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Review of Significant Epidemics Occurred in Taiwan and International Community in 2009

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Abstract

A total of 4,990 cases, including 81 deaths, caused by acute infectious diseases were confirmed in 2009 in Taiwan, a significant increase when compared with 3,982 cases and 40 deaths in 2008. The increase in number of cases is mainly due to influenza with severe complications, followed by leptospirosis, measles, typhoid fever, dengue/dengue hemorrhagic fever, and pertussis. The three diseases with the largest decrease in the number of cases in 2009 are, in descending order, enterovirus infection with severe complications, botulism, and meningococcal meningitis. The factors contributed to the increase of these disease are measles cluster infections occurred in hospitals from northern to southern Taiwan and military camp, a global pandemic of novel influenza A (H1N1), and leptospirosis cluster infections following the Morakot typhoon in August, a steep increase in typhoid fever cases imported from Indonesia, increase of pertussis cluster infections occurred in schools and household, and large dengue epidemic occurred in Kaohsiung County and City and Pingtung County. Other significant cluster infections include seasonal diarrhea epidemic occurred annually during mid-October to February of the following year, chickenpox found in schools and household, shigellosis identified in children's home and travel group, amoebiasis in long-term care center and psychiatric care center, rubella in factory, and melioidosis following the strike of Morakot typhoon. The death in 2009 was mainly due to influenza with severe complications, followed by invasive pneumococcal disease and dengue hemorrhagic fever. The infectious disease given the biggest concern in international community in 2009 should be novel influenza A (H1N1) pandemic, followed by avian influenza A (H5N1), measles, dengue fever, chikungunya virus disease, and epidemics in China. Taiwan CDC has always been able to

INSIDE

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capture the information on occurrence of all these epidemics in time. In 2010, we suggest that, in accordance with the existing infectious disease surveillance system, government should improve border quarantine procedures, establish a well surveillance system for infectious disease following natural disaster, prevent cluster infection of enteric diseases in populous institutions, and strengthen medical examination policy for foreign workers, so that we will have a better disease defense system to ensure health of people in this country.

Keywords: acute infectious diseases, influenza with severe complications, leptospirosis, foreign worker, natural disaster

Introduction

The Communicable Disease Control Act was revised in 2007 to include 66 mandatory notifiable infectious diseases in Taiwan, which were classified into five categories based on the level of risk in public health such as fatality, incidence, and transmission speed [1]. Of these diseases, a total of 4,990 cases, including 81 deaths, caused by acute infectious diseases, but not comprising those caused by chronic infectious disease, were confirmed in 2009. A significant increase was found as compared with 3,982 cases and 40 deaths in 2008. The increase in number of cases is mainly resulted from diseases of influenza with severe complications, followed by leptospirosis, measles, typhoid fever, dengue/dengue haemorrhagic fever (DHF), and pertussis. The three diseases with the biggest decrease in the number of cases in 2009 were, in descending order, diseases of enterovirus infection with severe complications, botulism, and meningococcal meningitis.

The sharp increase in number of influenza cases with severe complications was largely resulted from the globe epidemic of novel influenza A (H1N1) in 2009 [2]. For leptospirosis, most of the cases came from the cluster infections occurred in Wandan Township and Sinyuan Township of Pingtung County following the strike of Morakot typhoon in August, especially in Wannei Village of Wandan Township. Measles cases mainly reported from the nosocomial infections occurred in Taipei County, Taoyuan County, Taichung City, Nantao County, Tainan County and City, and Kaohsiung County and City, which the infection sources were largely implicated in imported cases [3-4]. In addition, a measles cluster infection also occurred in a military camp in Pingtung County. For typhoid cases, the cluster infections occurred in two families and the rest confirmed cases are imported cases (80%). The outbreaks occurred in four schools and clusters in 11 families are the main reasons that doubled the number of pertussis cases in 2009, as compared with those in 2008. The significant increase of dengue cases is caused by outbreaks occurred in Cianjhen and Xiaogang Districts in Kaohsiung City, Fengshan City in Kaohsiung County, and Pingtung City in Pingtung County. The number of DHF cases has also increased more than double in 2009 compared with the previous year.

In 2009, except the cluster infections described above and infectious diarrhea epidemic usually occurred during the period of mid-October to next February, a number of additional cluster infections have occurred. These include chickenpox in schools, workplaces, and households; shigellosis in children's home and travel group; amoebiasis in long-term care center and psychiatric care center; rubella in factory; and melioidosis following the strike of Morakot typhoon.

The largest number of deaths caused by infectious disease in 2009 is observed in patients of influenza with severe complications, followed by invasive pneumococcal disease, and DHF. However, the disease with the highest fatality rate is DHF, four deaths of 11 confirmed cases, followed by invasive haemophilus influenzae type b infection, 14 confirmed cases with two deaths.

Among a variety of epidemics occurred in international community in 2009, novel influenza A (H1N1) pandemic was considered to be the most critical. A total of more than 208 countries in the world have reported cases and it is estimated that at least 12,800 deaths have occurred. Others include measles epidemic in Burkina Faso, the most serious outbreak in ten years in the country; the largest outbreak of mumps in the USA since 2006, the disease was rapidly spreading in a summer camp in New York from a boy (index case) who returning from a trip to United Kingdom; dengue outbreak in the Republic of Cape Verde, the first epidemic in the country's history; epidemic of chikungunya virus disease in Lampung Province, Indonesia, which more than ten thousands of cases have been reported and is the epidemic with the highest number of cases in ten years; and poliomyelitis cases occurred in the Republic of Sierra Leone, the Republic of Liberia, the Republic of Burundi, and Uganda where no cases have been reported during 2000-2008.

The descriptions in this report are divided into two parts, domestic epidemics and international epidemics. Data used for analysis of domestic epidemic are based on the databank in the National Notifiable Communicable Disease Surveillance System operated by Taiwan CDC. We first identify diseases with a significant increase in number of cases in 2009 compared with those in 2008 and then conduct further analysis on person-time-place distribution, cluster infection, and the countries from where the infections imported. For international epidemic, an overall summary analysis for some relatively important diseases occurred in international community in 2009 is provided. Finally, a suggestion on directions and emphasis for future disease control is formulated based on these data explorations and analysis. Data or statistics used in this report are all collected from either the National Notifiable Communicable Disease Surveillance System or materials presented in the weekly meeting held by Taiwan CDC specifically for epidemic surveillance and control.

Summarized analysis on important acute infectious diseases occurred in Taiwan in 2009

1. Influenza with severe complications

Since influenza season in Taiwan occurred during October through March, in order to accurately evaluate the epidemic situation in one season, the case number of influenza with severe complications was calculated on the basis of a 12-months period covering the epidemic season (A year is defined as the time period from July 1 to June 30 of the following year). Although novel influenza A (H1N1) was added to the list of Category 1 communicable diseases by Taiwan CDC on April 27 in response to the continuing occurrence of novel influenza A (H1N1) since April 2009, it was soon removed from the list on June 19. However, local health authorities were requested to conduct control activities as for seasonal influenza with severe complications, one of the Category IV communicable diseases, when they received report on cases of novel influenza with complications [5]. A total of 61 novel influenza cases were confirmed during this period but these were not included into the data set in the following analysis because of being unable to determine whether these were with severe complications.

A total of 20 influenza cases with severe complications were confirmed during July 2007 – June 2008, 28 cases [61 novel influenza A (H1N1) cases were excluded] during July 2008 – June 2009, and 1,152 cases during July 2009 – January 2010. A 41- to 57-fold increase was observed during July 2009 – January 2010 as compared with the number of cases identified in previous two years, which is mainly resulted from the global pandemic of novel influenza A (H1N1) in 2009.

The first novel influenza A (H1N1) case with severe complications in Taiwan was confirmed in mid-July in 2009. Then, the number of cases with severe complications gradually increased and reached the peak during August-November. The highest number of cases with severe complications was observed during 35th-36th weeks, with an average of more than 100 cases per week. However, the occurrence of cases with severe complications became slow after December. The number of cases with severe complications confirmed in January 2010 is only slightly higher than that in July 2009. This decrease is probably associated with the activities of novel influenza A H1N1immunization campaign to all population starting from November 2009, and the vigilance and improvement of personal protection practice in general public and schools to the pandemic threats.

