衞生防護中心
Centre for Health Protection

Scientific Committee on Vector-borne Diseases

Update on Epidemiology, Prevention and Control of Dengue Fever in Hong Kong

Purpose

This paper reviews the latest global and local epidemiology of dengue fever (DF) and examines the prevention and control measures in Hong Kong.

Background[1-4]

2. Dengue fever is a mosquito-borne viral disease that is rapidly spreading in the world in recent years. It is transmitted to humans through the bites of infective female Aedes mosquitoes. Dengue viruses encompass four distinct serotypes and recovery from infection by one serotype provides lifelong immunity against that particular serotype. However, subsequent infections by other serotypes of dengue virus increase the risk of developing severe dengue encompassing dengue haemorrhagic fever (DHF) or/and dengue shock syndrome (DSS), severe and potentially fatal complications of DF. Without proper treatment, case-fatality rates of severe dengue can exceed 20%, but with modern intensive supportive therapy, the rates should be less than 1%.

3. The disease is widespread throughout the tropics, but the actual number of DF cases worldwide remains uncertain. Its distribution is strongly influenced by rainfall, temperature and unplanned rapid urbanisation. International trade as well as movement of goods containing dried mosquito eggs facilitates the spread of vector.

Epidemiology

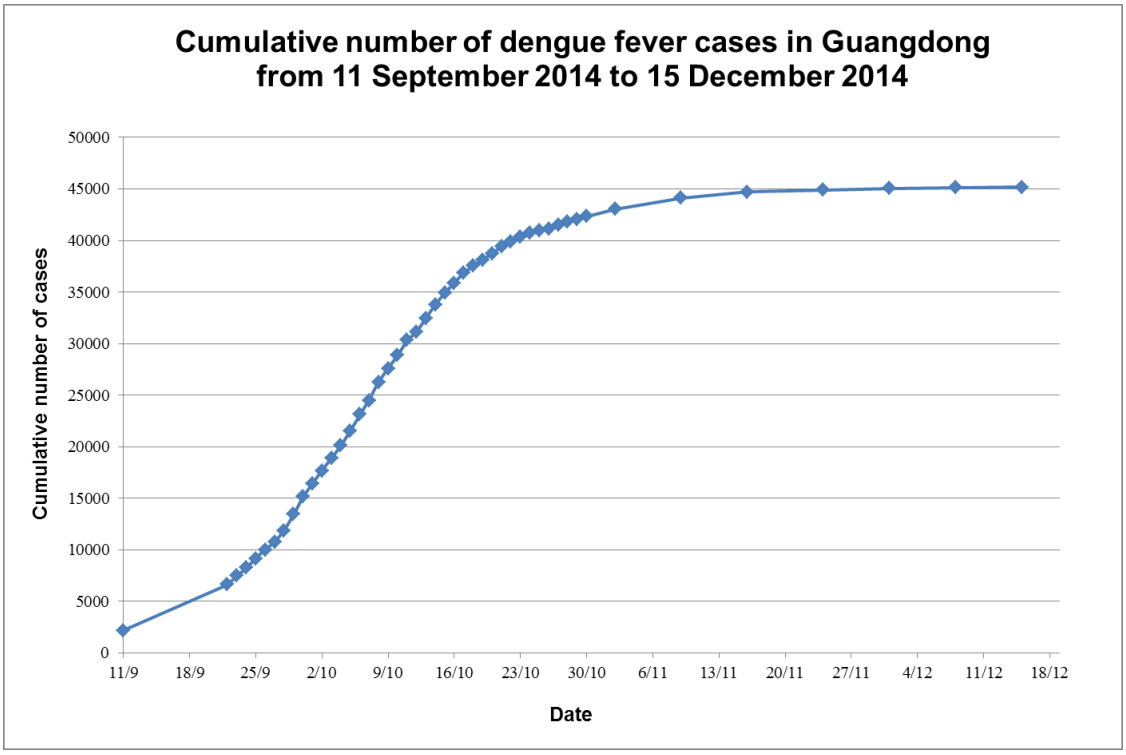
Global Situation

4. DF is now endemic in more than 100 countries. According to the World Health Organization (WHO), about half of the world population is at risk and the maximum burden is borne by countries of the Asia Pacific Region.[2,5] One recent study estimates that there are 390 million dengue infections per year, of which 96 million manifest clinically.[6] The WHO estimated that around 500,000 people with severe dengue require hospitalisation each year and about 2.5% of those affected die.[2]

5. The epidemiology of DF is evolving rapidly with outbreaks occurring with increasing frequency and expanding to previously unaffected geographical areas.[3] In Southeast Asia where DF is endemic, Malaysia and Singapore experienced sustained epidemic activity during 2013-2014 after a lapse of several years.[2,7] A total of 160 local dengue cases were recorded from August to October 2014 in Tokyo, Japan, where local transmission of dengue has not been reported for nearly 70 years.[8]

