A REVIEW OF FOODBORNE DISEASE OUTBREAKS FROM 1996 TO 2005 IN HONG KONG AND ITS IMPLICATIONS ON FOOD SAFETY PROMOTION

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ABSTRACT

Foodborne diseases are an important cause of morbidity and mortality and are a growing global concern. A series of recent food safety problems has raised much public concern in the Hong Kong Special Administrative Region*. Despite the fact that many resources have been spent on food safety promotion, there has been no noticeable impact on the rising trend of local foodborne disease outbreaks. This quantitative research study aimed to identify what should be targeted in the current local food safety promotion. It presented a descriptive analysis of local official statistics from 1996 to 2005, followed by a comparison of foodborne disease outbreaks and food safety measures in some Asian places. Results found that about 72% of total local confirmed outbreaks were caused by Vibrio parahaemolyticus and Salmonella spp., while around 46% of the total outbreaks were due to inadequate cooking and contamination by raw food. It suggests that food safety promotion targeted on these factors may greatly reduce local foodborne disease outbreaks. Further elaboration could have been given if detailed breakdown in each outbreak had been provided.

PRACTICAL APPLICATIONS

Based on the official figures, the annual incidence of local foodborne disease outbreaks and the number of victims affected are generally increasing.

* Hong Kong became a Special Administrative Region (SAR) of China on July 1, 1997, after a century and a half of British administration. It is situated at the southeastern tip of China (Hong Kong in Brief 2006).

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despite the fact that many resources and much manpower have been spent on food safety promotion and on investigating each foodborne disease outbreak in the Hong Kong Special Administrative Region. Official statistics for the past decade indicate that the majority of foodborne disease outbreaks has been dominated by some causative agents and contributing factors. Under limited resources, instead of providing some general food safety promotion programs, it suggests that the local food safety promotion should be targeted on these dominant factors. This may greatly reduce the number of outbreaks and victims affected. If this were carried out, not only could the economic burden in this health sector be reduced, but the public health campaigns could also be conducted more efficiently, and more resources could be released to prepare for combating other newly emerging diseases.

INTRODUCTION

The Food and Environmental Hygiene Department (FEHD) and the Department of Health (DH) are the local health authorities providing food safety promotion programs in the Hong Kong Special Administrative Region (HKSAR). In response to successive incidents of problematic food such as malachite green in fishes (FEHD 2006a), pesticide residues in fresh vegetables (FEHD 2006b), norovirus in oysters (FEHD 2006c) and clenbuterol-stained pork and pig offal (FEHD 2005a), the new “Centre for Food Safety” under FEHD (FEHD 2007a, b) has been established with the objectives of strengthening food safety measures and liaison with Mainland and overseas food authorities, and of overseeing food safety education (FEHD 2007a,b).

Despite the fact that many resources and much manpower have been spent on food safety promotion, there has been no noticeable impact on the rising trend of local foodborne disease outbreaks from 1996 to 2005 (Fig. 1). In 2006, there were 4,093 victims from 1,098 foodborne disease outbreaks (DH 2007a). What gives rise to this situation? The above would suggest that the current food safety promotion strategies, where general food safety promotion programs are provided, although essential, are not in themselves an effective preventive measure.

A lack of research into local foodborne disease outbreaks and the rising concerns over food safety from the public have formed the impetus for undertaking this study. This study aimed to identify what preventive measures could be targeted during running a food safety promotion program for the general public of the HKSAR with the goal to reduce the local foodborne disease outbreaks. Based on the official statistics on foodborne disease outbreaks (DH 2006), all locally reported outbreaks for the period from January 1, 1996, through December 31, 2005 in the HKSAR were reviewed. Any dominant
factors for the outbreaks were identified and regarded as the areas to be targeted in later food safety promotion programs. Some successful preventive measures on foodborne diseases practiced in some Asian places that share similar food consumption characteristics and are similarly developed as the HKSAR can also be a reference to that of the local food safety promotion programs.

There are four sections in this research article: Materials and Methods, Results, Discussion and References.

MATERIALS AND METHODS

Study Criteria

The DH is the only official source for collection and recording of foodborne disease-related information in the HKSAR. Each reported foodborne disease outbreak (suspected or confirmed) was investigated by health inspectors of the FEHD, identified and determined by the medical officers of the Centre for Health Protection. In general, the presence of similar clinical symptoms in two or more people after the consumption of common food(s) is regarded as a foodborne disease outbreak. The kinds of causative agents were identified and confirmed by other government testing agents and recorded by the DH.

Because all the local official statistics in the analysis were provided by the DH, the data were from a secondary source. The DH had also granted permission for the use of the statistics in this study. Use of statistics from a secondary...
source can obviously save manpower and resources during data collection for such a long period of time as 10 years. Moreover, official statistics were reliable and accurate. However, the types and details of the figures could not be selected. Because not all details in each foodborne disease outbreak were given, the results could only be presented and analyzed under certain constraints.

