RAPID RISK ASSESSMENT

Dengue outbreak in Réunion, France

16 April 2018

Main conclusions and options for response

A dengue outbreak of unusual magnitude is currently taking place in the French Outermost Region of Réunion. *Aedes albopictus* mosquitoes are considered to be the principal vector of dengue virus in Réunion. Dengue virus (DENV) transmission in Réunion is not unexpected: over the last ten years a number of limited dengue outbreaks have been reported on the island.

The current epidemic could continue and intensify in the coming weeks. Based on previous *Aedes* mosquito-borne outbreaks on the island, further transmission is expected up to the beginning of the southern-hemisphere winter (which lasts from July to September).

The risk of onward transmission of dengue fever in Europe is linked to the importation of virus by viraemic travellers into receptive areas with established and active competent vectors, i.e. *Aedes albopictus* in mainland Europe, primarily around the Mediterranean, and *Aedes aegypti* on Madeira. Environmental conditions in Europe are expected to become more favourable to the growth of mosquito populations in the coming weeks, reaching a high vector abundance in summer and early autumn. Prior to this high-activity season, there is a low likelihood of sustained autochthonous transmission of dengue virus in continental Europe associated with introduction by returning travellers from Réunion or other areas with active DENV transmission.

During the high vector activity season in southern Europe, early detection of imported cases is essential to prevent the establishment of local transmission. The detection of an autochthonous case in Europe in receptive areas should trigger epidemiological and entomological investigations to assess the potential for onward transmission and guide vector control measures aimed at lowering mosquito population density in order to reduce the probability of further spread. Increased awareness among clinicians and travellers returning from areas with active dengue virus transmission, combined with adequate laboratory diagnostic capability, are instrumental for the early detection of travel-associated cases.

Travellers returning from areas where dengue virus transmission occurs should be advised to seek medical attention if presenting with symptoms compatible with dengue fever in the first two weeks after return, particularly if returning to areas where competent vectors are established, especially during the high vector activity season. This will help reduce the risk of further local transmission by ensuring timely detection of cases. Symptomatic patients should be advised on how to apply personal protective measures against mosquito bites in order to prevent further transmission.

Erratum, 18 April 2017: The date of an earlier dengue outbreak in Réunion (p. 5) was corrected to 1977–78.

Suggested citation: European Centre for Disease Prevention and Control. Dengue outbreak in Réunion, France – 16 April 2018. Stockholm: ECDC; 2018.

As no vaccine or prophylactic drug is available, dengue fever prevention is based on protection against mosquito bites. *Aedes* mosquitoes have a diurnal biting pattern, both indoors and outdoors. Personal protection measures should be applied all day long and especially during the hours of highest mosquito activity (mid-morning, late afternoon to sunset). Personal protective measures to reduce the risk of mosquito bites include the use of mosquito repellent in accordance with the instructions indicated on the product label; wearing long-sleeved shirts and long trousers; using insecticide-treated mosquito bed nets, which are essential in providing protection from mosquito bites in rooms that are not adequately screened or air-conditioned.

Advice to travellers to areas endemic for *Aedes*-transmitted arboviruses (including Réunion due to the ongoing dengue outbreak) regarding personal protective measures against *Aedes* mosquito bites can also limit the risk of infection and reduce the probability of introduction of dengue virus to areas in the EU that have established competent *Aedes* vectors and offer conditions suitable for transmission.

EU Member States should also consider applying safety measures to prevent the transmission of dengue virus through donations of substances of human origin (SoHO) by travellers to Réunion. For more details, see the section on SoHo below.

Source and date of request

ECDC internal decision, 9 April 2018.

Public health issue

This risk assessment was triggered by the unusual size of the current dengue fever outbreak driven by *Aedes albopictus*, a mosquito vector that is present in Réunion and widely distributed in the southern part of Europe. This assessment addresses the public health significance of the event and the possibility of further local and international spread, notably to EU areas with established *Aedes albopictus* mosquito populations.

Consulted experts

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Disease background information

Dengue virus

Dengue is a mosquito-borne disease caused by dengue virus, a member of the *Flaviviridae* family. There are four antigenically distinct serotypes of dengue virus (DENV 1–4). The main mosquito vector is *Aedes aegypti* but other mosquitoes, including *Ae. albopictus*, have been implicated in virus transmission. The virus is not transmitted directly from human to human, except in the case of blood transfusion, or organ and tissue transplantation from viraemic donors.

The majority of infections are either asymptomatic or result in a mild febrile illness. Symptoms include a sudden onset of febrile illness lasting an average of 2–7 days, usually characterised by severe headache, retro-orbital pain, arthralgia and a maculo-papular rash. The more severe and potentially deadly forms, classified as severe dengue, develop in less than 5% of patients.

