

Original Article

An Indigenous Outbreak of Dengue Fever at Shilin District of Taipei City in 2011

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Abstract

A medical center in North Taiwan reported a suspected case of dengue fever (DF) on September 8, 2011, affecting a 42-year-old man who lived on Yangde Boulevard, Shilin District, Taipei City. The case was tested positive by laboratory of Taiwan Centers for Disease Control (Taiwan CDC) on September 9, and was confirmed as an indigenous case since he had no recent travel history abroad. The health authorities then expanded blood sampling in the case's residential area, and continuously detected a total of five positive cases. Subsequently, a branch of Taipei City Hospital reported another suspected case on September 30 in a 46-year-old woman. There was geographical correlation between her activity area and the locality of this outbreak that revealed the outbreak was spreading. As of October 26, 20 positive cases had been identified, marking the most serious outbreak of indigenous DF in Taipei Region for the past two years. Presumably, it might be related to geographic environment (mountainous areas), and a lack of awareness and protective knowledge of the disease for public and the medical institutes. After Taiwan CDC in conjunction with the local government urgently mobilized the resources and took a comprehensive prevention and control measures, including removing the vector breeding sources, container reduction, reorganizing the environment, health education, fumigation, and strengthening medical institutes in reporting and diagnosis, the epidemic wave had reversed to a downtrend since late October.

Keywords: dengue fever, indigenous, imported, outbreak

Foreword

Dengue fever (DF) caused local epidemic in southern Taiwan each year; while in Taipei region, cases were mostly imported in recent years. However in 1995, an outbreak of DF with six confirmed cases had occurred in Taipei City. Afterward there were mostly small-scale

clusters. In 2008, twenty cases of DF were confirmed in Shihlin District which confined in Yonglun Village. Then there was no outbreak of DF in Shihlin District in the next few years [1]. The outbreak in 2011 was worst ever and the most geographically extensive in history regarding DF outbreaks in Shihlin District. Since Taipei City is the capital of Taiwan, the outbreaks will make huger impacts on international image than other counties or cities. Hence early response and timely control is crucial.

In 2011, a medical center in North Taiwan reported a suspected case of DF on September 8, affecting a 42-year-old man who lived on Yangde Boulevard, Shilin District, Taipei City. The case presented with fever and poor appetite symptoms and sought medical consultation from the medical center and was subsequently admitted to the hospital. He was tested positive by laboratory of Taiwan CDC on September 9, and was confirmed as an indigenous case since he had no recent history of travel abroad. The outbreak became distinct after expanding the specimen collection, notifying and epidemic investigation. We describe the overall outbreak profile, investigation and determination of the source of infection, the control measures, and also propose the related discussion and recommendations as references to deal with similar situations in the future.

Outbreak description

Since the index case was confirmed on September 10, 2011, the local health authorities had set two blood stations at a radius of 50 meters around his house to expand specimen collection. As of September 18, we collected a total of 91 specimens. After further analysis, we found the association in five positive cases. Of whom, two were mother and daughter-in-law and also residents in the neighboring of a college (Cases 2 and 3), two were employees of the college (Cases 4 and 5), and the other one resided 77 meters from the index case (Case 6). The epidemic investigation disclosed the geographical correlation between positive cases found in expanded specimen collection and the index case, and revealed a small scale cluster of DF had occurred in the area. Taiwan CDC therefore asked local health authorities to strengthen environmental surveillance and control measures in this area, while the First Branch of Taiwan CDC continued the epidemic surveillance.

A branch of Taipei City Hospital reported another suspected case of DF on September 30 in a staff of Shihlin District Health Center (Case 7). The patient presented with headache, myalgia, arthralgia, back pain, bone pain, loss of appetite and fever symptoms, and was confirmed on October 1. Another two positive cases (Cases 10 and 12) were detected through expanded specimen collection from contacts of Case 7. Epidemic investigation of the two cases revealed that they engaged in DF prevention and control on Yangde Boulevard in Shihlin District during the incubation period. They both developed symptoms on September 30, whereas were confirmed on October 1 and October 4, respectively. Shihlin District afterward received reports from hospitals of several suspected DF cases from October 4 to October 24. Totally, 11 cases were laboratory confirmed. The epidemic investigation showed

that the epicenter appeared to be from the mountainous areas toward the urban areas and the outbreak had spread from Yongfu Village to other villages of Shihlin District, including Villages of Fujia, Fude, Fuzhi, Yanshan, Linxi and Dehua (Figure 1). Based on "Guidelines for Dengue Control" [1], the Class B emergency control strategies need to be launched immediately when more than six cases have been detected in a hotspot. Therefore, Taiwan CDC monitored the epidemic, and directed the local health authorities to undertake the urgent control measures at the same time.

