Taiwan Epidemiology Bulletin

September 6 , 2011/ Vol.27 / No.17

Original Article

Operation Mechanism of the Forward Command Center of the Central Dengue Fever Command Center in Taiwan, 2010

Shu-Hua Huang [1]、Li-Jen Lin [1]
Yi-Chun Wu [2]、Wen-Yi Shih [3]

1. Fifth Branch, Centers for Disease Control, Taiwan
2. Director Secretarial Office, Centers for Disease Control, Taiwan
3. Deputy Office, Centers for Disease Control, Taiwan

Abstract

The dengue clusters continually occurred in Baoshu village of Gushan District in Kaohsiung City and in Xiangyang village of Guanmiao Township in Tainan County since August 14, 2010, ignited the large-scale dengue epidemic in Kaohsiung and Tainan counties/cities. Up to mid-October, a total of 743 indigenous dengue cases were identified nationwide. The number of newly diagnosed cases in three consecutive weeks was even higher than 100 cases per week. The epidemic appeared an increasing trend in number of cases, with no signs of reversion. Therefore, in order to effectively control the epidemic, the Executive Yuan, based on Article 17 of the Communicable Disease Control Act, activated the Central Dengue Fever Command Center (CDFCC) during October 21-December 31, 2010, with a total of 72 days of operation. The CDFCC consists of Administration and Logistics Division, Epidemiological Investigation and Control Division, and Forward Command Centers (FCC). The FCC resided in the Fourth and Fifth Branches of the Taiwan CDC and acted for combating dengue epidemics in Tainan and Kaohsiung areas, respectively. Since the epidemics were under control and presented in a stable situation, the FCC submitted a request for ending its operation on December 24. This report describes in detail the actions taken during the operation of the FCC initiated in response to the epidemics, including topics on classification of missions, epidemiology analysis and counselor, enforcement of government power, manpower scheduling and management of the Mobile Task Force, logistics and supply, health education, public complaints, response to public media, source reduction,

INSIDE

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
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].

tracking the completion of monitored items. This report described the practical experience, faced problems, and recommendations in narrative style. The lesson we have learned from the activities includes that the occurred epidemic is the best scenario for practicing the team cooperation between central and local governments; to establish good channels for interior, exterior, horizontal, and vertical communication and coordination is helpful for ensuring consistence of orders and messages; the enforcement and implementation of government power can not be performed merely based on the Communicable Disease Control Act; to conduct mobile health dissemination with multiple channels and local language is more effective; we should keep sensitive to media news or public complaints that may occur at all times and carefully respond to each of them; and we should adjust the combat tactics along with the evolution of epidemic, define the “war zone” and aggregate experts experienced in dengue control for these areas, and establish indicators for evaluation of combat results. We recommend that the application of epidemiological analysis and determination of overall epidemic situations should be practiced with more advanced technology and provided in a more timely manner; the procedures for issuing Penalty Notice should be simplified and the time needed for approving of official documents should be decreased; source reduction program should be included as part of the dengue control activities at the usual time in the environmental protection unit, public health unit, and schools; special hotline should be set up in the CDFCC to provide public with a channel for making a complaint or raising a question about the issues of environment protection or public health.

Keywords: dengue fever, forward command center, cluster infection, operation mechanism

Introduction

A total of 1001 dengue cases (743 indigenous cases, including two deaths, and 258 imported cases) were reported nationwide in Taiwan during January 1 (1st week)-October 16 (41st week), 2010, which is higher than 306 cases (139 indigenous cases and 167 imported cases) occurred during the same period in 2009. The number of newly diagnosed cases was even higher than 100 cases per week in three consecutive weeks in 2010, with the highest number of cases, 134, in 41st week [1]. Most of the cases (703 cases) in 2010

occurred in counties/cities of southern Taiwan, including Kaohsiung City (418 cases), Tainan City (193 cases), Tainan County (72 cases), Kaohsiung County (18 cases), and Pingtung County (two cases). Of these counties/cities, Kaohsiung City and Tainan City recorded the highest increase in number of cases and entered a high epidemic period. The number of imported cases in 2010 was also the highest in the history, as compared with those occurred during the same periods in previous years. Moreover, all the four serotypes of dengue viruses have been continually isolated from the indigenous cases. This situation may increase the risk of dengue hemorrhagic fever in cases that are repeatedly infected with different serotypes of dengue virus. In addition, the factors of the tropical wet climate with high temperature and humidity in southern Taiwan, and the mayoral election campaign activities will even threaten the dengue epidemic that have been growing rapidly, just like the instances of large-scale dengue epidemic that occurred in 2002 and2006.

In response to the epidemic, the Department of Health (DOH), Executive Yuan, Republic of China (R.O.C.), in consideration of the necessity to integrate various available resources and coordinate relevant personnel in different units for strengthening dengue control and preventing further spread of the epidemic or even a large-scale epidemic, initiated the Central Dengue Fever Command Center (CDFCC) on October 21, 2010 on the approval of the Executive Yuan according to Article 17 of the Communicable Disease Control Act [2]. Mr. Wen-Yi Shih, deputy Director of the Centers for Disease Control (Taiwan CDC) of the DOH, and Jian-Rong Lai, Head of the Southern Branch of the Bureau of Environmental Inspection of the Environmental Protection Administration (EPA), Executive Yuan, R.O.C., were assigned as the Co-Commanders of the Forward Command Center (FCC); and Mrs. Yi-Chun Wu and Mr. Li-Jen Lin, the Directors of the Fourth and Fifth Branches of the Taiwan CDC, respectively, were both designated as the deputy Commanders. The Fourth and Fifth Branches of the Taiwan CDC were used as the base of the FCC, where the deputy Commander conducted an integrated on-site command to assist local governments to effectively enforce dengue control program by coordinating resources in central and local governments and in community. The dengue epidemic trend appeared a reverse pattern start from the 48th week. The number of newly identified cases decreased in a ladder type in two consecutive weeks and reached to less than 50 cases per week. Since the epidemic in Tainan and Kaohsiung Counties/Cities were under control and presented in a stable situation, activated the Central Dengue Fever Command Center (CDFCC) during October 21-December 31, 2010, with a total of 72 days of operation, and returned the dengue control works to local governments for continuous implementation.

During the duration of the FCC operation, the Fourth and Fifth Branches have integrated all available manpower and grouped the missions into several divisions

in order to effectively implement orders made by the commander of the CDFCC and FCC and to perform other emergency response to the epidemic. This report describes the facts and experiences in the implementation of dengue epidemic control by each division of the CDFCC and FCC through the written statement and figure or table presentation for future reference.

Missions and structures of CDFCC and FCC

The CDFCC consists of Administration and Logistics Division, Epidemiological Investigation and Control Division, and Forward Command Centers. (Figure 1) The missions, structures, and manpower arrangement for the FCC were decided in reference to the missions in each division of the CDFCC and based on the capacity of the Fourth and Fifth Branches and the epidemic situation in their individual region. Therefore, the components in the FCC include Supervision and Evaluation Division, Mobile Task Force, Administration and Logistics Division, and Epidemiological Investigation Division (Fifth Branch) or Staff Counselor Division and Vector Control Division (Fourth Branch). (Figure 2, Figure 3) The detailed descriptions for each of the divisions are as follows:

