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Risk Evaluation of Epidemic Disease – Taking Chikungunya Disease as an Example

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Abstract

Chikungunya disease is mainly prevalent in South East Asian countries neighboring Taiwan, areas along the coast of the Indian Ocean and African nations. At the present time, sporadic cases and outbreaks in countries in Europe and America also are mostly caused by imported cases from South East Asian or African countries. To investigate the epidemic risk of Chikungunya disease in Taiwan, this research adopted the rapid risk evaluation toolkit developed by the Europe Union to simulate epidemic situations and obtain expert assessments on the likely scale of infection among the general public and the level of social impact of during a local epidemic of Chikungunya disease in Taiwan.

Through reviewing literature and data on evidence-based epidemic situational backgrounds and summarizing experts' discussions, a conclusion was derived that if a local epidemic of Chikungunya disease occurred in Taiwan's Kaohsiung City, the disease infection rate in both the county where the epidemic originated and in other counties would be classified as "High risk rate," and the social impact caused by the epidemic would be a "Medium shock;" summing up the outcomes of disease infection rate and the social impact of the epidemic, the overall risk level of an epidemic would be judged at a "High risk" level.

Because of constant flows of travelers, foreign workers and business people between Taiwan and South East Asia, there are few imported cases of Chikungunya disease in Taiwan every year. Furthermore, the vector mosquitoes needed to spread the Chikungunya disease are distributed throughout Taiwan. As soon as the virus invades, if the epidemic situation is not promptly controlled, and under the influence of additional factors such as Aedes albopictus' genetic mutations that gives them increasing ability to carry the virus, cluster outbreaks can occur and spread to other counties. As a result, besides understanding the characteristics of the virus and the disease vector, attention should be paid to disease risk evaluation and the operational mode of risk evaluation. Through simulating epidemic situations and becoming familiar with the risk evaluation toolkit, measures can be taken early in an epidemic to assess

and evaluate risk, and this in turn can guide the development of prevention policy and enhance the comprehensiveness of the prevention plan.

Keywords: Chikungunya disease, risk evaluation, ECDC rapid risk evaluation toolkit

Preface

The word Chikungunya comes from Tanzania's local language, and its original meaning is "Body bended as folded" because the disease would cause severe joint pain. Chikungunya disease is caused by infection with the Chikungunya virus, whose gene group is single-stranded RNA, which is further divided by genotype and antigen type into three pedigrees, including the West African genotype, East/Central/South African genotype(ECSA) and Asian genotype. The virus was first isolated in 1952, and it is mainly spread by mosquitoes. This disease is prevalent in East Africa, West Africa, South Africa, Central Africa, the Indo-West Pacific region, and South East Asian countries [1].

Chikungunya disease's incubation period can last between two to twelve days, with three to seven days being most common. Two days before and five days after the patient's disease onset is the period of viremia, and if the mosquito vector suck in the blood of the patient in the period of viremia, the virus would reproduce in the mosquito's body and become infectious. At this time, if the mosquito bites other people, the virus would spread. The main symptoms of Chikungunya disease are fever, distal joint pain and swelling, skin rash, nausea, vomit, muscle ache, etc. Among the symptoms, joint pain can last for several months to several years. Besides, there has been research reporting atypical symptoms, including abnormalities in the cardiovascular system, such as heart failure, arrhythmia, cardiomyositis, unstable blood pressure, coronary vessel disease and acute myocardial infarction, abnormalities in the neural system such as encephalitis, depression, and meningitis, and other symptoms like kidney failure, pneumonia and skin disorder[2].

Since the first isolation of the Chikungunya virus in 1952, epidemics have occurred successively in Africa, the French Reunion Island, Italy, coastal areas along the Indian Ocean and South East Asia. Taiwan began screening for Chikungunya disease at the Taoyuan International Airport in March 2006, and before announcing Chikungunya disease as a designated infectious disease in September 2007, two imported cases had been detected, one from Singapore and the other from Indonesia. [5] Since the Department of Health announced the inclusion of Chikungunya disease in the list of Category II designated infectious diseases in October 2007, a total of thirty-six imported cases had been detected up to September 2012 (Table 1 and Table 2).

In early years in Taiwan, survey of Chikungunya disease blood serum epidemiology was conducted in the Annan district located in Tainan's south west coastal line, and the outcomes showed that the serum antigen positive rate among residents aged forty years or older was 90%, while the serum antigen positive rate among residents aged below forty years old was 5%[6].

Though there has not been any reported and confirmed indigenous case of Chikungunya disease in Taiwan since the start of nationwide surveillance, imported cases from South East Asian have been detected every year due to factors relate to the environment, disease vector and frequent international interaction [7]. Chikungunya disease may well become like Dengue fever and pose a threat to Taiwan, and consequently, it is necessary to evaluate the risk of an epidemic and its associated consequences.

The UK Department of Health and European Centre for Disease Prevention and Control (ECDC) [9] have both developed risk evaluation toolkits, which utilize the risk evaluation method of having experts discussed and decided on a risk route according to every items of evaluation. The risk level of the disease ("Very low risk," "Low risk," "Mid risk," "High risk," and "Very high risk") is determined according to the last site where the evaluation procedure stops at, and experts make prevention recommendations based on this. Although the two risk evaluation toolkits are similar, the risk evaluation toolkit developed by ECDC emphasized on rapidly conducting the evaluation in the first twenty-four to forty-eight hours after an epidemic situation has occurred, and it also suggests the kind of evidence and information needed for each evaluation item, which makes it a relatively clear in operational definition and execution.

