Taiwan Epidemiology Bulletin

Biweekly May 3 , 2011/ Vol.27 / No.9

Salmonella Food Poisoning Outbreak at a School in Kaohsiung County in 2010

Tzu-Fen Chen, Min-Nan Hung, Su-Hua Huang ,Mei-Man Hsu, Hui-Chen Lin, Chi-Chuan Huang, Chao-Ching Chang, Li-Jen Lin

Fifth Branch, Centers for Disease Control, Taiwan

Abstract

From the dawn of July 5, 2010, many students at School X began having food poisoning-like symptoms, such as fever, nausea, vomiting, abdominal cramps, and diarrhea. In order to find out the source of this food poisoning outbreak, as well as to provide preventive recommendations, we conducted a retrospective outbreak investigation on students and employees who were at school on the day before the outbreak.

This study was based on self-reported questionnaires. The response rate was 93.3% (475/509). The analysis of data (male 462, female 13) showed the range of age is from 18 to 33, and the median is 19. There were 64 people matched with the case definition, and the main clinical symptoms were as follows: fever (n=54, 84.4%), abdominal cramps (n=48, 75%), headache (n=40, 62.5%), diarrhea (n=24, 37.5%), nausea (n=17, 26.6%), chills (n=15, 23.4%), and vomiting (n=12, 18.8%).

After analyzing the three meals they had on July 4 (the date before onset), statistically significant association appeared between food poisoning and these dishes – Malar Cake for breakfast, steamed egg custard with dried bonito flakes and popcorn chicken for lunch, and crisp fried pig's ears for dinner. *Salmonella* was isolated from the leftovers of steamed egg custard with dried bonito flakes and cabbage with bacon. Besides, 24 people had isolated *Salmonella* from rectal swab among 29 symptomatic individuals. According to the symptoms, incubation time, and laboratory findings, we infer that the steamed egg custard with dried bonito flakes for lunch was the main source of this *Salmonella* food poisoning outbreak.

Keywords: food poisoning, Salmonella, eggs, egg products

The Taiwan Epidemiology Bulletin series of publications is published by Centers for Disease Control, Department of Health, Taiwan (R.O.C.) since Dec 15, 1984.
Publisher : Feng-Yee Chang
Editor-in-Chief : Min-Ho Lai
Executive Editor : Li-Gin Wu, Hsiu-Lan Liu
Telephone No : (02) 2395-9825
Address : No.6, Linshen S. Road, Taipei, Taiwan 100 (R.O.C.)
Website : http://teb.cdc.gov.tw/
Suggested Citation :
[Author].[Article title].Taiwan Epidemiol Bull 2011;27:[inclusive page numbers].

Introduction

Salmonella is a type of gram negative bacteria; the optimal temperature for *Salmonella* to grow and multiply is 37℃. They are frequently found in humans' and animal intestinal lumens; and they infect humans by fecal-oral transmission or contaminated food, particularly meats and egg products [1]. The incubation time of *Salmonella* food poisoning is about 5-72 hours, usually 12-36 hours [2], the symptoms, like diarrhea, abdominal cramps, chills, fever, nausea, and vomiting, are not obvious until ingested bacteria is more than 10^6-10^8 [3]. The mechanism of disease development is due to the synergistic effect of large amount of bacteria and the released endotoxin [4]. The living bacteria ingested by humans through food cause inflammation in digestive tract and release of endotoxin which increases the body temperature by destroying the body temperature regulatory system, accelerating peristalsis in digestive tracts, and then leading to vomiting and diarrhea [3]. Therefore, high fever and bacteremia are also clinical symptoms along with acute gastroenteritis.

Previous studies showed egg products are the most frequent source among *Salmonella* food poisoning outbreaks [5]. In 1986 and 1987, *Salmonella* caused 65 food poisoning outbreaks in the northeast of the United States. Among the 35 confirmed food sources, 77% are related to egg products [6]. In 1992, a British study pointed out *Salmonella* bacteria can be isolated from egg yolk [7]. The egg may be contaminated by infected hens fed with *Salmonella*-contaminated feed. Japanese studies in 2009 showed *Salmonella* can be isolated from 1.7% eggs treated with Pasteurization [8-9].

In the ranking of food poisoning cases in different countries, Salmonellosis is No.1 in the United States, No.2 in Japan (only next to *Vibrio parahaemolyticus*), and No.4 in Taiwan (next to *Vibrio parahaemolyticus*, *Staphylococcus aureus*, and *Bacillus cereus*) [10-12].

Event Background

Before the food poisoning outbreak at School X was reported on July 5, 2010, there were 509 students having meals together on July 4. Several dozens of people fell sick from the dawn of July 5. Their main symptoms were fever, headache, nausea, vomiting, abdominal cramps, and diarrhea. The officers from the bureau of public health came to hospitals and the school to collect rectal swab specimens and leftovers for bacterial test immediately after receiving the notification on July 5. Officers from CDC Fifth branch joined in this epidemiological survey at School X on July 6. Due to the fact

that the outbreak occurred at a boarding school, it is necessary to determine the source of this food poisoning outbreak, and prevent similar outbreaks from happening in the future.

School X has two campuses. There are offices for teachers and school officials on the first campus, and classrooms and dorms for students on the second campus where the outbreak occurred. The total number of students on the second campus is around 1,600. Most of them are males. Students have to live in the dorms and dine in the student restaurant except on weekends. The school kitchen served foods in metal buckets, which the senior students helped putting in the allocated food serving area. All students lined up to get food in the area. Students had their own eating areas but no assigned tables.

The food poisoning outbreak occurred on Sunday (July 4). Most of cases were new students registered on June 30. New students were asked to live in the dorm and to dine at school for orientation on July 3-4, with no exception. From the dawn of July 5, many students began having the above symptoms. On July 6, there were more than 70 students having been to the school's clinic, GanShan Armed Forced Hospital, and other hospitals near the school. Some of them were required to be hospitalized because of serious symptoms. A large number of cases were new students.

Environmental Survey

We investigated the hygiene in the kitchen at School X including the display and cleanness of kitchenware, the sources of foods, the storage methods of foods, the way to prepare foods, separated areas of cooked and uncooked foods, the way to clean tableware, dining schedules, kitchen workers' health conditions and management.

Epidemiological Investigation

A. Subjects：509 students including new students and returning students at School X on July 3 and July 4.

B. Methods：The study was a retrospective outbreak investigation based on self-report questionnaires including demographic data (name, age, sex, units/troops), symptoms, the date and the time of onset, medical treatments, and dishes served on July 4.

C. Case definition：Anyone dining at school on July 4 and having diarrhea (at least twice a day) or fever, abdominal cramps during the period of July 4 to July 6, as well as having one of the following symptoms: chills, nausea, vomiting and headache, is viewed as a case.

D. Data analysis：The distribution of demographic data and symptoms were analyzed by descriptive statistics. The relative risks with 95% CI of each risk factor (food item) were calculated.

Laboratory Findings

There were two categories of samples taken from humans and leftovers:

A. Human specimens include: (1) Rectal swabs of patients and kitchen helpers were sent to South Regional Laboratory of Research and Diagnostic Center, CDC, to isolate *Vibrio cholerae*, *Vibrio parahaemolyticus*, *Shigella*, *Salmonella*, *Staphylococcus aureus*, and *Bacillus cereus* ; (2) Blood cultures of some people

admitted at hospitals; (3) Kitchen workers' stool specimens were sent to KunYang laboratory, Research and Diagnostic Center, CDC for testing of Rotavirus and Norwalk virus.

