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Surveillance for foodborne disease outbreaks in China, 2003 to 2008

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ABSTRACT

Knowledge of implicated food vehicles and contributing factors derived from foodborne disease outbreak (FBDO) investigations allows consumers to be educated on decreasing high-risk behavior to reduce the risk of being affected by foodborne diseases. Food safety regulatory authorities also need summary of outbreak data, as these data indicate where the existing food supply system should be improved. To obtain information on epidemiology of FBDOs in China, FBDOs reported to the China National Foodborne Diseases Surveillance Network by 12 surveillance provinces that include 43% of the Chinese population was summarized. Between 2003 and 2008, 2795 FBDOs were reported, resulting in 62559 illnesses, 31261 hospitalizations, and 330 deaths. Outbreak size ranged from 2 to 464 cases, with a median of 14 cases. The outbreak rate had decreased from 1.37 per 1 million population in 2003 to 0.46 per 1 million population in 2008. Of the 2176 outbreaks with a single known etiology, bacteria (1051 outbreaks, 48%), man-made chemical hazards (550 outbreaks, 25%), and animal and plant toxins (536 outbreaks, 25%) were the main courses. Only one outbreak was caused by virus. Of the 1930 outbreaks with a single commodity, plant-based foods were the most common reported (930 outbreaks, 48%), followed by animal-based foods (590 outbreaks, 31%). Outbreaks most frequently occurred in private residences (32%), workplace cafeterias (21%), and restaurants (17%). The most common factor reported in the 2190 outbreaks with known contributing factors were improper cooking (510 outbreaks, 23%), contaminated ingredient (503 outbreaks, 23%), cross contamination (475 outbreaks, 22%) and improper storage (295 outbreaks, 13%). It is considered that FBDOs continue to be an important public health problem in China.

1. Introduction

Foodborne disease is a significant public health concern in both developed and developing countries. Although the disease is usually mild and self-limiting, due to the high number of individuals affected each year, foodborne disease exerts a substantial socio-economic burden on the population and healthcare system. In the USA, foodborne disease causes about 47.8 million illnesses, 127839 hospitalizations, and 3037 deaths per year (Scallan, Griffin, Angulo, Tauxe, & Hoekstra, 2011). In Australia, foodborne gastroenteritis causes an estimated 5.4 million illnesses, 14700 hospitalizations, and 76 deaths each year (Hall et al., 2005). In England and Wales, foodborne gastroenteritis caused an estimated 2.4 million illnesses, 21138 hospitalizations, and 718 deaths in 1995 (Adak, Long, & O'Brien, 2002). A study of acute gastrointestinal illness (AGI) in China estimated 209 million episodes of foodborne disease occurred in 2010–2011, and the relative incidence in China appears to be within the range of incidence reported in the above-mentioned countries (Chen et al., 2013). However, the method used to estimate the burden of foodborne disease in the United States, England and Wales and Australia was different from that in China. In the above-mentioned studies, pathogen-specific data were used to calculate the foodborne proportion of AGI. However, due to the lack of pathogen-specific data used to calculate the foodborne proportion of AGI, the Chinese study only used the

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foodborne proportions calculated by those studies to roughly estimate the foodborne disease in China.

Cases of foodborne disease are typically under-reported by traditional surveillance, which needs cases to present to the healthcare system. Only a small part of foodborne diseases, hospitalizations, and deaths happen as portion of identified outbreaks (Dewey-Mattia, Roberts, Vieira, & Fullerton, 2016). However, the outbreak report is essential for a better understanding of the epidemiology of foodborne diseases. Although the summary of the outbreaks cannot lead to a clear conclusion of the disease trend, by identifying the implicated food vehicles and contributing factors, the health administration could be encouraged to evaluate and adopt suitable measures to prevent and control outbreaks in the future. Knowledge of implicated food vehicles and contributing factors allows consumers to be educated on decreasing high-risk behaviors, thereby reducing the risk of being affected by foodborne diseases. Up to date outbreak data can help food safety regulatory authorities to identify problems in the existing food supply system. Several countries systematically review foodborne disease outbreaks (FBDOs) in order to develop strategies to reduce the disease burden (Dalton et al., 2004; Gould et al., 2013; Lindqvist, Andersson, de Jong, & Norberg, 2000; O'Brien, Elson, Gillespie, Adak, & Cowden, 2002).