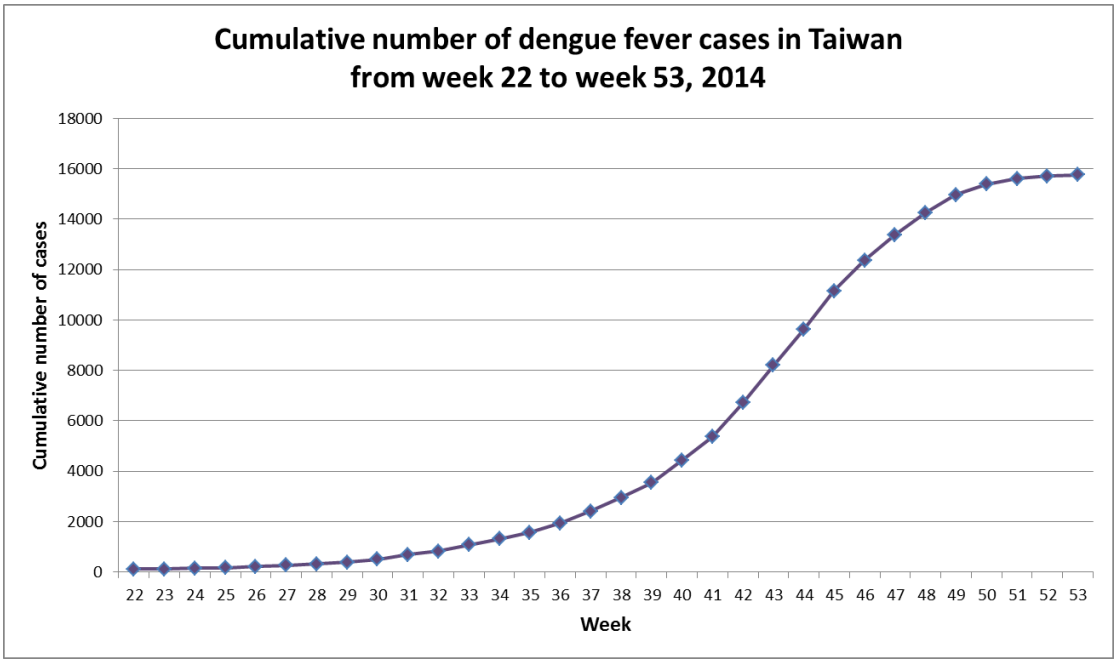
6. DF became notifiable in Mainland China in 1989. The number of cases was less than a thousand in most years except in 1995, 1999, 2002, 2006 and 2013 with around 1,000 to 6,800 cases recorded during years with high DF activity.[9] In 2014, there was an upsurge in Guangdong with more than 45,000 cases recorded. The cumulative number of cases in Guangdong increased sharply from around 2,000 cases as of 11 September 2014 to over 10,000 cases in about two weeks (Figure 1). There were 553 to 1826 cases recorded daily from 22 September for one month and the daily number started to decline thereafter. The majority of the cases occurred in Guangzhou.[10]

Figure 1. Cumulative number of DF cases recorded in Guangdong from 11 September 2014 to 15 December 2014.



7. Upsurge of cases was also observed in Taiwan in 2014. There were over 15,000 cases of DF in 2014, of which over 95% were local cases. The number in 2014 was more than 18 times that of 2013. The epidemic started in May 2014 and the number of local cases increased remarkably from July 2014. The DF activity peaked in October and November and started to decline in December, with over 95% of the local cases occurring in Kaohsiung (Figure 2).[11]

Figure 2. Cumulative number of DF cases recorded in Taiwan from week 22 to week 53, 2014.



8. Threat of DF outbreaks also expands to Europe after a lapse of over 50 years, with local transmission of the virus reported for the first time in Croatia and France in 2010 and an outbreak in Portugal in 2012.[3] While transmission of DF was interrupted in the Americas during the 1970s, the Caribbean and Central and South America are now in a hyperendemic state with local transmission of DF in almost all countries.[3] Such an increase in disease activity is thought to be consistent with global warming. An upsurge of disease activity has also been reported in Brazil this year.[12]