B.Only leftovers from lunch and dinner on July 4 were sent to Taiwan Food and Drug Administration for testing of pathogenic *Escherichia coli*, *Salmonella*, *Vibrio parahaemolyticus*, *Bacillus cereus*, *Staphylococcus aureus*, and enterotoxin.

Results

A. Environmental survey

The school kitchen had screened windows and doors. The sanitation was acceptable, but there were a few flies. The food-chopping area was an outdoor space. The cooking area was clean, but there were puddles of water on the floor. In addition, food containers, such as metal buckets, plates, and pots, were carefully washed and air dried. Students' plates were treated with heat sterilization before use. However, the refrigerator temperature controller and the defrosting regulator were unstable. There were 4 cooks and 8 kitchen helpers working in the kitchen. All workers wore plastic caps and plastic gloves while working. No kitchen workers had hand wounds, but they did not cut their nails regularly.

B. Questionnaire analysis

Our dataset mainly from 475 valid questionnaires among 509 responses included 462 (97.3 %) males and 13 (2.7 %) females. The range of age was between 18 and 33, and the median was 19. During the period of July 4 to July 6, symptoms occurred in 70 (14.7%) people in different levels; 51 people went to hospitals. The hospital visit rate was 72.9%. Sixty-four people fit in with the case definition. The attack rate was 13.5% (64/475).

The main clinical symptoms of 64 cases are fever (n=54, 84.4%), abdominal cramps (n=48, 75%), headache (n=40, 62.5%), diarrhea (n=24, 37.5%), nauseas (n=17, 26.6%), chills (n=15, 23.4%), and vomiting (n=12, 18.8%). Fifty-one people were hospitalized. The hospitalization rate was 79.7%. The duration of recovery in most patients was 4-7 days. Only one female with a *Salmonella* positive result from blood culture had serious symptoms and bacteremia, but she fully recovered after 12 days.

The participants in this survey were 475 students including 185 returning students and 290 new students (Males 277, Females 13) registered on June30. The analyzed demographic data showed 6 returning students and 58 new students (Males 49, Females 9) were cases (Table 1). The attack rate of new students (20%) was higher than that of returning students (3.2%). In addition, the attack rate of females (69.2%) is higher than males (11.9%).

Table 1. Demographic analysis（n=475）

Items	Ill (n=64)	Not Ill (n=411)	Attack Rate %	*P* value
Status				
New students (M=49, F=9)	58	232	20	<0.001
Returning students (M= 6,F=0)	6	179	3.2	
Sex				
Females	9	4	69.2	<0.001
Males	55	407	11.9	

The incubation time calculated using breakfast, lunch and dinner on July 4 as exposure time was shown in Table 2. Among 64 cases, only 54 people remembered the exact time of onset. We created an epidemic curve using lunch time (12 p.m.) as the start point (Fig). The epidemic curve showed few cases appeared from 6 p.m. on July 4 and there was a peak between 12 a.m. and 3 a.m. on July 5.

Because all students in this outbreak dined at school for three meals, we compared the incubation time of common food poisoning pathogens and assumed all dishes served on July 4 as suspicious sources for analysis. The results showed the dishes with statistically significant differences were as follows: Malar cake, steamed egg custard with dried bonito flakes, popcorn chicken, assorted rice noodles, crisp fried pig's ears, pork rib soup with corn, and fries (Table 3). Assorted rice noodles for lunch, pork rib soup with corn and fries for dinner are statistically protective factors; Malar cake for breakfast, steamed egg custard with dried bonito flakes and popcorn chicken for lunch, crisp fried pig's ears for dinner are food poisoning related risk factors.

C. Laboratory findings

Among 55 human rectal swabs for bacterial tests, 24 specimens (82.8%) were *Salmonella* positive (23 were *Salmonella* group 09, 1 was *Salmonella* group 08) from 29 symptomatic individuals, the other 26 specimens from asymptomatic kitchen workers were negative. In addition, 5 specimens from hospital patients in GanShan Armed Forces Hospital were *Salmonella* positive (4 rectal swabs and 1 blood culture were all *Salmonella* group 09). All 9 stool specimens were negative for virus testing.

Table 2. Comparison of the incubation times using breakfast, lunch, and dinner on July 4 as exposure time

Time	Median (hr)	Mode (hr)	Mean (hr)	Range (hr)
Breakfast 06:00	25.8	30	27±8.5	12-57
Lunch 12:00	19.8	24	21±8.5	6-51
Dinner 18:00	13.8	18	15±8.5	0-45

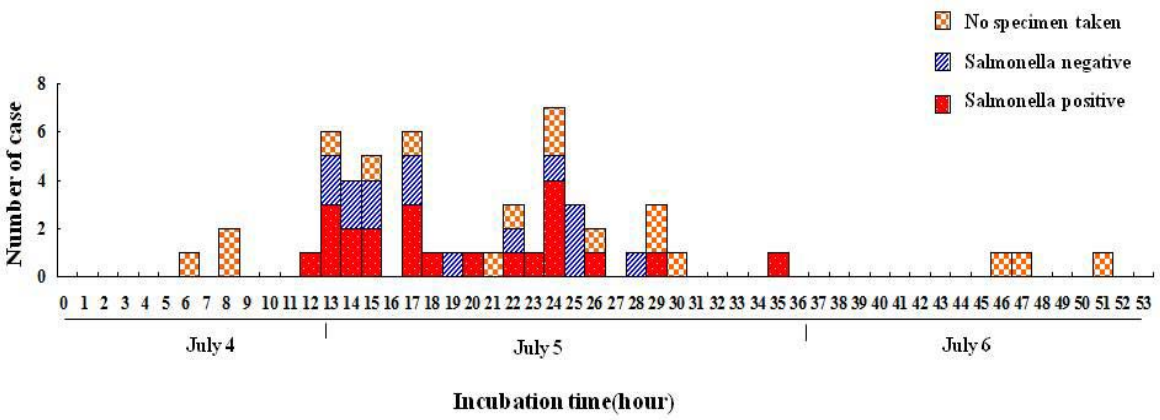

Fig. Epidemic curve illustrating the incubation time of the infection（N=54）

Note: Set lunch time (12 o'clock) on July 4 as the exposure time.