Chikungunya disease is still an imported disease in Taiwan. To prepare for and respond to the possibility of this disease invading Taiwan and causing local cluster outbreaks, this research invited experts to use the rapid risk evaluation toolkit developed by ECDC and simulated epidemic situations to conduct the risk evaluation, anticipating that that would result in familiarity with the entire process and operation of risk evaluation. In the future, if an epidemic situation occurs, we can rapidly reenact the experience, implementing and finishing the evaluation process within the time limitation.

Table 1. Confirmed case numbers of imported Chikungunya disease in Taiwan from 2007 to 2012

	Indonesia	Malaysia	Thailand	India	Singapore	Bengal	Philippines	Myanmar	Unknown	Total
Total	22	6	2	1	1	1	2	0	1	36
2007 (after October)	2	0	0	0	0	0	0	0	0	2
2008	4	3	0	1	0	1	0	0	0	9
2009	3	2	2	0	1	0	0	0	1	9
2010	12	1	0	0	0	0	0	0	0	13
2011	0	0	0	0	0	0	1	0	0	1
2012 (up to 9/30)	1	0	0	0	0	0	1	0	0	2

Table 2. Identity of confirmed cases of imported Chikungunya disease in Taiwan from 2007 to 2012

	Taiwanese National	Foreign workers	Foreigners	Foreign Spouses	Total
Total	12	12	10	2	36
2007(after October)	0	1	1	0	2
2008	3	1	5	0	9
2009	3	2	3	1	9
2010	4	7	1	1	13
2011	1	0	0	0	1
2012(up to 9/30)	1	1	0	0	2

Materials and Methods

This research consulted the risk evaluation operational guide published by ECDC in 2011 August [9], using simulated situations to hypothesize that the first indigenous case of Chikungunya disease has occurred in the Fung Shan District in Kaohsiung City of Taiwan and conducted the risk evaluation. This research followed the ECDC risk evaluation operational guide and began by collecting disease-related information, and after that, an expert discussion forum was held to evaluate the risk onwards.

The epidemic situation hypothesized by this research is as follows: In September 4, 2011, the first case of indigenous Chikungunya disease appeared in Fung Shan District of Kaohsiung City. The case is a fifty-eight-year old woman, and her workplace and residence are both in Kaohsiung City's Fung Shan District, and her job was the shop keeper of a snack bar. The disease onset was at September 4, and she has been to the clinic near her house for treatment. However, because her symptoms haven't improved, she is hospitalized in a medical center in September 29. The outcome of her blood test is positive of IgG and IgM, and she is diagnosed as a confirmed case of Chikungunya disease. Before the disease onset, the case had no travel history to foreign countries, and her main active area was at her workplace and the park near her house during the viremia period. Four positive cases are subsequently found during an expanded examination of 115 people, among whom two are household contacts, and two are residents in the same community. Eighty-one of them are found to be negative, and thirty of them are still being examined. A survey of vector mosquito vector density for Chikungunya disease indicates that her area at the second grade of Bruth grade.

Below is a list of ECDC risk evaluation steps and what each step entails:

Stage 0: Preparation

Stage 1: Collect event information.

Stage 2: Perform structured literature search/systematically collect information about the (potential) etiologic agent. .

Stage 3: Extract relevant evidence.

Stage 4: Appraise evidence.

Stage 5: Estimate risk.

The risk defined by ECDC=probability X impact. Besides the infectious rate and the impact brought by the disease, ECDC also mentions the risk of the disease may be affected by current situation and environmental factors, and as a result, it is necessary to take into consideration the feelings, knowledge, opinions, interest of politicians, lay individuals and media organizations with regard to this disease when evaluating its risk.

This probability of being infected by the disease can be discussed in two contexts: the probability of disease spread in the area where the epidemic originated and the probability of disease spread in other areas. The impact of the disease is discussed next, and overall risk is finally calculated by multiplying probability of spread with impact. The evaluation process is divided to two stages: First, collect the background information related to the disease, from

sources including international periodicals and documents, reference books and text books, official websites, important international websites of the epidemic situations (e.g. PubMed) and surveillance data in Taiwan; after that, offer the whole collected and organized information for experts to consult with, and hold an experts' forum to conduct formal discussions. The content of the discussions is mainly about evaluating the quality of the evidence and advising sites that could be improved. Finally, the experts decide the level of disease risk and make recommendations regarding future directions for disease prevention based on their professional knowledge.

The results

The experts at the discussion forum (including experts in disease vector entomology, tropical medicine, epidemiology, mathematic modeling of infectious disease, and clinical medicine) conducted the evaluation and decided the risk level according to the collected data on Chikungunya disease and evident documents, referring back to the eleven questions of Europe Union ECDC's rapid risk evaluation guide/the outcome of parameter evaluation(yes/no), determination of the quality of evidence and collected data(good/ requirement-compliant/falling short of requirement).