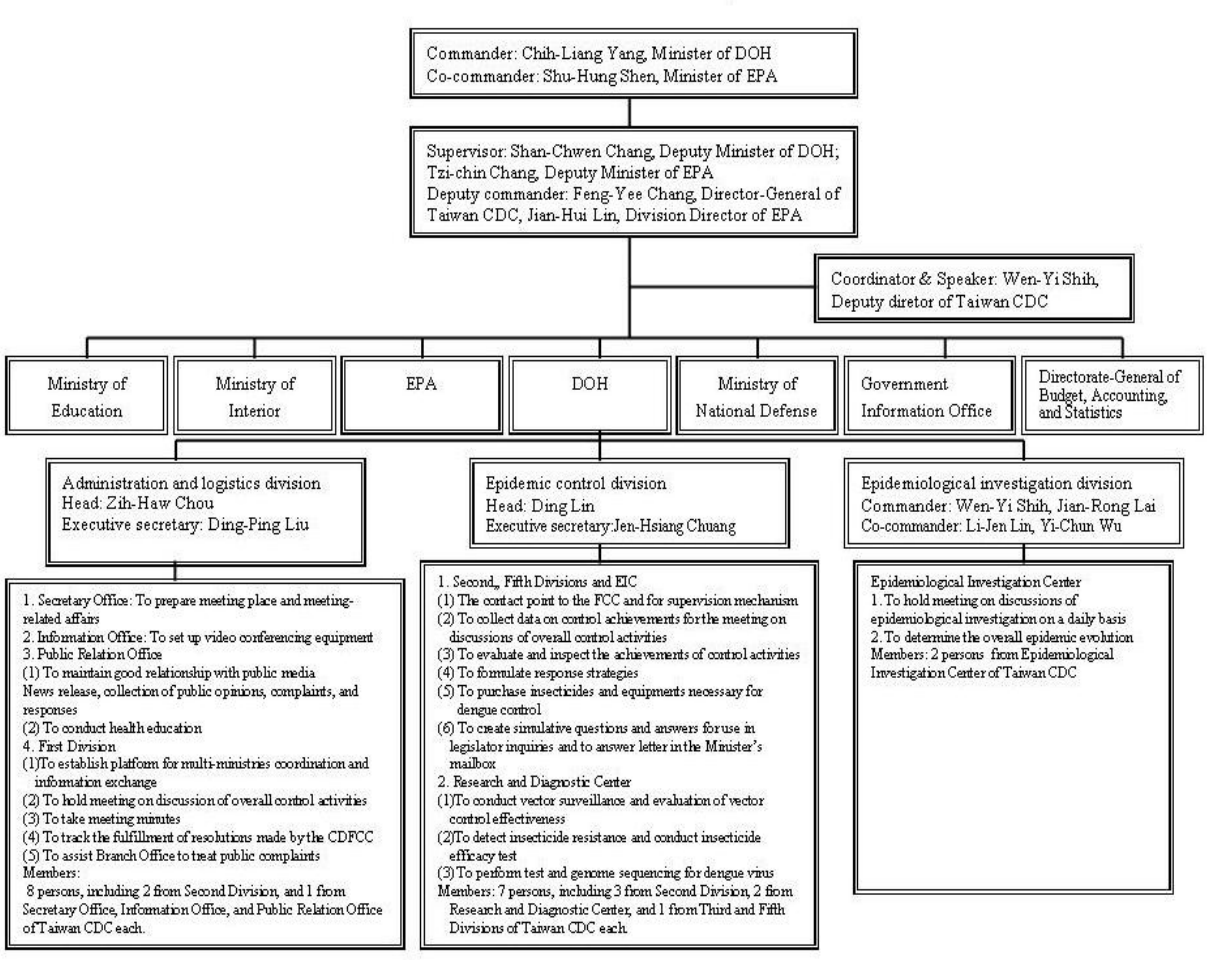

Figure 1. Framework of the CDFCC, 2010

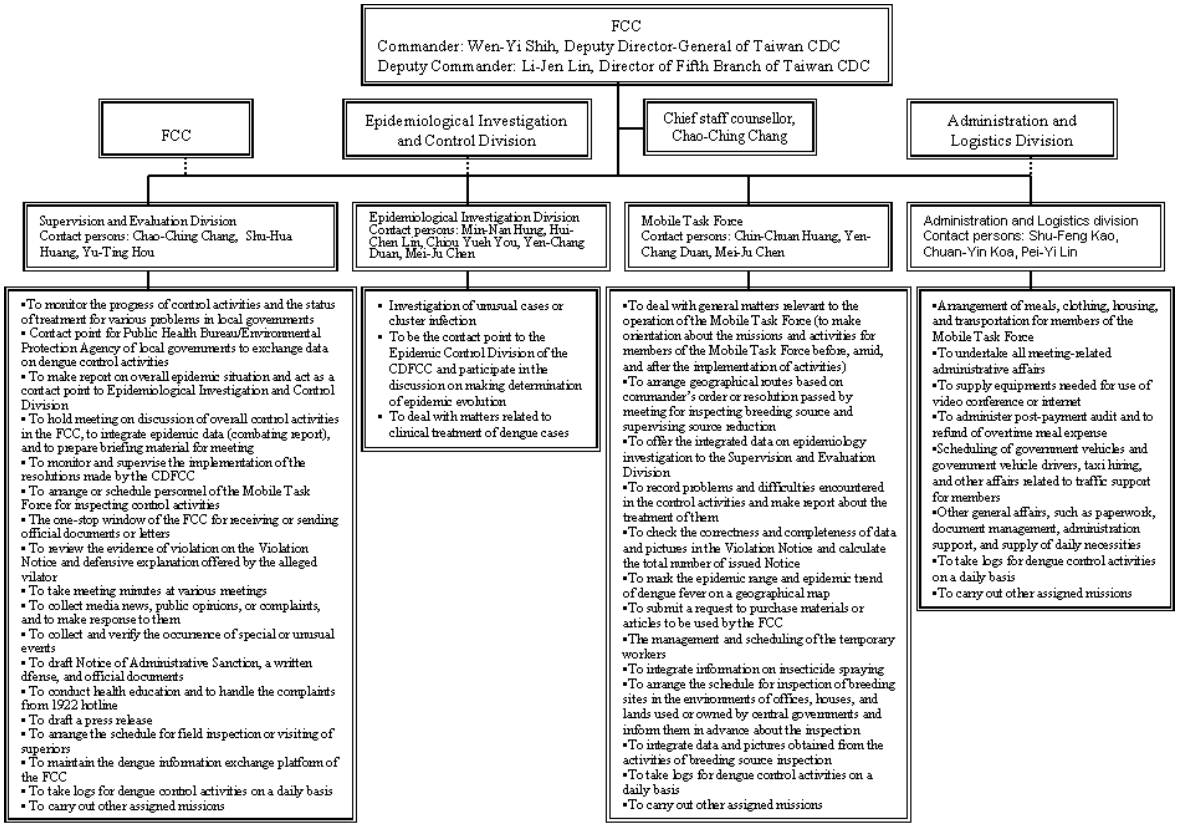

Figure 2. Framework of the CDFCC at Fifth Branch, 2010

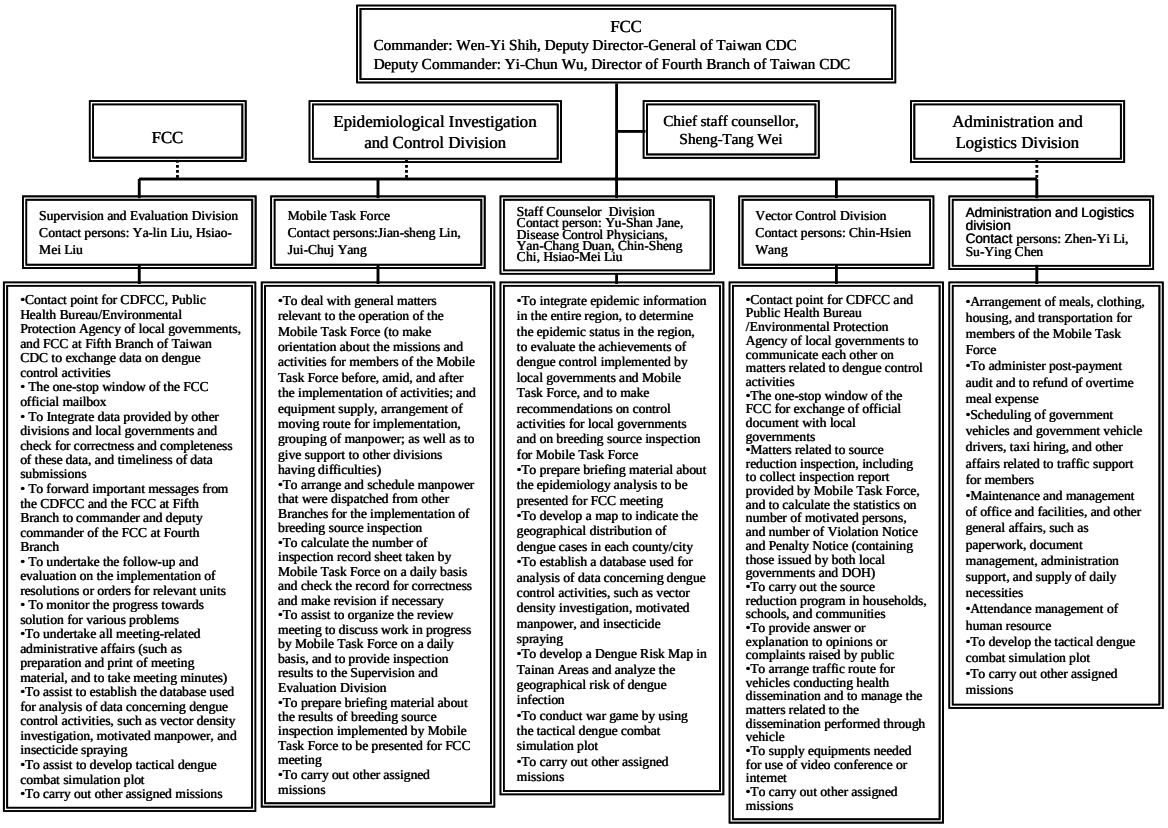

Figure 3. Framework of the CDFCC at Fourth Branch, 2010

A. Supervision and Evaluation Division

Missions for Supervision and Evaluation Division include collection and analysis of data on epidemiological investigation; recognition, dissemination, and implementation of message and order from the command center; follow-up of matters under supervision and monitoring; preparation of briefing materials and meeting materials, taking meeting minutes, and doing paperwork or general affair.

(A) Collection and analysis of epidemiological investigation data

Although the Epidemiological Investigation and Control Division of the CDFCC would provide report on nationwide dengue occurrence at 6 p.m. each day, the so-called dengue combating report [3], some other data were unavailable because of the limitation of the information exchange platform between local governments and the Taiwan CDC. Therefore, we would have to apply Access and Arc GIS software to combine and analyze data from multiple sources, and from the analysis, to identify the work places and activity history common to the cases during the communicable duration, and the temporal or geographical relationship among cases, or the geographical distribution of the cases. These analyses allow us to provide commander and counselors of the FCC with timely information for them to make decision on the control strategies and to offer mobile dengue control task force for them to arrange routes for conducting vector breeding site reduction and for evaluating the performance of source reduction.

(B) Enforcement of government power

From many years of practices on dengue epidemic control, we perceived that part of the residents in epidemic areas were not active enough in cleaning of vector breeding sites and the law enforcement power in local governments were usual very weak. For some residents who refused to cooperate with or even inveighed against public health officers over dengue control practices, or who objected signing their tickets, local governments always treats them in a way of tolerance or admonition instead of punishment. The CDFCC considered that government facilities in epidemic areas affiliated with the central governments should set a good example for and be a positive influence on general public in terms of vector breeding site elimination. Therefore, the CDFCC decided to first conduct inspection of breeding sources to facilities owned or used by central governments, and to punish those of violators in lieu of the local governments according to Article 75 of the Communicable Disease Control Act [2], showing the government power to general public and, then, allowing government to take more strict requirement to the public on the implementation of environmental sanitation self-management. In addition, since the Form of Supervision and Inspection Record on Vector Breeding Source Elimination used by Mobile Task Force of the Taiwan CDC did not have legal basis in imposing a penalty for violation citizens, the Taiwan CDC, therefore, instituted the Procedures for Imposing Administrative Penalty and Criteria for Issuing a Penalty for Violation of the Communicable Disease

Control, the Notice of Violation of the Communicable Disease Control Act (Violation Notice), and the Notice of Penalty (Penalty Notice). Generally, the Violation Notice was issued by the Mobile Task Force and, then, was handed to Branches of the Taiwan CDC for issuing Penalty Notice.

Although Taiwan CDC has formally informed other Ministries in central government and required them to strengthen the performance of vector breeding source elimination and to provide relevant training for their staff involving source reduction, and again reminded them of taking the responsibility for source reduction by making a phone call before undergoing the breeding source inspection, part of the Ministries were still issued a Violation Notice for not actively eliminating breeding sources in the environment in their facilities for the reason of lack of manpower and a wide geographic areas owned by the ministries. In addition, based on previous experience that some penalty previously issued by local health authorities have been judged invalid by courts, which the judges said that it is illegitimate to punish the landowner when the defendants are those of owners, managers, or users of the facilities who are fail to eliminate the vector breeding sources, Mobile Task Force should first recognize violation of the regulation and carefully collect relevant evidence before issuing a Violation Notice, and should give the alleged violator the opportunities to provide explanation before issuing a Penalty Notice. In other words, the Violation Notice and Penalty Notice should be issued in consideration of the evidence, and in reference to the alleged violator's explanation or experience-based rules.

(C) To push source reduction activities inside and outside the household, in school, and in community

Based on the concepts of "to solve the problem by using the fundamental solution, to win a combat by having an overwhelming advantage in numbers" and "risk management," to eliminate the large amount of Aedes mosquito breeding sites is the most basic way to reach the goal of controlling dengue epidemic. This could be done by pushing the source reduction program through integration of resources in, and joint participation of, relevant authorities in local governments (such as the Bureaus of Civil Affairs, Environmental Protection, Education, Information, and Health, and District Office). Since this was the first program initiated in dengue control, relevant authorities in local governments, in the implementation process, needed to actively communicate and coordinate with each other, sufficiently clarify any questions and concerns about the program, and keep flexibility. Moreover, governments should teach students, parents, and general public about what kind of containers are the favorite breeding sites of Aedes mosquito and let them know the importance of source reduction and breeding site elimination. We also suggest that local governments should first promulgate the entire contents of the source reduction program or strategy before it was implemented, including the date of transportation for the removed containers; the target number of containers removed, such as "five containers for each house;" criteria for

giving rewards or punishment to participants; involved government authorities (such as Bureaus of Civil Affairs, Environmental Protection, Education, and etc.); and the main geographical areas involved, such as giving priority to the areas of township/district/village (including schools in this areas) with serious epidemic.