Table 3. Single-variable analysis of the food poisoning outbreak for all dishes served on July 4 at School X

Food item	Ate		Did not eat		Relative risk	95% Confidence interval	*P* value
	Ill	Not ill	Ill	Not ill			
Breakfast (n=433)							
Egg porridge w/ corn	10	240	12	171	0.61	0.251~1.406	0.231
Poached egg	15	343	7	68	0.45	0.167~1.081	0.080
Garlic stir-fried cabbage	18	354	4	57	0.74	0.237~2.218	0.532
Pickled cucumber	11	225	11	186	0.83	0.351~1.950	0.663
Peanut egg crisp	8	203	14	208	0.60	0.240~1.426	0.234
Malar cake	17	226	5	185	2.66	1.008~7.686	0.040*
Congee	9	170	13	241	0.98	0.410~2.348	0.966
Milk	19	274	3	137	3.03	0.921~10.886	0.054
Milk tea	14	279	8	132	0.84	0.339~2.022	0.678
Lunch (n=474)							
Roasted chicken drumstick	52	330	12	80	1.04	0.536~2.060	0.886
Steamed egg custard with dried bonito flakes	56	308	8	102	2.12	1.069~5.026	0.029*
Popcorn chicken	54	296	10	114	1.91	1.024~4.224	0.039*
Assorted rice noodles	17	164	47	246	0.59	0.301~0.978	0.040*
Cabbage with bacon	55	353	9	57	0.99	0.462~2.106	0.973
Fish sticks	30	181	34	229	1.10	0.658~1.893	0.683
Dinner (n=474)							
Crispy chicken chop	53	329	11	81	1.16	0.593~2.373	0.630
Milk tea	55	350	9	60	1.04	0.492~2.231	0.904
Crisp fried pig's ears	47	237	17	173	1.85	1.121~3.635	0.018*
Pork rib soup with corn	18	205	46	205	0.44	0.219~0.698	0.001*
Stewed pork ball in brown sauce	37	215	27	195	1.21	0.730~2.117	0.423
Fries	50	361	14	49	0.55	0.250~0.941	0.030*
Fried rice with eggs and tomato	22	153	42	257	0.89	0.506~1.530	0.650
Garlic stir-fried cabbage	49	336	15	74	0.76	0.383~1.352	0.305

Note: * means p<0.05.

Among 11 leftovers, 2 were *Salmonella* positive (*Salmonella* group 09). These were steamed egg custard with dried bonito flakes and cabbage with bacon for lunch.

Discussion

This was a diarrheal outbreak occurring in a boarding school. Because School X had regular water examinations, and not everyone at school was suffering from diarrhea, we excluded water as a possible source of the outbreak.

The symptoms among infected individuals were fever (84.4%), abdominal cramps (75%), headache (62.5%), diarrhea (37.5%), nausea (26.6%), chills (23.4%), and vomiting (18.8%). There appeared to be a high proportion of cases with fever (84.4%). The incubation time of the infection was 6-51 hours. The recovery period was 4-7 days. According to the epidemic curve (Fig), the number of cases rose abruptly and fell

slowly. Therefore, the source in this outbreak was a point source. The population at risk was exposed in a short period of time. Although the wide range of incubation time (6-51 hours) made the peak unapparent in the epidemic curve, the incubation time among all cases with *Salmonella* positive results was concentrated in 12-36 hours, which fit the incubation time of *Salmonella* (6-72 hours, but usually 12-36 hours) [2]. In addition, *Salmonella* group 09 was detected from both human specimens and leftovers. There was a case with bacteremia, which is a typical characteristic of Salmonellosis. Based on the incubation time of the infection, the symptoms, the recovery period, the food sources, and the laboratory findings, we concluded this outbreak was a *Salmonella* food poisoning outbreak.

Moreover, demographic analysis (Table 1) showed new students, especially females, were at increased risk. All 13 female students (9 were cases) in our study were new students registered on June 30. However, the causation of increasing risk in new students and, females were not clear. A possible reason might be that new students had weaker immune responses because they needed to adapt to a new environment. But we believed the difference between the occurrence of *Salmonella* food poisoning among new students and that among returning students was a result of unanalyzed confounding factors. Our assumption was supported by the difference in eating time and tables between new students and returning students. For example, the batch of foods and food containers were different between new students and returning students. We need more detailed information for further studies.

Table 3 shows possible food sources among dishes served on July 4. The usual incubation time for *Salmonella* infection (12-36 hours) [2] and types of contaminated food were used to estimate possible food sources. The incubation time (Table 2) calculated from breakfast was too long to fit that for *Salmonella* infection, and Malar cake was a cooked food which is less suspicious. Therefore we excluded breakfast foods as risk factors.

According to laboratory findings, the type of *Salmonella* isolated from steamed egg custard with dried bonito flakes and from cabbage with bacon were the same as isolated from human specimens. Previous studies also pointed out egg products as a large proportion of food sources in *Salmonella* food poisoning [5]. On the basis of statistical analysis (Table 3) and laboratory findings, the steamed egg custard with dried bonito flakes served for lunch on July 4 was the main source in this outbreak. Although cabbage with bacon was also contaminated by *Salmonella*, there was no significant difference in the statistical analysis. The leftovers of cabbage with bacon may have been contaminated while officers collected or transported samples. In our study, we used leftovers as the food samples. Using food scraps instead of leftovers would have been good way to improve the representation of food samples and to avoid cross-contamination.

The food ingredients used in the school kitchen were bought daily on workdays from non-staple Food Supply Station, which is one of the markets for military only, but workers

have to buy foods for weekends in advance on Friday. Therefore, the food ingredients used on July 4 were prepared on July 2. We found that the eggs they purchased were level 1 eggs, which have lower prices. In Taiwan, eggs were divided into three levels depending on cleaning methods, and the price reflects the quality: Level 1 eggs are sold in traditional markets. The eggs were simply washed by egg producers and then shipped out. Level 1 eggs have the lowest price, but contain a lot of residual bacteria. Level 2 eggs are washed eggs sold in boxes in supermarkets. The eggs are washed by water, detergents, or bactericides, and then boxed. The prices of Level 2 eggs are moderate. Level 3 eggs are eggs with "CAS" sign. The raising management of chicken, the sanitation of poultry farms, residual drugs among egg products, and pathogen examinations are all guaranteed. Eggs are packed by different grades after passing examinations. Due to their higher quality, Level 3 eggs have the highest price.

The shell of the eggs is easily contaminated with pathogens, such as *Salmonella*, by feces or environment after the eggs are laid [2]. If eggs are not adequately cooked or heat-treated, they are likely to be contaminated with *Salmonella* by food processing, food preparation, or food storage. According to the investigation, prepared foods were stored in metal buckets at room temperatures and were taken to the restaurant from the kitchen an hour before the food was served. From the time when the food was finished cooking to when the students began eating, the prepared food was at room temperatures at least 1-2 hours. The sultry weather in summer (the highest temperature was 30℃) and the incompletely cooked egg products or meat dishes, allowed bacteria to easily multiply, which lead to food poisoning.

Conclusions and Recommendations

After the investigation conducted by the bureau of public health, the outbreak was determined to be related to the inadequate food storage, the incompletely cooked foods, and the cross-contamination between the raw foods and the cooked foods. We recommend educating all food handlers about the importance of food preparation, food contamination sources, and food storage, and to establish standard food operating procedures in the kitchen.

First, thoroughly cook all food products that are derived from animal sources, particularly egg products, poultry, and meat dishes to kill bacteria. The internal temperature should be kept at 60℃ for 20 minutes or 65℃ for 3 minutes during cooking. Second, only purchase fresh foods. Third, store foods below 4℃ or above 63℃. The best control measure is to store foods at low temperature, because room temperature (18-25℃) is the best condition for *Salmonella* to multiply. Fourth, process raw foods and cooked foods separately. Fifth, ask food handlers to wash hands after touching the egg shells, and to avoid contaminating foods with contaminated hands directly or indirectly. Lastly, avoid recontamination within the kitchen after cooking is completed by separating food-preparing-routes or storage space for raw foods.