Part A1: The risk that Chikungunya disease spread in Taiwan (Figure 1)

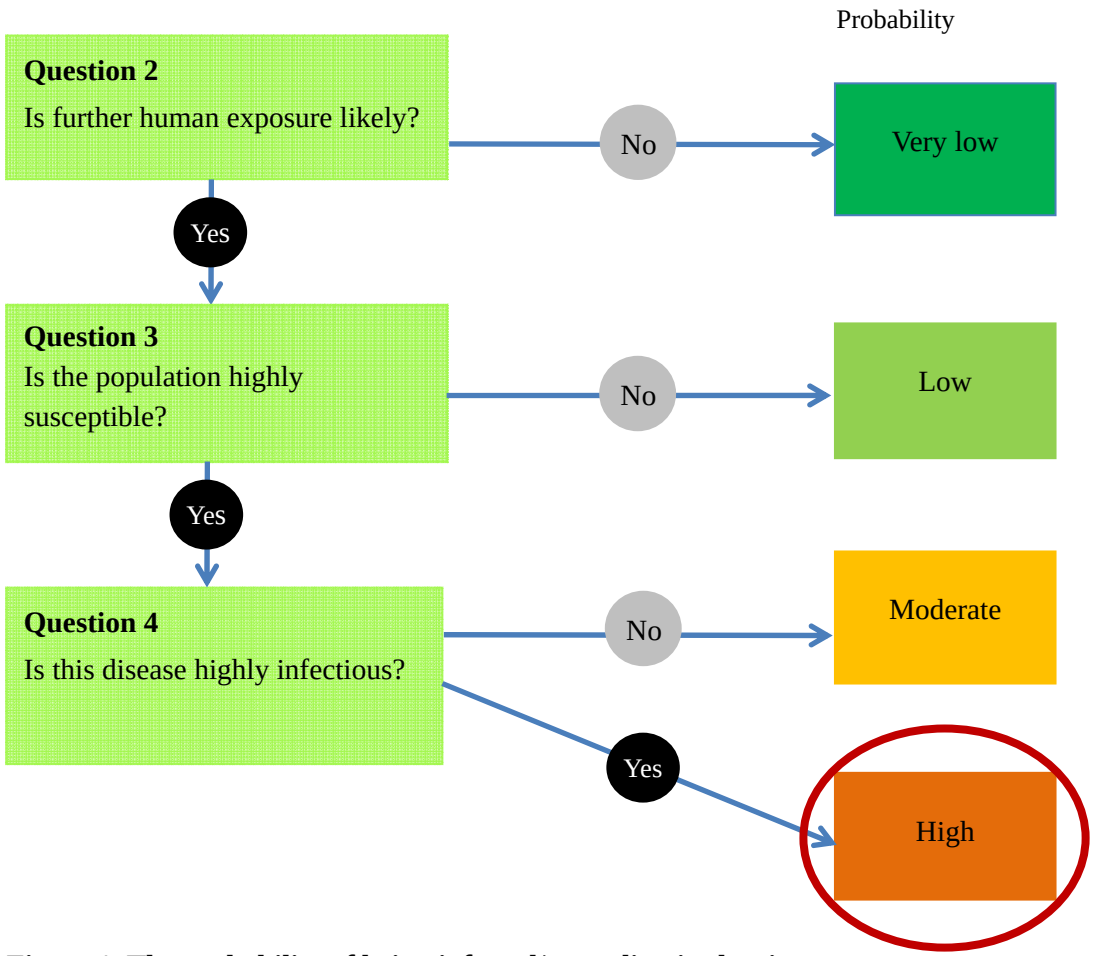

Figure 1. The probability of being infected/spreading in the city or county where the epidemic originated

Part A1-1: “Are there specific groups at increased risk of infection”

Chikungunya disease is not limited to infecting special groups only, and it is possible for all residents to be infected; as for the part of indirect risk, countries like Honduras, Brazil and Australia have used blood samples for research, and they did not find that Chikungunya disease would infect others through blood transfusion, showing the low probability of being infected by blood transfusion[10]. During the epidemic on the French Reunion Island, the risk of being infected by blood transfusion was estimated to be 0.7%, and the risk of being infected by platelet transmission was 0.4%. Research has also shown that though the risk of infection through blood donated by patients with viremia during an epidemic is high, it is lower compared with being infected through mosquito bites[11].

Part A1-2:”Is further human exposure likely”

Aegypti and Aedes albopictus are the mosquito vectors of Chikungunya disease. The infectious occurs in a cycle of “human-mosquito-human”, while the incubation period is two to twelve days (most commonly from three to seven days). Furthermore, two days before the disease onset and five days after the disease onset is the period of viremia, and the virus will infect other people through mosquito bites. As for the countries in Asia who have experienced epidemics before, Aegypti is the main mosquito vector, and epidemics happen more frequently in cities; contrarily, Aedes albopictus is regarded as a weaker viral vector[12]. Nevertheless, this trend turned after the epidemic Chikungunya disease on French Reunion Island from 2005 to 2006. During that time, the E1-A226V protein on the Chikungunya viral coat mutated, causing Aedes albopictus to become the superior disease vector in spreading the virus [13]. Several reports have pointed out that when the mutation of single amino acid occurred on Chikungunya viral coat’s E1 protein, it would greatly improve the virus’ ability to reproduce and spread in Aedes albopictus’ body, while decreasing the incubation period [14-15]. The incubation period determines the mosquito vector’s infectious cycle and also has a great effect on the epidemic capability in the relationship of virus and disease vector [16]. Though there is still no definite proof as to whether the mutation has an effect on the disease toxicity produced after being infected by Chikungunya virus, with regards to regions where Aedes albopictus already exist, this kind of mutation has undoubtedly increased the possibility of Chikungunya disease’s potential to cause epidemics. Taiwan is located in a subtropical area, so the climate is warm enough for Aegypti and Aedes albopictus to reproduce. Because vector mosquitoes exist throughout Taiwan, as long as imported cases are not completely screened out in the airport, the virus could be brought into Taiwan. In addition, adding on the factor that mosquito vectors commonly exist in every place, it may accelerate the virus’ spreading speed and range, while all residents living in regions where outbreaks have occurred will be confronted with the risk of being infected through mosquito bites.