A DENV infection can be identified through detection of the viral antigen NS1, the viral genome, or DENV-specific antibodies. In primary DENV infections, the NS1 antigen can be detected typically up to day 14 post onset of symptoms while in secondary infections it can be detected up to day five. Viral RNA usually can be detected up to day seven. Confirmation of infection based on routine serology only is complicated by extensive cross-reactivity between the four DENV serotypes and other flaviviruses (including Zika virus, yellow fever, West Nile virus, tick-borne encephalitis virus and Usutu virus, the latter three being endemic in parts of Europe) and related vaccines. In addition, an acute flavivirus infection might boost cross-reactive antibodies due to a previous infection with, or vaccination against, another flavivirus thereby interfering with a proper interpretation of serological tests. Serological diagnosis can be performed by detection of DENV-specific IgM antibodies five to six days after onset of symptoms or detection of a fourfold rise in DENV-specific IgG antibody titres on paired serum samples taken 14 days apart. In secondary dengue, IgM antibodies usually appear from day two post symptom onset [1,2].

Patients with severe dengue can recover without sequelae if diagnosed early and treated appropriately. There is currently no vaccine available for dengue fever, and treatment of the disease is symptomatic and supportive. More information on dengue fever is available in the ECDC dengue fever factsheet.

Mosquito vectors

Ae. aegypti is considered the main primary vector for dengue virus transmission. *Ae. aegypti* is not present in the continental EU, but the species is established around the Black Sea and in Madeira. In 2017, this species was introduced to Fuerteventura, Canary Islands. For more information on *Ae. aegypti*, see the ECDC factsheet for experts and the map on the current distribution of *Aedes aegypti* in Europe (January 2018).

Ae. albopictus is competent for all four dengue virus serotypes, but it is considered less susceptible to DENV infection than *Ae. aegypti* [3]. From an epidemiological historical perspective, there are only a limited number of dengue outbreaks described that were sustained by *Ae. albopictus*. Therefore this mosquito species is considered as a less efficient dengue virus epidemic vector than *Ae. aegypti* [3]. However, *Ae. albopictus* might act as a driver of an epidemic in areas where *Ae. aegypti* is absent or its population is too low to be considered having an epidemiological importance [4]. For instance, outbreaks likely to have been driven by *Ae. albopictus* in the past include earlier outbreaks in the main islands of Japan; in Hawaii; and in the city of Guangzhou, Guangdong Province, China, in a location where *Ae. aegypti* is reported to be absent [4-8].

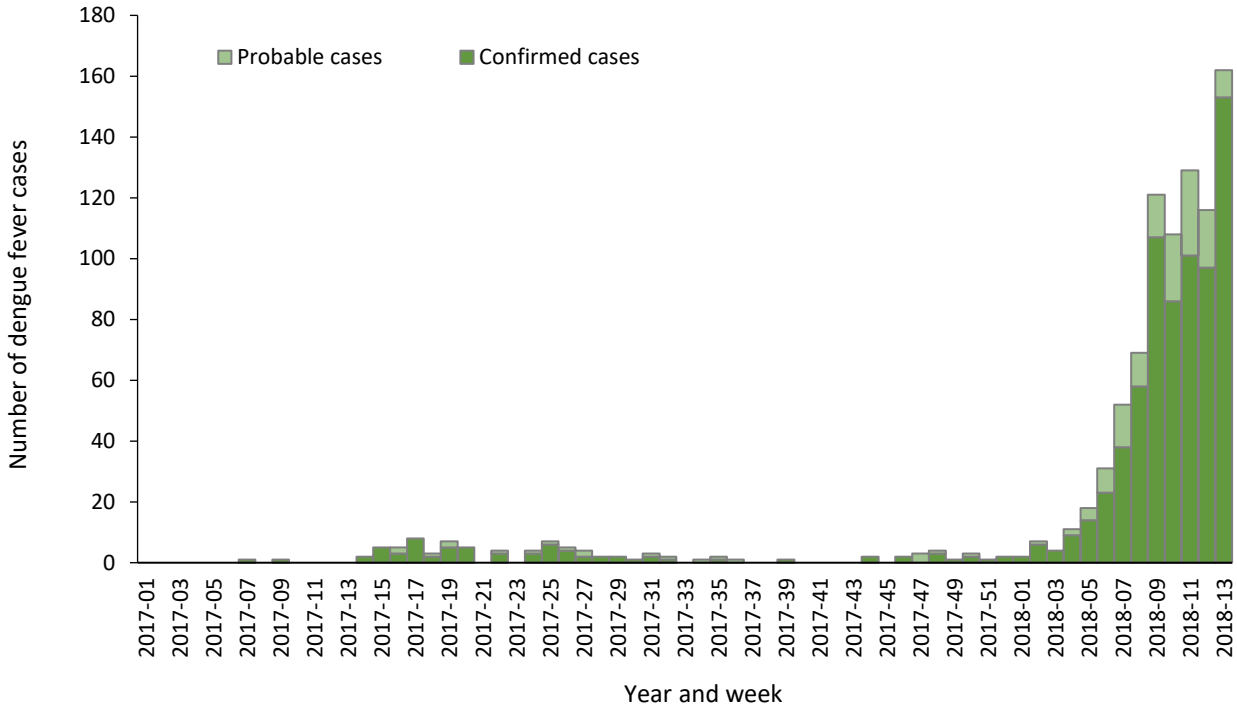
In Réunion, dengue virus transmission is driven by *Ae. albopictus*. The vector is widespread below 800 meters of altitude, especially present in anthropised areas [9]. *Ae. albopictus* is the dominant species while *Ae. aegypti* persists only as residual populations, mainly found in natural habitats, such as ravines located on the west coast [10,11]. The mosquito population shows seasonal variation throughout the year, with the highest density in the humid season from December to April, but can remain active all year long [12]. The local *Ae. albopictus* populations are historically known to be competent for the transmission of dengue virus and chikungunya virus, with a vector capacity for dengue virus able to support seasonal transmission as illustrated by recurrent episodes of transmission (see Annex 1) [13].