As of October 26, the total cases reached 20. Based on their activity records, the above-mentioned cases did not travel abroad within two weeks prior to the onset, and had been exposed to the same location or lived in the same area. Also their onsets were less than 14 days apart (Figure 2). Thus it was determined as an indigenous outbreak of DF (Table 1). We continued to monitor the epicenter area until 28 days after the onset date (October 19) of the last confirmed case. As of November 17, no further cases were reported or confirmed and the public health emergency had been lifted over the area.

Investigation and the determination of the source of infection

After the index case was test positive, the investigation of his habitation, occupation and daily life was launched. The case, owning a gardening shop, was a horticultural designer and often worked in Taipei City and New Taipei City. He also took a trip to Qigu District, Tainan City and Lugu Township, Nantou County during the incubation period. None of these areas had any cases of DF at that time. It was primarily identified as an indigenous transmission of DF event in Taipei City. The epidemic investigation and outbreak evolution are as follows.

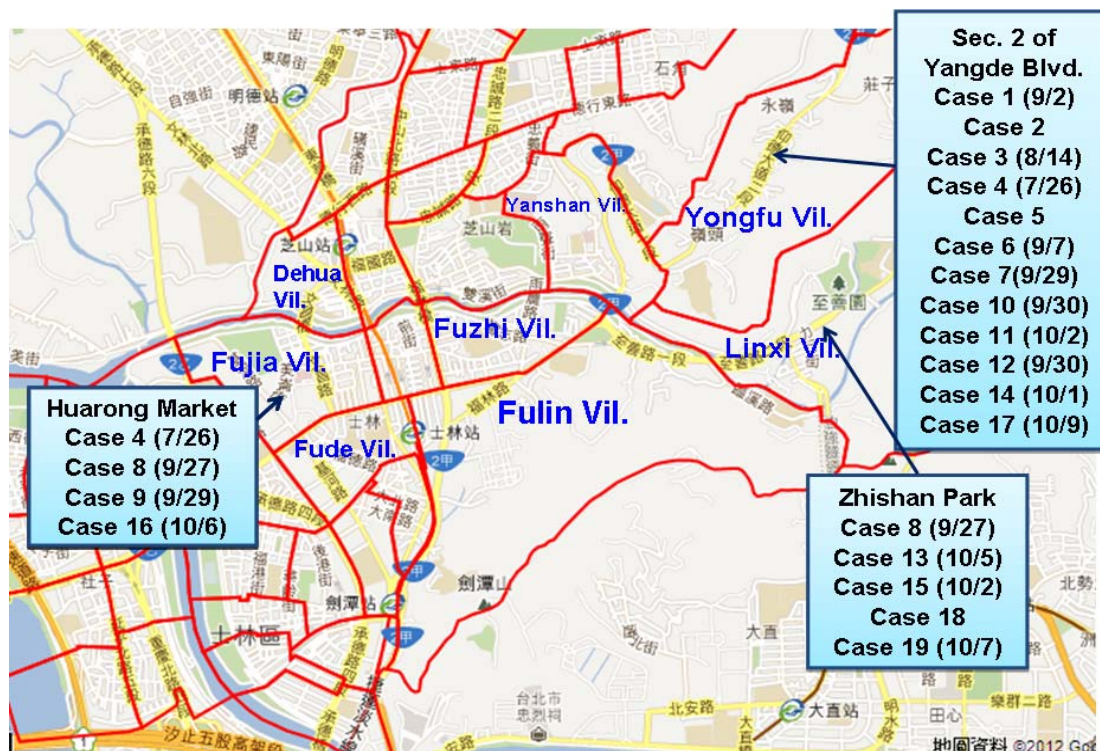


Figure 1. The geographical distribution of indigenous cases of dengue fever in Shihlin District of Taipei City with onset date marked in the brackets