Part A1-3:”Is the population highly susceptible”

The epidemic of Chikungunya disease is mainly spread by mosquito bites, which run by the cycle of “human-mosquito-human”. Taiwan has the distribution of Aegypti and Aedes

albopictus, and it will increase the risk of spreading if mosquito vectors bite patients in viremia. In addition, there has been no indigenous outbreak of Chikungunya disease in Taiwan. From the perspective of immunology, all residents are thus easily-infected group, and from the perspective of epidemiology, this group of people is hypersensitive to the disease.

Part A1-4:"Is this disease highly infectious"

The spread of Chikungunya virus is affected by the distribution of mosquito vectors, seasons, the number of patients in viremia and the size of the hypersensitive group, and furthermore, the occurrence rate of infected people with no symptom and disease's basic recovery rate. Researches point out that the occurrence rate of infected people with no symptom is 10 to 15.7% [17], while the disease's basic recovery rate is 3.4 to 4.3 [18]. As for Kaohsiung City where we simulated the epidemic situation, it possesses all conditions needed for the occurrence of an epidemic and therefore Chikungunya disease should be classified as a highly contagious disease based on research from South East Asian countries where epidemics have occurred before.

Part A2: The risk of Chikungunya disease spreading in places other than where the epidemic originated (i.e. Kaohsiung City) (Figure 2)