Since the 1990s, *Ae. albopictus* has become increasingly established in EU countries. The current known distribution of *Ae. albopictus* in Europe corresponds to the southern part of Europe (see Annex 1 for a detailed map). Areas with established presence of *Ae. albopictus* in southern Europe are receptive for arbovirus transmission in the summer and early autumn. This is illustrated by sporadic events of transmission of dengue virus and chikungunya virus driven by *Ae. albopictus* in southern Europe. (See Annex 1 of the ECDC Rapid Risk Assessment, Cluster of autochtonous chikungunya cases in France – 23 August 2017) [14].

Event background information

The epidemic curve of autochthonous cases of dengue fever in Réunion since January 2017 is presented in Figure 1 below [15].

Figure 1. Number of autochthonous cases of dengue in Réunion, by week of onset (week 1–2017 to week 13–2018)



Source: Adapted from 'Surveillance de la dengue à la Réunion. Point épidémiologique au 3 avril 2018', Cire océan Indien. Santé publique France (2018) [15].

In 2017, a first dengue outbreak in Réunion peaked in late April (week 17), with 94 probable and confirmed autochthonous cases [15]. Between the end of July (week 31) and December 2017 (week 52), only sporadic autochthonous cases occurred, mainly in the commune of Saint-Paul, supporting a possible residual low transmission level during the southern-hemisphere winter (June to September) [16].

Since the beginning of 2018 and as of 8 April, 992 autochthonous cases of dengue have been reported in Réunion [15]. Among these cases, 237 were reported between 2 and 8 April 2018 [15]. The most prevalent serotype among dengue cases is DENV-2. The other serotypes identified are DENV-1 and DENV-4, mostly among imported cases [15]. The main vector of infection implicated in this outbreak is *Ae. albopictus.*

As of 8 April 2018, the municipality of Saint-Paul, one of the most populated areas in the island, remains the most affected area [16]. Additional cases in the western part of the island have been reported in the communes of La Possession, Le Port and Saint-Leu. In the southern part of the island, cases were reported from Saint-Pierre and Ravine des Cabris.

Integrated and multi-sectoral vector control measures have been carried out in the neighbourhoods affected by dengue fever [17]. On 27 March 2018, the administrative authorities decided to raise the emergency level as indicated by the emergency plan, *Organisation de la Réponse de Sécurité Civile* (ORSEC), to respond to a low-level epidemic [18]. This plan includes the following measures: active case finding, intensification of vector control, reinforcement of communication to the public and healthcare workers, and mobilisation of additional resources [18]. The aim of the plan is to limit the spread of the virus in affected areas by reducing the mosquito population (e.g. insecticide treatments, destruction of larvae habitats).

ECDC threat assessment for the EU

Risk of further transmission in Réunion

The ongoing dengue epidemic in Réunion is of an unusual magnitude compared with the previous outbreaks. Since 2004, between 10 and 228 probable and confirmed autochthonous dengue fever cases have been reported annually (Annex 2). Before this period, only one large dengue outbreak in Réunion was documented in the literature: the 1977–78 outbreak had an estimated overall attack rate of 30%; DENV-2 was the suspected associated serotype [19,20].

The reasons for the sudden upsurge in cases in 2018 are not well understood, but multiple and synergic factors might have played a role in the development of this epidemic. First, the absence of herd immunity for dengue virus in the local population seems to favour a rapid spread of the transmission in the immunological naive community (seroprevalence survey: 3.1% of all blood donors were positive for DENV in 2008) [16]. Secondly, the intense tropical cyclone Berguitta (9–20 January) and the tropical cyclone Dumazile (1–6 March 2018) hampered the implementation of vector control activities, which might have favoured higher abundance of the vector in the aftermath of both tropical storms [21]. Thirdly, the residual level of transmission likely to have been present at the end of the winter season might have triggered a rapid increase of transmission when the environmental conditions became favourable to the growth of the vector population [16]. In this respect, the situation shows similarities to the large 2006 chikungunya epidemic that was preceded by the persistence of viral circulation throughout the winter. However, the chikungunya outbreak was enhanced by an alanine-to-valine substitution in the E1 envelope glycoprotein (E1-A226V), a mutation that emerged in the second wave and that enhanced the vector competence for CHIKV of the local *Ae. albopictus* population [22]. To date, there is no evidence of local genetic adaptation of dengue virus to *Ae. albopictus* in Réunion which would lead to enhanced virus transmission. Nevertheless, due to the unusual upsurge of cases, further genetic and entomological investigations are needed to better assess the on-going outbreak and evaluate the potential for its extension.