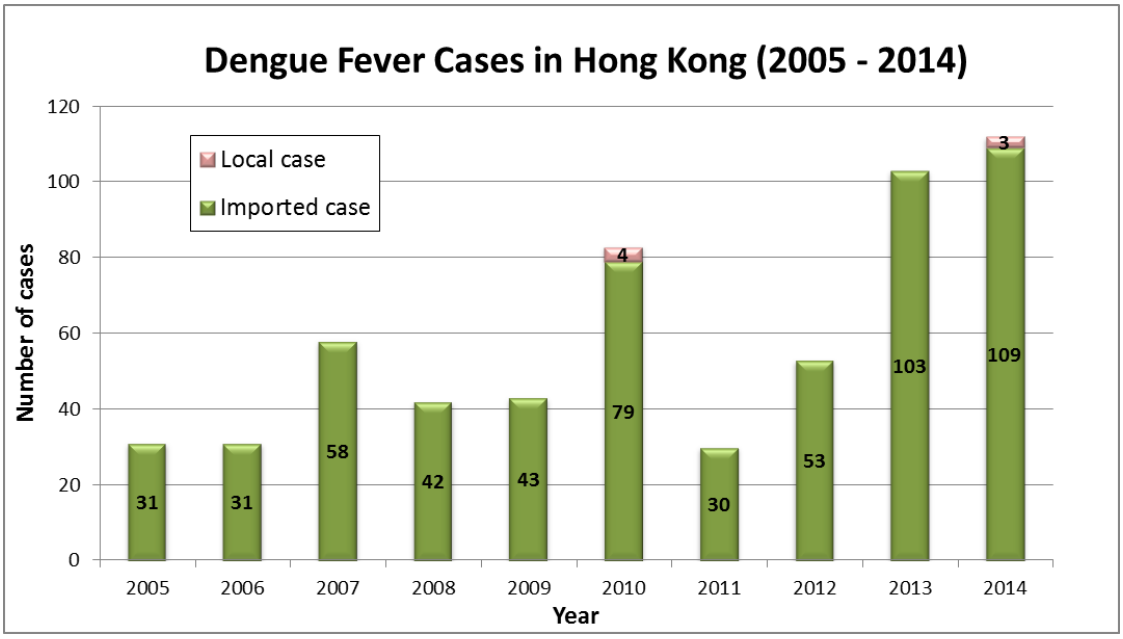
Local Situation

9. In Hong Kong, DF has been made statutorily notifiable since March 1994 and all medical professionals are required to report suspected or confirmed cases to the Centre for Health Protection (CHP), Department of Health (DH). A total of 782 cases of DF have been recorded in Hong Kong from March 1994 to 2014. Almost all cases were imported cases, but local cases were also recorded in 2002 (20 cases), 2003 (1 case), 2010 (4 cases) and 2014 (3 cases). In 2015, there was also a local case recorded in early June.

10. In the past decade (2005-2014), the annual number of cases ranged between 30 to 112 and an increasing trend was observed in recent years (Figure

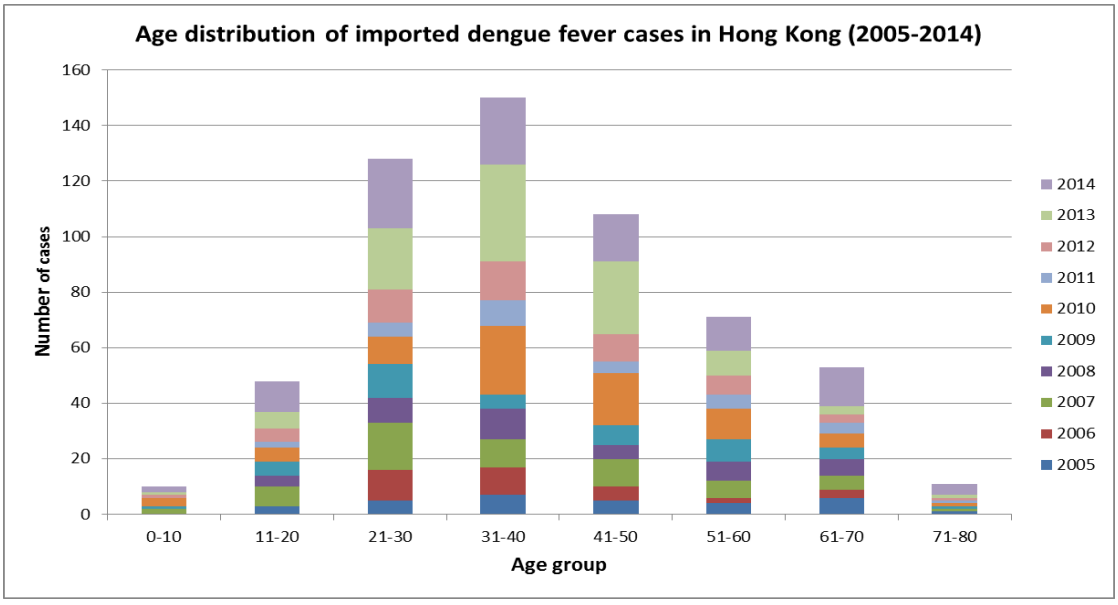
3). The majority of the cases were imported cases (579 out of 586 cases, 99%).

