is predominant and followed by 1b,3a, 4a and 6(6) | ● Diarrhoea, abdominal pain and cramps, and fever but is often more severe than *S. sonnei* infection<br>● Inflammation and ulceration of the lower part of the bowel is also common. Illness can be prolonged and more severe | Developing countries e.g. Bangladesh, China, Pakistan, Indonesia, Vietnam, except Thailand |
| *S. boydii* | C | 1-18 | ● Diarrhoeal diseases of varying severity, but mostly are similar to those caused by *S. sonnei* | Mainly in Indian subcontinent (7) |
| *S. sonnei* | D | 1 | ● Less severe<br>● Diarrhoea (which is sometimes bloody), abdominal pain and cramps, and fever. Nausea and/or vomiting, loss of appetite, headache or malaise can also occur. | Developed countries e.g. US, Europe |

## Pathogenesis

4. *Shigella* organisms can survive in gastric acidity and pass to the terminal ileum and colon after oral inoculation. The ingested pathogens invade and penetrate the mucosa, replicate within and spread between the mucosal epithelial cells. This process destroys the colonic epithelial layer causing mucosal microabscesses, inflammatory colitis, bleeding and ulcerations (1, 8). *Shigella* species induce two *Shigella* enterotoxins, ShET1 and ShET2, which are incriminated as mediators of watery diarrhoea that presented in early stage of infection (9). Among all *Shigella* species, *Shigella dysenteriae* serotype 1 (*Sd*1) is the most pathogenic as it produces highly potent cytotoxin called Shiga toxin that increases the severity of the disease by destroying the endothelium in the local capillary loops and causing ischemia in the intestinal tissue. The Shiga toxin is implicated as the etiologic agent of the thrombotic microangiopathy that characterizes haemolytic uremic syndrome following infection with *Sd*1 (1).

## Disease transmission and clinical presentation

5. Shigellosis is transmitted via the faecal-oral route, either directly from person-to-person contact (e.g. anal sex contact) or indirectly through ingestion of contaminated food, water (e.g. contaminated swimming water) or fomites. (10-13). Transmission by houseflies via contaminated food and eating utensils has been documented (14). *Shigella* is highly communicable, and as few as 10 organisms are sufficient to cause infection in some species. The incubation period is about 1 to 3 days but can be up to 7 days (15). Humans are the main reservoir of this bacteria (6).

6. While the infection can be mild and asymptomatic, it is commonly presented as frequent but small volume of loose stools with blood and mucus with moderate dehydration (3). Abdominal cramps, tenesmus (unproductive, painful straining), fever and anorexia are also commonly presented due to invasion of the distal small bowel and/or colon by the bacteria (5). Most patients recover uneventfully within seven to ten days. However, *Shigella* infection can become life-threatening in immunocompromised patients, malnourished children or if not properly treated. Acute complications may occur that include metabolic abnormalities, convulsions, rectal prolapse, toxic megacolon, intestinal perforation, peritonitis, septicaemia and severe haemolytic uremic syndrome with renal failure (3, 6).

## Laboratory diagnosis (16)

7. Bacillary dysentery can be confirmed by a positive culture of *Shigella* species in stool specimen or rectal swab. Specific serotype of the causative *Shigella* species can be determined by slide agglutination test with polyvalent somatic (O) antisera, followed by agglutination test with

monovalent antisera. Sensitivity test can also be performed to determine the antimicrobial susceptibilities for effective treatment.

## Patient management

8. *Shigella* infections are usually self-limiting. For symptomatic cases, appropriate use of antibiotic treatment can shorten the illness by a few days. Nevertheless, this treatment should only be used for severe cases due to increasing concern of antimicrobial resistance among *Shigella spp.* and local antibiotic susceptibility data of *Shigella* strain should be considered. Fluid and electrolytes replacement can be used for cases with severe diarrhoea. Above all, anti-diarrhoeal agents should be avoided (17).

## Global epidemiology

9. Shigellosis is endemic throughout the world and is the most common cause of bloody diarrhoea. Pandemic waves of this disease have hit sub-Saharan Africa, Central America and South and South-East Asia since 1960s(6). It was estimated that there were 165 million cases of *Shigella* diarrhoea annually in 1990s and about 99% of them occurred in developing countries causing 1.1 million deaths. Of all fatal cases, 66% occurred among children less than five years of age (18). A study conducted in 2009 indicated that the disease burden reduced to 90 million episodes and 108 000 deaths per year but still caused a major public health concern. In addition, the development of antimicrobial resistances also resulted in frequent treatment failure in developing countries (6).