This epidemic could continue to intensify in the coming weeks, with new areas of active transmission and, potentially, the severe manifestation of disease. Based on previous outbreaks caused by *Aedes* mosquitoes in Réunion, transmission is expected to persist up to the beginning of the southern-hemisphere winter (July–September), and perhaps longer.

Due to the current intense transmission in several foci, the current outbreak increases the probability of dengue cases among regional and international travellers.

Risk of transmission in the EU/EEA

The risk for onward transmission of dengue fever in Europe is linked to the importation of dengue virus by viraemic travellers to areas with established and active competent vectors, i.e. *Ae. albopictus* in mainland Europe, primarily around the Mediterranean, and *Ae. aegypti* in Madeira. For Europe, according to data (2011 and 2016) from the International Air Transport Association (IATA), an average of 500 000 people travel from Réunion to Europe every year. The most popular travel periods are i) December–January and ii) July–August, when between 40 000 to 50 000 people travel to Europe every month, mostly to mainland France. The current outbreak would, to some extent, increase the likelihood of introduction of dengue to the EU through viraemic travel-associated cases, notably in France. It should be noted that imported cases of dengue fever linked to travel to other global destinations are frequent in Europe: in 2016, 2 705 imported dengue cases were reported to The European Surveillance System (TESSy) at ECDC; 1 504 of these cases included information on the suspected country of infection. The most frequently reported probable countries of infection were Asian countries: Thailand (21%), Indonesia (18%) and India (12%). In 2016, France reported one imported case from Réunion.

Continental Europe is permissive to autochthonous transmission of arboviruses transmitted by *Ae. albopictus* during the summer and autumn. This was exemplified by the chikungunya outbreaks in Italy in 2007 and 2017 and sporadic autochthonous cases of DENV and/or CHIKV reported in France and in Croatia (see Annex 1 of a 2017 ECDC Rapid Risk Assessment: *Cluster of autochthonous chikungunya cases in France – 23 August 2017*) [14]. With regard to dengue, all reported events of transmission corresponded to sporadic cases or limited clusters and always occurred during the season of high vector activity.

Environmental conditions in continental Europe are expected to become more favourable to the growth of mosquito populations in the coming weeks. In early summer, parts of southern Europe will reach a high vector abundance, which will last well into early autumn. Prior to this period, there will be only a low likelihood of sustained autochthonous dengue virus transmission in continental Europe.

Outside of continental Europe, the European Union Overseas Countries and Territories (OCTs) and Outermost Regions (ORs) with established populations of *Ae. aegypti* remain vulnerable to dengue epidemics, as demonstrated by recurrent dengue fever outbreaks in the Caribbean region and the outbreak in Madeira during the summer and autumn 2012 [23,24].

Diagnostics and diagnostic capacity in EU/EEA

Diagnostics for DENV are available in reference laboratories in 28 EU/EEA countries, with 25 countries offering molecular detection, 24 countries offering routine serology, and 10 countries offering virus neutralisation tests (gold standard serologic method). All countries with *Ae. albopictus* presence have DENV diagnostic capacity. A complete overview of DENV diagnostic capacity in the EU/EEA can be found in the EVD-LabNet directory [25].