(D) Treatment of opinions and complaints from the general public

The mailboxes of Minister of the DOH and General Director of the Taiwan CDC, and 1999 hotline in local governments and 1922 hotline in the Taiwan CDC have always been all the channels currently available for general public to express their opinions or complaints about dengue control activities. We have received more opinions or complaints during the CDFCC activated period than usual time. The highest percentage of them was those related to the problems of vector breeding source elimination and insecticide spraying. All these problems were forwarded to the competent authorities to get further understanding and to provide suitable solutions. On receiving the complaints from general public, personnel in charge at governments should handle them based on the following principles: listening to their voices carefully, investigating the real facts objectively, communicating and coordinating with them sufficiently, offering explanations and suggestions euphemistically, and documenting the treatment process and making a continuous follow-up of the event. When facing complaints, questions about the reality of the Violation Notice from the public, or even threatening of lodging the complaints with public media, personnel in charge should communicate with the complainants in a calm and euphemistical manner, and then carefully investigate the fact and circumstance of the event to make sure whether complaints have really been dealt with illegally or inappropriately. If it is necessary, the responsible personnel can seek assistance from other team members. The most important thing that should be kept in mind is never having a verbal disputation or acting evasively in dealing with public complaints.

(E) Health education and multi-channel dissemination

The contents of health education should be made in reference to updated epidemic situation, local culture, native language, and resident’s life style and customs, and should be released through various channels and a systematic plan on the time and traffic routes for dissemination to remind residents of the importance of conducting source reduction and breeding source elimination at any time. During the operation of the FCC, the recordings of broadcast tapes for health education were prepared with multi-language, native Taiwanese and mandarin, and voiced by the commander and deputy commanders of the FCC. These tapes were broadcasted in villages with similar epidemic situation by renting mini-truck or through garbage truck during the garbage collection service in the communities. In addition, the interior and exterior of the vehicles for public transportation, internet, electric media, and flyer were also all used as the channels for health education dissemination. Furthermore, under the assistance of the Southern Taiwan

Joint Services Center, Executive Yuan, the commander and staff counselor of the FCC have received interviews with radio stations, television stations, and campus clubs talking about the topics of “infectious disease control” and “dengue control” to explain updated dengue epidemic situation, dengue control strategies employed by central and local governments, and matters related to dengue control and needing more supports from general public, reaching the goals of effectively disseminating information on dengue control activities.

(F) Taking meeting minutes, tracing the implementation of meeting resolutions, monitoring public media for relevant news

To provide accurate, consistent, complete, and timely messages for members in a team is the most important rule in document management, and it also a determinant to examine the team ability in vertical and horizontal communication and coordination and the team effectiveness in response to and cooperation for disease control. The fighting pattern and response strategy of the FCC were changed in different stages based on the dengue epidemic evolution. Therefore, Supervision and Evaluation Division has to push relevant units or other divisions to accomplish the assigned works in its due time, and collect reports documenting the implementation and achievement concerning these works from the responsible units or divisions and timely submit the integrated report to superior for reviewing. When preparing the briefing materials on dengue control progress in local areas for working meeting of the FCC, the combat strategies, strategy implementation, and comprehensive evaluation on the situation in the field of dengue fever control made by the FCC needed to be included, except that the actions taken and accomplishments obtained by Tainan and Kaohsiung counties/cities should be described. These briefing materials were then submitted to the CDFCC for them to update the progress of dengue control. Planning and control of tactic for fighting dengue in the FCC is shown in Figure 4.

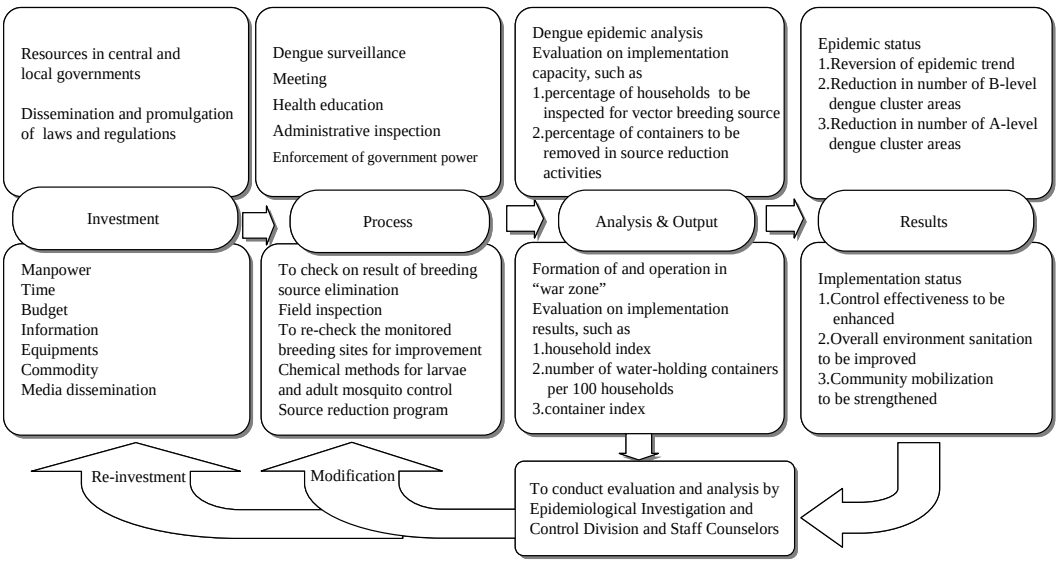

Figure 4. Planning and control of tactic for fighting dengue in the FCC

A working meeting was held via video conference by the FCC at 5:00 p.m. every day with the CDFCC, the Southern Branch of the Bureau of Environmental Inspection of the EPA, and local governments. Each of these authorities would have to send electronic files describing the updated implementation of dengue control one hour before the meeting to the e-mailbox specifically created for FCC operation. These files were first checked for their correctness by one nominated person and then were printed out and submitted to the commander of the FCC for reviewing. The transmission of the files sometimes can be delayed due to the problems of personnel, time, or internet communication. In this situation, the supervisor should be informed immediately of the problems, and the units with the problems were asked to first give an oral report and send the supplement at a later time. The minutes of the working meeting should be taken based on principles of faithfulness, expressiveness, elegance, and timeliness, and should complete the commander's approval within one day. For some assigned matters or emergency incidents, the Dashboard for Monitoring Solution and Completion of Assigned Matters, and the Problem Submission Form should be created so that they can be forwarded to relevant units for subsequent implementation and updating the completion status of these matters.

The monitoring of and timely response to public opinions covered by public media was one of the most important missions. Any news or opinions related to dengue control were the objects being monitored no matter it was covered by two-dimensional media or electronic internet news, and whether it is displayed in front page or other sections. To manage issues covered in the news media, we should keep high sensitivity and respond rapidly and assertively to them. In some occasions, we might need to reversely interpret the news to know the implication of it. In any cases, we would first have to know the fact immediately, to clarify the truth, and provide timely response to the news or opinions, so that the analysis on effectiveness of epidemic control activities and the decision-making of the control strategies would not be influenced.

B. Mobile Task Force

(A) Establishment and missions

The Mobile Task Force was composed of personnel from the divisions, centers, and branches of the Taiwan CDC, the operation mechanism and missions of the Mobile Task Force was changed based on the scale of the epidemic of indigenous dengue cases. In referring to the experience of dengue epidemic control in 2002 and 2006, owing that 2010 was the year of local political election held in a four-year interval, and because of the A-level dengue cluster occurred in July in Gushan District of Kaohsiung City, the Mobile Task Force was activated on July 19, 2010, earlier than in previous years. In practice, the operation of the Mobile Task Force was divided into several sections by time, three days each. Eight persons were dispatched for each section to conduct breeding source inspection and to collect epidemic information, especially, the inspection of breeding sites in the environment of offices, houses, and lands

used or owned by central governments. In response to the epidemic evolution, the operation of the Mobile Task Force was expanded to five days and nine persons for each section. In addition, Taiwan CDC recruited 20 persons working on temporary basis on 7 October to implement the inspection and cleaning of breeding sources and relevant dengue control activities in the areas where the aggregated dengue cases occurred. A-level or B-level dengue cluster have continually emerged in Tainan County/City since 14 August, and no evidence of reversing the trend of dengue epidemic in Kaohsiung City was found, so the DOH activated the Center Dengue Fever Command Center on 21 October for the purpose of effectively containing the spread of dengue infection. The Mobile Task Force was, therefore, strengthened by expanding its activity span to eight days and 13 persons for each section and acted for four major missions, including supervision of field dengue control implementation, community diagnosis, inspection of breeding source in the offices, houses, or lands used or owned by central governments, and joint inspection conducted with the EPA on breeding sources. In practice, the first mission of supervision was to examine whether the emergency control strategies and control approaches have been appropriately implemented by local governments, and the purposes of community diagnosis was to make assessment on risk of infection and to identify large hidden breeding sources. The Mobile Task Force would upload documents about the inspection results, breeding sites needed to be continually monitored for improvement, and pictures of the found breeding sources to information exchange platform before 4:00 p.m. every day, and would attend the videoconference meeting held at 5:00 p.m. After the end of videoconference meeting, the resolution or other matters considered by the meeting to be continually monitored on their improvements would be transferred to the one-stop window shop in local governments that were required to complete these resolution and matters in due time and to inform the Mobile Task Force of the completion. The monitored resolution or matters will be removed only when they were improved and re-checked by the Mobile Task Force.

(B) Achievement and efficacy evaluation on chemical insecticide spray

To evaluate the achievement in dengue control activities, data on number of water-holding containers per 100 households, household index, container index, and source reduction were collected and offered to commander and staff counselors for reviewing and analyzing, and, by using its results as a basis, for making recommendations and formulating strategies to strengthen dengue control activities for local governments. In order to block dengue epidemic from overwintering, the Kaohsiung City government initiated the Winter Dengue Virus Termination Program intending to totally eliminate dengue vector by using disposable insecticide spray can. This program was supported by the CDFCC and the evaluation of efficacy of the insecticides used in this program was conducted with the assistance of the Administration and Logistics Division of the CDFCC. The

Mobile Task Force was designated to co-implement the evaluation of insecticide efficacy before and after the insecticide spray. During the entire evaluation process, the selection of control group was decided depending on the epidemic evolution, so the Mobile Task Force will have to stay in a highly mobilizable position and be ready to combat at any time. Therefore, all the components of manpower allocation, working procedures, communication and coordination, or management of incident event should be considered entirely and make simulation for helping commander to make decision in practical operation.