## Situation in the United States (US)

10. From 1978 to 2003, there were over 17 000 laboratory confirmed cases of shigellosis reported each year in the US. The number of cases decreased to 14 000 in 2004 but it rebounded to about 22 000 in 2008.

11. Most of the outbreaks in the US were resulted from person-to-person transmission in daycare settings with inadequate hygiene practices (19). Besides, outbreaks associated with recreational contact with contaminated water, sexual contact among men who have sex with men, living in communities or institutions with crowding or compromised hygiene and consuming contaminated water had also been reported.

12. There is a small portion of foodborne shigellosis outbreaks reported in the US each year and is in decreasing trend. There were a total of 120 foodborne *Shigella* outbreaks reported in 1998 – 2008 that affected 6 208 persons. The incubation period ranged from 5 to 18 hours (median of 10 hours). These cases constituted 1.3 - 5.6% of all confirmed foodborne outbreaks in this period. Of all cases, 197 required hospitalisations and one fatal case was

recorded (20) (Figure 1). Nevertheless, a large international foodborne S*higella* outbreak was reported in 2004 that associated with food served on airplanes. Forty seven air travellers from 12 flights who departed from Hawaii were confirmed with *Shigella* infection by laboratory tests, with other 116 probable cases recorded. A cold salad served that contained raw carrot was common to all affected flights and it was suggested to be the vehicle of *S. sonnei* transmission in this outbreak (21).

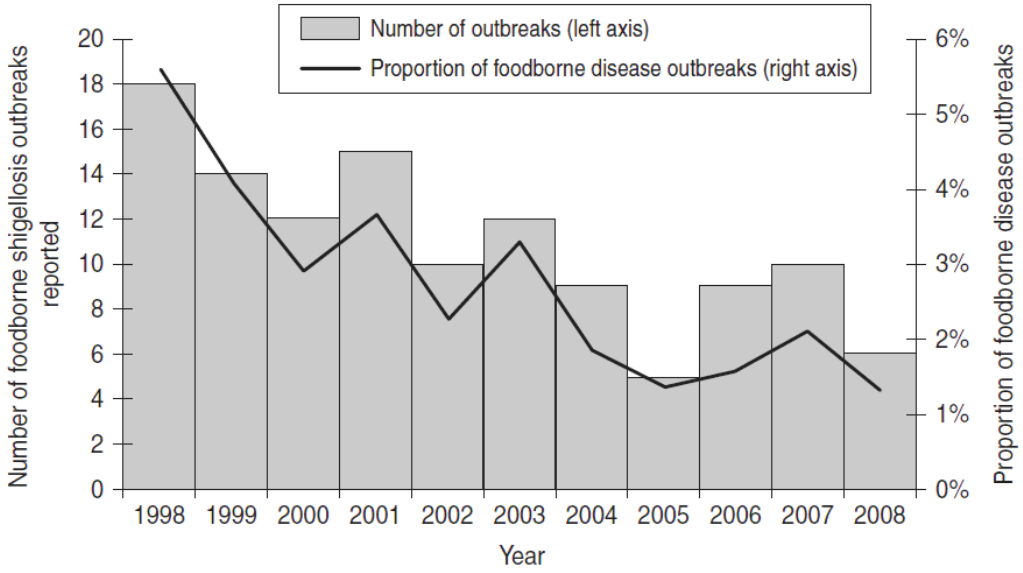


Figure 1. Number of confirmed foodborne outbreak of shigellosis reported and proportion of foodborne disease outbreak in the US, 1998 -2008 (20)

## Situation in Europe

13. In Europe, shigellosis is relatively uncommon and in decreasing trend. The incidence rate decreased from 1.79 cases per 100 000 population in 2006 to 1.63 per 100 000 population in 2009 (Figure 2). In 2009, among the countries in European Union, Bulgaria reported the highest incidence rate with 9.87 cases per 100 000 population, followed by Slovakia with 6.84 cases per 100 000 population. The reported rates in more developed countries are generally lower. For example, the reported rates in Germany, France and the United Kingdom were 0.75, 1.62 and 2.56 per 100 000 population respectively (22).