Dengue and safety of substances of human origin

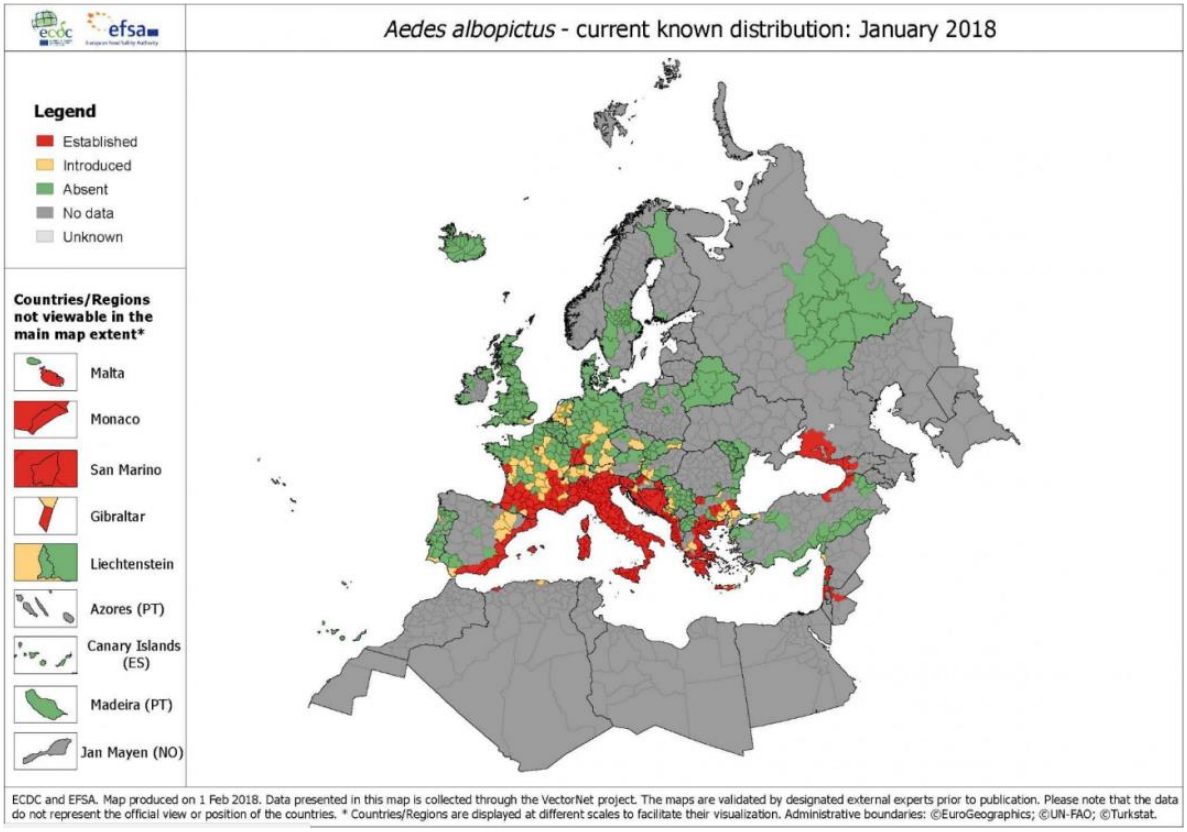
DENV can be transmitted through infectious substances of human origin (SoHO) donated by asymptomatic, viraemic donors. Transmission of DENV through transfusion of erythrocytes, platelets and plasma [26-31] as well as through kidney [32,33], liver [33-35], heart [33] and bone marrow [36,37] transplantation have been reported. The precise level of risk of DENV transmission through SoHO cannot be adequately assessed due to the small number of cases reported. The rarity of reported SoHO-transmitted dengue cases could be partly explained by under-recognition and under-diagnosis in many endemic countries. Other factors include the hypothetical enhancement of DENV replication and DENV virulence by the saliva of the mosquito, the presence of protective antibodies among transfusion recipients or in co-transfused antibody-positive blood components [27]. Further data are needed to assess the risk of DENV transmission thorough SoHO more precisely.

To prevent transfusion-transmitted DENV infection, blood donors should be deferred for 120 days after full recovery from clinical dengue [41]. In affected areas, donors with flu-like symptoms should be deferred for 28 days after the resolution of symptoms [41]; alternatively, donations should be quarantined for 72 hours and released upon the information of absence of symptoms in the donor. Donation screening using nucleic acid testing (NAT) is the main tool to reduce the risk of transmission in affected areas when deferrals may potentially affect supply. For plasma and platelets donations, pathogen-reduction technology may also be considered. Post-donation information should be reinforced. Potential asymptomatic donors whose travel histories place them at risk of dengue infection should be deferred for 28 days upon return to non-endemic areas [41].

Donors of organs, cells and tissues living or coming from dengue affected areas should be tested for the presence of viral RNA using NAT [42,43]. Organs from viraemic donors should not be used without consulting a transplant infectious disease expert [42].

Annex 1

Figure A-1. Distribution of *Aedes albopictus* in Europe, January 2018



Source: Aedes albopictus, current known distribution: January 2018

Annex 2

Table A-1. Dengue transmission events with more than 10 cases in Réunion between 2004 and 2017

Years	Start month	End month	Number of cases*	Prevalent dengue serotype	Source
2004	April	June	228	1	[44]
2006–2007	December	October	1 in 2006, 27 in 2007	1	[45]
2008	January	July	33	1	[45]
2010	March	May	18	3	[46]
2012	February	July	31	1 and 3	[47]
2013	February	July	21	1 and 3	[48,49]
2014	March	August	29	1	[50]
2015–2016	October	July	231	1	[51]
2017–2018	February	Underway	1086	2	[15]

** = confirmed and probable dengue cases. NA: not available.*
In 2011, only two sporadic confirmed cases were reported: one in May and one in September [52] .