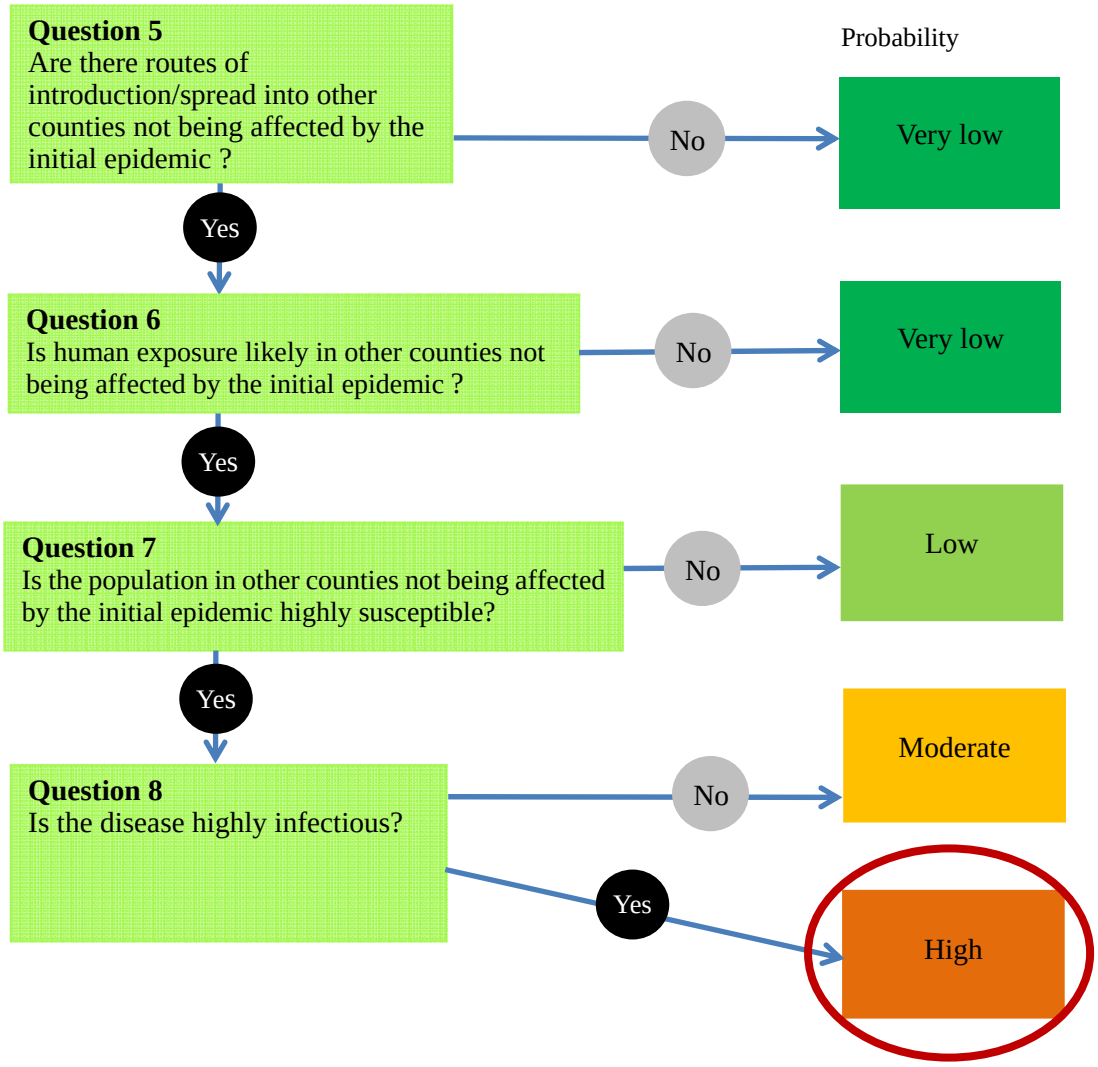

Figure 2. The probability of people being infected with/spreading of Chikungunya disease in cities and counties not being affected by the initial epidemic

Part A2-1: "Are there routes of introduction/ spread into other counties not being affected by the initial epidemic"

Taiwan's roads connect all places and people interact with each other frequently, and as a result, the virus may be brought to counties outside the place where the epidemic originated due to people's movement. Besides, Aegypti is distributed in counties to the south of Jiayi County, and Aedes albopictus is distributed in regions under 1,500 meters in altitude in Taiwan. In addition, past surveillance data on Dengue fever show that virus does follow people's movement to and spreads from southern counties to other regions, and this supports the possibility that the simulated epidemic could be brought from Kaohsiung County to other counties. Taiwan is close to countries where Chikungunya disease is prevalent, and the frequent cross-border movement of people increases the risk of virus importation. Thailand is the first South East Asian country to find the Chikungunya virus, discovered by Hammon's and others' research. In 1958, through the examination of virus culturing, Chikungunya virus was found to exist in the blood samples of Dengue fever and Dengue hemorrhagic fever cases in Bangkok [19]. In 1962, Chikungunya virus was found among 160 randomly selected cases from 815 Dengue hemorrhagic fever patients hospitalized in Bangkok's children hospital. In addition, countries like India, Indonesia, Philippines, Singapore, Malaysia, Thailand and Bengal have all experienced outbreaks of Chikungunya disease. Dengue fever has become endemic in Singapore since 1960. Nevertheless, no case of Chikungunya disease had been detected before 2007, even though in November 2006, Taiwan reported one case where a student returning from Singapore was infected by Chikungunya disease and that this case's place of infection might be Singapore[5], Singapore only began announcing imported cases of Chikungunya disease in 2007, and the first local case was discovered in January 2008, which led to a cluster outbreak that resulted in a total of twelve cases. [21-22] India's first epidemic of Chikungunya disease occurred in 1963, and the last epidemic occurred in 1973; Chikungunya disease appeared again in December 2005 and spread continuously, leading to almost 1,400,000 cases having been reported from twelve provinces in India [23]. Malaysia experienced its first epidemic of Chikungunya disease in 1998, with a total of fifty-one people being infected [24]. Besides, more serious epidemics occurred in Malaysia in April 2008, and this epidemic situation spread to fourteen provinces in the country (out of fifteen provinces) and the federal state, resulting in at least 7,100 people being infected. In addition, an epidemic of Chikungunya disease occurred in two nearby villages in the Dongguan prefecture of Guangdong province in Mainland China, and in this epidemic, 173 cases were confirmed [25] .

Taiwan introduces foreign workers from Indonesia, Thailand and the Philippines every year. In addition, our people frequently visit South East Asian countries for business, work or vocation, and there are other types of cross-border movement, such as foreign spouses coming to Taiwan or returning to South East Asia for family reunion. These factors could all cause the virus to be imported from outside the borders. According to statistics, there were about 775,000 visitors from South East Asia to Taiwan every year and about 1,240,000 Taiwanese nationals

visiting South East Asia every year between 2008 and 2010. Cases imported from outside the borders had totaled thirty-six people from 2007 to 2012(up to 9/30), and those included twenty-two people from Indonesia, six people from Malaysia, two people from Thailand, one person each from India, Singapore, Bangladesh, the Philippines and Myanmar, and one more person whose country of importation remained unknown. Among these imported cases, foreign workers and Taiwanese nationals all numbered twelve each, ten were foreigners, and , two people were foreign spouses. According to past data, because of the frequent cross-border movement of people, such as the introduction of foreign workers and foreigners coming to Taiwan and our people visiting South East Asian countries for work or travel, the risk of Chikungunya virus being imported from outside the borders may be real but hidden under the surface.

Part A2-2 “Is human exposure likely in other counties not being affected by the initial epidemic have the possibility of being exposed;” Part A2-3 “Is the population in other counties not being affected by the initial epidemic highly susceptible;” and Part A2-4 “Is the disease highly infectious.”

The outcomes of questions above are similar to those in Part A1-24, as the ability of the Chikungunya virus to cause human exposure and affect hypersensitive groups and the disease’s level of contagiousness do not change with geographical locations.