Figure 3. Annual number of DF cases recorded by the CHP from 2005 to 2014.



11. Concerning the 579 imported cases recorded from 2005 to 2014, 308 were males and 271 were females (male: female ratio = 1.1: 1). Their ages ranged from five to 80 years old (median = 37 years old) were affected (Figure 4).

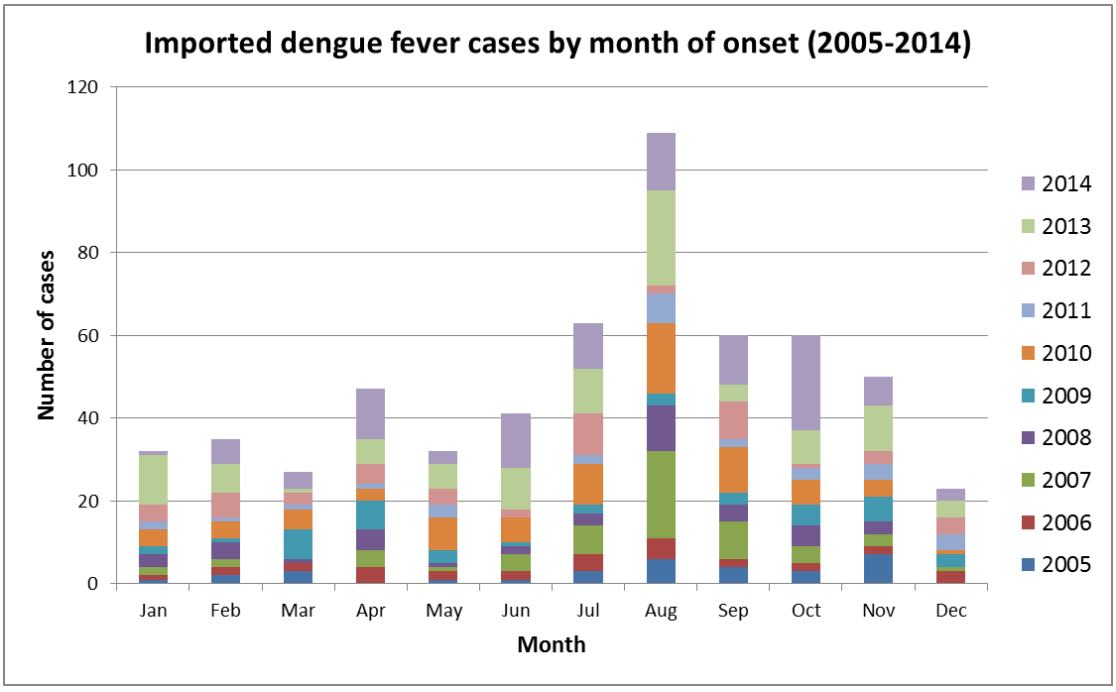
Figure 4. Age distribution of imported DF cases in Hong Kong from 2005 to 2014.



12. The majority of them had travelled to / stayed in Southeast Asian countries / areas namely Indonesia (27%), Thailand (19%), the Philippines (17%), India (6%), Malaysia (6%), Mainland China (5%), Cambodia (4%), Vietnam (3%), etc. Among the 461 patients with positive dengue virus genomic sequences detected in serum samples by polymerase chain reaction, the most common type of dengue virus was type 1 (43.7%), followed by type 3 (26.0%), type 2 (22.7%) and type 4 (7.6%).