(): Onset Date

Table 1. Details of the 20 confirmed cases of indigenous dengue fever in Shihlin District of Taipei City

Case No.	Age	Gender	Occupation	Onset Date	Confirmed Date	Village	Work Area	Clinic visits	Detection	Possible Infected Location
Case 1	42	M	Gardening shop owner	Sep. 2	Sep. 9	Yongfu Vil, Shilin Dist	Yongfu Vil., Shilin Dist.	5	Hospital reported	Sec. 2 of Yangde Blvd.
Case 2	34	F	Nil	-	Sep. 15	Yongfu Vil, Shilin Dist	Nil	0	Expanded specimen collection of case 1	Sec. 2 of Yangde Blvd.
Case 3	64	F	Nil	Aug. 14	Sep. 15	Yongfu Vil, Shilin Dist	Nil	1	Expanded specimen collection of case 1	Sec. 2 of Yangde Blvd.
Case 4	41	M	Staff of a seminary	Jul. 26	Sep. 15	Fujia Vil, Shilin Dist	Yongfu Vil., Shilin Dist.	6	Expanded specimen collection of case 1	Sec. 2 of Yangde Blvd., Huarong Market in Fujia Vil.
Case 5	47	M	Staff of a seminary	-	Sep. 15	Yanshan Vil, Shilin Dist	Yongfu Vil., Shilin Dist.	0	Expanded specimen collection of case 1	Sec. 2 of Yangde Blvd.
Case 6	51	M	Gardening farmer	Sep. 7	Sep. 16	Yongfu Vil, Shilin Dist	Yongfu Vil., Shilin Dist.	1	Expanded specimen collection of case 1	Sec. 2 of Yangde Blvd.
Case 7	46	F	Staff of Shihlin District Health Center	Sep. 29	Oct. 1	Bojia Vil, Wenshan Dist	Yongfu Vil., Shilin Dist.	1	Hospital reported	Sec. 2 of Yangde Blvd.
Case 8	70	F	Nil	Sep. 27	Oct. 4	Fude Vil, Shilin Dist	Nil	2	Hospital reported	Huarong Market in Fujia Vil., Zhishan Park
Case 9	60	M	Hardware store owner	Sep. 29	Oct. 4	Fujia Vil, Shilin Dist	Fujia Vil., Shilin Dist.	2	Hospital reported	Huarong Market in Fujia Vil.
Case 10	47	M	Village official of Shihlin District	Sep. 30	Oct. 4	Liming Vil, Taishan Dist, New Taipei City	Yongfu Vil., Shilin Dist.	1	Expanded specimen collection of case 7	Sec. 2 of Yangde Blvd.
Case 11	63	F	Nil	Oct. 2	Oct. 5	Yanshan Vil, Shilin Dist	Nil	1	Hospital reported	Sec. 2 of Yangde Blvd.
Case 12	28	M	Cleaner of Shihlin District	Sep. 30	Oct. 7	Wanhe Vil, Wenshan Dist	Yongfu Vil., Shilin Dist.	2	Expanded specimen collection of case 7	Sec. 2 of Yangde Blvd.
Case 13	58	F	Nil	Oct. 5	Oct. 9	Fuzhi Vil, Shilin Dist	Nil	2	Hospital reported	Zhishan Park
Case 14	60	M	Cleaner of Shihlin District	Oct. 1	Oct. 9	Loucuo Vil, Luzhou Dist, New Taipei City	Yongfu Vil., Shilin Dist.	4	Hospital reported	Sec. 2 of Yangde Blvd.
Case 15	21	M	University students	Oct. 2	Oct. 10	Dingdong Vil, Zhongzheng Dist	Linxi Vil, Shilin Dist.	3	Hospital reported	Zhishan Park
Case 16	51	F	Nil	Oct. 6	Oct. 12	Yanshan Vil, Shilin Dist	Nil	1	Hospital reported	Zhishan Park, Huarong Market in Fujia Vil.
Case 17	57	F	Kitchen worker of a Nursing home in Shihlin District	Oct. 9	Oct. 13	Yanshan Vil, Shilin Dist	Yongfu Vil., Shilin Dist.	2	Hospital reported	Sec. 2 of Yangde Blvd.
Case 18	59	M	Nil	Oct. 11	Oct. 18	Dehua Vil, Shilin Dist	Nil	3	Hospital reported	Zhishan Park, Huarong Market in Fujia Vil.
Case 19	70	M	Nil	Oct. 7	Oct. 18	Yong'an Vil, Zhongshan Dist.	Nil	4	Hospital reported	Zhishan Park
Case 20	24	M	Career military	Oct. 19	Oct. 25	Ganzhen Vil, Tamsui Dist, New Taipei City	Yanshan Vil., Shilin Dist.	1	Hospital reported	Zhishan Park, and Sec. 2 of Yangde Blvd.