Disclaimer

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References

1. Goncalves A, Peeling RW, Chu MC, Gubler DJ, de Silva AM, Harris E, et al. Innovative and New Approaches to Laboratory Diagnosis of Zika and Dengue: A Meeting Report. J Infect Dis. 2018 Mar 13;217(7):1060-8.
2. Muller DA, Depelsenaire AC, Young PR. Clinical and Laboratory Diagnosis of Dengue Virus Infection. J Infect Dis. 2017 Mar 1;215(suppl_2):S89-S95.
3. Lambrechts L, Scott TW, Gubler DJ. Consequences of the expanding global distribution of *Aedes albopictus* for dengue virus transmission. PLoS Negl Trop Dis. 2010;4(5):e646.
4. Gratz NG. Critical review of the vector status of *Aedes albopictus*. Medical and veterinary entomology. 2004 Sep;18(3):215-27.
5. Tsuda Y, Maekawa Y, Ogawa K, Itokawa K, Komagata O, Sasaki T, et al. Biting Density and Distribution of *Aedes albopictus* during the September 2014 Outbreak of Dengue Fever in Yoyogi Park and the Vicinity of Tokyo Metropolis, Japan. Jpn J Infect Dis. 2016;69(1):1-5.
6. Kutsuna S, Kato Y, Moi ML, Kotaki A, Ota M, Shinohara K, et al. Autochthonous dengue fever, Tokyo, Japan, 2014. Emerg Infect Dis. 2015 Mar;21(3):517-20.
7. Effler PV, Pang L, Kitsutani P, Vorndam V, Nakata M, Ayers T, et al. Dengue fever, Hawaii, 2001-2002. Emerg Infect Dis. 2005 May;11(5):742-9.
8. Luo L, Jiang LY, Xiao XC, Di B, Jing QL, Wang SY, et al. The dengue preface to endemic in mainland China: the historical largest outbreak by *Aedes albopictus* in Guangzhou, 2014. Infect Dis Poverty. 2017 Sep 22;6(1):148.
9. Boyer S, Foray C, Dehecq JS. Spatial and temporal heterogeneities of *Aedes albopictus* density in La Reunion Island: rise and weakness of entomological indices. PLoS One. 2014;9(3):e91170.
10. Delatte H, Paupy C, Dehecq J, Thiria J, Failloux A, Fontenille D. *[Aedes albopictus* , vecteur des virus du chikungunya et de la dengue à la Réunion : biologie et contrôle.]2008; 15(1):[3-13 pp.]. Available from: https://hal-pasteur.archives-ouvertes.fr/pasteur-01696240/document.
11. Bagny L, Delatte H, Quilici S, Fontenille D. Progressive decrease in *Aedes aegypti* distribution in Reunion Island since the 1900s. J Med Entomol. 2009 Nov;46(6):1541-5.
12. Gouagna LC, Dehecq JS, Fontenille D, Dumont Y, Boyer S. Seasonal variation in size estimates of *Aedes albopictus* population based on standard mark-release-recapture experiments in an urban area on Reunion Island. Acta Trop. 2015 Mar;143:89-96.
13. Vazeille M, Mousson L, Martin E, Failloux AB. Orally co-Infected *Aedes albopictus* from La Reunion Island, Indian Ocean, can deliver both dengue and chikungunya infectious viral particles in their saliva. PLoS Negl Trop Dis. 2010 Jun 8;4(6):e706.
14. European Centre for Disease Prevention and Control. Cluster of autochtonous chikungunya cases in France – 23 August 2017. Stockholm.2017 [cited 2018 Mar 31]. Available from: https://ecdc.europa.eu/sites/portal/files/documents/RRA-Chikungunya-France-revised-Aug-2017.pdf.
15. Cire océan Indien. Santé publique France. Surveillance de la dengue à la Réunion. Point épidémiologique au 9 avril 2018. Saint Denis, La Réunion.2018 [cited 2018 Apr 12]. Available from: http://invs.santepubliquefrance.fr/Publications-et-outils/Points-epidemiologiques/Tous-les-numeros/Ocean-Indien/2018/Surveillance-de-la-dengue-a-la-Reunion.-Point-epidemiologique-au-9-avril-2018.
16. Cire océan Indien. Santé publique France. Surveillance de la dengue à la Réunion. Point épidémiologique au 3 avril 2018. Saint Denis, La Réunion.2018 [cited 2018 Apr 3]. Available from: http://invs.santepubliquefrance.fr/fr/Publications-et-outils/Points-epidemiologiques/Tous-les-numeros/Ocean-Indien/2018/Surveillance-de-la-dengue-a-la-Reunion.-Point-epidemiologique-au-3-avril-2018.
17. Agence régionale de Santé OI. Dengue à La Réunion : L'ARS OI renforce le niveau d'alerte sur l'ensemble de l'île Saint Denis, La Réunion.2018 [cited 2018 Feb 27]. Available from: https://www.ocean-indien.ars.sante.fr/dengue-la-reunion-lars-oi-renforce-le-niveau-dalerte-sur-lensemble-de-lile.
18. Agence régionale de Santé OI. Dengue à La Réunion : activation du niveau 3 du dispositif ORSEC et mobilisation de tous les acteurs. Saint Denis, La Réunion2018 [cited 2018 Feb 27]. Available from: https://www.ocean-indien.ars.sante.fr/dengue-la-reunion-activation-du-niveau-3-du-dispositif-orsec-et-mobilisation-de-tous-les-acteurs.
19. Coulanges P, Clercy Y, Jousset F, ., Rodhain F, Hannoun C. [Dengue at Reunion: isolation of a strain at the Pasteur Institute of Madagascar]. Bull Soc Pathol Exot Filiales. 1979;72(3):205-9.
20. Kles V, Michault A, Rodhain F, Mevel F, Chastel C. [A serological survey regarding Flaviviridae infections on the island of Reunion (1971-1989)]. Bull Soc Pathol Exot. 1994;87(2):71-6.
21. Wikipedia - the free encyclopedia. 2016–17 South-West Indian Ocean cyclone season 2018 [cited 2018 Apr 8]. Available from: https://en.wikipedia.org/wiki/2016%E2%80%9317_South-West_Indian_Ocean_cyclone_season.