**Descriptive Analysis of Official Data from Secondary Source**

The study involved a descriptive analysis of the official statistics on foodborne disease outbreaks in the HKSAR. All confirmed and suspected foodborne disease outbreaks reported to the DH that occurred from January 1, 1996, to December 31, 2005 were included in the review. The period from 1996 to 2005 was selected because this 10-year period of time was quite enough to provide significant information for studying the recent trend of foodborne disease outbreaks in the HKSAR. In addition, it was known that any official statistics prior to 1996 needed extra manpower and time for collection from the DH database. As there was no definite answer from the DH officers if the information prior to 1996 could be obtained within a limited time, the period from 1996 to 2005 was selected in this research study.

Details of the total annual number of foodborne disease outbreaks and victims affected, the kinds of causative agents and main contributing factors, the total annual number of deaths and hospitalizations in the outbreaks for all foodborne disease outbreaks during the 10-year period were provided by the DH (DH 2006) (Appendix A). They were extracted, analyzed, interpreted and presented in the form of tables and charts.

**Comparison of Foodborne Diseases and Preventive Measures in Asian Areas**

While no relevant official statistics were found from the website from the Mainland China Government, the figures of foodborne disease outbreaks in Japan, Singapore, South Korea and Taiwan were searched and used to make a comparison to that of the HKSAR because they are similarly developed as the HKSAR and have similar food consumption characteristics. Some food safety measures in Japan, Singapore and Taiwan were discussed in detailed.

**RESULTS**

**HKSAR**

**Foodborne Disease Outbreaks and Victims Affected.** The official reported foodborne disease outbreaks were generally on a rising trend for the
period from 1996 to 2005 despite the distinctive drop in 2003. There were 5,967 foodborne disease outbreaks (both confirmed and suspected) for the past 10 years (Fig. 1) (DH 2006). The median number of annual outbreaks was 597.5 (range 314–972). Every reported case was diagnosed and confirmed by medical officers of the DH. When there was no sufficient evidence to confirm the case to be a foodborne disease outbreak (i.e., when there was no stool sample, food remnant, no common food, no common food history, no common symptoms or no common onset time among victims), it would be referred as a suspected case. From 1996 to 2005, there were about 30% of the total outbreaks that came from confirmed cases, while almost 70% came from suspected cases.

Out of the 5,967 reported foodborne disease outbreaks, 26,260 victims were affected (Fig. 2) (DH 2006) in which about 44% of the total victims came from confirmed cases, while almost 56% came from suspected cases (Fig. 3) (DH 2006). The median number of victims affected per annual outbreak was 2,673.5 (range 1,829–3,542).

**Etiological Agents.** Over 80% of the confirmed outbreaks (80.5%) were due to bacterial pathogens, and the rest were due to viruses, chemicals, biotoxin and others (Fig. 4) during the period from 1996 to 2005 (DH 2006). *Vibrio parahaemolyticus* was the most common identified pathogen that accounted for more than 47% (47.04%) of the total confirmed outbreaks. Almost 25% (24.97%) of all confirmed outbreaks were caused by *Salmonella* spp.; however, no serotype of *Salmonella* was provided. Other leading pathogenic agents in total confirmed outbreaks were *Staphylococcus aureus*
Norwalk-like viruses (6.75%), clenbuterol (3.84%), ciguatoxin (3.73%) and Clostridium perfringens (0.77%). The undetermined etiological agents accounted for about 5% (5.16%) of the total confirmed foodborne disease outbreaks.

Mortality and Morbidity. The number of hospitalizations in foodborne disease outbreaks is generally decreasing during the period from 1996 to 2005. Twenty-six thousand two hundred sixty people were involved in both the
confirmed and suspected foodborne disease outbreaks, out of which 1,854 (7.06%) (range 27–232) of them were hospitalized. Almost half of the hospitalizations came from confirmed outbreaks, while another half were from suspected outbreaks. No death was reported (Fig. 5) (DH 2006).

**Principal Factors Contributing to the Outbreaks.** Inadequate cooking and contamination by raw food explained over 45% (45.66%) of the total foodborne disease outbreaks during the period from 1996 to 2005 (Fig. 6) (DH 2006). Almost 10% of the total outbreaks were caused by the presence of toxin in food. Poor personal hygiene of food handlers (6.47%) and contaminated raw food explained (6.30%) about 13% of the total outbreaks. Other factors contributed to about 31% of the total outbreaks.