In the United States, *Salmonella enteritidis* is the main cause of bacterial food

poisoning, and eggs are the main sources of *Salmonella enteritidis* infection. The US FDA announced on September 8, 2009 that farmers have to implement the preventive measures of *Salmonella enteritidis* infection from egg laying, egg storage, to transportation, on Federal Register [13]. The farmers were also asked to register at FDA to show they do follow the preventive measures. Through implementing of these measures to lower the risk of exposure to *Salmonella enteritidis* contaminated eggs, the FDA expects to reduce the disease and the deaths caused by *Salmonella enteritidis*.

The number of food poisoning outbreaks caused by *Salmonella* has been continuously increasing in our country, and problems of drug-resistant bacteria should be stressed [14-16]. In order to prevent *Salmonella* from contaminating foods, particularly animal derived foods, we suggest health authorities cooperate with agricultural authorities. Local health authorities should control the place of origin of food sources that lead to food poisoning outbreaks. Educate the public to avoid consuming raw or incompletely cooked eggs, and to avoid using dirty or cracked eggs. Washed eggs are best. In order to avoid cross-contamination, Level 1 eggs should be completely washed before food preparation.

In addition, agricultural authorities should set up rules about sanitation for poultry farmers and egg producers. For example, eggs should be completely cleaned and disinfected before being shipped out. And the prevalence of *salmonella*-carrying chicken should be reduced to prevent the three main sources of *Salmonella* food poisoning: infected living animals, contamination during slaughter, and recontamination after cooking.

Acknowledgements

We are thankful to the assistance and support from Chiou-Yueh You, Fifth Branch of TCDC and the officers at the Pharmaceutical Affairs and Food Safety Section, and the Disease Control Section, the Health Bureau of Kaohsiung County Government throughout the study.

References

1. Pan TM, Wang GR. Salmonella and food poisoning. Taiwan Epidemiol Bull 1998;14:196-207.
2. Kang JJ, Chien CS, Chen HF, et al. Food poisoning prevention in warm weather: Salmonella. Food and Drug Consumer Newsletter 2010;241:2-3.
3. Murray PR, Rosenthal KS, Kobayashi GS, et al. Salmonella. In: Chen HY, Wang SY, Li SY, Eds., Medical Microbiology 4th ed. Taipei: Yi Hsien, 2005;273-5.
4. Murray PR, Drew WL, Kobayashi GS, et al. Medical Microbiology. London: CV Mosby Co,1990;109-12.
5. Braden CR. Salmonella enterica serotype Enteritidis and eggs: a national epidemic in the United States. Clin Infect Dis 2006; 43:512-7.
6. St Louis ME, Morse DL, Potter ME, et al. The emergence of grade A eggs as a major source of *Salmonella enteritidis* infections: new implication for the control of salmonellosis. JAMA 1988; 259:2103-7.

7. Richard JG. Food Hygiene in Relation to Foodborne Microbiology Pathogens. Public Health Laboratory: London, 1992;14-20.
8. Hara-Kudo Y, Takatori K. Microbial quality of liquid egg and salmonella infection status in Japan. Shokuhin Eiseigaku Zasshi 2009; 50:34-40.
9. Suzuki H, Mazmaru E, Yamane M, et al. Detection of Salmonella from raw meats and feces of food handlers in Koto-Ku. Food Sanitation 1989; 40:721-8.
10. The Food News Website, Food and Drug Administration (TFDA) Department of Health, Executive Yuan, R.O.C. – Records of food poisoning in Taiwan,1981 -2008. Available at: http://food.doh.gov.tw/FoodNew/MenuThird.aspx?SecondMenuID=34&ThirdMenuID=95
11. Lee CL, Chiou SY, Tsai JL. An investigation of bacterial food poisoning in Taiwan, 1996-2002. Taiwan Epidemiol Bull 2003;19:587-94.
12. Jing DD, Hsu CH, Lu YC, et al. A series of Salmonella food poisoning outbreaks occurred at one international-class hotel in Taichung City, Taiwan. Taiwan Epidemiol Bull 1999; 15:187-96.
13. Food and Drug Administration, HHS. Prevention of Salmonella enteritidis in shell eggs during production, storage, and transportation. Final rule. Fed Regist 2009;74(130):33029-101.
14. Lauderdale TL, Aarestrup FM, Chen PC, et al. Multidrug resistance among different serotypes of clinical Salmonella isolates in Taiwan. Diagn Microbiol Infect Dis 2006; 55: 149-55.
15. Matsushita S, Kudoh Y. Recent trend of Salmonella food-poisoning and serovars and drug-resistance of Salmonella isolates in Japan. In: lrimajiri S, Saito M, Nakaya R, Eds., Infection Enteritidis in Japan II. Saikon: Japan, 1997;131-40.
16. Matsushita S, Yamada S, Inaba M, et al. Serovar distribution and drug resistance of Salmonella isolated from imported and domestic cases in 1980-1989 in Tokyo. J Japn Asso Inf Dis 1992; 66: 327-39.

A Report of the Contingency Procedures and Effectiveness of the “1922 Disease Reporting and Consultation Service Center” During the H1N1 Influenza Pandemic

Mei-Chen Peng[1], Li-Li Ho[1], Shih-Hao Liu[1], Fa-Wei Tang[2], Su-Jane Shiue[3], Shu-Min Chang[3]

1.Public Relations Office, Centers for Disease Control, Taiwan
2.Epidemic Intelligence Center, Centers for Disease Control, Taiwan
3.Taoyuan Customer Service Center, Chunghwa Telecom

Abstract

A 24-hour, toll-free infectious disease consultation hotline-1922- has been operated by Taiwan CDC since 2004. This special telephone line provides services for disease reporting, consultation and propagation of disease prevention policies, and has

participated in several severe disease epidemics during the past 7 years. Help-seeking and consultation telephone calls reached the highest peak during H1N1 influenza pandemic. Thus, an analysis of the contingency procedures and responses of customer service personnel at the 1922 service center during H1N1 pandemic (from April 1, 2009 to March 31, 2010) provides an important reference for improving the services.

13,291 person-times (average 37 person-times per day) had been invested in 1922 service center and 130,778 calls had been serviced. Among these calls, 109,308 calls (83.6%) were direct dials of this toll-free number and 21,470 calls (16.4%) were transferred from Taiwan CDC. 125,159 calls (95.7%) were answered directly by 1922 online service staffs and 5,619 (4.3%) were transferred to Taiwan CDC for appropriate services. In addition, 2,603 people (0.2%) terminated their calls without completing the consultation. H1N1 influenza ranked the highest among the diseases for which help or consultation was sought (96,190 calls, 73.6%). We also analyzed the content of all questions about H1N1. 76.7% of all calls responded via the interactive voice response system pertained to requests about facilities providing H1N1 vaccination service, while 47.6% calls responded by a customer service representative pertained to the seeking of H1N1 influenza-related information. Furthermore, 57.3% of calls transferred to CDC were related to vaccination. Six waves of survey on public satisfaction with the 1922 service center were conducted, and the average level of satisfaction was over 70%.