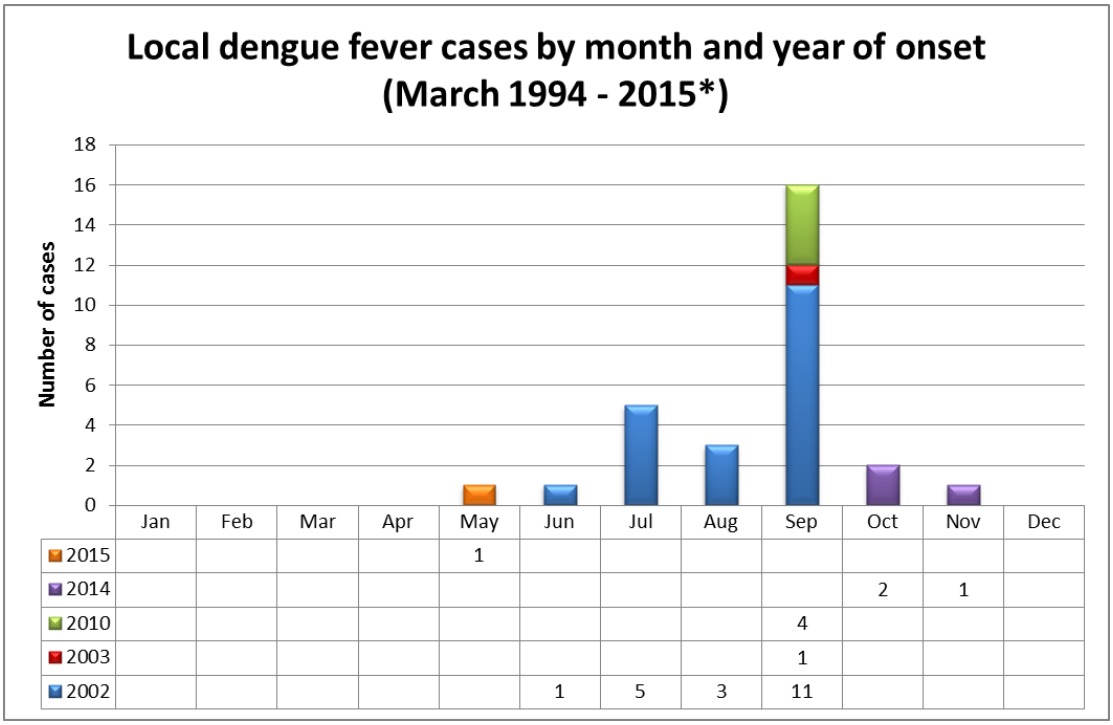
13. The imported cases occurred throughout the year with a slightly higher number of cases reported to have symptoms onset in August (Figure 5). This could potentially be explained by increased travel activities during the summer holidays in Hong Kong. Seven cases of severe dengue with no deaths were recorded in the past decade.

Figure 5. Number of imported DF cases by month of onset from 2005 to 2014.



14. A total of 29 local cases have been recorded by the CHP since the disease become notifiable in Hong Kong in March 1994. The majority of the cases had symptoms onset during the summer months when there is higher temperature and increased rainfall, compared with imported cases that occurred throughout the year (Figure 5 and Figure 6). Twenty-two males and seven females (male: female ratio = 3.1: 1) were involved. Their ages ranged from eight to 72 years old (median = 38 years old).

Figure 6. Number of local DF cases by month of onset from March 1994 to 2015.



** Figures as of 15 June 2015*

15. In 2002, a cluster involving 16 patients who worked / resided near a construction site in Ma Wan was recorded. One patient was infected via blood transfusion from a patient among the cluster and three other sporadic cases were recorded in the same year. The case in 2003 was sporadic while the local cases recorded in 2010 involved four members of the same family living in Deep Water Bay. For the local cases in 2014, the first two cases occurred in cluster with both patients working at the same construction site in Sai Ying Pun where they recalled mosquito bites during the incubation period. The third patient lived in Tsing Yi and she recalled mosquito bites at home and in Tsing Yi Northeast Park. A local case was recorded recently on 2 June this year. All the patients recovered subsequently and no fatal case was recorded.

16. The case recorded in 2015 involved a 58 year-old gentleman with good past health. He lived in Shatin and recalled frequent mosquito bites near his residence. He worked as an interior decoration worker who mainly worked indoor in Prince Edward. Epidemiological investigation revealed that he developed non-specific symptoms including fever, headache, myalgia, diarrhea and rash since 24 May. Laboratory investigation showed that he had thrombocytopenia and leukopenia. He had several visits to different doctors and was finally admitted to a private hospital where he was confirmed to be a case of DF. Field visit was conducted and found that renovation of the building with scaffolding had been present for over a year and numerous potential mosquito

breeding sites were identified. Active case finding did not identify further case so far. Vector survey and mosquito control measures were being conducted. Risk communication through various channels including press briefing, press releases, letters, health talks, hotlines and meetings was carried out to call for concerted actions by other Government departments and the community. Investigation and control measure is ongoing.

Prevention and control strategy

Surveillance and investigation of human cases

17. The WHO acknowledges that surveillance is an essential core intervention of any dengue prevention and control programme since it provides the information necessary for risk assessment and programme guidance, including epidemic response and programme evaluation.[3]

18. The CHP has established mechanism in place for the surveillance of DF. Case investigation and control actions are initiated immediately once a notification of DF is received by the CHP. Clinical information and travel history are obtained, whereas travel collaterals and close contacts are identified. In Hong Kong, so far the case load is of manageable size and all febrile patients can be isolated in hospital in a mosquito-free room in order to prevent secondary spread of the disease. DH had established collaboration with the Hospital Authority (HA) and private hospitals for arrangement of laboratory investigations. With the advancement in technology, demonstration of dengue virus antigen in serum sample had been added as one of the laboratory confirmatory criteria for DF in Hong Kong since March 2013 to allow enhanced diagnostic efficiency for early diagnosis.

19. DH also works closely with the Food and Environmental Hygiene Department (FEHD) to conduct vector survey and control at places where the patient had visited during the incubation period and after the onset of symptoms as appropriate.