The virus typing shows that the dominant types and subtypes of circulating influenza virus were AH1 and AH3 during the epidemic peak in both periods, from July 2007 through June 2008 and from July 2008 through June 2009. Influenza virus B appeared during the interval period between the two peak times. For the period July2009 to January 2010, although influenza virus AH3 was still isolated in some cases occurred during August–September, the dominant virus type has shifted to novel influenza virus A H1N1 after September, but the influenza virus AH1 and B were almost not seen (Figure 1).

The incidence analysis of cases with severe complications indicates that during the period of July2008 to June 2009, the age group with the highest incidence rate was 65 and older, followed by age group of 1-6 years; during the period of July 2009 through January 2010, the people with the higher incidence rate was those younger than 18 years old, especially those between the ages of 1 and 6 years, followed by those aged 65 years and older. This suggests that although the incidence rates of confirmed cases with severe complications caused by seasonal influenza virus and novel influenza virus were different in each age group, people with higher incidence rate for both of the two viruses fall on the age group of 0-6 and over 65 years (Figure 2).

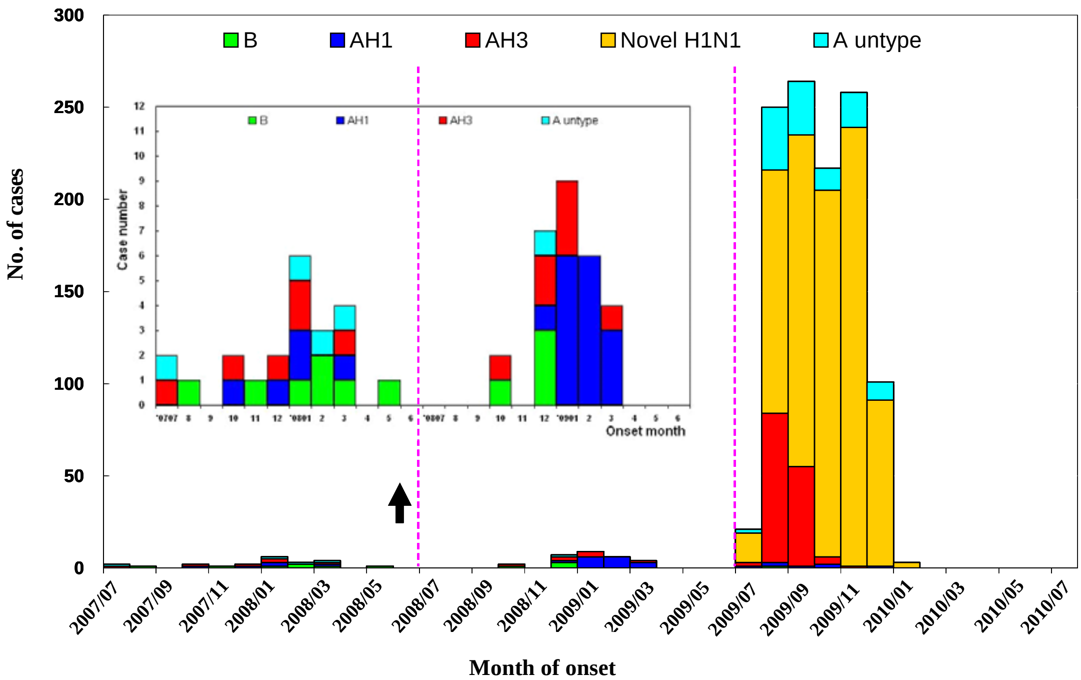

Figure 1. Number of influenza cases with severe complications, by type of virus and month of onset－Taiwan, 2007-2010

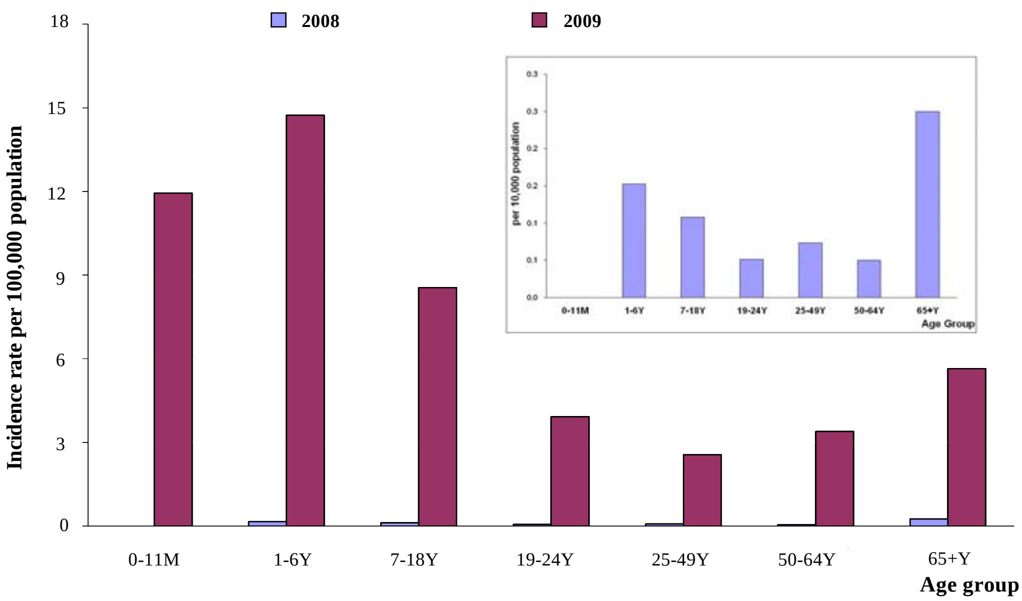

Figure 2. Incidence rate of influenza cases with severe complications, by age group and epidemic year, Taiwan

2. Leptospirosis and melioidosis

A total of 203 leptospirosis cases were identified in 2009, a 3-fold increase as compared with 49 cases in 2008 (Figure 3). Most cases were found in Pingtung County (127 or 62.6%), followed by Kaohsiung County and Taipei County, 15 cases each.

This increase was largely after Morakot typhoon striking Taiwan on August 6, 2009, which led to the occurrence of leptospirosis cluster infections subsequently identified in Wandan Township and Sinyuan Township of Pingtung County. The causative agent of leptospirosis was isolated from specimens collected from the patients and environmental water. Epidemiological investigation shows that all the confirmed cases had been working in flood damaged areas affected by typhoon (i.e. all of them have the experience of contacting dirty water) and no other significant exposure history were reported. Since this disease is more likely to occur in areas ever suffering from a flood, we speculate that these leptospirosis cases were probably infected from exposure to the contaminated water or soil when they were cleaning their houses and the surrounding areas affected by the flood. A total of 113 leptospirosis cases were identified in these cluster infections, including one fatal case. All these cases are in the age range of 10 to 74 years. Eight-two are males and thirty-one are females. The peak period for symptom onset of these cases occurred in week 34 and 35, 71 and 38 cases, respectively. The three villages with the highest number of cases are Wannei (47 cases, 41.6%), Howcun (21 cases, 18.6%), and Shiangsheh villages (11 cases, 8%), which are all located in Wandan township where suffered from very serious flood during the attack of typhoon.

Melioidosis cluster infections also occurred following the typhoon. Although the number of melioidosis cases (44) identified in 2009 is slightly less than in 2008 (45 cases). However, the number of melioidosis cases also increased apparently and an separate cluster