**Comparison of Foodborne Diseases in Some Asian Places**

**Total Foodborne Disease Outbreaks.** Because the available official figures are not presented as incidents of foodborne disease per capita (Fig. 7), only a general comparison of the number of outbreaks among these Asian places is allowed here. According to the official statistics from 1996 to 2004, it was found that Japan (18,160, range 1,217–3,010) ranked at the top of the total number of food poisoning outbreaks (Ministry of Health, Labour and
Welfare 2005a), followed by Singapore (12,085, range 600–2,300) (approximation) (MOH 2004), the HKSAR (4,995, range 314–821) (DH 2006), Taiwan (1,915, range 150–274) (BFDA 2006) and South Korea (1,043, range 78–174) (KFDA 2005) (Fig. 7).

With reference to Fig. 7 (no per capita adjustment), while there was a distinct peak for the annual number of foodborne disease outbreaks in Japan (1998) and Singapore (2002) respectively, there was a distinct drop in Hong Kong in 2003. Although there was quite a large difference for the annual number of foodborne disease outbreaks between Japan and Singapore from Welfare 2005a), the HKSAR (4,995, range 314–821) (DH 2006), Taiwan (1,915, range 150–274) (BFDA 2006) and South Korea (1,043, range 78–174) (KFDA 2005) (Fig. 7).

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From 1996 to 2001, the gap diminished and nearly overlapped each other for the years 2003 and 2004. The annual number of foodborne disease outbreaks in South Korea and Taiwan was found to be relatively stable and low as compared to other places, while that in the HKSAR was always in the median position among the others.

**Etiological Agents.** Because not much information on etiological agents for foodborne disease outbreaks in South Korea (KFDA 2005) and Singapore (MOH 2004) were found, for all outbreaks with known causes, comparison could only be made among the HKSAR, Taiwan and Japan.

With reference to Fig. 8, the total number of reported foodborne diseases due to *V. parahaemolyticus* from 1996 to 2004 in Japan (3,637, range 108–839) (Ministry of Health, Labour and Welfare 2005a) was higher than that of Taiwan (810, range 52–160) (BFDA 2006). There were 2,310 reported total outbreaks caused by *V. parahaemolyticus* from 1996 to 2005 in Hong Kong (DH 2006). Although Japan ranked at the top for *V. parahaemolyticus* among the HKSAR and Taiwan, *Salmonella* was the major etiological agent for foodborne disease outbreaks within the territory of Japan (4,372, range 225–825) from 1996 to 2004; it was followed by *Campylobacter jejuni* (3,761, range 65–558), *V. parahaemolyticus* (3,637, range 108–839), small round-structured virus (1,576, range 116–278) and *Escherichia coli* (1,516, range 45–285) (Ministry of Health, Labour and Welfare 2005a).

![Fig. 8 A comparison of the number of reported foodborne disease outbreaks due to specific etiological agents from 1996 to 2004 between Japan and Taiwan (Ministry of Health, Labour and Welfare 2005a; BFDA 2006)](image-url)
On the other hand, *V. parahaemolyticus* was the major etiological agent among all the reported food poisoning outbreaks in Hong Kong (2,310) from 1996 to 2005 and in Taiwan (810) (BFDA 2006) from 1996 to 2004. It then came into sequence by *S. aureus* (986), *Salmonella* (943) and ciguatoxin (376) in the HKSAR (DH 2006).

While *Salmonella* was the major etiological agent for foodborne disease outbreaks within the territory of Japan from 1996 to 2004, it (68, range 4–11) was only the fourth leading etiological agent in Taiwan during the same period. *S. aureus* (95, range 3–22) and *Bacillus cereus* (81, range 4–15) were the second and third leading etiological agents in Taiwan, while *E. coli* (2, range 0, 1) came as the seventh (BFDA 2006).

Apart from bacterial etiological agents, nonbacterial etiological agents were also the causes of foodborne disease outbreaks. From 1996 to 2004, for known sources of nonbacterial etiological agents, there were only 13 outbreaks in Taiwan and 75 in Japan because of chemicals, 58 outbreaks in Taiwan and 1,017 outbreaks in Japan because of natural toxins (Ministry of Health, Labour and Welfare 2005a; BFDA 2006) (Fig. 8).

**Type of Food Establishments Involved.** Because no such official statistics was provided by the DH of the HKSAR or the Singapore Government, the comparison could only be made among Japan, South Korea and Taiwan (relevant figures for South Korea covers 2001–2005, while those of Japan and Taiwan included 1996–2004).