14. Infections were usually associated with overseas travel. Foodborne outbreaks are uncommon and mostly caused by food imported from endemic countries. In 2007, a large scale outbreak of *S. sonnei* infections related to imported baby corn from Thailand was reported. The outbreak affected a total of 227 persons, in which 215 persons were in Denmark (23).

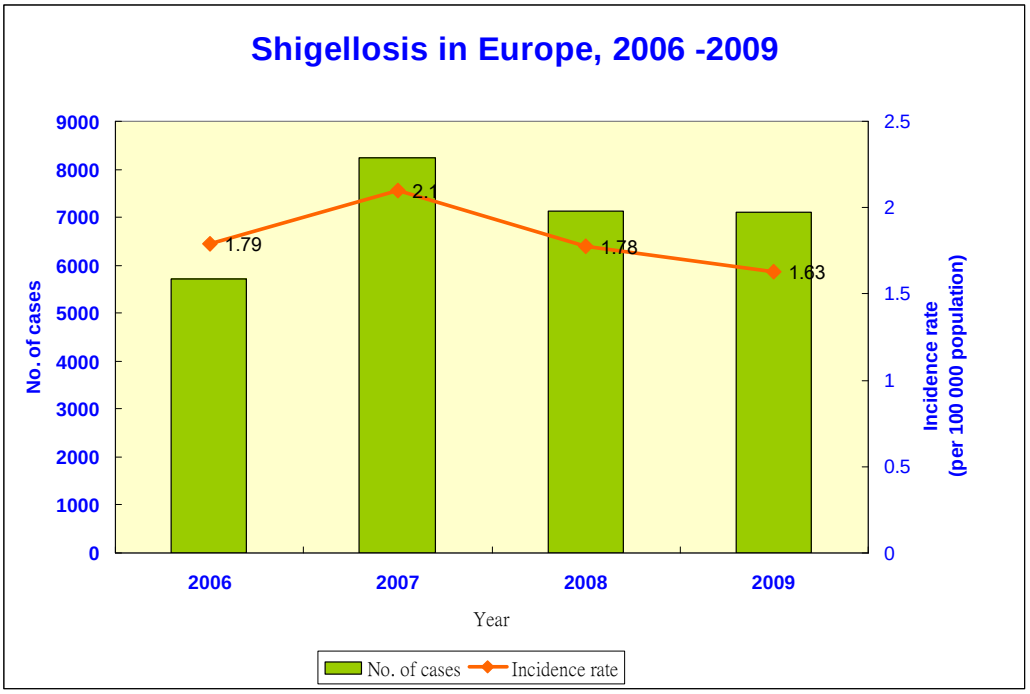


Figure 2. Annual number and incidence rate of confirmed cases of shigellosis in Europe, 2006 - 2009 (22)

## Situation in Asia

15. Shigellosis is more ubiquitous in impoverished population of Asia (24). It was estimated that about 130 million episodes occurred annually in Asia causing approximate 880 000 deaths in 1980s (18). A review suggested that the annual number of episodes in recent years was comparable to those in 1980s (about 125 million) but the number of fatal cases were significantly reduced from 880 000 to 14 000 (98% lower)(25). In fact, the burden of this disease has decreased in some Asian countries due to improvements in social-economic condition, water supply, sanitation and accessibility of affordable health care and treatment (26).

16. A study reviewed the burden of bacillary dysentery in Thailand from 1991 to 1999. It showed that the annual incidence and case fatality rate decreased from 13 per 100 000 population and 0.1% in 1991 to 2 per 100 000 population and 0% in 1999. Children aged below 5 year-old were the most vulnerable among different age groups and they accounted for 43% of the total cases reported (27).

17. In mainland China, bacillary dysentery is a national notifiable infectious disease. All health-care facilities at village, township, county and city levels are required to report confirmed cases to the official national health authority by law. The burden of bacillary dysentery in mainland China is still high as compared to developed countries, the incidence of this disease had decreased from 0.87 million in 1994 to 0.49 million in 2003. Of which, more than 40% were children aged below 10 year-old. The number of deaths due to bacillary dysentery ranged from 144 to 521 in the period (28).

## Situation in Hong Kong

18. The Department of Health (DH) received 1 006 cases of bacillary dysentery from January 2003 to September 2012. The figures were in general higher during 2003 - 2008, with more than 100 cases reported each year (except 2007). The figures were then in downward trend. There were 86, 78 and 54 cases in 2009, 2010 and 2011 respectively. In 2012, the number of cases reported in the first nine months was 46, which remained at the relatively low level (Figure 3). More cases were reported in summer period from July to October (Figure 4).