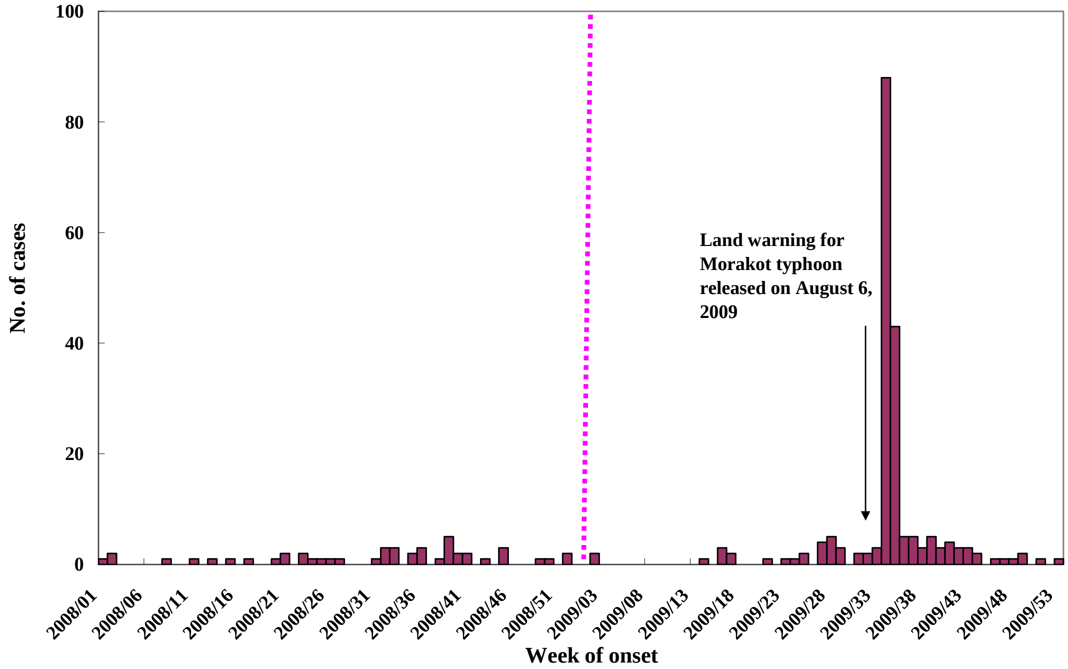

Figure 3. Number of leptospirosis cases, by week of onset－Taiwan, 2008-2009

infection had occurred in South District of Tainan City and Tzuoying District of Kaohsiung City [6-7] during the time following the typhoon strike, with ten and eleven cases in week 34th and 35th (from August 16 through August 29), respectively (Figure 4). The three counties/cities with the highest number of melioidosis cases are Kaohsiung City, Kaohsiung County, and Tainan City, with 15, 10, and 9 cases, respectively, in 2009.

3. Measles

A total of 48 measles cases was confirmed in 2009, a 3-fold increase as compared with 16 cases in 2008 (Figure 5). This increase was primarily attributed to the six clusters of

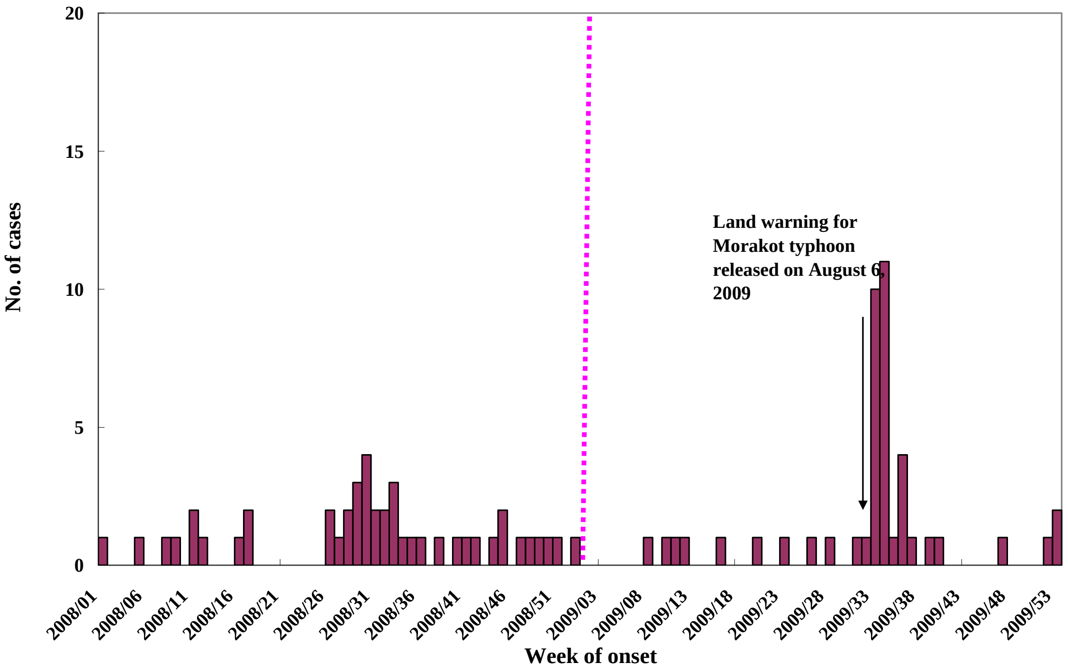

Figure 4. Number of melioidosis cases, by week of onset－Taiwan, 2008-2009

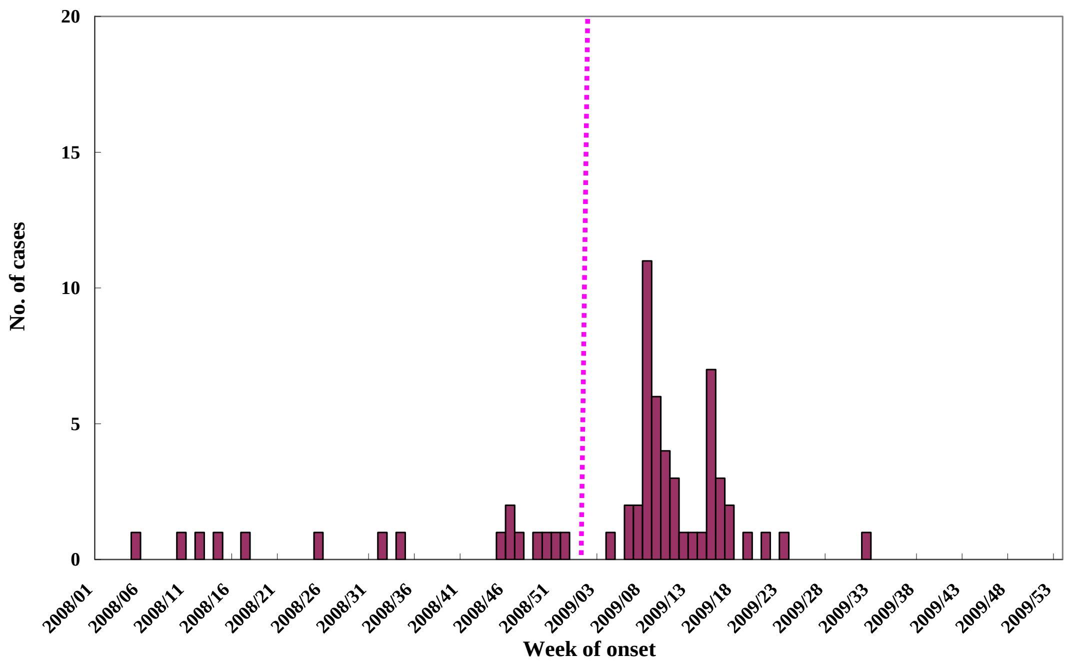

Figure 5. Number of measles cases, by week of onset Taiwan, 2008-2009

nosocomial infection occurred in 2009, which most of the clusters even occurred in large medical centers. Five of the six clusters have been identified that the infections were associated with importation (three from Vietnam, two from China) that infected others during hospital admission or at school; one cluster was unable to be clarified whether the infection source was related to imported cases. In addition, two other clusters were reported from military camp and kindergarten, respectively.

The age groups with the highest increase in incidence rate in 2009 are younger than 1, 1-4, and 20-24 years (Figure 6). Most of the infected cases are either younger than the age recommended for receiving the first dose of \measles-containing vaccine or failed to complete the scheduled vaccine series. The cluster infections occurred when these unvaccinated children contacted imported cases because of staying in the same ward during hospitalization, playing together in the same room, or going to the same child care center. For age group 20-24 years, the increase of incidence rate is associated with cluster infection occurred in a military camp in southern Taiwan, with nine cases identified. The national coverage rate for MMR immunization was higher than 98% for birth cohort of 2002-2007.

4. Typhoid fever

Eighty typhoid fever cases were confirmed in 2009, increasing more than double as compared with 33 cases in 2008 (Figure 7). Other than two family cluster infections occurred in Jhonghe City of Taipei County and Guanyin Township of Taoyuan County, respectively, of the total confirmed cases, 80% were imported cases.