With reference to Fig. 9, for the known sources of foodborne disease outbreaks, restaurants were found to be the place where the majority of

![FIG. 9 TYPES OF FOOD ESTABLISHMENT INVOLVED IN FOODBORNE DISEASE OUTBREAKS IN JAPAN AND TAIWAN FROM 1996 TO 2004 (MINISTRY OF HEALTH, LABOUR AND WELFARE 2005a; BFDA 2006)](image-url)
foodborne disease outbreaks happened from 1996 to 2004 in both Japan (4,108, range 357–502) (Ministry of Health, Labour and Welfare 2005a) and Taiwan (773, range 47–127) (BFDA 2006). Domestic outbreaks were the second commonest location of foodborne diseases in these places (Japan: 2,637, range 144–580; Taiwan: 356, range 17–65) (Ministry of Health, Labour and Welfare 2005a; BFDA 2006).

According to Fig. 10, catering (226) was the place where the majority of foodborne disease outbreaks happened in South Korea for the period from 2001 to 2005; restaurant (197), school (168) and domestic outbreaks (35) followed correspondingly (KFDA 2005).

Among all the known sources of foodborne disease outbreaks, restaurants, home, schools and catering sectors were all within the top four food establishments involved in the foodborne disease outbreaks among Japan, South Korea and Taiwan. Although the figures available in South Korea cover only 2001–2005, it showed that the number of annual outbreak in each type of food establishment did not exceed two digits, while it was not uncommon to notice there were always hundreds of annual outbreaks in each food establishment in both Japan and Taiwan.

**Incriminated Foods Involved in Foodborne Disease Outbreaks.**
Because no such official statistics was provided by the DH (DH 2006) of the HKSAR, Singapore Government (MOH 2004) or South Korea (KFDA 2005), the comparison could only be made between Japan and Taiwan.

**FIG. 10 TYPES OF FOOD ESTABLISHMENT INVOLVED IN FOODBORNE DISEASE OUTBREAKS IN SOUTH KOREA FROM 2001 TO 2005 (KFDA 2005)**

<table>
<thead>
<tr>
<th>Food Establishment</th>
<th>Number of Outbreaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catering</td>
<td>226</td>
</tr>
<tr>
<td>Restaurant</td>
<td>197</td>
</tr>
<tr>
<td>School</td>
<td>168</td>
</tr>
<tr>
<td>Home</td>
<td>35</td>
</tr>
</tbody>
</table>

![Diagram showing number of foodborne disease outbreaks in South Korea from 2001 to 2005](attachment://foodoutbreaks.png)
With reference to Fig. 11, for the known sources of foodborne disease outbreaks, seafood was found to be the source for the majority of foodborne disease outbreaks from 1996 to 2004 in Japan (1,623 range 139–251) (Ministry of Health, Labour and Welfare 2005a). The second major source for foodborne disease outbreaks within the territory in Japan was processed seafood products (990, range 7–20); it was followed by complex food (i.e., cooked food with several ingredients) and vegetables and processed vegetable products (Ministry of Health, Labour and Welfare 2005a). In Taiwan, complex food was the incriminated food for the majority of foodborne disease outbreaks from 1996 to 2004 (119, range 6–21); seafood (81, range 3–19), meat and poultry (20, range 0–7), and vegetables/fruit and their processed products (18, range 0–8) followed correspondingly (BFDA 2006).

Among all the known sources of foodborne disease outbreaks, fresh seafood, processed seafood products, complex food and vegetables/fruits and their products were the leading incriminated foods involved in the foodborne disease outbreaks in both Japan and Taiwan. In addition, “vegetables/fruits and their processed products” were in the fourth position in both Japan and Taiwan.

**DISCUSSION**

**Study Limitations**

Before the start of the proposal, several letters and emails were written, and many phone calls were made to the persons in charge in the DH and in Information Services Department of the HKSAR, urging for providing relevant
local statistics and information as the secondary source of data. At last, five sets of data were obtained (DH 2006) (Appendix A). In further studies, more analysis and interpretation on the association to each factor could be carried out if the incriminated food items, the types of food establishments involved, the causative agents, the contributing factors, the number of victims affected and hospitalizations in each reported foodborne disease outbreak are available.

The statistics of foodborne diseases in Japan, Singapore, South Korea and Taiwan were searched and used to make a comparison to that of the HKSAR because they were all similarly developed and had similar food consumption characteristics. The official statistics on foodborne diseases available from the official websites of Japan and Taiwan (Ministry of Health, Labour and Welfare 2005a; BFDA 2006) were found to be more comprehensive than those of the HKSAR (DH 2007a). Limited statistics on foodborne disease outbreaks from the official website in the HKSAR may hinder the local public from having a higher alertness on foodborne disease outbreaks. Besides, comprehensive statistics on an infectious disease like foodborne disease outbreaks could be helpful in predicting the next epidemic trend and in organizing better food safety promotion programs at local and international levels.