Part B:Chikungunya disease’s impact on Taiwan (Figure 3)

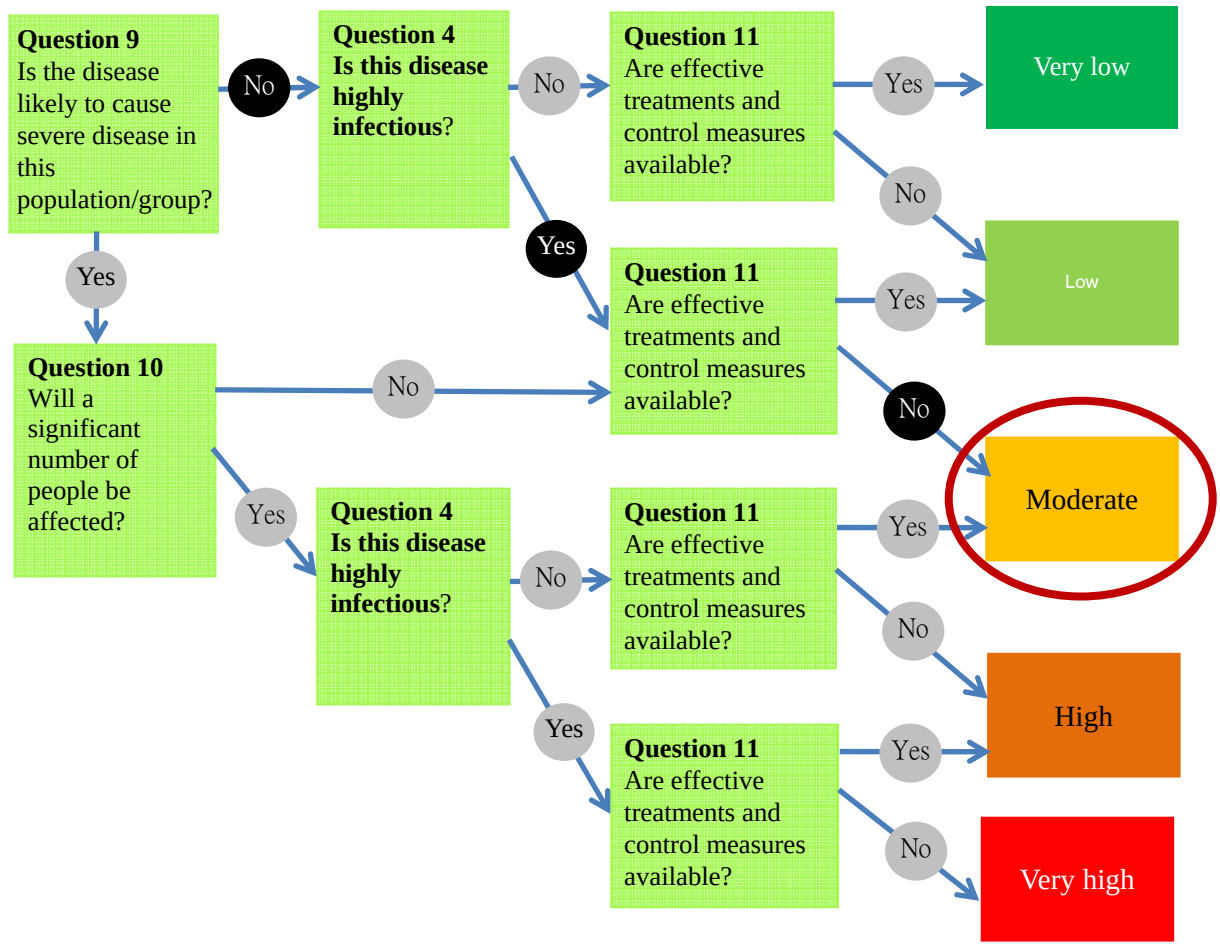

Figure 3. Impact caused by the epidemic (the severity level of disease in groups)

Part B1-1:"Is the disease likely to cause severe disease in this population/group"

Research in Indonesia shows that the death rate of Chikungunya disease is 5.50-10.05/100,000, and the disease rate is 1/1,000[26]. As for the hospitalized patients, high blood pressure, undetected respiratory tract disease and cardiovascular disease are the risk factors affecting the severity of the disease with the death rate about 10.6%, and this rate increases with age [2]. Fortunately, the infected will not become chronic viral carriers, because there is the possibility of spreading only if the mosquito vector bites patients in viremia.

Part B1-2: "Will a significant number of people be affected"

The general public may all be infected through bites by disease vectors carrying the virus. As for the attack rate of the disease, India's research indicates that the attack rate is 37.5% to 45% [27], while Indonesia's research suggests that the attack rate is 0.28% to 0.67% [28]. Different attack rates may be related to each country's monitoring ability and the effectiveness of implemented prevention measures.

Part B1-3: "Are effective treatments and control measures available"

At the present time, no specific anti-virus drugs exist, and as for methods of treatment, they remain primarily supportive in nature, such as lying on bed, intravenous infusion and drugs to relieve pain and fever [17,29]. There is also no effective vaccine to prevent the disease currently, and eliminating breeding sources of vectors, preventing being bitten by mosquitoes and spraying pesticide to kill mosquitoes remain the main prevention measures [29].