Of the 64 imported cases, 57 cases are female and 7 cases are male. Age range is from 21 to 42. Among the 64 imported cases, 60 (93.8%) are citizens of Indonesia, three are Taiwanese who became ill after returning from trip either to India, China, or Bangladesh, and one is a foreign spouse from Cambodia, who had onset after retuning from visiting her

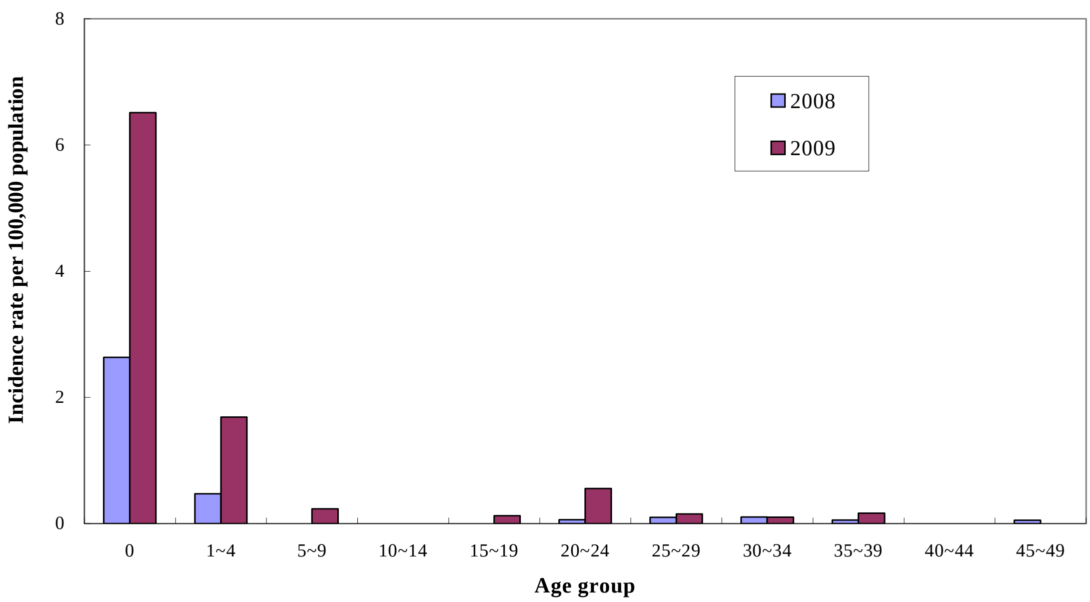

Figure 6. Incidence rate of measles cases, by age group－Taiwan, 2008-2009

relatives in Cambodia. Fifty-five of the 60 cases imported from Indonesia were foreign workers resided in Taiwan, who became ill after arriving Taiwan.

5. Dengue fever and Dengue haemorrhagic fever

A total of 1,052 dengue cases have been confirmed in 2009, an obvious increase is observed as compared with 714 cases in 2008. Of the total cases confirmed in 2009, 848 are indigenous cases and 204 are imported, and, in 2008, 488 are indigenous and 226 are imported (Figure 8). Eleven DHF/ dengue shock syndrome (DSS) cases were confirmed in 2009,

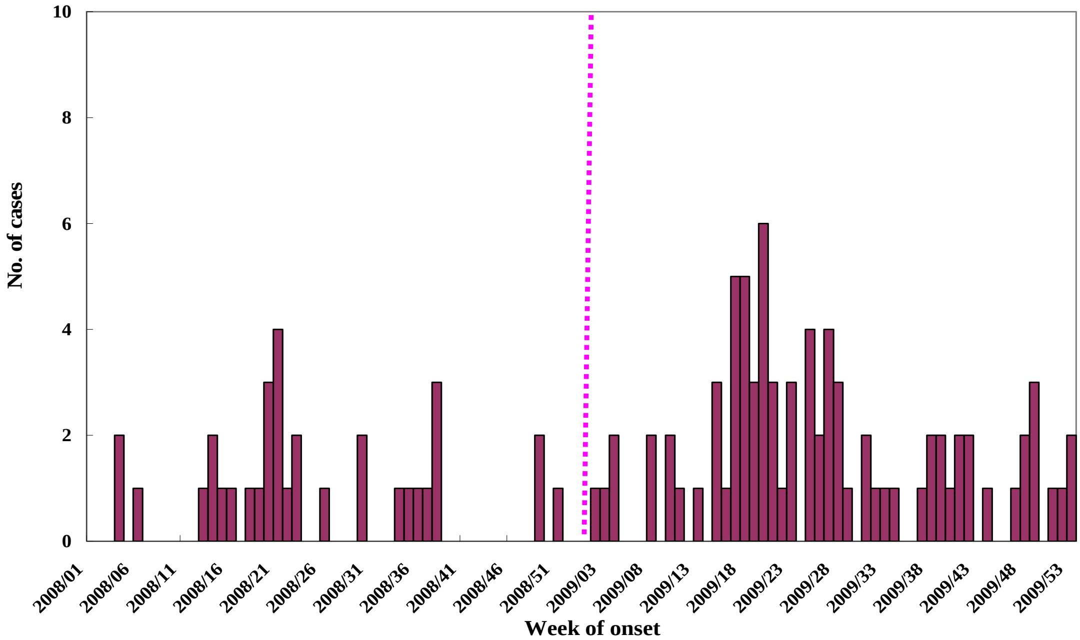

Figure 7. Number of typhoid fever cases, by week of onset Taiwan, 2008-2009

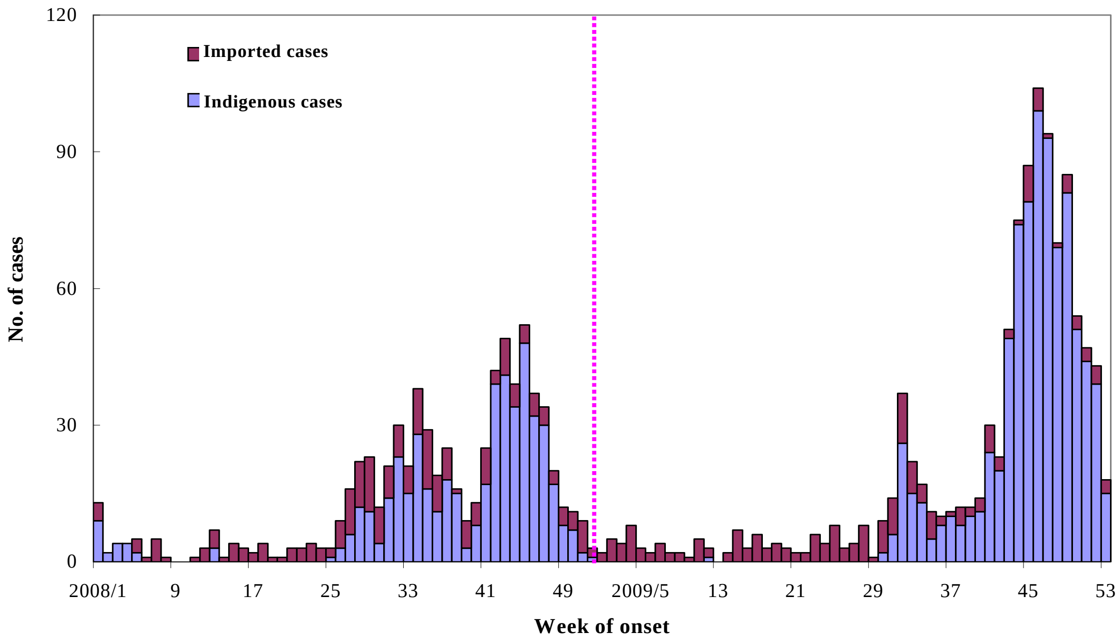

Figure 8. Number of indigenous and imported dengue cases, by week of onset－Taiwan, 2008-2009

including four fatal cases, and five DHF/DSS cases in 2008, no fatal case. The majority of indigenous cases in 2009 were reported from Cianjhen and Xiaogang Districts in Kaohsiung City, Fengshan City in Kaohsiung County, and Pingtung City in Pingtung County.

The type of dengue virus responsible for the epidemic in 2009 is mainly dengue-3 that was circulating in Kaohsiung City and Fengshan City in Kaohsiung County, and dengue-2 that was mostly in Pingtung County. The type of dengue virus in 2008 is mainly dengue-1, circulating in Kaohsiung County and City and Tainan City.

Nearly 56% of imported cases were detected through fever screening conducted at international airports and 40% were notified by physicians. The percentage of imported cases detected at entry point has been apparently elevated as compared with 46% in 2008. Among the countries associated with the infection source of imported cases, Indonesia is responsible for the largest number of cases (70), followed by Vietnam (60), Thailand (23), Philippines (19), and Cambodia (8).

6. Pertussis

A total of 90 pertussis cases were confirmed in 2009, with a double increase as compared with 41 cases in 2008 (Figure 9). The age groups with a higher increase are those younger than 1 year and 13-15 years, as compared with those in 2008.