Most of the official statistics in other Asian places were searched from the Internet. Further information and better elaboration could have been done if more time and resources were allowed for searching data overseas. No relevant official statistics was found from the website from the Mainland China Government. Limited official information on Singapore was available from the Singapore government website (MOH 2004). For South Korea, simple figures on foodborne diseases were found from the official website (KFDA 2005). Some emails were sent to the government of South Korea; however, no reply was received.

**Health Education in the HKSAR**

The DH and FEHD are the departments for the Health, Welfare and Food Bureau of the HKSAR. The Central Health Education Unit (DH 2007b) operates under the DH, while the Risk Communication Section, the Communication Resource Unit (FEHD 2006d) and the Health Education Exhibition and Resource Centre (FEHD 2006e) work under the FEHD to provide education on food safety, personal and environmental hygiene to the local public.

Despite the fact that these departments have been launching many varieties of food safety promotion activities and campaigns via posters, pamphlets, bulletins, forums, exhibition boards, “roadshows,” video tapes and CDs, and have been disseminating health messages through website, television and radio announcements, group visits, school talks, hotline, roving exhibition and media interviews to the public (FEHD 2002a,b, 2003, 2004, 2005b, 2006f;
DH 2007c, d), there is still an upsurge of the number of foodborne disease outbreaks in the HKSAR.

Foodborne Disease Outbreaks and Victims Involved

Because the available official figures on foodborne disease outbreaks were not population adjusted (Fig. 7), it allows only a general comparison among some Asian places. The low reported number of foodborne diseases in South Korea and in Taiwan may just be because of lower population in these places, or it may reflect there is a high standard for food hygiene in the country, or it may just underestimate the number of outbreaks because of an incomplete reporting system for foodborne diseases. The higher number of reported foodborne disease outbreaks in Japan may also be due to the fact that there is an exceptionally strong public health surveillance program. In further studies, formal application for the relevant figures from these authorities will allow a better analysis and elaboration.

When the number of foodborne disease outbreaks in the HKSAR was generally on a rising trend from 1996 to 2005, it was on a falling trend in Japan since 1998 (Fig. 7). The policies of the preventive measures on foodborne disease outbreaks in Japan may be a good reference to the local policy makers in food safety. It is worth trying to establish some official food safety tours to learn and inspect the food safety policies in Japan so that applicable reform could be made to the local food safety promotion programs. The distinctive drop in both the number of total foodborne disease outbreaks and victims involved in 2003 in the HKSAR (Fig. 7) may be because fewer people dined out during the infection by SARS (DH 2003) in that year.

Nevertheless, the reported foodborne disease outbreaks in this review most likely have underestimated the true number. This is because foodborne outbreaks caused by an etiological agent with a shorter incubation (e.g., bacteria, toxins) are usually more easily recognized than those with longer incubation (e.g., Hepatitis A) (Daniels et al. 2002, p. 627), which may usually go undetected eventually. The number may be further underestimated because not all people will report their illness in minor cases of foodborne diseases. In some cases where there is inadequate collection of data, poor recall on food history, lack of stool sample, food remnant or environmental swabs, confirmation of these outbreaks becomes more difficult. This makes the number of reported food poisoning outbreaks lower than expected.

Health Implications on Results of Etiological Agents and Contributing Factors

Eating Habits of Hong Kong People. The eating habits of Hong Kong people are changing over time. There are many varieties of cuisines available
from thousands of food premises throughout this metropolitan city. The most common traditional Chinese cuisine found in the HKSAR refers to Canton-style dishes. Conventional Chinese food is always cooked and served hot; therefore, it may be less liable to foodborne disease outbreaks. A fusion of the local culture with foreign cultures has introduced the idea of eating raw seafood food like sushi and sashimi to Hong Kong people in the past decades. Although there is no concrete evidence to relate this change of eating habit to the increasing trend of foodborne diseases in the HKSAR, *V. parahaemolyticus*, which is usually found in contaminated seafood, accounts for almost half of confirmed foodborne disease outbreaks during the period of 1996–2005 (DH 2006).

**Dominant Etiological Agents and Contribution Factors.** *V. parahaemolyticus* and *Salmonella* were found to be within the top four causative agents among the HKSAR (DH 2006), Japan and Taiwan (Ministry of Health, Labour and Welfare 2005a; BFDA 2006) (Fig. 8). These dominant causative agents may be due to similar eating habits in these different places in which the underlying factors in these areas need further researches. The findings will be particularly useful not only to the prevention and monitoring of foodborne disease outbreaks in these Asian places, but also to the developing countries such as Mainland China and India where there are relevant low food safety standards. Because these two causative agents explained over 70% of total local confirmed foodborne disease outbreaks from 1996 to 2005, while inadequate cooking and contamination by raw food accounted for over 45% of the total outbreaks (DH 2006), it may imply that the current local food safety promotion where general food safety promotion programs are given needs to be modified. It is reasonable to expect that the foodborne disease outbreaks in the HKSAR could be significantly reduced if the food safety promotion programs could target these dominant risk factors. Better elaborations could have been obtained if the incriminated food, the types of food establishment involved, the number of victims affected and hospitalization could be taken into consideration.