Part B1-4: "Are there contextual factors that may affect the risk assessment"

People's understanding of Chikungunya disease, the media's interest and current political and financial problems and circumstances may all have an effect on the outcome of risk evaluation. So far, Taiwan has not discovered any local epidemic of Chikungunya disease. If the first local case occurred, because people have lesser understanding of this kind of disease, it probably would not cause a huge impact on people in initial stage, and people's activity or cooperation with the call to eliminate the breeding sources may need to be enhanced. Nevertheless, if the epidemic is not controlled well, causing the number of infected people to continuously increase in a short period, it may arouse people's anxiety and the media's concern. Though this crisis may turn into an opportunity. Due to the elevated public attention, the push for breeding source elimination and the promotion of prevention work may become easier than in the beginning stage of the epidemic, and this may in turn increase the effect.

Part C: Risk matrix (Table 3)

Table 3. Risk matrix；Probability×Impact = Risk

Impact \ Possibility	Very low	Low	Moderate	High
Very low	Very low	Low	Low	Moderate
Low	Low	Low	Moderate	Moderate
Moderate	Low	Moderate	Moderate	High
High	Moderate	Moderate	High	High
Very high	Moderate	High	High	Very high

Probability (part A) x impact (part B) = risk (part C)

Chikungunya disease is not limited to infecting special groups only. People can be exposed to the risk of being infected by this virus and subsequently infect others by the bite of disease vectors. In addition, the places where mosquito vectors exist are considered highly contagious regions, and as a result, if an epidemic situation occurred in Kaohsiung City, Chikungunya disease would be a highly contagious disease.

In addition, convenient transportation leads to the flow of people and disease vectors, causing the epidemic to spread between different counties, and people in other counties may be infected because of the flow of virus. The people in these counties is same as people in Kaohsiung City who are all highly susceptible groups, and wherever in Kaohsiung City or other counties where the epidemic occurs, the virus have the same high level of contagiousness. Moreover, in counties other than Kaohsiung City, Chikungunya disease remains a disease with high infectious rates.

As for the possibility of spreading, this evaluation is conducted with strict criteria for disease prevention purposes. Because of the relatively lack of local evidence, on the basis of objectively evaluating possible local impact in the future and the timing and need of activating the prevention mechanism, we need to reevaluate whether the disease remains highly contagious based on the disease's own characteristics and surveillance data in local areas and in neighboring countries, so that we can maintain an active alert and evaluate the need to raise or lower alert level at any time.

If an epidemic of Chikungunya disease occurs, the affected range may be huge and the infected people may be a lot, however, except people with chronic disease, normal people may have symptoms such as fever, skin rash and joint pain only, which has a relatively lower severity. Nevertheless, because the virus has the characteristic of being hard to eliminate, without effective elimination methods of disease vectors and vaccine to conduct prevention at present, the impact caused by the epidemic is still classified as medium.

Wherever in Kaohsiung City or other counties does Chikungunya disease occurs, it is classified as having a high contagious rate with regard to infection/spreading rate, while the severity level of the disease in the population/groups is classified as having a medium impact. To sum up, if an epidemic of Chikungunya disease occurs in Kaohsiung City, its overall risk is classified as "High risk" with regard to Taiwan.

Discussion

According to the outcome of the risk evaluation just mentioned, we discuss appropriate response measures below:

A. Enhancing the monitoring and reporting of Chikungunya disease

Chikungunya disease is prevalent in South East Asian countries nearby Taiwan, such as Indonesia, India, Thailand and Malaysia. To enhance disease monitoring and prevent disease importation from outside the borders, Taiwan has included Chikungunya disease on as a

designated communicable disease since October 2007. As a result, individuals with acute fever above 38 degrees and severe arthritis or joint pain, which cannot be explained by any other medical diagnosis and possess any one of the following epidemiological factors at the same time: (1) There are confirmed cases of Chikungunya disease or contact history with confirmed cases of Chikungunya disease in areas near residence or daily activity; or (2) There is a travel history to regions where Chikungunya disease is prevalent; should be reported to Centers for Disease Control within twenty-four hours in order to detect cases rapidly and obstruct the spreading of the epidemic in time.

B. Monitoring of incoming travelers who carry the disease and epidemic surveillance of countries in frequent contact

Taiwan and South East Asia have frequent and intimate contact due to travelling and tourism, commercial interaction, and personnel communication, and as a result, actions like inspecting incoming travelers from regions where Chikungunya disease is prevalent, fever screening in airports, and symptoms detection should be enhanced, and people with an abnormal temperature during screening should receive a subsequent blood test. In addition, monitoring of epidemic situations and trends in countries in frequent contact and interaction should also be enhanced, and our people and disease prevention units should be reminded to be cautious at any time. The samples sent to conduct Dengue fever tests by airports' fever screening stations have also been tested for Chikungunya disease in Taiwan since March 2006, and the testing mechanisms include antigen examination (separation and RTPCR) and antibody examination (ELISA) in order to differentiate between Chikungunya disease and Dengue fever infection.

C. Elimination of breeding sources and control of disease vectors

Mosquitoes are intimately related to human life. As for the control of mosquitoes, up until now, it is still hard to find a fast and effective way to eliminate mosquito vectors and then prevent virus from spreading.