Note: The numbering sequences of the cases were based on the notification dates.

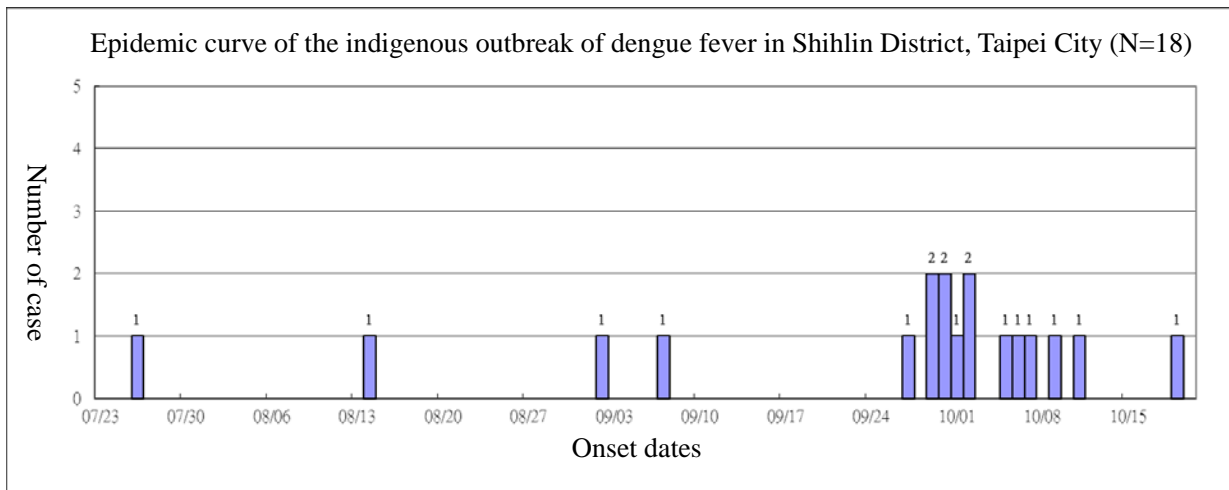


Figure 2. Epidemic curve of the indigenous outbreak of dengue fever in Shihlin District, Taipei City
(Excluding two asymptomatic positive cases detected by expanded specimen collection)

1. Possible high-risk areas

DF is principally transmitted by *Aedes aegypti* and *Aedes albopictus*. The main vector in Taipei area is *Aedes albopictus* which are mostly found in the outdoors, and can breed both in artificial and natural containers, such as tree holes and defoliations [2]. In the rainy season, the mountainous and rural areas in Taipei City are ideal breeding sites for *Aedes*. The results of the epidemic investigation showed that most of the high-risk areas were near the mountains. To analyze the areas where the confirmed cases frequently appeared, we found three possible high-risk areas, including Huarong Market in Fujia Village, Zhishan Park, and Yangte Boulevard in Yongfu Village.

- (1) Huarong Market in Fujia Village: The market was densely populated. Cases 8, 9 and 16 had been to this area during their incubation periods, while Cases 4 and 9 lived close to the market. Staffs were sent to survey the density of mosquito breeding sources, but had not found dengue vector larvae in any containers. The environment of the market was quite clean. Cases appeared to the market frequently probably just because there was the place that residents of Shihlin District used to visit in their daily life. We speculated there wasn't a high-risk location to spread the disease, and excluded it from the high-risk areas.
- (2) Zhishan Park: Case 8 and Case 13 had gone to a river bank together near the park during their incubation periods. Case 8 also went to farm her crops on the riverbed every day. She described the mosquitoes were numerous and bit frequently. Moreover, Cases 15, 18 and 19 had taken exercises at the park during their incubation periods. The result of the mosquito density surveys revealed the container index was higher than level 3 (6-9%). The park faced mountains which were adjacent to Sec. 2 of Yangte Boulevard. Mosquitoes in mountain areas can multiply and grow into adult mosquitoes rapidly under natural unrestricted environment and appropriate climate to spread dengue virus. Therefore, this park could be a possible high-risk area.