**Recommendations.** Targeted preventive protection against the dominant etiological agents includes strengthened legislation on the wholesome sources of seafood supplies (e.g., enforced provision of official health certificates from the country of origin and the maintenance of the filter systems in fish tanks), reinforcement in inspection and prosecution for unwholesome fish supply and fish tank water by the official health inspectors, strengthened liaison and communication with the Mainland authorities so as to effectively control the distribution of problematic food from the origin, extensive food tests by the local authorities (e.g., tests for fish tank water, enhanced food
sampling), effective recall systems for problematic foods, crisis management plans for massive foodborne disease outbreaks and intensification of the legislation on environmental protection (e.g., proper discharge of sewage).

Targeted preventive education on *V. parahaemolyticus*, *Salmonella* and *S. aureus* includes publicizing proper food preparation and food handling in seafood, especially shellfish; thorough cooking of seafood and maintenance of filter systems for fish tank water; encouragement of application of egg powder or eradicated eggs for making dishes or dessert containing raw egg; good personal, food and environmental hygiene; proper storage condition and temperature; their acute symptoms (e.g., salmonellosis), chronic sequelae and their economic impact. Above all, enhanced education for morality (Chen 2006, p. 560) should be the paramount education where self-discipline, self-cultivation and conscience can ensure “good farming practices,” wholesome food sources, good personal and food hygiene from farm to fork.

It is definite that food safety practices are somehow associated with the local culture, value, norm and behavior in a population. A very common phenomenon in the local market is the practice of the sale and purchase of the exposed cooked food such as “siu-mei” and “lo-mei” (i.e., barbeque food). Official food safety education should be therefore started earlier in school-age children from the kindergarten level. Some proper food safety concepts such as the association of food with food safety and health rather than with taste or other factors should be consolidated in the younger generation by formal education. The Education and Manpower Bureau should incorporate the local food authorities to launch some formal curriculums in food safety, food and personal hygiene.

On the other hand, it is not possible to rectify some improper food safety practices in adult groups by merely food safety cognitive education. Under such circumstances, more concentration should be made on the impact of foodborne disease outbreaks. Although there was no local death report for foodborne disease outbreaks for the past 10 years, the consequences of foodborne diseases should never be underestimated. For domestic foodborne disease outbreaks, the costs for medical consultation, absence for work and school, discomfort, sickness and chronic sequelae would influence each of the family members especially the vulnerable ones (e.g., babies and the elderly). For commercial outbreaks, not only a massive outbreak may occur, but also the reputation of the business would be inversely affected. In serious cases, money compensation and court cases are inevitable. The food handlers involved and other employees may even suffer the risk of unemployment!

**Introduction of Risk Perception on Food Safety.** Although knowledge is a prerequisite to food safety practices, it does not in itself guarantee the
implementation of safe food preparation and handling practices. It is observed that most of the food safety education activities provided to the general public is confined to a provision of cognitive knowledge and information by the government in a one-way direction. It is quite a different strategy from that taken in some European countries (EC 2006), in which the public’s risk perceptions are considered and applied before the formulation of prevention and control measures for food safety.

According to another research study in the investigation of the factors underlying consumers’ implementation of specific food safety practices, social cognition models (i.e., the theory of planned behavior and the health belief model), which have been a success in explaining and predicting some health-related behaviors such as smoking, diet and exercise, were applied to determine the beliefs, attitudes and knowledge of consumers toward food safety (Clayton et al. 2003, pp. 434, 435). The results show disparities between the consumers’ knowledge of specific hygiene practices and their implementation of these practices. Its suggestions in measures of perceived behavioral control, perceived barriers and perceived risk in food safety are also new and applicable intervention materials for the local policy makers in food safety.

Undetermined Etiological Agents. The undetermined etiological agents contributed to about 5% (5.16%) of the total confirmed local foodborne disease outbreaks (DH 2006). Unlike Japan and Taiwan, where there were figures on nonbacterial etiological agents like chemicals and natural toxins available on the Internet, no relevant data were provided by the DH of the HKSAR. It is a fact that a series of problematic foods such as pesticide residues in fresh vegetables (FEHD 2006b) and malachite green in fish (FEHD 2006a) have caused the public to panic. Because of the fact that almost 10% of the total outbreaks were caused by the presence of toxin in food (DH 2006), food safety education on “good farming practices,” “code of practice” and “environmental protection” should be introduced at farm levels. It is also important to strengthen the liaison and communication with the Mainland authorities (FEHD 2007b) so as to effectively control the distribution of problematic food from the origin and to introduce a better understanding of environmental protection to farmers and the adjacent industries.