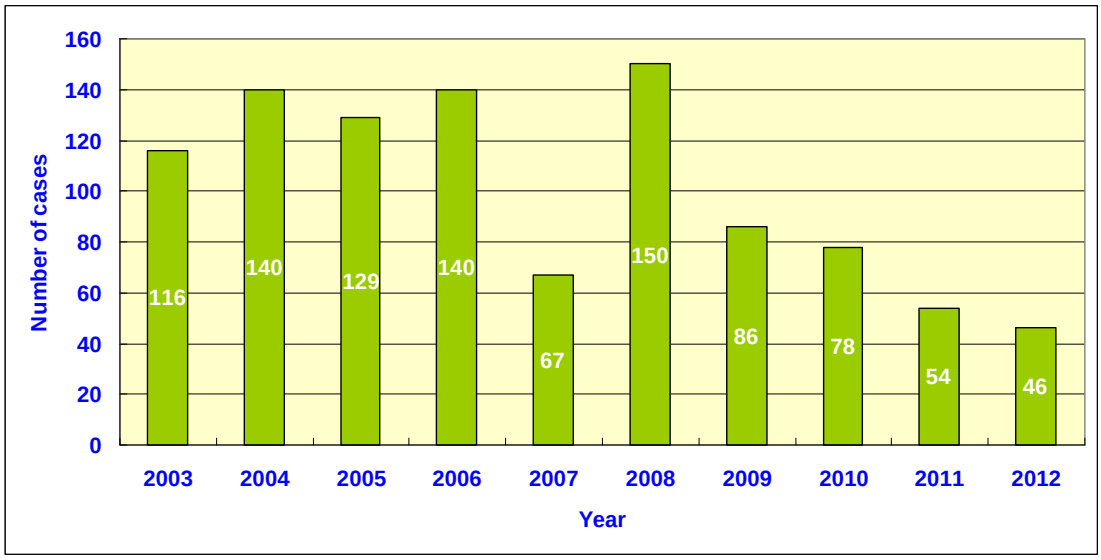


Figure 3. Annual number of bacillary dysentery reported in Hong Kong from Jan 2003 to September 2012

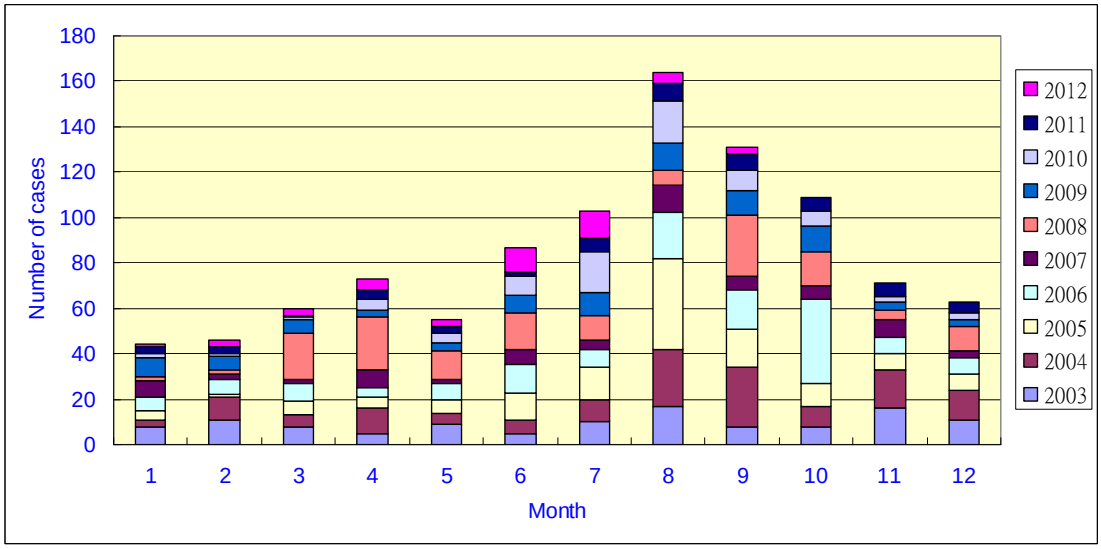


Figure 4. Monthly number of bacillary dysentery reported in Hong Kong from Jan 2003 to September 2012