22. Tsetsarkin KA, Vanlandingham DL, McGee CE, Higgs S. A single mutation in chikungunya virus affects vector specificity and epidemic potential. PLoS Pathog. 2007 Dec;3(12):e201.
23. Torres JR, Orduna TA, Pina-Pozas M, Vazquez-Vega D, Sarti E. Epidemiological Characteristics of Dengue Disease in Latin America and in the Caribbean: A Systematic Review of the Literature. J Trop Med. 2017;2017:8045435.
24. European Centre for Disease Prevention and Control. Surveillance, prevention and control of dengue in Madeira: lessons learnt after the 2013 ECDC mission 2013 [cited 2014 Mar 19]. Available from: https://ecdc.europa.eu/en/news-events/surveillance-prevention-and-control-dengue-madeira-lessons-learnt-after-2013-ecdc.
25. EVD-LabNet. EVD-LabNet directory search. Rotterdam: EVD-LabNet secretariat; 2018 [cited 2018 Apr 10]. Available from: https://www.evd-labnet.eu/evd-labnet-directory-search?species=996-dengue-virus.
26. Chuang VW, Wong TY, Leung YH, Ma ES, Law YL, Tsang OT, et al. Review of dengue fever cases in Hong Kong during 1998 to 2005. Hong Kong Med J. 2008 Jun;14(3):170-7.
27. Tambyah PA, Koay ES, Poon ML, Lin RV, Ong BK. Dengue hemorrhagic fever transmitted by blood transfusion. N Engl J Med. 2008 Oct 2;359(14):1526-7.
28. Stramer SL, Linnen JM, Carrick JM, Foster GA, Krysztof DE, Zou S, et al. Dengue viremia in blood donors identified by RNA and detection of dengue transfusion transmission during the 2007 dengue outbreak in Puerto Rico. Transfusion. 2012 Aug;52(8):1657-66.
29. Levi JE, Nishiya A, Felix AC, Salles NA, Sampaio LR, Hangai F, et al. Real-time symptomatic case of transfusion-transmitted dengue. Transfusion. 2015 May;55(5):961-4.
30. Oh HB, Muthu V, Daruwalla ZJ, Lee SY, Koay ES, Tambyah PA. Bitten by a bug or a bag? Transfusion-transmitted dengue: a rare complication in the bleeding surgical patient. Transfusion. 2015 Jul;55(7):1655-61.
31. Matos D, Tomashek KM, Perez-Padilla J, Munoz-Jordan J, Hunsperger E, Horiuchi K, et al. Probable and possible transfusion-transmitted dengue associated with NS1 antigen-negative but RNA confirmed-positive red blood cells. Transfusion. 2016 Jan;56(1):215-22.
32. Tan FL, Loh DL, Prabhakaran K, Tambyah PA, Yap HK. Dengue haemorrhagic fever after living donor renal transplantation. Nephrology, dialysis, transplantation : official publication of the European Dialysis and Transplant Association - European Renal Association. 2005 Feb;20(2):447-8.
33. Rosso F, Pineda JC, Sanz AM, Cedano JA, Caicedo LA. Transmission of dengue virus from deceased donors to solid organ transplant recipients: case report and literature review. The Brazilian journal of infectious diseases : an official publication of the Brazilian Society of Infectious Diseases. 2018 Jan - Feb;22(1):63-9.
34. Gupta RK, Gupta G, Chorasiya VK, Bag P, Shandil R, Bhatia V, et al. Dengue Virus Transmission from Living Donor to Recipient in Liver Transplantation: A Case Report. Journal of clinical and experimental hepatology. 2016 Mar;6(1):59-61.
35. Saigal S, Choudhary NS, Saraf N, Kataria S, Mohanka R, Soin AS. Transmission of dengue virus from a donor to a recipient after living donor liver transplantation. Liver transplantation : official publication of the American Association for the Study of Liver Diseases and the International Liver Transplantation Society. 2013 Dec;19(12):1413-4.
36. Rigau-Perez JG, Vorndam AV, Clark GG. The dengue and dengue hemorrhagic fever epidemic in Puerto Rico, 1994-1995. The American journal of tropical medicine and hygiene. 2001 Jan-Feb;64(1-2):67-74.
37. Punzel M, Korukluoglu G, Caglayik DY, Menemenlioglu D, Bozdag SC, Tekgunduz E, et al. Dengue virus transmission by blood stem cell donor after travel to Sri Lanka; Germany, 2013. Emerg Infect Dis. 2014 Aug;20(8):1366-9.
38. Linnen JM, Vinelli E, Sabino EC, Tobler LH, Hyland C, Lee TH, et al. Dengue viremia in blood donors from Honduras, Brazil, and Australia. Transfusion. 2008 Jul;48(7):1355-62.
39. Mohammed H, Linnen JM, Munoz-Jordan JL, Tomashek K, Foster G, Broulik AS, et al. Dengue virus in blood donations, Puerto Rico, 2005. Transfusion. 2008 Jul;48(7):1348-54.
40. Busch MP, Sabino EC, Brambilla D, Lopes ME, Capuani L, Chowdhury D, et al. Duration of Dengue Viremia in Blood Donors and Relationships Between Donor Viremia, Infection Incidence and Clinical Case Reports During a Large Epidemic. J Infect Dis. 2016 Jul 1;214(1):49-54.
41. European Directorate for the Quality of Medicines and Healthcare. Guide to the preparation, use and quality assurance of blood components 19th. ed. Strasbourg2017 [cited 2018]. Available from: https://www.edqm.eu/en/blood-transfusion-guide.
42. European Directorate for the Quality of Medicines and Healthcare. Guide to the quality and safety of organs for transplantation 6 the ed. Strassbourg2016 [cited 2018]. Available from: https://www.edqm.eu/en/organs-tissues-and-cells-technical-guides.