In our investigation, consultations or assistance requests about infectious diseases to the hotline tend to dramatically increase during certain disease epidemics or any sudden event. Via this hotline, people may obtain disease information and questions may be clarified timely. This service has been contracted to a private telephone company and, thus, sufficient customer service staffs were recruited promptly and were trained with professional knowledge for a pandemic. This system decreases the strain on CDC's human resources and reduces the chances of CDC's phone lines being overwhelmed with requests from the public and thus not able to meet the demand of daily disease control work. Our investigation has confirmed that the "1922 disease reporting and consultation service center" provides an important service in disease prevention.

Keywords: H1N1 influenza, 1922 disease reporting and consultation service center, customer service consultation, transferred requests

Introduction

In recent years, "call center" has been applied for public health use. People may request infectious disease information and ask questions or make a complaint. Correct and proper answers by customer service staffs, good service manners, use rates and customer satisfaction levels were important indexes for service effectiveness. The Centers for Disease Control of R.O.C. (hereafter Taiwan CDC) launched the "1922 disease reporting and consultation service center" (hereafter 1922 service center) on February 17, 2004. Requests for infectious disease information or

consultation are met through call center method. In the meantime, infectious disease prevention information is also provided by interactive voice response (hereafter the voice system). This research analyzes the effectiveness of this service as a reference for further improvement.

The National Cancer Institute, USA, launched telephone and internet services in 2002 for patients and medical staffs to request health information about tobacco hazard, cancer and so on. A nation-wide satisfaction survey was conducted in 2003. 95% of participants were satisfied with this service and 88% were able to have their questions answered. Over 800,000 people had used this service from 2003 to 2008. The 1922 service center has been operated by Taiwan CDC since 2004 and has played an effective role in infectious disease prevention [1-5]. In 2009, an H1N1 epidemic was recorded in New Jersey State, and a call center was set up by the local public health authorities and medical facilities to provide correct information about the H1N1 situation. American Academic of Disaster Medicine has indicated that this method is effective in meeting public requests and has recommended the use of this service for disease reporting on a national scale [6-7]. The Hong Kong government established an “1823 comprehensive service hotline” in 2001 to offer services from 14 government departments. On average, about 300,000 calls and 3,000 e-mails are received monthly in this center, and 95% of the callers were able to have their requests answered immediately. Fax, internet and mail are also available. Furthermore, people may leave messages and wait for a reply. Satisfaction rates and calling rates are high; however, training of customer service staffs and prompt updates of related information are the main areas for improvement [8].

The Ministry of Health of the People’s Republic of China set up a “12320 national public health telephone line” in 2005. The service items include: reporting of a public health event, complaining of contingency event, promotion of infectious disease prevention, and health consultation. At present, this service is only available in 6 provinces or cities (Beijing City, Shanghai City, Jiangsu Province, Hebei Province, Fujian Province and Jilin Province). Bureau of Public Health, Beijing City, has combined its public complaining line, public service line and disease prevention consultation line within the 12320 center. This system provides 24-hour service and on average manages 1,500 to 20,000 calls per month. A satisfaction survey was conducted one year after this system established, and the satisfaction rate was 99.2%. More and more people acknowledge this system, and the number of consultations is increasing. However, there is a pressing need to increase the sufficiency of professional knowledge and communication skills of the customer service personnel. Thus, the center has cooperated with other personnel training facilities and universities/institutes for further in-service training of their customer service staffs. In Jiangsu Province, the 12320 center received 31,828 calls from January 2007 to October 2009 and served during the H1N1 influenza pandemic, high pathogenic avian influenza (HPAI) epidemic, hand-foot-and-mouth disease, and San Lu milk powder event.

However, a province-wide survey revealed several problems, including: (1) Jiangsu residents still did not fully understand the 12320 service system; (2) customer service staffs were not medical professionals and thus unable to answer questions about clinical treatment; and (3) high turnover rates of customer service staffs [9-12].

This study investigates the operation of the 1922 service center in response to the H1N1 influenza pandemic and analyzes relevant data to serve as references for improving customer service capacities, utilization rates of 1922 and service quality for future disease epidemics.

Scope of Service

1922 service center provides information about disease prevention and assistance with managing disease situations to the public. Service items include: reports of disease, consultations on infectious disease, disease prevention education and recommendations, receiving and communicating with individuals about their complaints, gathering feedback on policy efficacy, and providing a point of contact for contingency events. 1922 service is a 24-hour, toll-free hotline and provides service in 4 languages (i.e. Mandarin, Taiwanese, Hakka, and English) for public consultation. People may also select a preferred language for health education information, such as knowledge and prevention of dengue fever or enterovirus infection in the voice system.

Customer service staffs are able to answer common questions and to give proper health education. However, the staffs are not professional disease prevention personnel and may be under high pressure when carrying out these tasks. Thus, when encountering a call that requires access to the communicable disease reporting system or needs a professional explanation on relevant policies or disease control measures, this call may be transferred to the local branch office of Taiwan CDC in the caller's city of residence.

Contingency Measures

A. Hardware supply of 1922 service center: Taiwan CDC contracts Chunghwa Telecom for 1922 service. The service center is a branch unit of Chunghwa Telecom in Taoyuan area. During the H1N1 pandemic, 1922 service center continued training of staffs and drafted plan of additional hardware supply in response to the increasing telephone inquiries. This plan was activated when over 1,000 calls were transferred to customer service staffs within a period of 24 hours. This plan included scheduled expansions of electrical and voice systems, monitoring and testing of internet ability, and additional software and hardware supply. Northern, central and southern customer service centers of Chunghwa Telecom were also on standby for further service if necessary.

B. Training and supply of human resources

a. Increased reserved human resources and training: In order to respond to the pandemic situation, Taoyuan Customer Service Center of Chunghwa Telecom

had recruited 19 reserve staffs from May 2009 to February 2010. Each reserve staff member received 40 hours of disease prevention course and 8 hours of 1922 onsite practice. In addition, Chunghwa Telecom also recruited staffs for further H1N1 education. In all, 245 staffs accomplished this 40-hour H1N1 prevention course.

b. Support of Taiwan CDC personnel to 1922 service center: From November 13 to 16, 2009, Taiwan CDC sent 13 disease prevention personnel to 1922 service center to assist in public consultations. The CDC officer in charge of 1922 service was also stationed in the center supervising all related tasks.