(C) Management model and management practice

In management practice, the slogan "Disease Control Is Just Like A Battle, to Be Consolidated, Specialized, and Toiled for Winning" was placed at the heart of team spirit, and the Spartan model was adopted in the management of team members to build up the authoritative leadership and administrative ethics. The team members were aggregated at 8:00 a.m. every day, and then undertook the inspection of personal belongings or instruments necessary in work, made sure personal missions by iterating the items of the given task, and accepted the assigned contingency missions. In this aggregation, superiors often used fable story, Buddhism philosophy, or real-life story as an example to encourage members in the FCC, to lift team's morale, and to consolidate minds of members on common ground. Before the start of doing everyday activities, the Mobile Task Force will provide map showing the locations for implementation, and assign the important items for completion, geographical spot of being monitored, and other relevant information, so that every members will definitely understand the message and correctly implement missions. Newly arrived members in each section of the Mobile Task Force will have to take part in the before duty orientation at the first day to listen to the lectures provided by vector experts and seeded members on topics of dengue vector ecology, vector control methods, and potential blind corner in vector control activities. If necessary, a situation simulation or field instruction will also be offered to make progress in work attitudes and capacities. In the activities of fighting dengue fever, members will inevitably confront frustration or conflictions. In this situation, the timely assistance from the members in staff team for settling conflictions and dealing with frustration is indispensable.

C. Epidemiological Investigation Division (or Staff Counselor Division)

Given the rising epidemic and the rapid increase in number of villages newly affected, commander of the FCC regrouped team members and adjusted operation pattern in late October, which staff counselor was created. In addition, with the concept of "war zone," the villages with severe epidemic were divided into several blocks which the data on previous and current epidemic were analyzed and the effectiveness for the epidemic control was evaluated. Based on these analysis and evaluation, a solid recommendation for control strategies and methods was

formulated and provided to health authorities in local governments.

(A) The role and missions of the staff counselor

The role and missions of the staff counselor included to evaluate epidemic situation and to delimit the “war zones,” to evaluate control activities in the “war zones,” to select villages for undergoing community diagnosis, to compile a map showing the risk of dengue epidemic, and to evaluate effectiveness of control activities in critical time point.

(B) Methods of implementation

These missions could be reached through the activities as follows: to collect and analyze epidemic data to evaluate epidemic evolution; to delimit the “war zones” and check the control activities in these zones to provide information for community diagnosis and achievement evaluation; to discuss issues on epidemic control with the CDFCC,; to participate in regional meeting specifically organized for staff counselor and members of the other divisions; to share data base built by staff counselor and to join the discussion and analysis of the data.

(C) Implementation courses and achievements

Based on the demand in different time period and different stages of epidemic, the implementation courses and achievements were changed. They are described as follows:

a. To evaluate epidemic situation and to delimit the “war zones”

The “war zones” were decided based on the definition of the “affected areas” in the Dengue Control Guidelines [4] and the trend of dengue epidemic in the areas. They included Sanmin and Wanchang war zones in West Central District, Wennan war zone in South District, and Guoxing war zone in North District of Tainan City; and Sanwan war zone, Sanxin former war zone, Lingzheng war zone, and Ruizhu sub-war zone in Kaohsiung City.

b. To set relevant indicators and to evaluate control activities in the “war zones”

The 2010 Guideline for the FCC to Evaluate Local Governments’ Dengue Control Activities in War Zones was completed. Information on process and actions of dengue controls in relevant villages of each district, and various parameters and measurement indicators were collected, and an evaluation on control activities in the war zones was conducted. The indicators having been created include the first indicator (percentage of households that the vector source inspection have been completed) and the second indicator (percentage of containers that have been removed in source reduction activities) for evaluation of implementation ability, as well as the first indicator (household index), the second indicator (number of water-holding containers per 100 households), and the third indicator (container index) for evaluation of the achievements in dengue control. In addition, the percentage of containers that have been removed in source reduction

activities was also used as one of the indicator for the evaluation of achievement. The achievement evaluations in the war zone were conducted by using various indicators, and the results obtained from evaluation and the recommendations on improving control action made on the basis of the results were offered to each war zone for attracting their attentions and being used as a reference in adjusting dengue control strategy.

c. To compile a map showing the risk of dengue epidemic

The compilation of risk map, and the identification of areas sharing the same risk and co-controlled by different district offices were made based on the number of dengue cases in previous years and the community data. The risk map and the co-controlled risk areas were sent by the CDFCC to local governments as a reference for planning dengue control activities.

d. To complete ecological file by applying the geographic information system (GIS) mapping software

The map indicating the spots that has high epidemic risk and should be closely monitored was established by using two different GIS software package (the West Central District and Tianhou co-controlled risk area in Tainan City were taken as an example by the Fourth Branch of Taiwan CDC in the application of the map). The map was then offered to communities as a reference for establishing the monitored and traced areas in the future.

e. Analysis of the dengue epidemic and its control activities in previous years

To analyze the historical data, we first set the definition of the variables, the indicators for achievement evaluation, and the relevant parameters. The historical data base from villages without dengue cases during the past ten years and part of the co-controlled risk areas during 2007-2009 was used to analyze the difference in community characteristics, humanitarian attitudes, household environment, and control activities between the two areas. Moreover, the relationship between the control actions taken at the critical point of dengue epidemic and the success or failure in dengue control, and the issues regarding the dengue epidemic and the control strategies in response to the epidemic in Kaohsiung and Pingtung areas in 2009 were explored. Hopefully, the valid indicators of evaluating the performance of dengue control activities would be established through the process of these analyses.

D. Administration and Logistics Division

Based on the principles of administering regulation according to the law, giving priority to dengue control activities, and managing working practices in a flexible pattern, the Administration and Logistics Division was responsible for the minions as follows: (A) Attendance management of human resources: The division would have to obtain name list of the members of the Mobile Task Force in advance of the dispatching for each section and inform the

relevant human resources management units of the list, and would offer different assistance based on the demands of the members, such as overtime work application, and giving and lifting the rights of login in electronic attendance management system. (B) Logistics supplies: The division should understand the detailed specifications of the wanted products before making a purchase by communicating with units intending to use them so that the price inquiry and price negotiation could be completed smoothly and the products and equipments with reasonable price and suitable for business use could be bought. (C) Arrangement of lodging and meals: The division would first talk with reputed hotel operators about the number of rooms necessary and the flexibility in the number of rooms. Meals or drinks should be purchased from manufacturers obtained health certificates from health authorities. Moreover, the division would need to pay attention to the members' health and the provision and quality of drinking water at all times. (D) Vehicle scheduling: Except that vehicles running for the function of picking up superior to the field for examining the progress of control activities and for official use of persons involving dengue control should be designated, vehicles used for business other than dengue control or for emergency purposes should be arranged flexibly based on the consideration of the available drivers, vehicle conditions, fuel costs, and overtime pay and expenditure for overtime meals. If necessary, a rental vehicle or taxi could be considered in dealing with the needs for fulfilling assigned contingency missions. For example, for a group with four persons, it was more economical and had a higher mobility to hire a taxi than to use vehicles owned by the offices. Moreover, this arrangement would allow the drivers in the offices to have sufficient time for rest, and, therefore, to be able to provide high quality and safety services. (E) Facilities management and mechanic scheduling: To ensure a clean and high quality office environment, to assist to construct the office room for the FCC commander and the discussion room for the Mobile Task Force, and to install equipments for communication and internet use were all the jobs for the division. In addition, the division should periodically conduct inspection and maintenance of the equipments for official use, and rapidly repair or restore equipments with problems incidentally occurred during operation. The mechanics should be scheduled flexibly and given different missions based on the personal traits to maximize the team capacity in dengue control. (F) Hiring and managing vehicles for dissemination use: Although this item was not a part of Taiwan CDC's regular job, the Taiwan CDC has the responsibility to supervise its implementation. The major work in this item included to build up a specific one-stop window to administer the driver attendance management, to create a mechanism for checking the performance of the drivers (such as assigned a specific person or member of the Mobile Task Force to check the performance and make record), and to offer a map indicating the driving route for dissemination on a daily basis.

Discussion and Recommendation

A. Data integration, timely analysis, and application

(A) Horizontal Integration of data from multi-surveillance systems and their applications: The epidemic was closely monitored through the multi-surveillance systems. However, although data on dengue fever could be obtained from several surveillance sources, the data input was changed among these sources, depending on the surveillance purposes, time interval for data collection, and the nature (active or passive) of the surveillance system. For example, the National Notifiable Disease Surveillance System required that the data of newly diagnosed dengue cases should be actively imported into the system within 24 hours of diagnosis. In contrast, the Vector Breeding Source Monitoring System can only passively and periodically receive data because of the time gap needed for local health authorities to make a selection about the monitored spots and to send feedback on the system. That is to say that when a newly diagnosed dengue cases was reported, the relevant data of the cases were not definitely available on the Vector Breeding Source Monitoring System. Therefore, how to horizontally integrate data from multi-system into a specific data base system to maintain and manage large amounts of data and to allow the users to be able to promptly obtain the data based on the different demand of them have been the issues needed to be resolved urgently.

(B) System-to-system data exchange system between central and local governments

In order to effectively implement dengue control program, most of the local governments have established an internal platform for the purposes of surveillance data input, management, and analysis, such as data on vector density investigation, and follow-up of monitored items, including large-sized breeding sites and dingy places, and locations at high risk of epidemics. We wonder whether it is possible to establish a system-to-system information exchange platform through system connection software, just like the Taiwan Nosocomial Infections Surveillance System, so that data on vector breeding sites and monitored items can be obtained immediately from local governments by uploading them through the platform and the problems of data input repeatedly performed by health workers in local and central governments can be decreased or avoided.

B. To simplify the workflow of the electronic official documents to elevate the processing efficiency

Because of the limitations of the current electronic official document processing system, the official document sent in the name of the DOH could not be worked out directly through the system at the Branch office of the Taiwan CDC. The format form for making this document did not exist even in the system, and some elements, such as series number of the document, address of the DOH, and the space for indicating the title of the

document's attachment will have to be manually added to the documents during the process of writing the official document. Therefore, we recommend that the current electronic official document processing system should be simplified to improve the efficiency of the administrative workflow and to avoid the long interval between the occurrence of the violation and the receiving of the Penalty Notice, which was resulted from the unsuitable computer interface between central and local governments and from the complicated workflow.

C. The time-point for implementation of source reduction

(A) Recognition of responsibility of disease control: A small part of residents, parents' association of the school, and government units did not favor to encourage students in elementary schools to participate in the source reduction activities because they thought that dengue control was the responsibilities of the environmental protection agency and the health departments of the governments, the dengue vector breeding sources was unlikely to be found inside household or in school, and the students might have chance to acquire infection in the implementation of sources reduction activities. Once these concerns or an uncooperative attitude have happened, we would have to instruct local governments to strengthen the horizontal communications among the bureaus or departments. If necessary, the environmental protection agency and the health department should provide explanation of the importance of source reduction and the ways to prevent infection in a communication meeting so that these wrong concepts and attitudes would not continue to expand and influence the performance of disease control activities.

(B) Time-point for implementation of source reduction: The implications for source reduction were to take prevention measures before the occurrence of dengue fever and to eliminate the places good for breeding of dengue vectors. We recommend that school should encourage students to conduct source reduction on ordinary occasion to allow students to have opportunities to know the importance of dengue control from their daily activities. Should dengue epidemic occur, whether the health department or the environmental protection agency or the school would more actively strengthen the implementation of the source reduction activities.