The formation of a set of reporting, investigation and analysis system with high efficiency is essential to the efficient management and minimization of foodborne disease. The primary source of information relating to foodborne disease in China mainly captures information on outbreaks, although occasionally information on sporadic illnesses was collected. Before the establishment of the National Foodborne Diseases Surveillance Network (NFDSN), there had been no systematic collection of detailed and standardized information on FBDO in China. Previous summaries of data reported to the China NFDSN were published for 1992–2001 (Liu, Chen, Wang, & Ji, 2004), 2003 (Liu, Chen, Fan, & Wang, 2006), 2004 (Chen, Liu, Fan, & Wang, 2008), 2005 (Liu, Chen, Guo, & Wang, 2008), and 2006 (Chen et al., 2010). The objective of this study was to summarize epidemiologic data on FBDOs reported to the China NFDSN between 2003 and 2008.

2. Materials and methods

2.1. Outbreak definition

A FBDO is defined as the occurrence of $\geq$2 cases of a similar illness resulting from the ingestion of the same type of food, or if the food vehicle was undetermined, sharing a common meal or food facility (Wu, Wen, Ma, Ma, & Chen, 2014). *Food poisoning diagnostic criteria are mainly based on epidemiological survey data, the incubation period and the unique clinical features of the patients, while the aim of laboratory diagnosis is to determine the cause of poisoning* (Ministry of Health of the People's Republic of China, 1994). Outbreaks that did not meet these criteria were not reported to the NFDSN by surveillance provinces.

2.2. Data source

To better understand foodborne disease epidemiology in China, China National Center for Food Safety Risk Assessment (previously known as the Food Safety Section of the National Institute for Nutrition and Food Safety, Chinese Center for Disease Control and Prevention) established the NFDSN in 2001 in 13 surveillance provinces. Since 2003, surveillance provinces began reporting FBDO data to the NFDSN through the web-based National Food Safety Surveillance Information System. According to the Food Safety Law of the People's Republic of China issued in 2009, a national food safety risk surveillance system that includes foodborne disease surveillance was built. Since then, foodborne disease surveillance had expanded to the entire nation, and the work of NFDSN was shifted to the new system. Thus, the research period of this study was limited to 2003–2008.

Between 2003 and 2008, outbreak reports were available from 12 surveillance provinces including Beijing, Neimenggu, Jilin, Shanghai, Jiangsu, Zhejiang, Fujian, Henan, Hubei, Guangdong, Guangxi, and Chongqing. In 2006, the surveillance provinces represent about 43% of the Chinese population (1314 million). Information collected for each outbreak included reporting province, date of illness onset, incubation period, number of cases, hospitalizations and deaths, etiology, suspected food vehicle, setting of food preparation or consumption and contributing factors.

2.3. Food vehicle classification

Food vehicles were coded into four levels of classification. Level one foods include animal-based foods, plant-based foods, other foods, mixed dishes, multiple foods, and unknown. Level two breaks the foods into a second level, such as animal-based foods, divided into aquatic products, dairy and dairy products, egg and egg products, meat and meat products, and other animal-based foods. Level three breaks the foods into a third level, such as aquatic products, divided into crustacean, fish, molluscs, etc. Level four breaks the foods into a fourth level, such as crustacean, divided into crayfish, lobsters, crabs, etc.

2.4. Statistical analysis

Data were entered into Microsoft Access and analysed in Excel 2010. The per capita rate of FBDOs during 2003 and 2008 was calculated for each province by using population data from the National Bureau of Statistics of China. We used 2006 population as the denominator since it was in the middle of the study period (National Bureau of Statistics of China, 2007).

3. Results

3.1. Time and province of outbreak

Between 2003 and 2008, a total of 2795 FBDOs were reported, which resulted in 62559 illnesses, 31261 hospitalizations, and 330 deaths (Table 1). Reports of outbreaks peaked in 2003 (772 outbreaks), falling to 262 outbreaks in 2008, with an average annual number of 466. The average annual rate of outbreaks and cases was 0.8 and 18.4 per 1 million population, respectively. Outbreaks are markedly seasonal, peaking in warmer months (Fig. 1). The seasonal trend of microbial outbreaks was similar to that of FBDOs, but other causes of outbreaks did not have such seasonal trend.

Province-specific rate of outbreaks and cases ranged from 0.2–3.1 and 7.1–51.9 per 1 million population, respectively (Table 2). Guangxi, Hubei and Zhejiang recorded the highest number of outbreaks during the six-year period; the average number of outbreaks per 1 million population by province for the six-year period was highest in Beijing, Guangxi and Shanghai (Table 2). No outbreak occurs in multiple provinces was reported.

3.2. Etiologic agent

A total of 2227 (80%) outbreaks had a known etiology and these outbreaks accounted for 79% (49422/62559) of illnesses (Table 3). Of the 2176 outbreaks with a single known etiology, bacterial disease was responsible for 48% (1051/2176) of outbreaks, 66% (31810/48044) of cases and 6% (18/299) of deaths (Table 3). Of the 2176