The statistics in the HKSAR did not show if there was more than one etiological agent or contributing factor in each single foodborne disease outbreak. A better analysis could have been made if data were given to relate the etiological agent with the number of hospitalizations and victims affected, the contributing factor, the incriminated food and the type of food establishment involved in each single foodborne disease outbreak.
Health Implications on Types of Food Establishment Involved and Incriminated Food

Among all the known sources of foodborne disease outbreaks, restaurants, home, schools and catering sectors were all within the top four food establishments involved in the foodborne disease outbreaks among Japan, South Korea and Taiwan (Figs. 9 and 10). Although there were no relevant statistics given by the local health authority, they are also believed to be the common food establishments involved in the local foodborne disease outbreaks.

The existing local system of official inspections to licensed food premises by health inspectors in the HKSAR is entirely based on the concept of good manufacturing practices under the departmental guidelines of the FEHD. It is time for the department to introduce a proactive idea (Rooney et al. 2004, p. 433) of the Hazard Analysis Critical Control Point (HACCP) into the practice in the local food industries. The HACCP plan shares the similar idea in this article where the food safety control in the food industries is focused on some identified critical control points rather than on a general quality assurance control so as to effectively prevent foodborne disease outbreaks. It is certain that more tailor-made strategies of food safety promotion could have been designed for different types of food establishments if the relevant official statistics could have been provided (e.g., different strategies to Cantonese-style food establishments, Western-style food establishments and Thai-style food establishments).

Among all the known sources of foodborne disease outbreaks, it would easily be understood that fresh seafood or processed seafood products occupied the majority of the foodborne disease outbreaks in both Japan and Taiwan (Fig. 11) because they were highly perishable foods. Nevertheless, it was surprising to realize that “vegetables/fruits and their processed products” were in the same leading position (i.e., the fourth) in both Japan and Taiwan (Fig. 11) because they were regarded as low-risk foods as compared to other foods with high protein contents.

Although no relevant statistics were given by the local health authority, it is reasonable to believe that the situation is similar in the HKSAR. The gap here suggests that food safety education should be emphasized on “good farming practices” and the accumulative harmful effects on overuse of pesticides at farm levels, and on good personal hygiene and hygienic food handling of food handlers. A close liaison with the food authorities from Mainland China, an effective announcement and recall system are also important preventive protection measures to problematic foods.

A better descriptive analysis could have been made if the figures on the incriminated food vehicles and the types of food establishments had been
obtained and had been related to the etiological agents, the contributing factors, the number of hospitalizations and victims affected in each outbreak.

**Measures on Food Safety**

It is clear that if some proactive food safety measures are started from the origin of the food chain and are associated with a comprehensive system on food sampling and food surveillance, investigating each foodborne disease outbreaks and launching health education on food safety and personal hygiene, foodborne disease outbreaks can be effectively controlled.

The Centre for Food Safety is a new branch under the FEHD that offers a variety of services including food import control and export certification, food surveillance, investigation of food complaints and foodborne disease outbreaks, risk assessment studies on food safety, risk communication and health education activities on food safety (FEHD 2007b). The safety of food is governed by Chapter 132 of the Public Health and Municipal Services Ordinance (FEHD 2005c).

Nevertheless, the HKSAR can learn some effective food safety measures from other Asian places. While there is no restriction on the importation of genetically modified food and the corresponding labeling regulations in the HKSAR, measures are strengthened (Ministry of Health, Labour and Welfare 2005b) for importation of genetically modified food items as food or animal feed in Japan. Food labeling regarding food allergies and genetically modified foods have also been established in Japan. In Singapore, the importation of chilled shucked raw oysters, chilled cockle meat, chilled cooked prawn/shrimp and chilled crab meat is prohibited (AVA 2006a), whereas there is no special legal restriction for importation of any seafood or seafood products into the HKSAR provided they are wholesome. A shellfish sanitation program practiced in Singapore for importation of live oysters may also be introduced to the HKSAR so as to safeguard the public health (AVA 2006a). Moreover, the Veterinary Public Health Laboratory in Singapore provides food inspection services and laboratory testing services to support food safety monitoring and surveillance programs (AVA 2006b). Clearly, this one-stop service is more effective than that in the HKSAR, where the samples taken by the FEHD are sent to other government agents (e.g., the Government Laboratory and the Institute of Pathology) for testing.

It is well known that the majority of food, especially fresh food, is supplied and imported from Mainland China to the HKSAR. Food importation in Japan (Ministry of Health, Labour and Welfare 2005c) and Singapore (AVA 2006c) also occupies more than 60 and 90% of the total food supply, respectively. In response to the recent local food safety crises, which were
mostly related to the supply of fresh food from Mainland China, the food surveillance in the HKSAR should be strengthened at import level. Crisis management planning (USFDA 2004) on food safety problems should also be well prepared so that prompt actions could be taken the next time we are faced with a food safety crisis.