D. To set up a temporary one-stop hotline to handle public complaints during the period of combating dengue epidemic

(A) The current hotline 1922 was almost jammed due to a large number of simultaneous calls during the period of combating dengue epidemic. Although most of the complaints were resolved after being forwarded to local governments, the management processes, including forwarding the complaints to relevant agency, tracking

the resolution of the complaints, replying the resolution to the complainants, and removing from the list of complaints monitored for resolution, were a time-consuming work and have increased the manpower loading of the Branch office, and the long processes have given the public a negative impression of the administrative efficiency of the FCC. We, therefore, recommend that, during the period of the combating dengue epidemic, a special hotline run by specifically assigned persons should be set up in the CDFCC to provide public with a channel for making a complaint or raising a question about the issues of environment protection or public health.

(B) A professional and accountable one-stop window: Usually, it is required that the public complaints have to be resolved within a limited time period, and beyond that, the complainants raising complaints either from phone call or written letter during the critical period of the dengue epidemic and the period of actively enforcing government power were more emotional than those in ordinary occasion. They often even inveighed against public health officers or provoke them to lodge the complaints with the court. Undoubtedly, these complaints have created huge pressures on the persons in charge of them. Therefore, we recommend that governments in peacetime should train personnel skilled in communication, coordination, and problem-solving.

E. To maintain accurate and timely information on progress of dengue control

(A) To be the winner in a combat field, collection and analysis of information on the overall progress of the combat are the most important missions. We recommend that the framework of the CDFCC should be in flat type. For example, the Epidemiological Investigation and Control Division currently included in the CDFCC can be resided in the FCC or directly created a new component, Combat Information Analysis Division, to be responsible for the integration of intelligence, analysis of the combat information, making suggestion on combat tactics and action plans, and to proximately provide the commander of the FCC with timely, important combat information or superior strategies.

(B) For some information not so emergent or important to the implementation of dengue control, the approving procedures should be simplified and the submission frequency should be reduced so that the superiors and commander could immediately update the epidemic information.

(C) To ensure the completeness and timeliness of the information, the instances of sending a wrong message or delaying the uploading of the files due to shift turnover or manpower shortage should be avoided. Should it happen, the supervisor should be orally informed immediately of the problems and a supplement file should be sent at a later

time. The one-stop windows responsible for integration of various informations in central or local governments should strengthen vertical and horizontal communications, and arrange manpower for replacement in the entire combat plan.

F. Response and management of emergency incidents

Based on the Guideline on Procedures for Closure of Work Site and School Because of Natural Disaster [5], the governors of local governments are empowered to make decisions on whether the schools or work sites in the administrative district shall be closed based on the Guideline and information on weather forecast provided by the Central Weather Bureau. During the time period of combating dengue epidemic, we have experienced incidents, such as the Megi typhoon and election campaign activities. In this instance, whether the FCC operation should be closed or continued depended on the definitive decision made by the FCC commander. Therefore, staff should consider in advance about the operational scenario and establish response mechanism to the incidents of natural disaster or unforeseen event, and must monitor and collect relevant information at all times to provide the FCC commander with timely reference for making decision. Once an order was made, we need to ensure whether the information was consistently understood among team members and whether the order was implemented at an optimal time point, which was inappropriate to implement it in the either early or delay time.

Acknowledgement

We would like to express our deepest gratitude to colleagues for their assistance in providing written material that makes this report much more informative. They are Chao-Ching Chang and Sheng-Tang Wei, staff counselors, and Yu-Zhu Wang, Chin-Hsien Wang, Jin-Jen Lee, Zhen-Yi Li, Shui-Yun Shen, Jian-sheng Lin, Yi-Ying Lin, Ching-Li Lin, Pei-Yi Lin, Yu-Ting Hou, Hung-Chun Chou, Mei-Ju Chen, Szu-An Chen, Yu-Hsin Chen, Su-Ying Chen, Tzu-Fen Chen, Mei-Man Hsu, Shu-Feng Kao, Chuan-Yin Kao, Chin-Sheng Chi, Chiou-Yueh You, Mei-Ling Huang, Jui-Chuj Yang, Ya-lin Liu, Hsiao-Mei Liu, Shu-Chuan Jan, Ying-Ying Tsai, Su-Chen Ou, Wen-Chieh Hsiao

References

1. Taiwan CDC. Infectious disease data warehouse. Available at:http://dwweb.cdc.gov.tw/dwweb/
2. Taiwan CDC. Collection of communicable disease control acts and regulations 2009 (In Chinese).
3. Taiwan CDC. Communicable disease control special subjects. Available at: http://www.cdc.gov.tw/lp.asp?ctNode=2539&CtUnit=1453&BaseDSD=7&mp=130
4. Taiwan CDC. Guidelines for dengue control. Available at: http://www.cdc.gov.tw/public/Data/16159141271.pdf
5. Taiwan MOJ. Law & regulations database. Available at: http://law.moj.gov.tw/LawClass/LawContent.aspx?pcode=S0110022

Preparation and Application of Prospective Risk Map of Dengue Fever

Tuan Yen-Chang[1], Chi Chin-Sheng[2], Shih Wen-Yi[3], Hung Min-Nan[1], Liu Hsiao-Mei[2] Huang Chi-Chuan[1], Chang Chao-Ching[4] Lin Li-Jen[1]

1. Fifth Branch, Centers for Disease Control, Taiwan
2. Fourth Branch, Centers for Disease Control, Taiwan
3. Deputy Director-General, Centers for Disease Control, Taiwan
4. Fourth Branch, Centers for Disease Control, Taiwan

Abstract

The endemic dengue fever cases in 754 villages and neighborhoods in Tainan City and Tainan County from 2006 to 2010 were collected and analyzed for risk scores. Four risk levels: low, medium, secondary and primary high risk areas, were categorized by total risk scores within 5 years. Among all villages/neighborhoods, 527 (69.9%) were low risk areas, 127 (16.8%) were medium risk areas and 100 (13.3%) were high risk areas. The accumulation of risk scores within 5 years was believed to be associated to which of the next year and certain level of prediction was possible. Risk map prepared based on risk level may be re-edited with the disease situation within 5 years. As for risk map application, the establishment of common risk management area is one of the purposes. The 100 high risk villages/neighborhoods were divided into 15 common risk management areas for disease prevention resources allocation and zone defense when outbreak occurs. Secondly, regular monitoring map can be planned. Take "Tien-Ho common risk management area" for example, all environmental and ecological items were monitored and were marked on this regular monitoring map for dengue fever vector monitoring. Reservoir elimination and container reduction should be proceeded when the mosquito vector density increased.

Key word: dengue fever, risk map, common risk management area, zone defense, regular monitoring map

Introduction

Dengue fever and dengue hemorrhagic fever (DHF) are re-emerging infectious diseases and are mainly distributed in tropical areas (from 25 ^{0} North to 25 ^{0} South). The increase of imported dengue fever cases in recent years due to serious epidemic situation in Southeast Asia and the risk of emerging of dengue virus transmitted to Taiwan is elevated. Furthermore, the climate of southern Taiwan (southern than tropic of cancer) is suitable for mosquito vector, *Aedes aegypti*, and thus, the major dengue fever outbreak areas are distributed in Tainan City, Tainan County, Kaohsiung City, Kaohsiung County and Pingtong County. However, most of the villages and neighborhoods in Tainan City and Tainan County had no risk of dengue fever outbreak in 2006-2010. This disease was mainly recorded in high risk villages/ neighborhoods and might transmit to neighboring areas and cause dengue fever outbreak. Risk map construction is believed to be useful in disease prevention and action

strategies and would be more beneficial in disease prevention and control.

A study using the number of dengue fever cases and weather factors (temperature, rainfall, and humidity) collected from Sukhothai Province, Thailand, and risk map was prepared. Based on this result, it recommended the health authorities to implement the strategies of prevention in high risk areas to prevent large scale outbreak [1]. Another research [2] conducted in Taiwan analyzed the incidence of dengue fever in 356 counties, township and cities from 1998 to 2002, and risk score was indexed according to population density and temperature. Three risk levels were categorized (low, medium and high) and risk map was drawn. The high risk areas remained high risk score in 2003-2006. It also recommended that prevention procedures should be initiated within high risk areas. Risk map may also be produced based on humane factors such as frequency of washing containers or garbage cleaning, rate of covering container and residence type [3].

Our research collected all dengue fever cases in Tainan areas from 2006 to 2010 and analyzed the risk score in this time frame. Four risk levels were categorized (low, medium, secondary high, primary high) based on summed risk scores in 5 years and risk map was prepared. Common risk management area was then established and regular monitoring map was made through filing all environmental and ecological data (in accordance with Tien-Ho common risk management area). It is expected that this monitoring model may apply to all common risk management areas in Tainan City and Tainan County and may provide information for further dengue fever prevention policy decision.

Materials and Methods

A. Preparation of risk map

a. Categorization of risk level: information of dengue fever cases in Tainan areas (May 1 to March 31 of next year) were collected in a 5-year period. Risk score was given according to the number of dengue fever cases, e.g., 0 for areas with 0-1 case, 1 for areas with 2-5 cases (equivalent to degree A of centralized zone) and 3 for areas with 6 or more cases (equivalent to degree B of centralized zone). Four risk levels: low, medium, secondary high and primary high, were categorized by summed risk scores within 5 years and analyzed by Natural Breaks (Jenks) Distribution.

b. The relationship of risk score between 5-year, 4-year and 3-year summed risk score and risk score of the next year: In order to verify that risk score of the very year may be predicted by summed score of previous 5-year period, we collected all information of dengue fever cases in Tainan areas (754 villages/neighborhoods) from May 1, 2003 to March 31, 2011. Risk score was evaluated by method described previously. A time frame from 2003 to 2009 was selected for summarization of risk score with 3 different 5-year periods (2003-2007, 2004-2008, 2005-2009). Spearman's Rho was obtained through analyzing these summed scores with risk score of 2008,

2009 and 2010, respectively, by Spearman's rank-order correlation (N=2262). Similarly, a time frame from 2004 to 2009 was selected for summarization of risk score with 3 different 4-year periods (2004-2007, 2005-2008, 2006-2009). As for risk score of 3-year period, a 5-year time frame was selected (2005-2009) and three 3-year periods were marked (2005-2007, 2006-2008, and 2007-2009). Correlations were also analyzed with risk score of the next year. Software for statistical analysis was SPSS, version 14.

c. Preparation of risk map: The summed risk scores (5-year time frame, 2006-2010) and categorized risk levels of the 754 villages were input in ArcGIS to generate the risk map. Low risk areas were displayed in blue, medium risk areas were in yellow, secondary high risk areas were in orange and primary high risk areas were in red.

d. Evaluation of renewal time for risk map: All 756 villages had 4 summed 5-year risk scores of different time period within 2003-2010 (2003-2007, 2004-2008, 2005-2009, 2006-2010). Risk level of these villages was categorized and grouping: low risk area was 0, medium risk area was 1, secondary high risk area was 2 and primary high risk area was 3. Kappa reliability test was used for data analysis and result revealed consistence of risk level grouping in these 4 different time period. Software for statistical analysis was SPSS, version 14.