Taiwan's average temperature has increased 1.4℃ within a hundred years since the beginning of the twenty century. The effects of climate warming on development and reproduction of disease vectors include accelerating disease vectors' development and reducing their growth history, reducing the hibernation stage, changing the distribution of disease vectors, reducing the compartment of blood sucking, and increasing the number of times and frequency of that, and moreover, increasing the activity of the pathogen and disease vectors. Research shows that the epidemic situations of Dengue fever and Yellow fever in South America, Africa and other regions are related to abnormal climate change. El Nino phenomenon causes part of the regions or countries to have high precipitation and also causes disease spread by insect vectors in affected regions to increase. The variation of regional climate may have an effect on virus spread by arthropods, and if the variation in the global environment continues, the spread of Aegypti and Aedes albopictus can extend beyond geographical regions where they are currently active, which will result in the virus invading regions where it could hardly exist before[30].

Mosquito vectors that could spread Chikungunya disease is commonly distributed throughout Taiwan. As a result, no matter it is the prevention of Chikungunya disease or Dengue fever, health units should conduct routine survey of mosquito vectors' density in normal times, and also proclaim that people should be cautious of eliminating and cleaning the water-filled vessels in their residential environment, thus preventing the breeding of mosquito vectors' larva.

D. Health education to the public and enhancing alertness of doctors in disease diagnosis

When people travel to countries prevalent of Chikungunya disease, travel agents should take the initiative to offer tourists health education related to Chikungunya disease and instruct tourists on how to use mosquito repellent or implementing good mosquito-preventing measures so that they can avoid being infected through mosquito bites and bringing the virus home.

We should raise people's understanding of and alertness to Chikungunya disease, and implement measures to prevent people from being bitten by mosquitoes. As for residents, if any symptom which seems like Chikungunya disease infection occurred, people could immediately receive medical treatment of their own accord and inform doctors about related travel history.

In addition, hospitals and clinics' health education should be enhanced, and re-education seminars should be held for doctors to remind them of Chikungunya disease's diagnosis and medical treatment in order to avoid delaying the reporting of any case suspected as having Chikungunya disease. To avoid disease spread caused by imported cases, the Centers for Disease Control can issue press releases or letters to the medical community in appropriate time regarding the need of disease prevention, reminding people or the medical community of the need to raise alertness to related epidemic situations in order to receive medical treatment early and also be discovered and diagnosed promptly.

E. Measures of disease prevention and control

Though there has been no report or confirmation of local cases of Chikungunya disease Taiwan started to monitor for the disease, imported cases are detected every year. As a result, the Centers for Disease Control and local health units have produced health education materials to enhance people's understanding of Chikungunya disease and related disease prevention measures. At the same time, they also visit hospitals at regular intervals, reminding doctors of the need to raise alertness when seeing patients with suspicious symptoms or related travel history. In addition, they monitor epidemic situations of Chikungunya disease in countries nearby Taiwan regularly, and they irregularly issue press releases on the outcome of disease monitoring, reminding people to take note of prevention when heading to those regions

Besides, once imported cases are detected, the Centers for Disease control Center would authorize local health units to conduct an epidemiological survey and implement prevention measures aimed at those cases, which include measures such as sampling and inspecting people in contact, expanding elimination of breeding sources, spraying pesticide, health education, visiting nearby hospitals and clinics and reminding doctors to enhance the reporting of suspected cases. In doing so, we could prevent the epidemic situation from

expanding and threatening people's health.

Carrying out an epidemiological survey of epidemic situation, removing possible sources of infection, eliminating breeding sources, implementing chemical prevention of mature mosquitoes and enhancing education aiming at both residents and doctors are strategies to prevent epidemic situation from expanding.

The outcomes of our risk evaluation show that although Chikungunya disease is prevalent in South East Asian countries nearby Taiwan and countries along the coast of the Indian Ocean, compared to Dengue fever, Taiwan's residents, medical units and public health system are less familiar with Chikungunya disease. Besides, under the circumstances where factors related to disease spreading are commonplace, Taiwan in fact has a high risk to have an epidemic of Chikungunya disease. When such an epidemic occurs, due to the factors related to the environment, transportation and disease vectors, its hidden epidemic range and level of impact may surpass those of Dengue fever. As a result, besides understanding the characteristics of the virus and the disease vectors and collection of related parameters, the operational procedures for evaluating the disease's risk should also be practiced in advance in order to diagnose risk in the early stages of an outbreak and to provide recommendations for formulating prevention policy promptly through risk evaluation when an epidemic has occurred.

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Outbreak Investigation Express

The Prevention and Control Strategies for the Response of Animal Rabies Outbreak in Taiwan: A Preliminary Report

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Abstract

By means of vaccinating domesticated dogs, stray dogs control and careful quarantine inspections in Taiwan, no human rabies case has been reported since 1959. The last animal case was reported in 1961 and since then Taiwan had become one of the few rabies-free countries in the world. Until fifty years later, rabies virus was detected in wild Formosan ferret-badgers. Taiwan is now listed as a rabies-affected area by the World Organization for Animal health (OIE) after confirmation on July 17, 2013. By July 25th, four ferret-badgers from Yuchi and Lugu, Nantou County; Gukeng, Yunlin County and Donghe, Taitung County were confirmed infection by rabies virus. To contain the spread of re-emerging zoonotic disease, the Cabinet established the Rabies Prevention and Control Taskforce, a cross-departmental collaboration between the Council of Agriculture (COA) and Ministry of Health and Welfare (MHW) on July 24th. Through integrating information and coordination of strategies, the animal outbreak should be under controlled and prevent human rabies.

Key words: Ferret-badger, rabies

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