20. In case of suspected indigenous transmission of dengue virus, CHP conducts field investigations, performs active case finding, enhances surveillance, sets up telephone hotlines and delivers health talks for case identification, prevention and control of disease transmission and risk communication. The FEHD is called for conducting vector investigation and enhanced vector control. Other departments also participate in controlling the

vector as necessary. These actions aim to identify the foci of infection, prevent local transmission of the disease, as well as to prevent exportation of the disease to other places.

Vector surveillance and control

21. In Hong Kong, the principal vector *Aedes aegypti* is not found, but the prevailing species *Aedes albopictus* can also spread the disease. A dengue vector surveillance programme operated by the FEHD is in place to monitor the distribution of *Aedes albopictus* at selected areas, evaluate the effectiveness of mosquito prevention and control work carried out by various parties, and provide surveillance information to the public for timely adjustment to their mosquito control strategies.

22. Under the vector surveillance programme, small plastic containers (ovitraps) are placed at selected locations for detection of larval breeding rate of *Aedine* mosquitoes. Ovitrap index for *Aedes albopictus* is the percentage of ovitraps that are found to have positive larval breeding result. Two different indices, namely Area Ovitrap Index (AOI) and Monthly Ovitrap (MOI) would be enumerated. AOI indicates the extensiveness of the distribution of *Aedine* mosquitoes in that particular area surveyed while the MOI is the average of all AOIs within the same month, which reflects the territory-wide situation of *Aedes albopictus*. In addition, survey of *Aedes albopictus* had been carrying out in the Hong Kong International Airport since 1998. Starting from 2004, dengue vector surveillance work had also been extended to cover all the port areas. Specific preventive and control measures would be initiated according to the level of the Ovitrap Index. All the AOIs are released to the public once available on FEHD's website and the MOIs are announced each month on FEHD's website and through press release.[13]

23. Starting from 2015, tests on dengue virus have been conducted on dengue vectors collected in areas where AOIs have reached / exceeded 10% but below 15% and have reached/exceeded 20%. Collaboration had been made with a local University on dengue virus test by testing dengue vectors collected in areas where AOIs have reached 15% or above but below 20%. Since late October 2014, dengue vectors collected from port areas by FEHD are also tested for the presence of dengue virus. Tests on dengue virus would also be conducted on dengue vectors collected in areas 500 meters around the places visited by patients of local DF cases. So far, all specimens were tested negative for dengue virus.

24. In response to the local DF case notified in early June 2015, all the dengue vectors collected from the ovitraps set in the Shatin District, Central and Western District as well as Tsing Yi in June and July would be tested on dengue virus.

25. FEHD has been taking the lead in mosquito control with other Government departments and stakeholders in the community. In addition to regular mosquito control work, FEHD launches territory-wide anti-mosquito campaign in collaboration with other Government departments every year. The campaign aims to deepen public awareness on the potential risk of mosquito-borne diseases and the importance of mosquito prevention and control in the community. It encourages community participation and forges close partnership of Government departments in carrying out mosquito control work within their venues. FEHD also invites active participation of District Council members, relevant Government departments and relevant stakeholders in launching mosquito control operations at district level.

26. There are also three bodies coordinating interdepartmental action in mosquito control, namely the Anti-Mosquito Steering Committee (AMSC), the Inter-departmental Coordinating Committee of Vector-borne Diseases (ICC) and task force meetings. The AMSC, chaired by the Permanent Secretary for Food and Health (Food), comprises members from various policy bureaux and Government departments with an objective to map out and oversee the policy, strategies and directions for comprehensive, territory-wide anti-mosquito efforts. The ICC, chaired by the Controller, CHP, was set up to coordinate public health actions on the prevention of vector-borne diseases among Government departments. Task force meetings, chaired by FEHD district officer, are also convened to strengthen mosquito prevention and control work at the district level among the district stakeholders.

Laboratory support

27. Accurate and efficient diagnosis of DF is of primary importance for clinical care, surveillance activities and disease control.[14] The Public Health Laboratory Services Branch (PHLSB) of DH is equipped with various dengue diagnostic methods including nucleic acid detection, antigen detection, serological tests and serotype identification. The PHLSB collaborates closely with HA and private hospitals to support timely diagnosis of DF.

Risk communication

28. The CHP has been issuing weekly press release on the local situation

of DF since October 2014 to alert members of the public in maintaining vigilance against the disease. Through the network of supporting organisations of the territory-wide campaign against vector-borne diseases, the latest news and information is disseminated to the community stakeholders. Letters to doctors, private hospitals and institutions including residential care homes and schools are issued and press briefings are held whenever there is significant update on the latest situation and risk.