B. Application of risk map

a. Planning of common risk management area

Definition of common risk management area: According to Shi et al, [4], it was created on the basis of "zone defense" and "risk management". It implies that if dengue fever epidemic occurs in one village or neighborhood, disease prevention procedures should also be initiated within the neighboring villages/neighborhoods. Considering of limited disease prevention capability, common risk management areas are mainly in primary and secondary high risk areas in Tainan City and County (100 neighborhoods total). Universal Transverse Mercator (UTM) average value (X, Y axis) of each village or neighborhood was calculated using total number of dengue fever cases in a 5-year time frame as the population. This coordinate was defined as the center of this village/neighborhood, 17 clusters were planned by SPSS Cluster analysis and the distance between each center coordinate was calculated by Squared Euclidean Distance in Ward's method. Further regulation of cluster grouping was mainly based on: (1) planning of 3-9 neighboring high risk areas as 1 cluster; (2) villages/neighborhoods in same administrative division should be grouped prior to others; (3) villages/neighborhoods with similar name; (4) result of virus typing examination. Geo-relation of the virus with disease development was obtained based on the local dengue fever case

data and the result of viral typing within 5-year time frame (2006-2010). Virus typing using PCR was conducted in viremia stage (within 7 days after clinical symptoms occurred). This result may also provide information for evaluating the possibility of cross-district or cross-County epidemic and the risk of increased DHF due to cross-infection.

b. Designing of regular monitoring map

One of the common risk management areas was selected and all environmental and ecological factors were filed, such as temple, church, market, vacant property or land, and recycle yard. This information was obtained from central government website (e.g., Ecolife website of Environmental Protection Administration), local government website (e.g., Tainan Government website) and regular disease data in Taiwan CDC. Relative data was also collected from District administrations and the Bureau of Public Health in Tainan City. The addresses of the factors described above were converted into UTM coordinates by Disease Geographic Information System in Taiwan CDC (https://gissl.cdc.gov.tw/login/login.aspx?ReturnUrl=%2findex.aspx) and then set up by ArcGIS to display the locations.

Results

The summed 5-year risk score of Tainan areas ranged from 0 to 6. Areas with risk score 0 were categorized as low risk areas (527 neighborhoods), while areas with risk score 1-2 were medium risk areas (127 neighborhoods), areas with risk score 3-4 were secondary high risk areas (88 neighborhoods) and areas with risk score higher than 5 were primary high risk areas (12 neighborhoods) (Table 1). For example, an area with risk score 4 indicated: (1) 1 large scale (degree B in centralized zone) and 1 minor epidemic (degree A in centralized zone) occurred in this area in two separate years within 5-year period; or (2) 4 minor outbreaks recorded in four separate years within the same time frame.

The summed risk score of different time frame was highly related with that of the next year ($p<0.001$) and the correlation coefficient of Spearman's Rho was also higher than other correlation coefficient (Table 2). Risk map was established based on the result shown in Table 1. Low risk areas (risk score 0) were indicated blue, while medium risk areas (risk score 1-2) were yellow, secondary high risk areas (risk score 3-4) were orange and primary high risk areas (risk score ≧5) were red (Figure 1).

Table 1. Risk level and score of dengue fever in Tainan areas, 2006-2010.

County/City	Total No.	Summed risk score within 5 years			
		0	1-2	3-4	≧5
Tainan	754	527 (69.9%)	127 (16.8%)	88 (11.7%)	12 (1.6%)
Risk level		Low risk	Medium risk	Secondary high risk	Primary high risk

Table 2. Correlation coefficient of Spearman's Rho between summed risk score with different time frame and that of the next year.

County/City	Spearman's Rho		
	Summed risk score of 5-year time frame	Summed risk score of 5-year time frame	Summed r[-isk score of 3-year time frame
Tainan(N=2262)	0.236	0.230	0.231

$p<0.001$

Table 3. Consistency analysis of different year range.

Year (N=1648)	Year(N=754) 2005-2009	2004-2008	2003-2007
2006-2010	0.914	0.911	0.908
2005-2009	-	0.997	0.994
2004-2008	-	-	0.997

Note 1: All values were displayed by weighted kappa and all p value<0.001

2: Each value, such as 2006-2010, was using summed risk score of that time frame and grouped based on risk level.

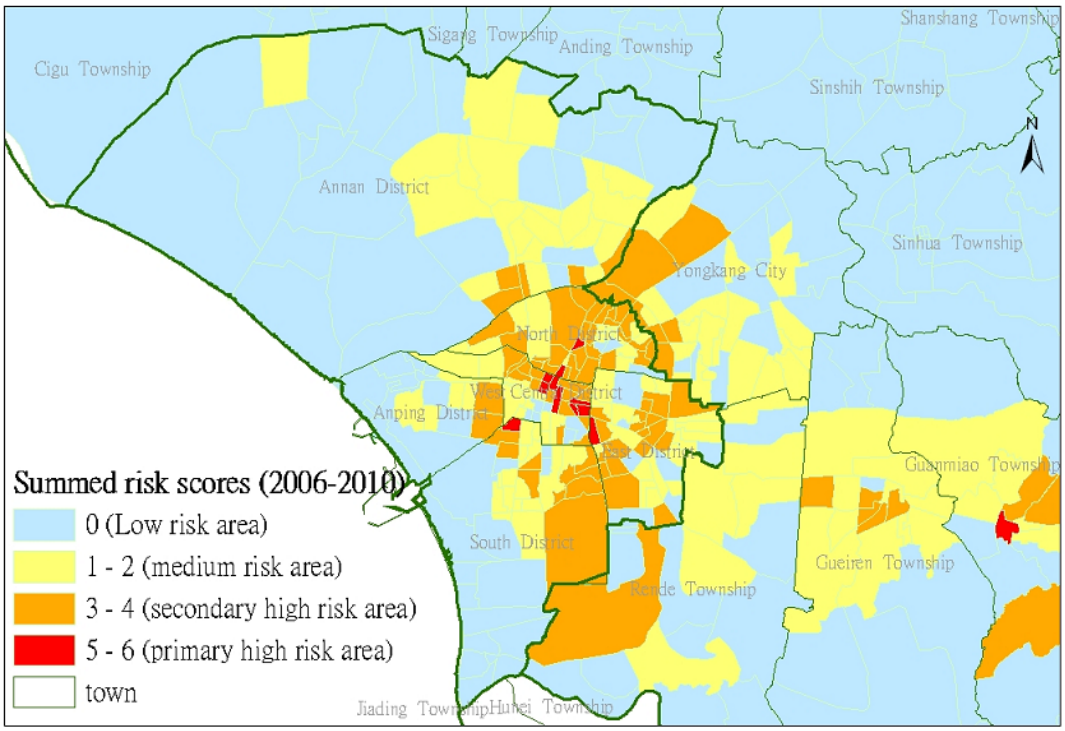

Figure 1. Risk map, Tainan areas

The result of consistency analysis of different time frame revealed that groups with only 1-year difference (e.g., 2006-2010 vs 2005-2009, with 4-year overlapping) had higher consistency than other groups of different overlapping time frame (e.g., 2006-2010 vs 2004-2008, 2006-2010 vs 2003-2007). The consistency was decreased with lessened overlapping time frame (Table 3). Thus, it was recommended to re-edit risk map annually based on recent 5-year risk analysis and level.

There were 17 risk groups in Tainan areas. Take the 1st group for example, 15 primary high risk neighborhoods were recorded in this group (outlined by green line in Figure 2) and 3 common risk management areas (Yu Huang, Tian Hou and Wan Chang) were demarcated. In which, there were 6 primary high risk neighborhoods in Tien Ho common risk management area. These neighborhoods were next to each other and had dengue fever outbreak in 2007 and 2010 caused by the same dengue virus type (type 1 in 2007 and type 4 in 2010). This result indicated that the same pathogen was still circulating in these neighborhoods even with disease prevention intervention. Based on this method, 15 common risk management areas were planned covering 97 primary high risk areas in Tainan City and County. The names of these areas were listed in Table 4.

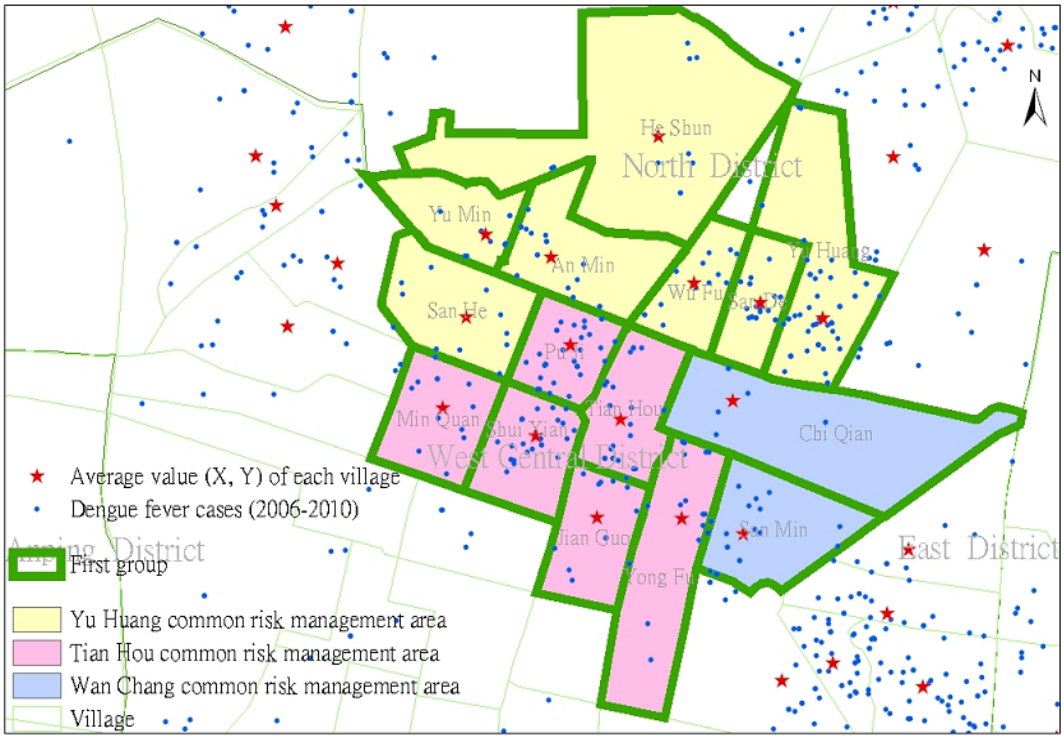

Figure 2. Modulated result of 1st

Table 4. Name list of common risk management areas in Tainan City and County.