(3) Sec. 2 of Yangte Boulevard: Cases 1, 2, 3, 6, 11 and 17 all lived around the Sec. 2 of Yangte Boulevard in Shihlin District, while the Case 4 and Case 5 worked there. This area was close to Yangming Mountain, and the premises mostly located at woodlands or bushes. The staffs investigated in the beginning of the outbreak and found out that the garbage was piled in the open air and weeds overgrew at the hillside. Breeding sources were detected after several mosquito density surveys at different locations in the area. The cleanups to the breeding sources was impeded and more risky due to the growing spaces of mosquitoes were more unlimited in mountains than in urban areas, and snakes or other dangerous creatures would pop in. This wide area needed not only the health personnel to do the disease prevention and control, but also assistance from cross-departmental manpower. We found Cases 7, 10, 12 and 14 were infected at work. Based on the frequency of confirmed cases' appearance, this area accounted for 60% of all possible locations (12 among 20 positive cases) and was identified as a probably high-risk area.

2. Epidemic origins

Shihlin District of Taipei City has not emerged indigenous outbreaks of DF in recent two years. The last confirmed case was a missionary of a seminary imported from Myanmar with a travel history to Myanmar from June 22 to June 30, 2011. The patient presented symptoms on July 1, and was reported by hospital as a DF case on July 8. Confirmation was made on July 9. That case stayed in the dormitory of the seminary in Shihlin District of Taipei City for a long time during the viremic stage. The residences of the Cases 2 and 3 in the outbreak were about 56 meters from the seminary. In addition, Cases 3 and 4 were both staffs of the seminary and might have contacted for a long time. The onset dates of cases with symptoms were on July 26 and August 14. According to the incubation period (up to 14 days) of DF, the vector mosquitoes possibly had existed in that area for a while before the index case was confirmed. Case 7, a staff of Shihlin District Health Center with onset date on September 29, had an interval of less than 28-day after Case 6's onset on September 7, and went to this area for epidemic campaign work at least five days a week, posting the simple and clear exposure and contact histories. Cases 10 and 12 were positive contacts of Case 7 and also the members of the work team on field checking, and then developed typical symptoms of DF. It demonstrated that the people appearing frequently in epicenters bear higher risk of infection with DF.

The 20 indigenous cases of DF were examined with the reverse transcription polymerase chain reaction (RT-PCR) tests by laboratory of Taiwan CDC and further subtyped the virus. Of which, ten cases (Cases 7-11, 13, 15-17 and 20) were all Type 1 virus. The further analysis of viral sequences for Cases 8-10, 13 and 15 indicated a 99.6% similarity with the 2007 Myanmar virus strain. According to etiology investigations on indigenous cases, outbreaks always initiate from undiscovered infected people imported after relative visiting, or travel abroad without follow-up intervention, leading to local spread via household mosquito bites during their viremic stages [3]. Hence this indigenous outbreak of DF is likely caused by imported

cases. As a positive case, a missionary, was imported from Myanmar on July 6, who probably had contacted with Case 4 in the incubation period and had geographical link with Cases 1, 2, 3 and 5, the imported case could be the trigger of this outbreak. However, the factor of untimely control cannot be ruled out. Furthermore, based on the results of viral sequence analysis, the area from Sec. 2 of Yangte Boulevard extending to Zhishan Park covered with natural containers, such as tree holes or defoliations, made vector mosquitoes breed and spread the disease downhill with sporadic cases.

Control measures and response strategies

1. Local health authorities

Since the indigenous index case was confirmed, the Department of Health, Taipei City Government had integrated Shihlin District Office, environmental protection brigade, and community volunteers to remove the vector breeding sources, reduce containers, reorganize the environment and fumigate. As the outbreak gradually expanded, Emergency Operations Center of Taipei City for level 2 responses on the campaign against DF was established on October 3, launching cross-departmental control measures. Sixty percent of cases (12/20) affected in this outbreak were reported after two to three medical consultations. We issued governmental documents to Medical Association and sent health educational posters to medical institutions in order to improve the awareness of early diagnosis and public cooperation. To highlight the public power, a notice of “Avoid mosquitoes breeding, and prevent dengue fever” was released on October 5 to require the citizens to cooperate with Taipei City Government on DF control with necessary penalties according to the Communicable Disease Control Act. Till the epidemic was lifted, the Department of Health, Taipei City Government had ticketed three verdicts based on the notice.