The increase of pertusssis cases in 2009 mainly attributed to several large clusters occurred in junior high schools and elementary schools in Neihu District and Sinyi District in Taipei City, Beitun District in Taichung City, and Douliou City in Yunlin County. The number of cases identified from these cluster infections, ranging from three cases to twenty cases, is the most important reason leading to an obvious increase in number of cases for the age group of 13-15 years old. In addition, a cluster infection was reported from a postpartum care center in Songshan District in Taipei City, with four cases being identified in

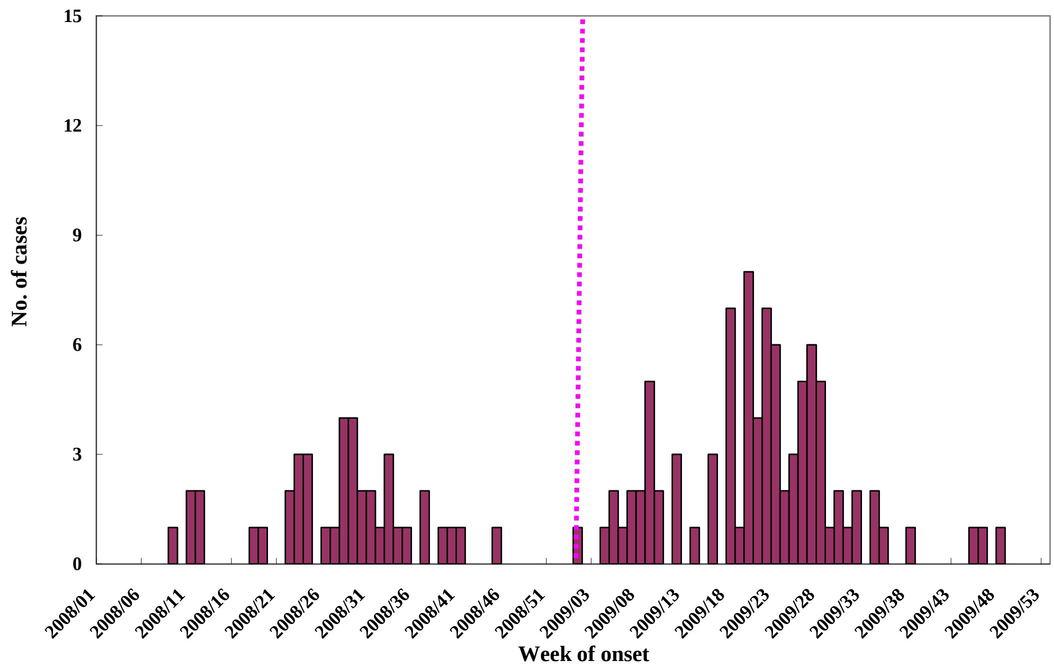

Figure 9. Number of pertussis cases, by week of onset－Taiwan, 2008-2009

this infection. Other factors that contributed to the increase of cases are cluster infections found in several households. Because of the immediate control measures for these clusters, the number of confirmed cases for a single cluster has been contained in 2-4 cases. All these household clusters were found in northern Taiwan (five clusters in Taipei County, two clusters in Taoyuan County), except one in Shincheng Township in Hualien County. This might be associated with the closer contact among people in metropolitan areas.

Imported infectious diseases and significant international epidemics in 2009

In recent years, due to the change in social environment, elevation of the living standards, and policy permitting to hire foreign workers and marriage to foreigner, citizens in Taiwan have largely increased visiting frequency to other countries because of traveling, business, or visiting relatives. Chinese New Year holiday and winter and summer vacations are hot seasons for people in Taiwan to travel to other countries. If people do not keep high vigilance on disease infection and conduct good personal hygienic practices during traveling, they may be very easily infected with disease. Therefore, surveillance of international epidemic, and identification of country where imported cases are infected have become more and more important in terms of providing epidemic information and releasing epidemic alert for travelers to other countries. Moreover, policy on physical examination of foreign worker could be appropriately modified when surveillance indicates that some diseases likely to import through foreign workers may occur, to decrease the risk of disease importation.

1. Imported infectious diseases

A total of 536 cases of imported infectious diseases, including 172 cases, or 32.1%, identified from foreign workers, have been confirmed in 2009, accounted for about 10.8% of the total number of cases. The three diseases with the highest number of imported cases are dengue fever (204), amoebiasis (67), and typhoid fever (64). The infection sources for majority of imported cases are countries in South East Asia. For example, among the 204 dengue cases, 73 were imported from Indonesia (including 24 cases identified from foreign workers), 61 from Vietnam (including 6 foreign workers and 5 foreign spouses), 22 from Thailand (including 4 foreign workers and 2 foreign spouses). Of the 67 amoebiasis cases, fifty-eight were imported from Indonesia foreign workers. Sixty of the 64 typhoid fever cases were imported from Indonesia and 55 of the 64 cases were foreign workers. Some cases of infectious disease among foreign workers might not be identified until they received post-entry physical examination. Moreover, imported cases of some disease may have resulted in endemic cluster infections before being identified, such as measles and shigellosis. The three countries sharing the largest number of imported cases in 2009 were Indonesia (213), Vietnam (83), and Thailand (57).

2. Significant epidemics in international community

In order to immediately capture the epidemic situation in international community, especially in the neighboring countries, to provide updated epidemic information for travelers to other countries, and to use as a reference in making quarantine and disease control policy, Taiwan CDC monitors daily on significant epidemic in the world. Among various important international epidemics, novel influenza A (H1N1) was considered as the most serious in 2009. A summary description for novel influenza A (H1N1) and other significant epidemics in 2009 are as follows:

（1）Novel influenza A (H1N1) pandemic: As of January 3, 2010, a total of 208 countries worldwide have ever reported novel influenza A (H1N1) cases, causing at least 12,800 deaths. The fatal cases were primarily reported from America during early stage of pandemic but the number of deaths reported from Europe presented in a significant increase after week 47, 2009.

（2）Avian influenza H5N1: A total of 72 confirmed cases have been reported from five countries worldwide in 2009, including 32 deaths. From 2003 up to January 11, 2010, 467 cases have been identified in 15 countries in the world, including 282 deaths.

（3）Measles: The measles epidemics at a larger scale were observed in Austria and Bulgaria in 2009. The countries with an obvious increase in number of cases in 2009 as compared with those in previous years are Australia, Chad, Iraq, New Zealand, South Africa, and Zimbabwe. However, the number of cases in China became less than those in previous years. As of June 30, 2009, a total of 51,000 cases, including 300 deaths, have been reported in Burkina Faso in 2009, which is the most serious measles epidemic in ten years in that country.

（4）Mumps, rubella, scarlet fever, pertussis: The countries having reported outbreak events of these diseases in 2009 include Israel (Mumps), Bosnia and Herzegovina (rubella), and Vietnam (scarlet fever). The countries with an obviously higher number of cases of these diseases than those in previous years include United Kingdom and USA (mumps), Australia and New Zealand (pertussis), and United Kingdom and Vietnam (scarlet fever). In the USA, a total of 938 mumps cases were reported in 2009, the epidemic with the largest number of cases since 2006 in that country, while it was only 454 cases in 2008. The index case of the mumps epidemic in 2009 was a boy who just returned from a trip to United Kingdom and participated in a summer camp in New York, causing the spread of the disease.

（5）Dengue fever: The dengue epidemic in 2009 mainly occurred in areas of South East Asia and Central and South America as before. The number of cases in Sri Lanka and Australia in 2009 is largely higher than those in 2008. Cape Verde has the first dengue epidemic in history in 2009.

（6）Chikungunya virus disease: This disease has currently become one of the endemic diseases in South East Asia. More than 12,000 cases have been reported in Lampung Province, Indonesia, since mid-December 2009, the highest number of cases in record in near a decade.

（7）Poliomyelitis: The number of

poliomyelitis cases either decreased or remained unchanged in 2009 among countries where the disease is endemic except that it increased in India. Although no cases have been reported in countries including Sierra Leone, Republic of Liberia, Burundi, and Uganda during 2000-2008, new cases re-emerged in 2009.