C. Workload dispersion

a. Voice recording system: In order to handle heavily increasing telephone inquiries, information about disease prevention policies, such as the starting date of H1N1 vaccination, the prioritization of vaccination target groups and medical facilities providing vaccination, was per-recorded in the voice system. Eleven messages about H1N1 were recorded from May 2009 to March 2010. The voice system may only record the number of times with which each voice option is selected and is unable to record the total number of telephone calls. The number of times with which each option of the H1N1 voice system service was selected is listed in Table 1.

b. Recording and updating introductory messages in the voice system: The pre-recorded introduction in the voice system provided an opportunity for health education before a caller selected a voice system option or chose to be connected to a customer service

Table 1. Number of times with which each option of the H1N1 voice system service was selected, May 2009 to March 2010

category	Option	No.	%
Vaccine	Prioritization of H1N1Vaccination target groups	9,996	(23.8)
	Starting date of H1N1innoculation	883	(2.1)
	Medical facilities offering H1N1inoculation	20,972	(50.0)
	Group H1N1 inoculation facilities in each County	326	(0.8)
Disease	H1N1information	3,152	(7.5)
	Clinical symptoms and transmission routes of H1N1	3,123	(7.4)
	Level of disease alert of H1N1	213	(0.5)
Class suspension	Notice of Class suspension at schools during H1N1 pandemic	115	(0.3)
	Criteria of Class suspension during H1N1 pandemic	655	(1.6)
Examination	Medical facilities offering the rapid influenza diagnostic test	1,886	(4.5)
Treatment	Tamiflu use	618	(1.5)
Total		41,939	(100)

representative. Six messages of H1N1-related information were pre-recorded in the introduction to enhance the public's knowledge of disease prevention measures implemented by the government.

c. Expanding the electrical system: 1922 service system originally kept 2 trunks and was able to receive 60 calls at the same time. In accordance to the increasing severity of the H1N1 pandemic, another 2 trunks requested by Taiwan CDC were put into operation and monitored. The average usage of these trunks was 5.6% monthly.

d. Publication of H1N1 Q&A: The Public Relations Office of Taiwan CDC and 1922 service center compiled a document with 58 commonly asked questions and answers in the 4 areas of H1N1 vaccination, vaccination target groups, charges for vaccination and H1N1 prevention and uploaded this document to the official website of 1922 service.

D. Enhanced management

a. Sending messages: In order to inform the competent unit in Taiwan CDC about public usage of the hotline during the pandemic, 1922 service center sent out text messages about the total number of calls received, calls transferred to customer service and calls transferred to Taiwan CDC as well as a brief explanation (within 72 words) of how the transferred calls were handled to responsible personnel at CDC. 3,339 messages in total were sent from November 30, 2009 to March 31, 2010.

b. Collecting daily work summary of 1922 service center: In order to understand public opinions during the pandemic, the Public Relations Office at Taiwan CDC reported the number of calls to the call center and categorized these calls under 5 topics (i.e. reporting, help-seeking, complaints, recommendations, and inquiries) during the daily morning meetings held in CDC's Command Center.

Service Efficacy Analysis

This investigation utilized information of 1922 measures and 1922 service center database, including the voice system and customer service, and downloaded related data including the serial number of each telephone call, number of voice system service offered, number of customer service offered, number of terminated calls, number of transferred calls, person-times of customer service, number of telephone calls from each County, purpose of consultation, consultation category, category classification, managing time, managing method, telephone line category and occupation category from April 1, 2009 to March 31, 2010. SAS 92 and Excel were used for statistical analysis.

A. Load analysis:

During this time frame, 130,788 calls were received in 1922 service center – with a peak of 3,2000 calls within 1 month – which was higher than the total number of calls received during the past 6

years (total 5,7000 calls) (Figure 1). H1N1 vaccine inoculation started on November 1, 2009. To encourage people to receive H1N1 vaccination, 14 million text messages were sent to the public between December 10 and 12, 2009. After H1N1 vaccine inoculation became available nation-wide on December 12, 2009, calls from the public reached the highest peak during November to December 2009. Consequently, the service ability of 1922 service center was approved and more people relied on 1922 service.

In our investigation, most calls were from the lay public (127,649 calls, 97.6%), followed by medical facility staffs (2,317 calls, 1.8%), teachers and medical staffs in schools (518 calls, 0.4%), public health facility staffs (222 calls, 0.3%), and police or fire department staffs (72 calls, 0.1%). 109,308 calls (83.6%) were direct dials to 1922 service center and others were transferred from Taiwan CDC (21,470 calls, 16.4%). It was suspected that people who called Taiwan CDC for consultation did not know about the1922 service hotline. It was necessary to analyze the calling areas in order to promote 1922 service to increase public usage.

The voice system was selected 52,123 times (average 4,313 times/month), which was higher than it was before H1N1 epidemic (648 times/month). Information of H1N1 inoculation facility was added into the voice system in December 2009, and the number of calls utilizing the voice system service was higher than that in November. This result may indicate that health education propagation by the voice system was acceptable to the lay public. Thus, adding more education propagation in the voice system during a disease epidemic to decrease the need of human resources of customer service is recommended. However, there were 2,603 terminated calls during this time frame (average 217 calls/month), which was much higher than it was before the H1N1 pandemic (24 calls/month). It was suspected

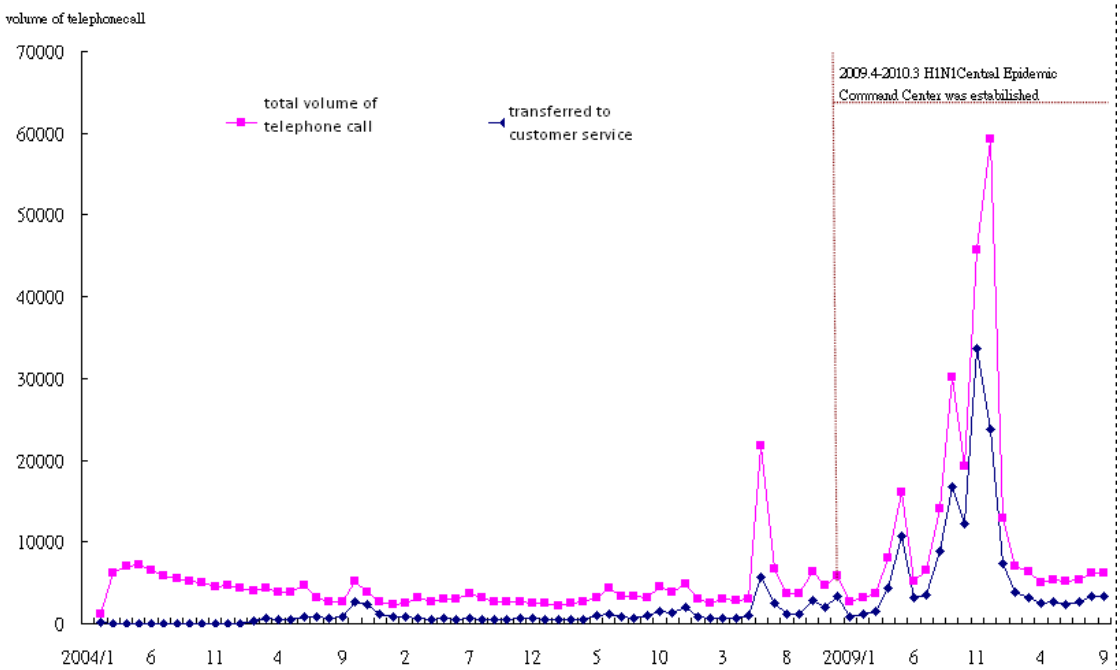

Figure 1. Total number of public calls and number of transferred calls to customer service

that the human resources of customer service were still insufficient so that people might have hung up the phone call due to long waiting time, although 120 telephone lines had been operated in 1922 service center.

125,159 calls (95.7%) were answered by customer service staffs and 5,619 calls (4.3%) were transferred to appropriate CDC offices or staffs. Average manage time of the transferred calls was 7.5 days, with the shortest time being one day and the longest time being 278 days. There were 16,810 harassing calls (12.8% of calls transferred to customer service) during this time period. Among them, 9,610 were meaningless inquiries (58%), 4,762 were terminated calls (28%), 1,415 were soundless calls (8%), and 1,063 were wrong number calls (6%) (Table 2).