19. Among the cases reported in Hong Kong from 2003 to September 2012, bacillary dysentery affected people of different age groups, with a median age of 28 years (range: 2 months to 91 years). More cases were below 40 (74%) while 9% of them were aged below 5. Male-to-female ratio was 1:1.2. No fatal cases were reported. Most cases presented with mild symptoms such as abdominal pain (76%), fever (73%) and diarrhoea (70%). More than half of the patients reported watery diarrhoea (63%). Other symptoms like bloody diarrhoea (30%), mucus in stool (40%), vomiting (34%) and nausea (31%) were also reported. Forty-five percent of the cases required hospitalisation with a median length of stay of 3 days (range: 1- 64 days). Patients of extreme ages (age <5 and >70) had higher proportion of hospitalisation (75% and 86% respectively) as compared with other age groups. Sixty seven percent of the total cases acquired the disease locally and one-third of the cases were imported. The imported cases contracted the disease mainly in mainland China (36%) and India (17%).

20. Among the laboratory confirmed cases, *S. sonnei* was the predominant (69%) species isolated, followed by *S. flexneri* (28%), *S. boydii* (2%) and *S. dysenteriae* (1%). No *Sd*1 have been isolated thus far. For antibiotic sensitivity, 72% and 89% of *S. sonnei* isolates were resistant to nalidixic acid and co-trimoxazole respectively. For *S. flexneri*, 69% and 77% of isolates were resistant to co-trimoxazole and ampicillin respectively. All of the *S. sonnei* and *S. flexneri* isolates were susceptible to co-amoxiclav and ciprofloxacin. In addition, 85% of *S. sonnei* and 96% of *S. flexneri* were sensitive to ceftriaxone, which was considered as second line treatment (3).

21. Although most cases (76%) were sporadic, there were 63 outbreaks, affecting 235 persons reported during the 10 year period. Below we further analyzed the bacillary dysentery outbreaks.

22. The sizes of these outbreaks ranged from 2 to 18 persons (median 2 persons). About half of these outbreaks (52%) were considered to be foodborne. Person-to-person transmission constituted only a minor portion (2%) and the route of transmission in the remaining outbreaks could not be ascertained. Similar to the overall bacillary dysentery cases, *S. sonnei* was the predominant causative agent in these outbreaks (75%), followed by *S. flexneri* (23%). A variety of suspected incriminated food items were identified in some of the foodborne outbreaks. These food items included dairy products, fruit, raw vegetable, sashimi, dimsum and seafood.

23. Nearly half (48%) of the outbreaks were imported, mainly from Asian countries. Of them, approximately 39% were imported from mainland China, followed by India (18%) and other countries in South East Asia including Cambodia, Indonesia, Malaysia, the Philippines, Thailand and Vietnam (17%). The sizes of these outbreaks ranged from 2 to 11 persons, with a median of 2 persons. Among the species of *Shigella*, *S. sonnei* was

predominant species (69%) causing the outbreaks, followed by *S. flexneri* (28%). In the imported outbreaks, no obvious differences in prevalence of *Shigella* species were noted among different source countries. Thirty percent of the imported outbreaks were travel group related.

24. Forty-nine percent of the bacillary dysentery outbreaks affecting 2 to 18 persons (median 2 persons) were locally acquired. Among them, *S. sonnei* was still the most common causative agent (84%). Institutional outbreaks were not common in Hong Kong. Three institutional outbreaks (less than 5% of all outbreaks) were recorded in the past 10-year period. These involved a hospital outbreak and a day centre cum hostel for mentally handicapped outbreak reported in 2006 and a correctional institution outbreak reported in 2008 affecting 2 , 15 and 17 persons respectively. Symptoms presented were mild and all recovered uneventfully.

25. Outbreaks involving food handlers were also uncommon (less than 2% of all outbreaks). In 2005, an outbreak involved a Japanese restaurant was reported to the Centre of Health Protection (CHP) of the DH. Investigation revealed that 18 persons, including four food handlers/ staff from the restaurant, were affected. Their symptoms included fever, nausea/vomiting, abdominal pain and diarrhoea that subsided in 2 to 14 days (median: 4 days). The causative agent of this outbreak was *S. sonnei*. It was considered to be transmitted by consumption of contaminated food but secondary transmission by food handlers could not be excluded. Operation of the food premises was temporarily suspended and the affected food handlers/ staff were suspended from food handling work until clearance of the infection.