Conclusions

In late 2008, a measles cluster infection occurred in a hospital located at Tzuoying District of Kaohsiung City and continued to the beginning of 2009. An emerging infectious disease, novel influenza A (H1N1) rapidly spread globally since April 2009. Subsequently, the novel influenza epidemic caused by imported cases occurred in Taiwan. In addition, some students returning during summer vacation from epidemic areas also became ill. Ultimately, because of low herd immunity and close contact among participants attending summer camp organized by schools or institutes, the novel influenza epidemic grew rapidly. The Morakot typhoon struck Taiwan in August brought the largest flood in 50 years to southern Taiwan and, therefore, resulted in the cluster infections of leptospirosis in Wandan Township and Sinyuan Township of Pingtung County. These outbreak events together with amoebiasis and shigellosis cases reported from long-term care center and psychiatric care center, and pertussis cases identified in schools and households brought the number of cases of acute communicable disease in 2009 evidently larger than those in 2008. Disease knows no boundary. The monitor of epidemics in international community is, therefore, particularly important. Since most imported cases in Taiwan have been almost associated with neighboring countries in South East Asia, we suggest that, except the global pandemic, the surveillance of international epidemics should specifically focus on countries of South East Asia, so that an adequate and timely response could be established.

Based on this report, we suggest that the following issues on disease control should be improved in 2010:

1. To revise physical examination policy for foreign worker according to the annual surveillance analysis.

   The open-door policy for foreign worker was approved and became effective in October 1989. In order to avoid the introduction of infectious disease with the recruitment of foreign workers, Taiwan government has established physical examination policy for foreign workers. Moreover, several revisions have been made for this policy in response to the epidemic occurrence. Currently, communicable diseases included in the list of required physical examination are tuberculosis, HIV, syphilis, parasites (including invasive amoebiasis), Hanson's disease, and hepatitis B. In addition, a requirement of either a report of positive measles and rubella antibody or a certificate of measles and rubella vaccination has been added to the list and became effective on September 1, 2009 [8].

   There are 191 cases (including 172 imported cases) whose resident identity is issued as foreign worker in 2009. Of the 191 cases, 153 hold Indonesian nationality, the country with the highest number of cases. The diseases with the largest number of cases among foreign workers are amoebiasis, typhoid fever, and dengue fever, with 65, 55, and 44 cases, respectively. In recent years, several cluster infections were continually identified among foreign workers and these infections have even caused household clusters, such as rubella, chickenpox, and shigellosis. Therefore, the items required in physical examination for foreign worker should be reviewed annually based on the analysis of disease surveillance, in order to strengthen health management of foreign worker and prevent imported cases from jeopardizing health of people in this country.

2. To strengthen the prevention and control of enteric diseases in populous institutions.

In 2009, at least eight cluster infections of amoebiasis or shigellosis, involved more than 60 cases, have been identified in some populous institutions, such as long-term care center, psychiatric care center, and children's home. What deserves to be emphasized is that the cluster infection of enteric diseases almost occurred every year among residents in some certain care centers or nursing centers. No matter whether the infected residents are symptomatic or asymptomatic carriers, the threats to health of other residents, care-giver, or people in community are always present. Therefore, the environmental sanitation should be closely supervised and improved, a standard care procedure emphasizing infection control shall be in place, and, if necessary, a screening test for specific diseases should be implemented and a complete treatment course should be provided to the infected, so that the potential infection sources could be eliminated and cluster infection would not happen again.

3. To establish a well-organized notification channel for infectious disease following natural disaster in response to environmental and climate change.

Taiwan is located at the subtropical area and often suffers from typhoons in summer and autumn seasons almost every year, and sometimes with earthquake owing to the movement of tectonic plates. Although the most important task immediately following the natural disaster is the rescue and settlement of victims no matter how serious is the natural disaster, the sanitary facilities and disease surveillance in the subsequently constructed settlement centers are also very important. When the sanitary facilities are not provided adequately or not enough, and if the disease is not detected and controlled at the first time, inevitably, the infectious disease will promptly spread among sufferers in the crowded centers. The surveillance of communicable disease in settlement center for residents suffering from Morakot typhoon was conducted by staffs in Branch Offices of Taiwan CDC, which they provided surveillance data on daily basis, and the diseases to monitor focused only on gastroenteritis, upper respiratory tract infections, and skin rash. In order to know whether the diseases under surveillance were adequate and enough and whether the surveillance procedures were working efficiently and smoothly, we should refer to the information published by international counterparts concerning the surveillance of communicable disease following natural disaster, then make further improvement to current policy, so the procedures for surveillance will be more flexible in response to the emergency needs. In addition, further investigate the causative risk factors for mandatory notifiable diseases associated with natural disaster, such as leptospirosis and melioidosis, and then educate residents about these factors and remind them to take precaution to prevent from getting infected.

In recent years, owing to the elevation of living standards, improvement of environmental sanitation, and provision of immunization, much progress has been made toward the prevention and control of infectious diseases. However, as the international exchange activities become more frequent and the threats of emerging and reemerging infectious diseases are growing day by day, in order to immediately detect the occurrence of infectious diseases and release alerts against the infectious diseases for public at the first time, Taiwan CDC has established multi-disease surveillance systems and integrated the judging mechanism for epidemics, at the same time, a disease control policy shall be formulated based on these analyses to prevent spread of the disease and safeguard the health of citizens in this country.

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Meningococcal Meningitis Cluster Outbreak in a Junior High School－Taipei County, Taiwan, 2008

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Abstract

Meningococcal meningitis is an acute bacterial infectious disease with severe sequelae and high mortality. The morbidity of this disease is low in Taiwan and most cases were sporadic. One junior high school student was reported in March, 2008 and later confirmed. In retrospective investigation and follow-up monitoring, another 4 cases were confirmed. Pulsed-field gel electrophoresis examination also revealed identical genotyping of bacterial strains isolated from these patients. This was a rare cluster outbreak of meningococcal meningitis occurred at school campus in recent years in Taiwan.

Two runs of mass chemoprophylaxis had been administered in school for disease control. This report discussed the effectiveness and adverse drug reaction of prophylaxis of this disease. Furthermore, crowding environment may be an important factor in this outbreak and, thus, environmental improvement was proceeding in this school to prevent further infection of meningococcal meningitis or other respiratory diseases.

Keyword: Meningococcal meningitis, cluster outbreak, chemoprophylaxis

Introduction

Meningococcal meningitis is a sudden infectious disease caused by *Neisseria meningitides*. The clinical symptoms include sudden onset of fever, severe headache, nausea and vomiting. These symptoms may progress very fast and neurological signs, including neck stiffness or photophobia, may occur. The mortality may up to 10 percent regardless of antibiotic and intensive medical care. Ten to 20 percent of survivors may have life-long complication of intelligence degeneracy, hearing loss or limb disability [1].

Meningococcal meningitis is classified as a Catergory 2 Communicable Diseases in Taiwan and the morbidity was low in recent years. According to the database in Taiwan CDC, the annual average number of confirmed case was 20.6 from 2003 to 2007 and the morbidity was 0.09 per 100,000 people [2], which was much lower than USA (1.1) and United Kingdom(3.7) [3-4]. Most of the confirmed cases occurred sporadically.

Human is the only natural host of *Neisseria meningitides*. Most of the nasopharyngeal carriers may not have clinical symptoms of this disease; however, pathogens can be transmitted to other people through direct contact or air droplets. Clinical symptoms may be noted in few infected people and it may also develop into invasive disease. However, the definite risk factor has not been confirmed. Thus, a confirmed patient is notified may indicate an ongoing infectious chain and emergency preventive procedures should be intervened immediately to prevent further transmission [1]. There are 5 pathogenic serotypes (A, B, C, Y and W135). Most of the cases in Taiwan were serotype B (70%), followed by Y and W135, and it is the only serotype that is not included in the tetravalent vaccine (A, C, Y and W135). Furthermore, the morbidity in Taiwan was very low and it is not recommended to apply this vaccine for regular use. Prophylactic therapy for people who have close contact with confirmed patients is now used as a disease control and prevention procedure [2].

This report described a cluster outbreak of meningococcal meningitis in a junior high school in Taipei County and also discussed relative problems in disease control and prevention.

Description of the outbreak

1. First wave of disease outbreak

A suspected meningococcal meningitis case (case 3) was reported to First Branch, Taiwan CDC, on March 7, 2008. The patient is a 13 years old girl and had symptoms of fever, headache and vomiting since March 4. She was diagnosed as influenza by local clinic but the symptoms were not improved after treatment. Cutaneous wheals and neck stiffness were then noted. The patient was referred to a medical center and was highly suspected and reported as a meningococcal meningitis case.