CONCLUSIONS

The ascending trend in the number of local foodborne disease outbreaks and the victims involved may remind us it is time to reform the local food safety promotion programs. In lieu of the conventional food safety promotion programs executed by the local food and health authorities, it has been suggested that they should target some dominant risk factors from the local outbreaks and should introduce risk perception on food safety with the goal to effectively compact the local outbreaks.

ACKNOWLEDGMENT

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APPENDIX A

Information and figures provided by the Department of Health.

<table>
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<tbody>
<tr>
<td>Confirmed</td>
<td>93</td>
<td>107</td>
<td>129</td>
<td>194</td>
<td>234</td>
<td>214</td>
<td>283</td>
<td>158</td>
<td>165</td>
<td>252</td>
</tr>
<tr>
<td>Suspected</td>
<td>221</td>
<td>257</td>
<td>448</td>
<td>344</td>
<td>384</td>
<td>457</td>
<td>387</td>
<td>264</td>
<td>656</td>
<td>720</td>
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<tr>
<td>Total</td>
<td>317</td>
<td>364</td>
<td>577</td>
<td>538</td>
<td>618</td>
<td>671</td>
<td>670</td>
<td>422</td>
<td>821</td>
<td>972</td>
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Total no. of persons affected in food poisoning outbreaks reported to DH

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<tbody>
<tr>
<td>Confirmed</td>
<td>980</td>
<td>998</td>
<td>1,421</td>
<td>1,570</td>
<td>1,177</td>
<td>1,292</td>
<td>1,137</td>
<td>995</td>
<td>831</td>
<td>1,241</td>
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<tr>
<td>Suspected</td>
<td>849</td>
<td>902</td>
<td>1,590</td>
<td>1,248</td>
<td>1,275</td>
<td>1,415</td>
<td>1,503</td>
<td>1,235</td>
<td>2,300</td>
<td>2,301</td>
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<tr>
<td>Total</td>
<td>1,829</td>
<td>1,900</td>
<td>3,011</td>
<td>2,818</td>
<td>2,452</td>
<td>2,707</td>
<td>2,640</td>
<td>2,230</td>
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Causative agents of food poisoning outbreaks reported to DH

<table>
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<tr>
<th>Causative agents</th>
<th>No. of outbreaks (confirmed)</th>
<th>No. of outbreaks (suspected)</th>
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<tbody>
<tr>
<td><em>Vibrio parahaemolyticus</em></td>
<td>857</td>
<td>1,453</td>
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<tr>
<td><em>Salmonella</em> spp.</td>
<td>455</td>
<td>488</td>
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<tr>
<td><em>Staphylococcus aureus</em></td>
<td>141</td>
<td>845</td>
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<tr>
<td>Norwalk-like viruses</td>
<td>123</td>
<td>244</td>
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<tr>
<td>Clenbuterol</td>
<td>70</td>
<td>0</td>
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<tr>
<td>Ciguatoxin</td>
<td>68</td>
<td>308</td>
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<tr>
<td><em>Clostridium perfringens</em></td>
<td>14</td>
<td>104</td>
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<tr>
<td>Others</td>
<td>94</td>
<td>704</td>
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<tr>
<td>Total</td>
<td>1,822</td>
<td>4,146</td>
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Total no. of deaths and hospitalizations in food poisoning outbreaks reported to DH

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</thead>
<tbody>
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<td>Confirmed outbreaks</td>
<td>Deaths</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
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<td>Hospitalizations</td>
<td>151</td>
<td>163</td>
<td>86</td>
<td>120</td>
<td>105</td>
<td>79</td>
<td>73</td>
<td>53</td>
<td>48</td>
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<tr>
<td>Suspected outbreaks</td>
<td>Deaths</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td></td>
<td>Hospitalizations</td>
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<td>107</td>
<td>232</td>
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<td>70</td>
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Main contributing factors of all food poisoning outbreaks reported during 1996–2005

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<th>Primary contributing factor</th>
<th>Percentage of outbreaks</th>
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<tr>
<td>Inadequate cooking</td>
<td>26.71</td>
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<tr>
<td>Contamination by raw food</td>
<td>18.95</td>
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<tr>
<td>Toxin in food</td>
<td>9.80</td>
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<tr>
<td>Poor personal hygiene of food handler</td>
<td>6.47</td>
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<tr>
<td>Contaminated raw food</td>
<td>6.30</td>
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<tr>
<td>Others</td>
<td>31.77</td>
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</table>
REFERENCES