Patient management and emergency preparedness

29. There is no specific treatment for DF and maintenance of the patient's body fluid volume is critical for severe cases.[2] To assist clinicians in recognising the evolution of the course of DF in its various forms of severity, as well as to apply appropriate principles of management, WHO has developed and made publicly available guidelines and handbooks for clinical management, prevention and control of DF.[14,15]

30. In Hong Kong, clinical protocol for triage and case management of DF in case of epidemics is being developed by HA. To prepare to combat against the impact of local transmission of DF, the CHP had drawn up a contingency plan to lay down the departmental responses to various scenarios.

Travel health measures

31. To prevent importation of DF into Hong Kong, the Port Health Office (PHO) of DH had implemented a series of measures at boundary control points (BCPs) in Hong Kong. Inspections are conducted at BCPs regularly to ensure mosquito control measures are implemented properly.

32. PHO has also been closely monitoring the overseas situation of DF. Updated information and travel health advice on DF has been made available at the Travel Health website.[16] Posters are displayed and pamphlets are distributed to travellers at BCPs to remind them on preventive measures against DF.

Health education

33. The DH had produced a variety of health education materials on prevention of vector-borne diseases, including DF. These include a thematic web page, animated videos, television and radio announcements in public interests, pamphlets, posters and exhibition boards to promote anti-mosquito actions and personal protective measures against mosquito bites.

34. To echo the World Health Day 2014 theming vector-borne diseases, DH together with over 50 partners including supporting organisations from health care and related sectors, Government departments / bureau, since April 2014, have launched an ongoing territory-wide publicity and public education campaign. The campaign aims to raise awareness of the general public about the threat posed by vectors and vector-borne diseases and to encourage families and communities to take relevant vector preventive actions. Various publicity and health education channels including press conferences, websites, television and radio stations, mobile apps, health education hotline, giant wall banners, public transports, newspapers and media interviews had been deployed under the campaign. In February 2015, the CHP launched a dedicated Facebook Page and a YouTube Channel with a view to further disseminating information on health promotion as well as disease prevention and control to members of the public, especially the younger generation.

35. A Personal and Environmental Hygiene Survey was conducted by the Central Health Education Unit of DH in 2014 to look into the knowledge, attitude and practice of the general public. According to the survey, members of the public generally had good knowledge on vector-borne diseases. The majority of the respondents (94%) were able to correctly indicate that DF is transmitted by mosquitoes and over 80% of them were able to correctly indicate that the preventive measures for DF is to prevent mosquito bites and its breeding. However, only around half of the respondents wore light-coloured long-sleeved clothing and trousers, applied mosquito repellent to exposed parts of the body and / or use mosquito nets / screens when the room was not air-conditioned during their travel to tropical or subtropical areas. Comparing the survey results with another similar survey performed in 2003, the knowledge on effective preventive measures against DF and the alertness on the risk of acquiring DF while travelling abroad had increased, but the practice on changing water in vases at least once per week and applying mosquito repellent to exposed parts of the body while travelling to tropical or subtropical areas had decreased. The survey reflected that the general public were well aware of the threats associated with DF but had not adopted appropriate preventive measures to reduce the risk of infection.

Vaccine development

36. Currently, no licensed dengue vaccine is available.[17] However, some vaccine candidates are being evaluated in clinical studies. The candidate that is at the most advanced clinical development stage is a live-attenuated tetravalent vaccine based on chimeric yellow fever-dengue virus, which had progressed to phase III efficacy studies.[18,19]

37. In order to provide guidance to national regulatory agencies and manufacturers on vaccine evaluation and registration, WHO had published Guidelines on the quality, safety and efficacy of dengue tetravalent vaccines as well as Guidelines for the clinical evaluation of dengue vaccines.[20,21] While WHO recommends prevention of DF through vector control methods in the absence of licensed vaccines or specific dengue therapeutics, future vaccine implementation is one of the technical elements of WHO's dengue control strategy.[1,22]

Local risk of DF

38. Taking into consideration the wide distribution of dengue vector, high volume of international travel, as well as geographical proximity with dengue endemic countries / areas, the risk of Hong Kong in having more imported DF cases or even indigenous transmission of dengue virus is high. As Hong Kong is highly urbanised and under the influence of global warming, dengue vector could proliferate rapidly which makes effective vector control extremely difficult. The disease is at high risk of becoming epidemic within a short period of time once indigenous transmission is established.

39. Despite that surveillance, prevention and control measures of DF are in place, more demanding resources in capacity building, central coordination of territory-wide mosquito control, information technology, formulation of public education and risk communication strategy are required to cope with epidemic which has yet to come.