This patient was an 8th grader in junior high school. Most of the students in this junior high school were boarders in the school. Meningococcal meningitis serotype B was confirmed from cerebrospinal fluid (CSF) sample by the Research and Diagnostic Center, Taiwan CDC, on March 8. The public health authorities provided antibiotics rifampin to patient's family, classmates and roommates. The disease investigation found that another female student in the same class was reported as a suspected case on February 7. The result of bacterial culture was negative and, thus, excluded (case 2). Furthermore, by checking CDC's database, an 8th grade male student in the same school was also reported as suspected case on January 23 (case 1) and the bacterial culture result was also negative.

The following investigation included reviewing of case history, follow-up of contacts, analysis of laboratory data and environmental investigation of the school. Besides prophylactic medication, body temperature monitoring for all school staffs and students and environmental disinfection were also enforced.

On March 20 (3 weeks since case 3 fell ill), Taiwan CDC received a report of another suspected case from another medical center (case 4). This patient was also an 8th grade student in the same junior high school, but in different class and dorm room from 3 other cases. Concerning about more cases may appear in the school, members of Field Epidemiology Training Program (FETP) were sent to the school for further investigation.

There were over 2000 people (staffs and students) in the school. Students were divided into 36 classes (3 grades, 12 classes in each grade) and averagely 55 students were in each class. The classroom where the confirmed cases studied was approximately 62.7 m^2 and the space between desks was small or even side by side. Most students were boarders in the school. The space of a dorm room was also small which was averagely resided for 16-18 students. The dining cafeteria could accommodate about 1000 people.

Based on the case history, the testing samples collected from case 1 and case 2 by the reporting hospital were positive in bacterial culture. All contacted medical staffs received prophylactic medicine. The bacterial strain of case 2, kept in the reporting hospital, was confirmed as *Neisseria meningitides* serotype B. In summary, there were 4 confirmed cases from January 20 to March 18. The attack rate was 189 per 100,000 people, which was much higher than the annual average in Taiwan. It was also considered conforming to the definition of cluster of meningococcal meningitis [5].

After discussion, Taiwan CDC, Taipei County public health bureau, and school authorities decided to initiate mass prophylaxis for all school staffs and students on March 21. Based on the convenience and efficacy of medicine, 1 dose of 500 mg ciprofloxacin was offered.

2. Second wave of disease outbreak

Eight weeks after prophylactic therapy, an 8th grade male student in the same school (case 5) was reported as a suspected case of this disease with clinical signs of fever, headache and neck stiffness. Gram negative diplococcus was found in CSF sample; however, the bacterial culture was negative. On June 1, 19 days later, another male student revealed similar symptoms and was reported as suspected case (case 6). *Neisseria meningitides* serotype B was isolated from blood sample.

Emergency prophylaxis to patient's family, classmates and roommates for these 2 events was given on May 20 and June 4, respectively. In order to prevent 3rd wave of disease outbreak, public health bureau recommended to stop classes on June 1 (for 7th grade and 8th grade students) and June 6 (for 9th grade students) and complete environmental disinfection was instituted during classes suspended. Second mass prophylaxis medication was then given again when classes resumed on June 9.

Until June 21, no new confirmed case was found on follow-up health monitoring. There were 5 confirmed cases and 1 suspected case recorded in these 2 waves of disease outbreak. The epidemic curve was shown on Figure 1.

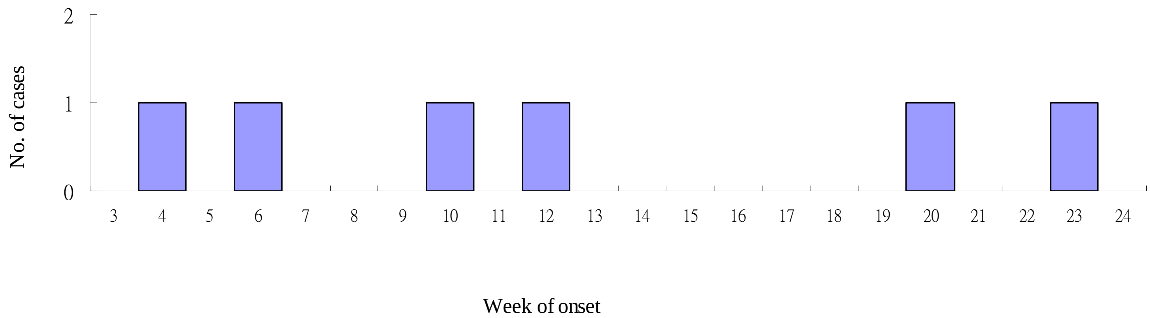

Figure 1. Number of meningococcal meningitis cases in a junior high school, by onset week－Taipei County, Taiwan, 2008

Epidemiologic data and clinical symptoms (Table 1)

Four male and two female patients were all boarder students in this junior high school. Case 2 and case 3 were classmates, and so were case 4 and case 6, in another class. However, all case students were not resided in the same dorm room. The median day of duration between disease occurrences was 19 days (from 12 to 56 days). The initial clinical symptoms were fever, headache, nausea and vomiting (100%), followed by hemorrhagic cutaneous wheals (50%), consciousness change (50%) and photophobia (33%). One patient had more severe clinical signs and was once placed to intensive care unit (ICU). All patients were fully recovered with no neurologic complication.

Bacteriological examination

In these 6 cases, case 1 was confirmed as *Neisseria meningitides* infection by culture from CSF sample processed by the hospital but the bacterial strain was not available for further confirmation. In case 5, the CSF sample was collected 3 hours after antibiotic treatment and may interfere in bacterial culture result (which was negative in this case). The bacterial strains were recognized by Research and Diagnostic Center as *Neisseria meningitides* serotype B in

Table 1. Case list of meningococcal meningitis cluster outbreak in a junior high school －Taipei County, Taiwan, 2008

Case No.	Date of onset	Clinical symptoms						Relationship	Other contact history	Laboratory examination	
		Fever	Headache	Nausea/ vomiting	Hemorrhagic cutaneous wheal	Consciousness change	Photophobia			Hospital	CDC
1	1/20	V	V	V						Culture positive	Culture negative
2	2/7	V	V	V	V	V	V	Classmate with case 3	Same dorm with case 3 (different floor and room)	Culture positive	Culture negative
3	3/4	V	V	V	V		V	Classmate with case 2	Same dorm with case 2 (different floor and room)	Culture positive	Culture positive
4	3/12	V	V	V	V	V		Classmate with case 6	Same dorm with case 5 & 6, same floor, different room	Culture positive	Culture positive
5	5/13	V	V	V					Same dorm with case 4 & 6, same floor, different room	Culture negative Gram Stain: Gram Negative diplococci	Culture negative
6	6/1	V	V	V		V		Classmate with case 4	Same dorm with case 4 & 5, same floor, different room	Culture positive	Culture positive

the other 4 cases and identical bacterial strain was confirmed by PFGE genotyping (Figure 2).

Prophylaxis therapy

During this event, 2 runs of mass prophylaxis medication were provided. The first prophylaxis medication was given on March 21, which was Friday (the last school day during that week). The reserved medication for meningococcal disease in Taiwan CDC was Rifampin and it should be given twice daily for 2 consecutive days. Drug resistance or even prophylaxis failure may occur in this procedure due to low medical obedience. And single dose of ciprofloxacin was included in the guidelines of chemoprophylaxis for meningococcal disease from USA CDC [1]. Thus, ciprofloxacin was selected after antibiotic sensitivity test considering the emergency of prophylaxis and convenience. Only 2 persons received rifampin due to drug contraindication, a single dose of ciprofloxacin 500mg was given to all other people. The target number receiving medication was 2115, including 1,969 students and 146 school staffs. The administered rate