B. Analysis of topics of consultations

The number times with which consultation was provided to the public regarding various diseases by the 1922 service center are listed in Figure 2. H1N1

Table 2. 1922 service provision from April 1, 2009, to March 31, 2010

		Customer human resources		Voice system	Customer service consultation			Reserve contact information	
Year	Month	(person-time)	person-time /day	(time)	Answered	terminated	%	Transferred	%
2009	4	965	32	1,601	4,320	46	(1.1)	167	(3.9)
	5	943	31	2,326	10,666	133	(1.2)	901	(8.4)
	6	979	33	1,626	4,714	26	(0.6)	412	(8.7)
	7	1,001	33	1,511	3,486	10	(0.3)	99	(2.8)
	8	1,080	36	3,353	8,857	120	(1.4)	338	(3.8)
	9	1,340	45	8,805	16,533	81	(0.5)	254	(1.5)
	10	1,326	43	5,074	12,121	104	(0.9)	223	(1.8)
	11	1,278	43	5,392	32,681	683	(2.1)	1,011	(3.1)
	12	1,366	44	20,452	23,352	898	(3.8)	1,019	(4.4)
2010	1	1,208	39	1,282	7,184	275	(3.8)	967	(13.5)
	2	854	31	316	3,698	118	(3.2)	151	(4.1)
	3	951	31	385	3,166	109	(3.4)	77	(2.4)
Total		13,291		52,123	130,778	2,603	(22.3)	5,619	(59.0)

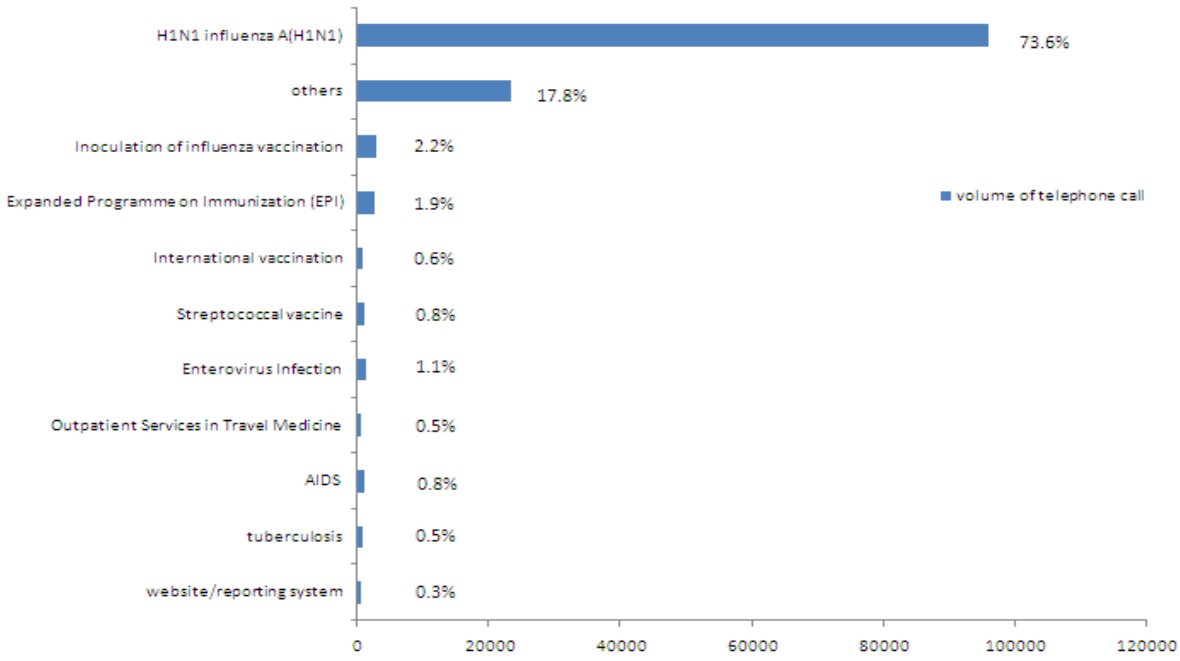

Figure 2. Top ten topics of consultation and other communicable diseases from April 1, 2009 to March 31, 2010

influenza was at the top of the list (96,190 calls, 73.6%), followed by other diseases. Topics of consultations that occupied the 3rd to the 10th places included seasonal influenza inoculation, regular inoculation, gastrointestinal viral disease, streptococcal pneumonia vaccination, AIDS, international travel inoculation, tuberculosis and communicable diseases during travelling, but they all had very low inquiring rates ranging from 2.837 to 425 calls (2.2-0.3%). Although the inquiring rates of topics from the 2nd to 10th places were much lower than H1N1 influenza, this result indicated that people did not clearly understand the diseases they inquired about, and it was recommended that Taiwan CDC enhances health education to reduce public questions.

1922 service system classified H1N1-related information requested by the public into sub-categories (132 categories), including vaccine brand, inoculation target groups, inoculation date, preserve method, vaccine complications, infectious period of H1N1, pathogen, disease definition, clinical symptoms, hospital discharge standards, critical symptoms, Tamiflu, contract medical facilities providing Tamiflu, contract medical facilities providing H1N1 inoculation, standards of class dismiss, fast H1N1 screening test, and H1N1 examination. The data were then grouped into 6 events (vaccine, disease, class dismiss, medical treatment, and other). In the voice system, most people selected vaccination information event (76.7%), in which 60% of people inquired about “contract medical facilities providing H1N1 inoculation”. Disease event was most common among people utilizing the customer service system (47.6%), followed by vaccine event (40.9%). Vaccine event had the highest transferring rate to Taiwan CDC (57.3%), followed by disease event (31.4%) (Figure 3).