From September 8 to November 20, 11,442 person times were mobilized in outbreak investigation, mapping the hot zones, coordinating households' disinfection, and delivering the fumigation notices door-to-door. At the same time, investigation and cleanup of breeding sources was implemented at the hot zones, the high-risk areas and the messy spots around cases' habitations and work places. Cumulatively, 17,730 mosquito breeding sources had been removed. With regard to the contacts tracing, a total of 268 people was tested in community outreach specimen collection.

For public health education, we used news releases, community broadcasting, red cloth strips and scrolling text marquee at organizations, schools, parking areas and hospitals to strengthen public awareness about DF. We closely monitored the ongoing outbreak in high-risk areas, and conducted daily vector density surveys. In order to avoid the epidemic prevention staffs infected at works, we arranged DF prevention training for epidemic prevention staffs, assistant volunteers, and staffs from Taipei City's 12 district health centers to enhance their protective knowledge, promote the measures, and reduce the risk of morbidity. Totally 3,386 staffs had participated in the training.

2. The central competent authority

For response to the epidemic, the First Branch of Taiwan CDC assigned a taskforce on October 5 to combat DF. The taskforce was divided into three teams, including:

- (1) Epidemic surveillance and investigation team was in charge of epidemic data collection, analysis and determination.
- (2) Maneuverable epidemic control team worked on vector density surveys and rechecking and supervising the vector breeding sources removing.
- (3) Logistics readiness team was responsible for the dispatch of manpower, vehicles and supplies, and the administrative supports as communications.

From October 5 to November 7, a total of 124 person times was mobilized. Breteau / container indexes were higher than level 3 at 31 locations. The results of daily check would be provided to the Department of Health, Taipei City to keep on removing the vector breeding sources.

In addition, we continuously monitored the DF epidemic, invited experts to conduct field surveys, and participated in Emergency Operations Center of Taipei City for level 2 responses on the campaign against DF to offer local governments the timely prevention recommendations as reference of improvement.

Recommendations and Discussion

An indigenous outbreak of DF occurred in Shihlin District of Taipei City in 2011. The factors of spread may be related to geographical environment (mountainous area), untimely intervention on the imported case, and poor awareness and preventive knowledge of public and medical institutes. Therefore, effective control on DF relies on efforts from governmental departments (such as health, environmental protection, education, and civil affairs) and citizens. Even in mountainous areas, we still can effectively avoid the spread of the outbreak if we immediately implement the relevant control measures when an infected case imported in Taiwan. Mountainous areas have geographical environmental limits as fewer premises, vast outdoor space, no barrier, covered with natural breeding sources (such as tree holes, *Alocasia macrorrhizos* and defoliations), difficult to access (such as small coves and steep slopes), and prone to hide dangerous creatures like snakes and rodents, so that it is not easy to remove the natural breeding sources and reduce containers. Also, chemical control is less effective to adult mosquitoes in no barrier mountainous areas and may be hazardous to the natural ecology, as well as may develop resistance on vector mosquitoes. As for Zhishan Park, people from different places came to spend their leisure time so often. Local health authorities were failed to take appropriate measures in the mountainous areas in the beginning, resulting in the spread of the outbreak.

In response to this outbreak, Taiwan CDC invited Professor Xu Er-lie of National Taiwan University, Associate Professor Du Wu-Jun of National Chung Hsing University and Assistant Professor Lin Ying-xi of Yuanpei University on October 21 to explore the affected

areas, providing control strategies including chemical control (spraying after removing the surrounding stuffs and water containers), hedge spraying (residual spraying of organophosphorus agents), tree hole fill, and epidemic announcement to the public. Breeding sources cleanup was still the best strategy.