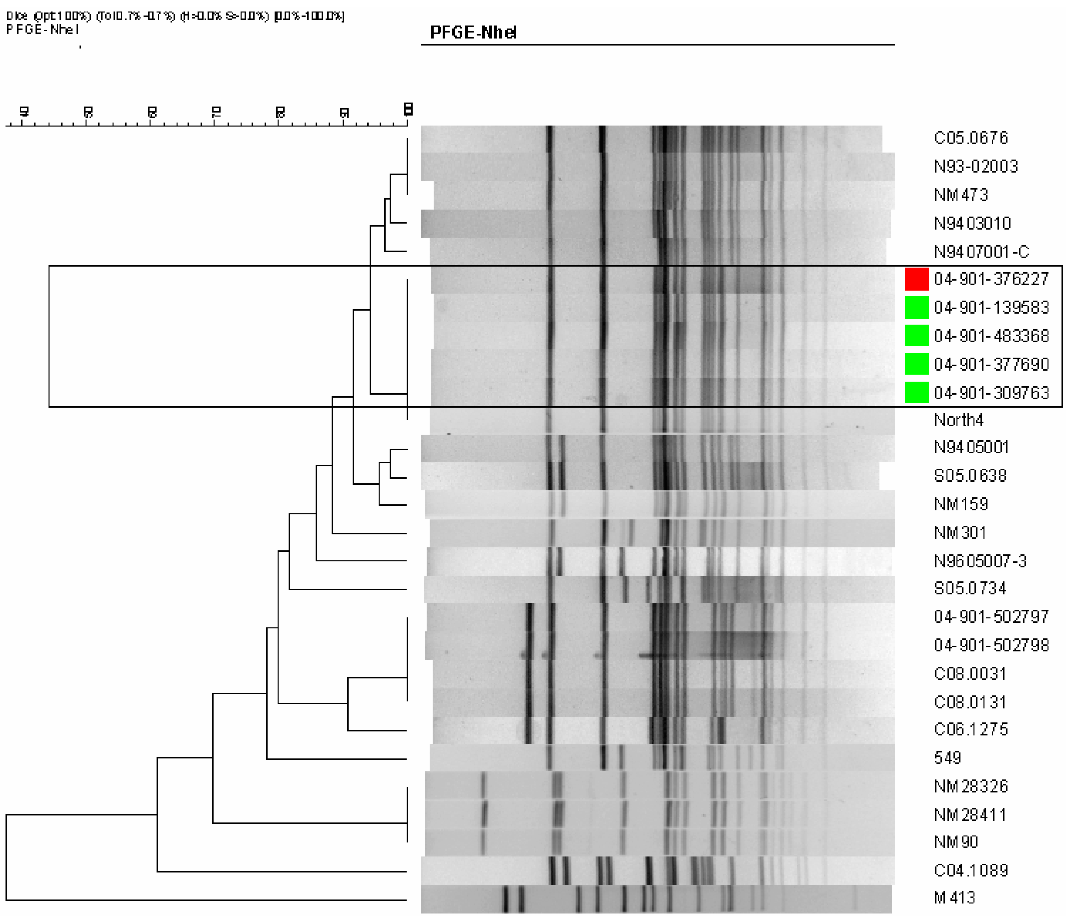

Figure 2. PFGE genotyping of *Neisseria meningitides* for meningococcal meningitis cases in a junior high school－Taipei County, Taiwan, 2008

Note:Identical genotyping was found for 5 bacterial strains (boxed) collected in this event from cases 2, 3 (2 strains), 4, and 6. Only one bacterial strain (North 4) isolated in 2001 had the same genotyping.

was 96.9% (2,050/2,115). Adverse drug reaction was noted in 18 people (0.9%), 3 persons had severe angioedema and were treated with injection medicine, others had milder adverse reaction(Table 2). The second mass chemoprophylaxis was instituted on the first day when classes resumed on June 9. A total of 2,014 people received the medicine (administered rate was 95.5%). Rifampin was used on the students who had drug reaction with ciprofloxacin found in last medication while others still received ciprofloxacin.

Environmental improvement

Crowding environment and insufficient ventilation was noted in the classrooms and dorm rooms. Taiwan CDC informed school and Education Bureau, Taipei County for environmental improvement. This school proceeded several measures including, the classroom was enlarged from 62.7 m^2 to 95.7m^2 and the wall was rebuilt by RC steel structure. Furthermore, exhaust fans and air conditioners were equipped, and bed partitions were applied in each dorm room to prevent close contact with roommates.

Discussion

Organization-based infection of meningococcal meningitis events were frequently reported in schools, jails or military facilities [6-8]. Large-scale outbreak in school had not been found in Taiwan before this event. Identical genotyping was obtained through PFGE examination from isolated bacteria, which confirmed the correlation between patients in this cluster outbreak. Cases 2 and 3, and cases 4 and 6 were classmates, respectively, but there were 26 days and 75 days difference when the clinical signs were noted between these patients, which indicated that there was sustaining transmission in subclinical carriers.

Extensive vaccination is the choice for preventing meningococcal meningitis. However, commercial vaccines most commonly seen recently, Meningococcal conjugate vaccine (MCV) and Meningococcal polysaccharide vaccine (MPSV), are tetravalent vaccine against serotypes A, C, Y and W135 [9]. These vaccines may have low efficacy in Taiwan because serotype B is the major pathogen. Furthermore, the morbidity of this disease in Taiwan is very low and

Table 2. Adverse drug reaction after mass chemoprophylaxis on March 21 for Meningococcal meningitis cluster outbreak in a Junior High School－Taipei County, Taiwan, 2008

Adverse drug reaction	Number
Angoiedema	3
Mild hypersensitivity (cutaneous wheals, eyelid swollen)	4
Giddiness	4
Nausea	7
Total	18(0.9%)

Note: Total covered people: 2,050.

cost-benefit should be considered. Thus, early diagnosis and proper chemoprophylaxis plays the most important role in control and prevention of meningococcal meningitis serotype B infection and cluster. The first 2 cases of this cluster were recorded in January and February. However, local public health authorities were unaware of the bacterial culture result from the hospital and negative result was obtained in the Research and Diagnostic Center; thus, preventive procedures could not be intervened timely. The bacterial strain may easily lose the activity during processing or shipping period. Taiwan CDC requested all public health authorities to quest the reporting medical facilities for cultured isolates. These bacterial strains should be examined by Research and Diagnostic Center for identification.

Ideally, chemoprophylaxis should be given within 24 hours after confirmed diagnosis. The efficacy is gradually decreased with prolonged or late dosage time, and it may be greatly decreased when the antibiotic is given after 2 weeks [1]. The target personnel for chemoprophylaxis should be restricted to those who closely contact with the patient within 1-meter distance over 8 hours, or who may directly contact to the oral secretions. If not consistent with the foregoing, classmates or colleagues are not advised for chemoprophylaxis. In addition, mass chemoprophylaxis is also not recommended. This procedure could be considered in certain conditions, including continuous occurrence of patients within crowded facilities (such as jails or military facilities) or fail to discriminate small range of contact people with over 2 or more patients [6]. During this event, it was unable to define a smaller contact group for these confirmed cases. Plus, cases continued to occur from January to March. Existing of subclinical transmission and healthy carriers were highly speculated, thus, mass chemoprophylaxis was applied to avoid new case.

In order to reach the highest efficacy, single dose of ciprofloxacin was used in this event to increase drug-taking compliance. Prophylaxis should be applied at the same time; otherwise persistent ping-pong infection may occur [10]. However, new cases were continually occurred even though the administered rate was 96.9% in first chemoprophylaxis. This indicated that loopholes still existing regardless of high administered rate. Furthermore, the cost, adverse drug reaction and drug resistance should also be considered. Different extent of adverse drug reaction was found in about 1% people, but no severe complication occurred due to proper management.

“Crowding environment” is a risk factor for many respiratory diseases. It may also play an important role in this event. It was reported that crowded environment was an important factor in cluster infection event in school [11]. In this study all cases were found in 8th grade (with smallest classrooms) and students were usually sitting side by side. In addition, most students were boarders in this school; 16-18 students shared one dorm room and the distance between beds was less than 1 meter. The investigation found that many cluster outbreaks of respiratory diseases were frequently occurred in this school during fall and winter. Thus, “environmental improvement” should be the most urgent work to prevent this disease or other respiratory infectious illness. Site-visit by specialists from Taiwan CDC, Institute of Occupational Safety and Health, and infection control experts also provided recommendations. Classroom enlargement and installation of ventilation systems have been completed before academic year starts in September.

Conclusion

This was a rare event of school-based meningococcal meningitis infection in Taiwan. Although no obvious epidemiological relationship among cases was observed, genetic analysis of the isolated strains had proved this correlation. Fortunately, all 5 confirmed patients and 1 suspected case were fully recovered without casualty or severe complication.

Through this outbreak, it is important to confirm bacterial strain to detect possible cluster infection event. In addition, adverse drug side effect, efficacy and possible drug resistance should be carefully considered before mass chemoprophylaxis is initiated.

Crowded environment was a very important potential risk factor in this outbreak. In order to prevent the similar event, authorities should regularly superintend schools maintaining proper space, ventilation system, and sanitation.

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