## Prevention and control of bacillary dysentery in Hong Kong

26. No effective vaccines are available for preventing bacillary dysentery. Disease surveillance, early identification of cases and prompt public health response carried out by relevant authorities are crucial to effective disease control. Food surveillance targeting at different levels of food supply is important to identify food items in problem timely. Health education on food, personal and environmental hygiene targeting to the general public and the food trade is also indispensible to sustain the decrease trend of the disease in Hong Kong.

## Disease surveillance and public health response

27. Bacillary dysentery is a statutory notifiable disease in Hong Kong. Doctors are required to notify suspected or confirmed cases to the CHP of the DH for investigation and public health control measures. Upon receiving notification, the CHP will initiate prompt investigation, collect clinical and epidemiological information from patient and implement relevant control measures. History of travel and food consumption and other risk factors such as

the mode of water supply and sanitary facilities at home is elicited to identify possible source of transmission. If appropriate, food or travel collaterals and household contacts are also traced.

28. The Food and Environmental Hygiene Department (FEHD) will be informed for further investigation at food premises if common food source is suspected. FEHD staff will collect food and environmental samples, and clinical specimens from food handlers if necessary, for laboratory investigation. They also provide specific advice on food hygiene, conduct food source tracing and take actions against any irregularities identified during investigation. For food handler cases, they will be assessed for temporary suspension from work related to food handling. Health advice on food hygiene and food safety will be stressed. Sale and distribution of suspected food items may be suspended as appropriate.

## Food surveillance and control

29. The Centre for Food Safety (CFS) conducted risk assessment studies for foodborne diseases. At the same time, CFS has a food surveillance programme with a three-tier approach that included routine food surveillance, targeted food surveillance and seasonal food surveillance. Targeted food surveillance is adopted to assess the microbiological quality of various types of high risk food for *Shigella* contamination such as salad, ready-to-eat vegetables, poultry, sandwiches and sushi etc. From 2010 to 2012, about 300 samples of food samples were collected each year at retail level for testing of *Shigella* species. No unsatisfactory samples were identified in 2010 and 2011 and all samples in 2012 were satisfactory so far as of September. If the test results of the food samples are unsatisfactory, CFS will trace the food items in question and request vendors to stop selling and dispose the incriminated food items. Warning letters would be issued to the vendors concerned if necessary.

30. At airport, Port Health Office (PHO) of the DH conducts routine food surveillance on the food catering services and portable water supplies provided for airlines and when necessary, referral to FEHD for follow up action will be made to ensure safety environment for travellers.

## Health education to public, travellers and food trade

31. Maintenance of good personal hygiene, especially hand hygiene, and adherence to food and water safety remain the mainstay of prevention. FEHD and CHP prepare a variety of health education materials, such as fact sheets on bacillary dysentery, pamphlets and messages in electronic media on hand washing, food and water safety, to increase awareness of the general public and food trade. Furthermore, the website of Travel Health Service of DH is uploaded with the most updated news on bacillary dysentery outbreaks around the world with relevant health tips available for travellers.

## Recommendations

32. In summary, there is a decreasing trend of bacillary dysentery in Hong Kong in recent years but outbreaks of bacillary dysentery were occasionally reported. Both foodborne and person-to-person transmissions attributed to the spread of the disease. For foodborne outbreaks, the incriminated food items were usually difficult to identify. About half of the outbreaks were locally acquired while another half of the outbreaks were acquired overseas and a significant portion of the imported outbreaks involved travel groups. In view of the situation, the following recommendations are provided:

(a) Researches, such as case control studies, are encouraged to identify common incriminated food in foodborne bacillary dysentery and to elucidate the routes of transmission in other cases in local community to facilitate implementation of prevention and control measures.

(b) As foodborne and person-to-person transmission are both effective routes, the current health education on personal hygiene, especially hand hygiene and food safety providing to the members of the public, food trade and institutions should continue. Regular review on the health education materials based on local and global epidemiology is recommended.

(c) To strengthen risk communication on prevention of foodborne illnesses to the travel agencies. Relevant health education materials could be delivered to travel agencies and hence to the outbound travellers before departure, especially for those travelling to endemic countries, to raise their awareness of prevention of foodborne illnesses during their trips.

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