Since the imported case in a missionary was confirmed, Department of Health, Taipei City Government had launched three times vector mosquito density surveys and cleanups of breeding sources on July 9, 11 and 18. However, many disadvantages in disease control like the vast space of the mountainous area and difficult to remove natural breeding sources may lead the high *Aedes* mosquitoes index and cause the subsequent spread. As for the follow-up control measures, besides to strengthen the removal of breeding sources, chemical control and health education, the Department of Health, Taipei City should warn the public and forced to clear away the illegal plants at the riverbed or mountainous places. So that people take activities here will be vigilant and protect themselves to reduce the risk of infection in these areas.

Up to 70 percent (14/20) of positive cases were diagnosed after repeated medical consultations (on an average of 2.1 times). Their initial choices of medical assistance were all clinics adjacent to their homes or workplaces. Thereby, in addition to promote public knowledge on epidemic and protective measures, medical institutes (particularly the clinics) should also strengthen the alertness of the disease. When an indigenous outbreak begins to spread, without travel histories to high-risk countries of DF infection (such as the Philippines and Myanmar) to provide information for diagnosis, the public or medical institutions' awareness of the local epidemic becomes especially important for management and investigation of the follow-up outbreak.

Another difference from other DF outbreaks is the high infection rate (20%, 4/20) among epidemic prevention staff by mosquito bites on duties with clear causality. The main reasons are that the epidemic prevention staff neglected to use mosquito repellents whenever necessary or insufficiently sprayed, as well as took inadequate protective equipments. The *Aedes albopictus* distributes throughout the entire Taiwan and island-wide circulation of DF has occurred in the past. Compared to the southern epidemic regions of Kaohsiung City and Pingtung County with extensive experience in campaigns against to DF, it is also important for local health authorities of other non-endemic regions to train for epidemic prevention and reinforce the knowledge of protection in peacetime. We recommend to implement educative training and to take logistical and protective measures against DF (such as wear long-sleeved clothes and use insect repellents containing DEET ingredients) before going to the field in the future in order to ensure the safety of epidemic preventive personnel.

Temperature decline was one of the major factors to terminate the outbreak. Low temperature is not suitable for mosquito breeding. Although the mountainous terrain of Shihlin District, Taipei City hampers disease control, the climate there can force the vector to reduce reproduction. Nevertheless, with global warming and frequent international travel [4],

this advantage may gradually disappear. In addition, asymptomatic infection ratio in DF cases is quite high. Therefore, to prevent the imported cases causing the spread of DF, we should implement cleanup of mosquito breeding sources and take epidemic prevention measures in peacetime, and particularly launch the relevant control whenever detect or report imported cases. Timely blocking the second wave of outbreaks from abroad to territory is the fundamental to ensure public health.

Acknowledgements

We are grateful to the staff of the First Branch, the Second Branch, and the Sixth Branch of Taiwan CDC for mobilization on the epidemic emergency. The work was also supported by the efforts of the Second Division and the Vector Biology Laboratory in Research & Diagnostic Center of Taiwan CDC, and the Department of Health in Taipei City Government.

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Outbreak Investigation Express

Investigation of a Family Cluster of Pertussis Infection in Kaohsiung City, early 2013

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Abstract

Pertussis is a vaccine-preventable respiratory disease with high virulence. Clinically, it is not easy to identify because its initial symptoms are similar to influenza. When cases are reported, contacts usually have already been infected, resulting in outbreaks. On January 30, 2013, Kaohsiung City reported a suspected case of pertussis in a 2-month-old boy. After pertussis was confirmed on February 7, the Fifth Branch of Taiwan Centers for Disease Control and the Health Bureau implemented prevention measures. The investigation revealed that his mother had cough since December 26, 2012. She had three medical consultations and was treated as having a common cold each time. Her nasal swab collected as part of contact screening was *Bordetella pertussis* positive, and was confirmed as a case of pertussis. This family outbreak of pertussis was caused by transmission from mother to son.

Keywords: pertussis, cluster, vaccination

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 : Yi-Chun Wu

Telephone No : (02) 2395-9825

Executive Editor : Hsin-Yi Wang, Li-Gin Wu

Website : <http://teb.cdc.gov.tw/>

Address : No.6, Linshen S. Road, Taipei, Taiwan 100 (R.O.C.)

Suggested Citation :

[Author].[Article title].Taiwan Epidemiol Bull 2013;29:[inclusive page numbers].