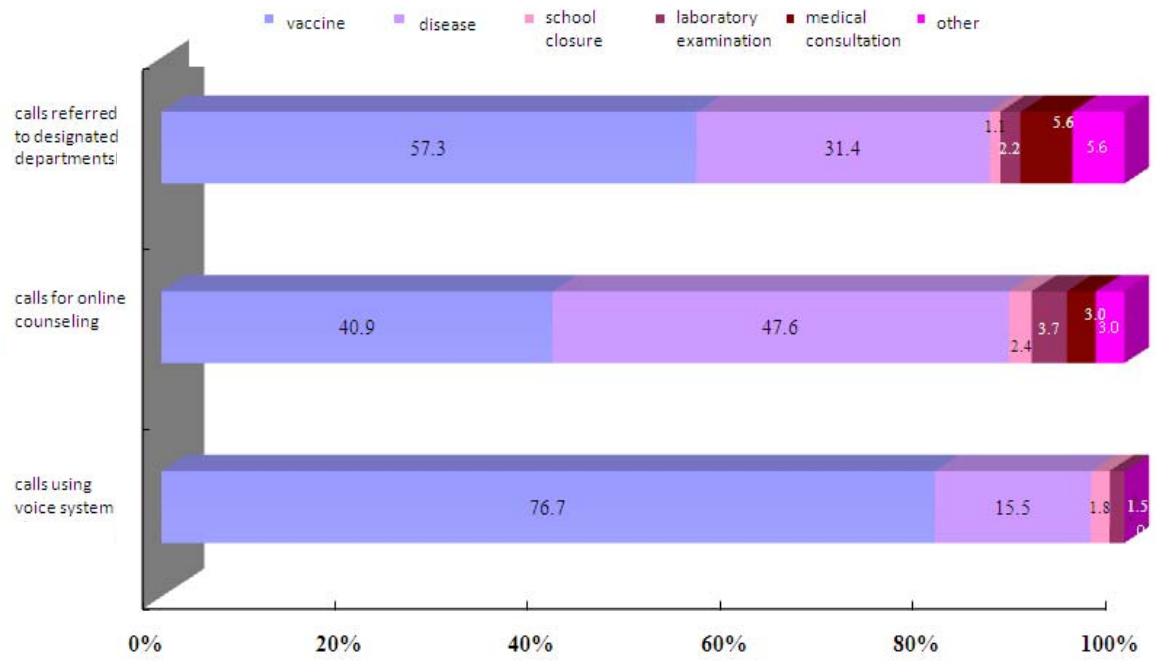

Figure 3. Percentage of 6 events of H1N1 information (disease, vaccine, class suspension, examination, medical treatment and other) in 3 systems (customer consultation, transferred to Taiwan CDC and voice system) from April 1, 2009 to March 31, 2010

Table 3. Satisfaction rate of 1922 service for each wave of public satisfaction survey

Year	Month	Valid questionnaire	Satisfaction rate (%)
2009	May	1122	72.5
	October	1123	70.8
	November	1120	81.4
	December	1127	80.7
2010	January	1135	64.3
	February	1123	70.0

Nine waves of satisfaction survey about the government's H1N1 prevention measures were conducted in this time period. Six of which investigated the satisfaction rates with the "24 hours a day, 7 days a week, toll-free 1922 reporting and consultation service," and over 70% of survey respondents approved of this service (Table 3).

Conclusion and Recommendations

A. Enhance service center ability:

Based on 1922 service center database, when people were concerned about infectious diseases, the volume of consultations or help-seeking dramatically increased. 1922 service was contracted to a private telephone company (Chunghwa Telecom) so large numbers of customer service staffs could be recruited in short time in response to a public health emergency. During the H1N1 pandemic, 13,291 person-times of customer service staffs (average 37 person-times per day) were invested in this service. However, the number of terminated calls might indicate insufficient service staffs. Continuous monitoring of the number of terminated calls and voice system service is recommended for further reference of manpower adjustment and voice system updates.

A catchphrase, "Please contact 1922 service center with any question!", was included in press releases or any promotional material issued by Taiwan CDC to inform the public about this service. However, this service had less relevance to the public's daily life and would not attract public attention when no major public health event occurred. In order to enhance public impression and to increase the usage of this service, Taiwan CDC may cooperate with local medical facilities or community organizations to promote the use of this service.

B. Enhance customer service quality:

Besides answering questions from the public, customer service staffs also served as windows of public communication. Thus, professional knowledge and image are important while most customer service staffs do not have a background in public health or medicine. During H1N1 pandemic, the Public Relations Office accepted 2 complaint cases about customer service (insufficient communication ability and unsatisfied answering about disease prevention). Improvement measures for these complain were established as follow:

1. Enhance professional knowledge and communication skill: regularly convening customer service staffs to share their experience and knowledge is important. It is also recommended for

service center to establish teaching materials for communication skills and infectious disease education. There were 16,810 harass calls (12.8%) in total. In order to avoid negative emotions and resource wasting, standard operation procedures were established, according to which customer service staff should voluntarily inform the reason for not being able to further help the caller further and tactfully notify the caller that this call will be disconnected shortly. Furthermore, an operation manual for 1922 service center should be compiled for customer service staffs to be familiar with the standard operation procedures and to enhance their confidence and ability.

2. Prompt update of information database: The customer service supervisor should review Taiwan CDC's website and other related information to renew the database and to remind other staffs of the new information through operation system. In addition, the computer system should be directly connected to Taiwan CDC's website or other related disease prevention websites for customer service staffs searching for relevant information to ensure correct answer.
3. Increase service satisfaction: During H1N1 epidemic, 6 waves of satisfaction survey about 1922 service revealed that over 70% of people were satisfied with this service. An automated customer service satisfaction survey system has been in operation since January 1, 2010, and calls from the public were transferred to this survey system after consultation service. The survey items pertain to "waiting time after connecting to 1922 service", "service attitude", "consultation content", and "answer question timely or not". Customer service center reviews telephone record of unsatisfied calls to understand the consultation situation, and then counsels the staff to enhance community skills or disease prevention knowledge.

Acknowledgement

We appreciate all units and branches of Taiwan CDC providing related information and assistance, which has made the operation of the 1922 service smoother. We also appreciate Miss Yu-Fen Hsu, Epidemic Intelligence Center, Taiwan CDC, for professional assistance.

References

1. Bush N, Vanderpool R, Cofta-Woerpel L,et al. Profiles of 800,000 users of the National Cancer Institute's Cancer Information Service since the debut of online assistance, 2003-2008 Prev Chronic Dis 2010;7(2):31.
2. Regidor E, de la Fuente L, Gutiérrez-Fisac JL, et al. The role of the public health official in communicating public health information. Am J Public Health 2007;97（Suppl 1）:93-7.
3. Madeline La Porta, Heather Hagood, Julie Kornfeld, et, al. Evaluating the NCI's Cancer Information Service Contact Centers: meeting and exceeding the expectations of the public. J Cancer Educ. 2007 Spring; 22(Suppl 1):18-25.

4. Belman S, Chandramouli V, Schmitt BD, et al. An assessment of pediatric after-hours telephone care: a 1-year experience. Arch Pediatr Adolesc Med 2005;159(2):145-9.
5. Chen CM, Yan JJ, Tsen SSH g, et al. Effectiveness Evaluation of 1922 Communicable Disease Reporting and Consultation Hotline, Taiwan Epidemiol Bull 2010;26:73-80.
6. Clancy T, Neuwirth C, Bukowski G. Lessons learned in implementing a 24/7 public health call center in response to H1N1 in the state of New Jersey. Am J Disaster Med 2009;4(5):253-60.
7. Chatterjee A, Lackey SJ. Prospective study of telephone consultation and communication in pediatric infectious diseases. Pediatr Infect Dis J 2001;20(10):968-72.
8. Jung Li, Yen Chiang. Thought on constructing 12320 commonweal telephone system form "health hot-line" in Hong-Kong. Chinese Journal of Public Health Management 2007; 23(1):24-6.
9. Wei Ban Fa(2005)#486. Department of Health Notification of Activation of 12320 National Public Health Hotline. Public Newsletter from the Department of health 2006;1:5-11.
10. Liu HS, Chu WS, Wang H. Need assessment of 12320 Public Health hotline in Beijing City. Medical Information 2008;(7):1040-1.
11. Xu ZY, Wei XM. Needs for training of telephone of 12320 hotline in the piolt provinces and cities. Chinese Journal of Health Education 2008;(24):525-33.
12. Zhu Ya. The study of a Public Health Holtlines in the Subthreshold of Health Management and Communication-Based on the Research of Nanjing 12320 from 2007 to 2009.News China 2010;(1):45-7.