City/ County	Name of common risk management area	Range	No. of neighborhood
Tainan (97 neighborhoods)	Yu Huang	San He, San De, Wu Fu, Yu Huang, An Min, He Shun, Yu Min	7
	Tian Hou	Tian Hou, Shui Xian, Jian Guo, Yong Fu, Pu Ji, Min Quan	6
	Wan Chang	San Min, Gong Zheng, Yong Hua, Chi Qian, Qing Nian, Kai Shan, Wan Chang, Yin Tong, Dong Men	9
	Guang Xian	Wen Xian, Guang Xian, Xie He, Yao Wang, Da Gang, Da Fong, Xing Fu, Hai Dian, Xi Qi	9
	Chong Ming	Da Zhi, Da Fu, Zhong Xiao, Chong Ming, De Guang, Da Zhong, Da Lin, Cheng Gong	8
	Da tong	Fa Hua, Da Tong, Da De, Quan Nan, Xin Sheng	5
	Yong Kang	Li Xing, Chong Xing, Hua Xing, Wu Wang, Liu He, Sheng Li	6
	Jia Ding	Cheng Gong, An He, Xi Ding, Jia Ding, Xi Chiao, Shang Ding, Yan Xing	7
	Kai Yuan	Xiao Kang, Zheng Fong, Zheng Jue, Yong Xiang, Kai Yuan, Xin Sheng, Shi Jian	7
	Guo Xing	Zhong Lou, Liu Jia, Gong Yuan, Cheng De, Yen Ping, Guo Xing, Xing Bei, Xing Nan	8
	Wen Hua	Wen Ping, Jian Ping, Wen Nan, Wen Hua, Tian Liao, Fu Nan, JinHua	7
	Fu Qiang	Zi Qiang, Chong Xin, Fu Qiang, Fu Yu	4
	Xin Dong	Gong Guang, Dong Ming, Hou Jia, Chong Hui, Xing Dong, Yu Nong	6
	Gui Ren	Nan Xing, Hou Shi, Xu Cuo, Gu Cuo, Xin Cuo	5
	Guan Miao	Bei Hua, Bei Shi, Xiang Yang	3

Tian Hou common risk management area was located in middle west part of Tainan County covering 6 neighborhoods (Jian Guo, Yong Fu, Shui Xian, Tian Hou, Pu Ji and Min Quan). Two markets, 6 temples, 50 basement and 37 vacant houses were recorded in this area. Regular monitoring map was revealed as in Figure 3.

Discussion

There were 754 villages/neighborhoods in Tainan areas and 527 (69.9%) villages/neighborhoods were low risk areas of dengue fever, which indicated that most of the villages/neighborhoods in Tainan areas were low risk in dengue fever epidemic. Primary and secondary high risk areas were mainly distributed in East, North, Middle-West and South District in Tainan City, and Gui Ren and Guan Miao village in Tainan County. This study calculated risk score of dengue fever based on the total number of cases and risk levels were marked out. A prospective risk map was prepared according to the result of this research. However, further discussion is still needed for evaluation of the efficacy and method improvement. There is an association between summed risk score of 5-year period and that of the next year, it implies that a certain level of forecasting disease situation and severity is possible (i.e. incidence of dengue fever outbreak was higher in high risk areas). In order to improve the ability of disease situation prediction, new method should be applied to calculate risk score, such as mathematical model which including climate factors (rainfall, humidity and temperature). Furthermore, the correlation coefficient of summed risk score of 5-year and 4-year period with that of the next year was higher than other group of different time period and the risk level grouping of 5-year and 4-year risk score had higher consistency analyzed by Kappa (weighted kappa=0.997, data not shown). This result pointed out that risk map might also be constructed based on

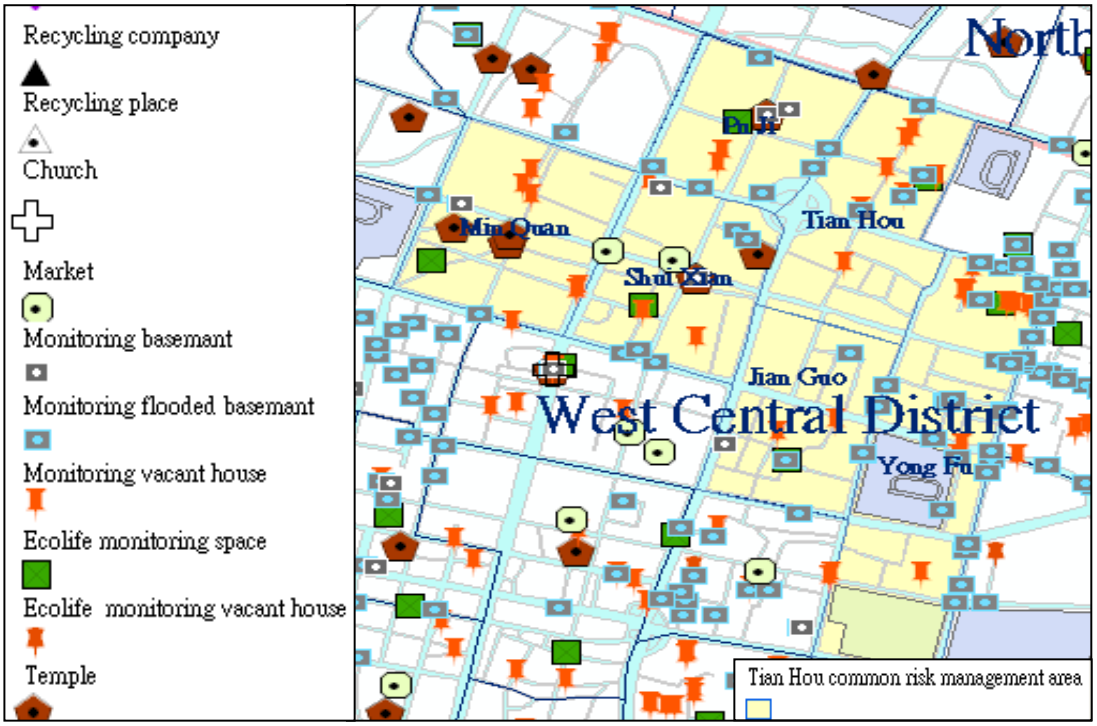

Figure 3. Regular mojitoring map of Tian Hou common risk

summed risk score of 4-year time frame. However, it is recommended to re-edit risk map based on summed risk score of 5-year time period and further study is needed to evaluate risk map according to summed risk score of different time frame.

Based on the risk map, different administrative district had different ratio of low risk area/high risk area. Disease prevention capability may be dispersed due to wide range while the risk map is edited on the basis of county/township. Thus, it is rational to narrow the range of the basic unit to few primary and secondary high risk areas. In "2010 Guidelines for Dengue Fever Prevention", it indicated that zone defense should be proceeded while case centralized area across 2 villages/neighborhoods or Counties/Cities and certain block of villages/neighborhoods (usually 6-8 villages/neighborhoods) should be marked out for dengue fever prevention. However, there was no reference of specific range of villages/neighborhoods for local government and, therefore, common risk management area was established in our study for further application. In addition, dengue fever prevention was commonly conducted thoroughly in case centralized area but not in villages/neighborhoods with no case adjacent to the areas. The possibility of dengue fever outbreak is dramatically increased while zone defense is not proceeded. For example, the 6 neighborhoods in "Tian Hou common risk management area" located adjacent to each other and 2 dengue fever outbreaks were recorded in 2007 and 2010 caused by dengue virus type 1 and type 4, respectively. Although emergency disease prevention procedures had been proceeded, the efficacy was limited while the pathogen was still circulating in adjacent neighborhoods. This result revealed the importance of risk management and zone defense. It was also recommended that zone defense may be progressed in medium risk areas. Similar recommendation was revealed in one study [5]. The conclusion indicated that areas of medium risk level may become the source of dengue fever outbreak and disease prevention measures should be enhanced to avoid further transmission [5].

Dengue fever is an environmental and community disease. Thus, dengue fever epidemic may occur while virus invades a place with proper breeding sites. This study collected and filed humanistic information, such as markets, temples, schools or other places with frequent human activity, in "Tian Hou common risk management area" in Tainan City. Furthermore, information about breeding sites such as empty houses and recycling market was also recorded and then risk map was constructed. Mosquito vector may be monitored based on the risk map and proper procedures (pathogen reservoir elimination and decreasing containers) should be processed. This map may also provide a reference for tracing transmission source while outbreak occurred. The effectiveness and integrity of regular monitoring map is mainly rely on breeding site investigation record and uploading relative information to "Management system for breeding site of vector" by central and local government.

According to 6th work report of central command center for dengue fever outbreak in December 15, 2010 [4], the analysis result of

risk map in this study may provide information about dengue fever prevention for local government and the major prevention work may focus on the primary and secondary high risk areas. Furthermore, risk map may also apply to: 1. clarify the major success/fail reason for dengue fever prevention and search for the key procedure; 2. analyze the beneficial innate and acquired environmental factors for disease prevention in low risk areas; 3. manage all environmental and ecological factors in common risk management areas by ArcGIS.

In this study, common risk management areas were marked out through risk map in order to enhance manipulation of disease prevention resources and zone defense. Furthermore, regular monitoring of vector density through regular monitoring map is also beneficial for increasing disease prevention capability and management of dengue fever outbreak.

References

1. Kanchana N, Tripathi NK. An information value based analysis of physical and climatic factors affecting dengue fever and dengue haemorrhagic fever incidence. Int J Health Geogr 2005;4:1-13.
2. Wu PC, Lay JG, Guo HR, et al. Higher temperature and urbanization affect the spatial patterns of dengue fever transmission in subtropical Taiwan. Sci Total Environ 2009;407:2224-33.
3. Alpana B, Haja A. Application of GIS in modeling of dengue risk based on sociocultural data: case of Jalore, Rajasthan, India. Dengue Bull 2001; 25:92-102.
4. Shi WY. Preparation and analysis of risk map in Tainan and Kaohsiung areas. 6th work report of the central epidemic command center for dengue epidemic, 2010, Taipei, Taiwan: National Health Command Center.
5. Wen TH, Lin NH, Lin CH , et al. Spatial mapping of temporal risk characteristics to improve environmental health risk identification: A case study of a dengue epidemic in Taiwan. Sci Total Environ 2006;367:631-40.

Biosafety and Biosecurity

Overview of Laboratory Biosafety Assessment

Yu-Yen Shih, Wen-Chao Wu, Jer-Jea Yan

Fifth Division, Centers for Disease Control, Taiwan

Laboratory biosafety accidents can simply impact on specimen contamination and damage the quality of test, or in the worst case, can infect the laboratory workers, administrative staff outside the laboratory, and community people, and thus threaten on public health or even cause lethal outbreak. Therefore, it is necessary for laboratories to launch laboratory biorisk assessment mechanism. Through effective hazard control, we can avoid or reduce the incidence of biosafety accidents, and therefore achieve the goal of improving laboratories' biosafety management and sustainable implementation.

Risk assessment, in short, is always to ask: “What can go wrong?”, “How big?”, “How often?”, “So what?”, and “What do I do?” whenever conducting an activity [1]. Laboratory biorisk assessment refers to ask the aforementioned questions to comprehend and assess all activities processed within a laboratory.

Laboratory biorisk assessment requires not only relative individual knowledge but also participation of inter-departmental personnel from organizations. In addition to frontline researchers, the organization managers, biosafety or biosecurity personnel or chiefs, safety standard makers, laboratory administrators, outsourcing hardware maintenance staff, and contract manufacturers should also equip themselves with the knowledge.