43. European Commission. COMMISSION DIRECTIVE 2006/17/EC of 8 February 2006 implementing Directive 2004/23/EC of the European Parliament and of the Council as regards certain technical requirements for the donation, procurement and testing of human tissues and cells 2006 [cited 2018]. Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32006L0017.

44. Pierre V, Thiria J, Rachou E, Sissoko D, Lassale C, P. R. Epidémie de dengue 1 à la Réunion en 2004. [Dengue 1 outbreak in Réunion in 2004]. Journées de veille sanitaire. 2005 [cited 2018 Apr 8]. Available from: http://invs.santepubliquefrance.fr/publications/2005/jvs_2005/poster_13.pdf.

45. D'Ortenzio E, Balleydier E, Baville M, Filleul L, Renault P. [Dengue fever in the Reunion Island and in South Western islands of the Indian Ocean]. Med Mal Infect. 2011 Sep;41(9):475-9.

46. Cire océan Indien. Santé publique France. Surveillance de la dengue à la Réunion. Point épidémiologique - N°32 au 18 mai 2010. Saint Denis, La Réunion.2010 [cited 2018 Apr 3]. Available from: http://www.invs.sante.fr/content/download/17600/111139/version/20/file/pe_rm_deng_32_180510.pdf.

47. Cire océan Indien. Santé publique France. Situation de la dengue et du chikungunya : bilan 2012 à la Réunion et dans l'océan Indien. Point épidémiologique au 14 février 2013. Saint Denis, La Réunion.2013 [cited 2018 Apr 3]. Available from: http://invs.santepubliquefrance.fr/fr/content/download/58427/236571/version/37/file/pe_chik_deng_reunion_140213.pdf.

48. Cire océan Indien. Santé publique France. Situation de la dengue à La Réunion. Point épidémiologique au 29 juillet 2013. Saint Denis, La Réunion.2013 [cited 2018 Apr 3]. Available from: http://invs.santepubliquefrance.fr/fr/content/download/72107/271351/version/27/file/pe_dengue_reunion_290713.pdf.

49. Cire océan Indien. Santé publique France. Surveillance des arboviroses à la Réunion. Point au 20 novembre 2013. Saint Denis, La Réunion.2013 [cited 2018 Apr 3]. Available from: http://invs.santepubliquefrance.fr/fr/content/download/80114/292118/version/54/file/pe_arbovirus_reunion_201113.pdf.

50. Cire océan Indien. Santé publique France. Surveillance des arboviroses à La Réunion. Point épidémiologique au 28 novembre 2014. Saint Denis, La Réunion.2014 [cited 2018 Apr 3]. Available from: http://invs.santepubliquefrance.fr/fr/content/download/99415/358075/version/37/file/pe_arbo_reunion_281114.pdf.

51. Cire océan Indien. Santé publique France. Les arboviroses à la Réunion et Mayotte. Bilan de l'année 2016. Saint Denis, La Réunion.2016 [cited 2018 Apr 3]. Available from: http://invs.santepubliquefrance.fr/fr/content/download/133547/478716/version/43/file/pe_arbo_rm_160117.pdf.

52. Cire océan Indien. Santé publique France. Situation de la dengue et du chikungunya à la Réunion et dans l'océan Indien. Point au 29 décembre 2011. Saint Denis, La Réunion.2011 [cited 2018 Apr 3]. Available from: http://invs.santepubliquefrance.fr/fr/content/download/26544/141851/version/13/file/pe_dengue_reunion_291211.pdf.