Recommendations

40. In response to the high activity of DF in neighbouring places and the occurrence of local cases of DF, the Scientific Committee of Vector-borne Diseases reviewed the current strategy on prevention and control of DF in Hong Kong and put forward a consensus summary of recommendations in December 2014.[23] Among others, enhancing awareness of health care professionals and public education are recommended. However, during the course of epidemiological investigations of DF cases, it is not uncommon to reveal that the attending doctors had a low index of suspicion and had never explored the travel history of the patients and proceeded with appropriate investigation. Many patients also did not volunteer their travel history as well. There is need to review the current public education and risk communication strategy with a view to improve the effectiveness.

41. Learning the experiences from Guangdong and Taiwan, it is appreciated that a remarkable upsurge of cases can occur rapidly within a short period of time. To cope with a potential epidemic, there should be capacity building and resources injection in public health, clinical management and laboratory support. It is also important to have development and application of information technology in handling massive surveillance data.

42. Furthermore, it is time to review and enhance the existing level of mosquito control, public and community participation, as well as coordination between Government departments. High level central coordination of mosquito control actions, legislation and enforcement, together with effective risk communication strategy would be vital for disease control and prevention.

43. Although no effective vaccine for DF is licenced in the market at present, it is important to keep abreast of the latest developments and consider needs assessment for local applicability when it is available.

Centre for Health Protection

Department of Health

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References

1. World Health Organization. *Global strategy for dengue prevention and control 2012-2020.*
2. World Health Organization. Dengue and severe dengue. http://www.who.int/mediacentre/factsheets/fs117/en/. Accessed 27 May 2015.
3. World Health Organization. *Sixty-eighth World Health Assembly, Dengue: prevention and control.*
4. World Health Organization. *Dengue Haemorrhagic Fever: Early recognition, diagnosis and hospital management.* 2006.
5. World Health Organization. *The dengue strategic plan for the Asia Pacific Region 2008-2015.*
6. Bhatt S, Gething PW, Brady OJ, et al. The global distribution and burden of dengue. *Nature.* 2013;496(7446):504-507.
7. National Environment Agency of Singapore. Dengue Updates. http://www.dengue.gov.sg/subject.asp?id=73. Accessed 27 May 2015.
8. Tsuda Y, Maekawa Y, Ogawa K, et al. Biting density and distribution of Aedes albopictus during the September 2014 outbreak of dengue fever in Yoyogi Park and the vicinity in Tokyo Metropolis, Japan. *Jpn J Infect Dis.* 2015.
9. Lai S, Huang Z, Zhou H, et al. The changing epidemiology of dengue in China, 1990-2014: a descriptive analysis of 25 years of nationwide surveillance data. *BMC Med.* 2015;13(1):100.
10. 廣東省衞生和計劃生育委員會. 疫情信息. http://www.gdwst.gov.cn/a/yiqingxx/index.html. Accessed 27 May 2015.
11. Centers for Disease Control of R.O.C. (Taiwan). 傳染病統計資料查詢系統. http://nidss.cdc.gov.tw/ch/SingleDisease.aspx?dc=1&dt=4&disease=061&position=1. Accessed 27 May 2015.
12. Pan American Health Organization. Dengue. http://www.paho.org/hq/index.php?option=com_topics&view=article&id=1&Itemid=40734. Accessed 27 May 2015.
13. Food and Enviornmental Hygiene Department. Dengue Fever Ovitrap

Index Update. http://www.fehd.gov.hk/english/safefood/dengue_fever/ovitrap_index.html. Accessed 27 May 2015.

14. World Health Organization. *Dengue - Guidelines for diagnosis, treatment, prevention and control.* 2009.

15. World Health Organization. *Handbook for clinical management of dengue.* 2012.

16. Travel Health Service of the Department of Health. HKSAR. Dengue fever. http://www.travelhealth.gov.hk/english/popup/popup_dengue.html. Accessed 27 May 2015.

17. World Health Organization. Dengue vaccine research. http://www.who.int/immunization/research/development/dengue_vaccines/en/. Accessed 27 May 2015.

18. Capeding MR, Tran NH, Hadinegoro SR, et al. Clinical efficacy and safety of a novel tetravalent dengue vaccine in healthy children in Asia: a phase 3, randomised, observer-masked, placebo-controlled trial. *Lancet.* 2014;384(9951):1358-1365.

19. Villar L, Dayan GH, Arredondo-Garcia JL, et al. Efficacy of a tetravalent dengue vaccine in children in Latin America. *N Engl J Med.* 2015;372(2):113-123.

20. World Health Organization. *Guidelines on the quality, safety and efficacy of dengue tetravalent vaccines (live, attenuated).* 2011.

21. World Health Organization. *Guidelines for the clinical evaluation of dengue vaccines in endemic areas.* 2008.

22. World Health Organization. Immunization, Vaccines and Biologicals http://www.who.int/immunization/diseases/dengue/en/. Accessed 27 May 2015.

23. Scientific Committee of Vector-borne Diseases. Consensus Summary of Recommendations on Prevention and Control of Dengue Fever in Hong Kong. 2014.