Risk assessment must be conducted in laboratories’ designing and constructing stage, and laboratory facilities and equipment setting stage, including the operation of existing equipments, unconventional equipments operations, equipments replacement or purchase, and equipment operating procedures [1].

Risk assessment is part of risk management. Effective risk management can minimize the hazard to procure the risk control [1]. Risk assessment is a continuous process, which the first step is to detect the possible risk in test. The second step of the process is hazard identification. We should be familiar with what may cause any hazard in laboratories to people or the environment. The knowledge include the source of biomaterials (human specimens, plants, animals or recombinant DNA), danger or impact on people, animals or environment, risk group (RG) levels of the pathogens and their corresponding laboratory biosafety levels, hazardous magnitude caused by different test operation, and the required protection equipments and facilities [1-3]. The third step of the process is risk analysis by qualitative risk assessment, semi-quantitative risk assessment, or quantitative risk assessment based on the information derived from hazard identification. Among the skills of risk analysis, risk matrix is the most commonly used for scoring the exams or tests in order to know the likelihood of the risk and its consequences. The fourth step is risk evaluation, to establish risk list and the recommended priorities according to the results from risk analysis. Multiple and strict protection strategies should be taken if the risk is high, otherwise relatively loose but still effective countermeasures are also acceptable. To run risk assessment process, constantly communicating is required. Request assistance of experts or consultants whenever necessary, also monitor and inspect risk at any time to grasp current situation [1].

The figure below illustrates the risk management process. The first step of risk management is to establish context that means to clearly recognize the activities in laboratory and to scope acceptable risk limits [1]. The risk assessment of operating *Mycobacterium tuberculosis*, for example, involves knowledge and experience of organizational personnel, investigation and assessment results of

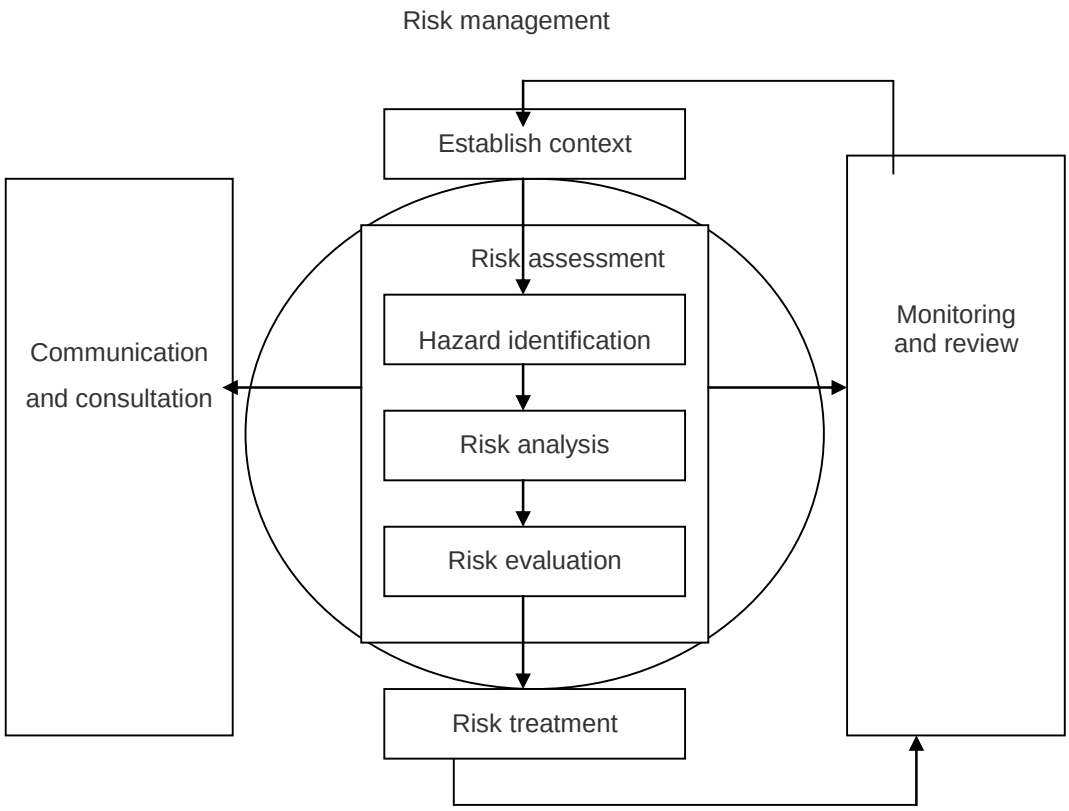

Figure. Risk management process

previous laboratory infection, the establishment of standard operating procedures, data retrospection and records, risk level definition, consequences, and risk tolerance. The process of these parameters identification and confirmation is called "establish context". Hazard identification, risk analysis and risk evaluation in risk management process are parts of risk assessment. In order to achieve the goal of continuous quality improvement (Plan, Do, Check, Action, PDCA) cycle, the result of risk assessment should rely on risk treatment, taking appropriate risk strategies, and continuous risk monitoring and review [1]. The ensuing article will introduce the tools of risk assessment to facilitate the laboratory staff's holistic understanding for risk assessment and practice, laying the foundation for creating safe working environment and culture.

References

1. CEN Workshop Agreement. CWA15793: 2008 Laboratory biorisk management. Available at: ftp://ftp.cenorm.be/PUBLIC/CWAs/wokrshop31/CWA15793.pdf
2. CDC. Biosafety in Microbiological and Biomedical Laboratories (BMBL), 5th ed., 2009. Available at: http://www.cdc.gov/biosafety/publications/bmbl5/BMBL.pdf
3. Public Health Agency for Canada. The Laboratory Biosafety Guidelines, 3rd ed., 2004. Available at: http://www.phac-aspc.gc.ca/publicat/lbg-ldmbl-04/pdf/lbg_2004_e.pdf

Introduction to Laboratory Biosafety Guidelines in Canada

Chih-Heng Liao

Department of Laboratory Accreditation,
Taiwan Accreditation Foundation

Since the 2001 anthrax attacks inthe United States, many countries have realized the need to strengthen controls of pathogens for protection from the threats to public health and safety. Many countries now take more rigorous control measures for the importation, possession, protection, and transfer of pathogens. The Public Health Agency of Canada (PHAC) is a national institution of biosafety and biological protection for human pathogens and toxins. This institution established the Pathogen Regulation Directorate (PRD), which is the agency in charge of the Human Pathogens Importation Regulations (HPIR) [1] and the Human Pathogens and Toxins Act (HPTA) [2]. Enacted in 2004, HPIR requires that human pathogens which are belong to the second to fourth risk-group of micro-organisms or toxins need to apply for permission before being imported into Canada. In the meantime, the Laboratory Biosafety Guideline (LBG) [3] was regulated to control the organizations which used the importing human pathogens and toxins and also supplemented the HPIR in non-importing human pathogens and toxins. In 2009, PHAC developed HPTA based on this consideration. The HPTA covers: the risk management of safety and security of both importation and possession of human pathogens and toxins, the implementation of the PRD, and the latest legal basis of improving biosafety and biosecurity. By legally controlling the importation, acquisition, utilization and handling of bio-hazardous materials , and prohibiting unauthorized use and abuse of human pathogens and toxins (such as the manufacture of biological weapons), they are able to reduce threats to public health and safety.

HPIR regulated the importation of human pathogens and toxins solely in the past. Nevertheless, there is no uniform management for non-importing human pathogens and toxins in Canada, which could bring about greater harm to public health and safety should those bio-hazardous materials be released by the relevant agencies, accidentally or otherwise. As a result, the execution of the HPTA expanded the scope and strength of control. All the laboratory work related to human pathogens and toxins, including importation, isolation or synthesis of pathogens, should be practiced after obtaining permission from PRD. Moreover, HPTA provides that handling, use, manufacture, storage, transfer, export, import or release of any human pathogens and toxins are not allowed in laboratories without the permission of PHAC. The application of permission will be approved after an investigation by PHAC and confirmation of meeting the relevant safety and security requirements. Approval requires

that those specific activities should be consistent with HPTA regulations before implementation, and also that authorized operators, cleaners and biosafety managers in agencies should be reported to the PHAC. Supervisors assigned from PHAC will conduct an on-site investigation at an opportune moment.

The pathogens listed in the HPTA are organized into five attachments as follows: table 1, toxins such as cholera toxin and tetanus toxin; table 2, human pathogens such as *E. coli*; table 3, human pathogens such as *Mycobacterium tuberculosis* and rabies virus; table 4, human pathogens like Ebola virus; table 5, pathogens which have been banned, for example, smallpox virus.

Hazardous microorganisms which are not included in the Risk Group 2, 3, or 4 are still monitored by the HPTA. HPTA requires that laboratories should have a list of human pathogens and toxins, and that any accidents in laboratories which may give rise to infection should be reported. Furthermore, laboratories are required to follow LBG as the laboratory bio-safety standards.

The second edition of LBG was issued in 1996. Under the authority of HPIR, laboratories which handle human pathogens will be managed mandatorily by PHAC. The third edition in 2004 updated the principle and standard of laboratory biosafety and biological protection. In addition to new sections containing bio-medical facilities for non-human primates, sheep and other animals, management of arthropods, and toxins in this guideline, there is an additional section for the safety requirement of mycobacterial laboratory work. Moreover, the difference between last versions to the third version in LBG is that the latest information of human pathogens in Risk Group will be provided up to date on line. Canada has compiled approximately 200 Pathogen Safety Data Sheets (PSDS), (previously known as "Material Safety Data Sheets for infectious substances" as the application of the use of infectious substances. These technical documents describe the hazards of particular human pathogens and toxins, and the standards and safety recommendations related to the pathogens. Canada will continue to update the PSDS regularly in order to meet current needs. However, such work still must abide by international, national, and provincial laws and standards.

The website of PHAC provides a series of questions and answers to facilitate users to recognize the classification of their activities. For example, do those clinical laboratories (medical lab) involved with clinical laboratory diagnosis and treatment in Canada have to apply for a permit based on HPIR? Laboratories performing only diagnostic tests after sample collection are not required to apply for permission. If laboratories have been involved in the cultivation and purification of the related pathogens, application for permission is necessary. Regardless of the need to apply for permissions, clinical laboratories performing clinical examination of

diagnosis and treatment should always be consistent with biosafety level 2 laboratory practices.

References:

1. Department of Justice Canada. Human Pathogens Importation Regulations (SOR/94-558). Available at: http://laws-lois.justice.gc.ca/PDF/SOR-94-558.pdf
2. Department of Justice Canada. Human Pathogens and Toxins Act (S.C. 2009, c. 24). Available at: http://lois-laws.justice.gc.ca/PDF/H-5.67.pdf
3. Public Health Agency of Canada. The Laboratory Biosafety Guidelines, 3rd ed., 2004. Available at: http://www.phac-aspc.gc.ca/publicat/lbg-ldmbl-04/pdf/lbg_2004_e.pdf