Dengue fever

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Key facts

To better understand public health terms included in this Disease Tool (e.g. What is a case definition? or What is an infectious agent?), consult our page on Key concepts on epidemiology.

Importance

Severe dengue fever affects most countries in Asia and Latin America. Globally there are approximately 390 million dengue fever infections per year, of which 96 million have a clinical manifestation. An estimated 500,000 people with severe dengue fever require hospitalization each year, and about 2.5 per cent of those affected die. The risk of epidemics is present in areas where the vector (*Aedes* mosquito) exists.

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Case definition

A **case definition** is a set of uniform criteria used to define a disease for public health surveillance. It enables public health officials to classify and count cases consistently.

The following are standard case definitions to allow national health authorities to interpret data in an international context. However, during an outbreak case definitions may be adapted to the local context and the Red Cross Red Crescent should use those agreed/established by national health authorities. NB: Consider that during community-based surveillance, ***volunteers*** *should use broad (simplified) case definitions (referred to as community case definitions) to recognize most or all possible cases, provide relevant risk communication and appropriate actions and encourage them to seek care. Other actors such as* ***healthcare workers or investigators*** *studying the cause of a disease, on the other hand, can use more specific case definitions that may require laboratory confirmation.*

Probable dengue fever:

- Fever AND two or more of the following criteria: nausea/vomiting, rash, aches and pains, clinical test for capillary fragility positive (tourniquet test), low white blood cells or warning signs.
- Warning signs can be: abdominal pain or tenderness, persistent vomiting, clinical fluid accumulation, mucosal bleed, lethargy, restlessness, liver enlargement greater than 2cm; laboratory: increase in haematocrit concurrent with rapid decrease in platelet count.

Confirmed case: A probable case with laboratory confirmation.

WHO case definition source of information:

https://www.who.int/docs/default-source/outbreak-toolkit/updates-documents_july-5/dengue-outbreak-data-collection-toolbox---inis-3-july-1.pdf?sfvrsn=ec3ffcf3_2#:~:text=WHO%20surveillance%20case%20definition,leukopenia%2C%20or%20any%20warning%20sign.

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Alert / epidemic threshold

An **alert threshold** is the pre-defined number of alerts that suggest the beginning of a possible disease outbreak and therefore warrant immediate notification.
Epidemic thresholds are the minimum number of cases indicating the beginning of a particular disease's outbreak.

At the local level a single dengue case may trigger action. At state or provincial level, the increase in reported cases above an established baseline for the same week or month in preceding years or increasing vector density may indicate impending epidemic activity. At national level, the detection of changes in virus serotype, subtype or genotype distribution, clinical severity or seropositivity rate, or the introduction of a dengue vector into a new ecological niche, are signals that should be investigated without delay.

Risk factors

- Dengue is widespread throughout the tropics with local variations in risk influenced by rainfall, temperature, relative humidity and unplanned rapid urbanization.
- Mosquitoes carrying the dengue virus often live in urban habitats and breed mostly in man-made containers that hold water, like buckets, bowls or flowerpots.
- Outbreaks of the disease are of particular concern when they occur in overcrowded settings with inadequate water supply and waste management services that allow the mosquitoes to breed easily.
- *Aedes aegypti* is a daytime feeder; its peak biting periods are early in the morning and in the evening before sunset. People being outside at this time are at higher risk of being bitten. Children and elderly who sleep outdoors during daytime in endemic areas are at greater risk.
- When infected during pregnancy, women can transmit a dengue infection to their foetus.
- People needing blood transfusion or organ transplantation in endemic areas.

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Attack rate (AR)

The **attack rate** is the risk of getting a disease during a specific time period (such as during an outbreak).

Attack rates will vary from one outbreak to another. In case of an outbreak, consult the latest information provided by health authorities.

During epidemics of dengue fever, attack rates among susceptible populations are often 40–50 per cent, but may reach 80–90 per cent.

Groups at increased risk of severe illness (most vulnerable)

- People with weakened immune systems such as people with HIV infection, those receiving chemotherapy or transplant recipients.
- People with chronic diseases.

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Infectious agent

Infectious agents are bacteria, viruses, fungi, prions and parasites. A disease caused by an infectious agent or its toxic products is defined as an infectious disease.

Dengue virus: four serotypes of dengue viruses exist.

Vector: Mosquitoes (*Aedes aegypti* and *Aedes albopictus*) that carry the dengue virus.

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Reservoir / host

A **reservoir of infection** is a living organism or material in or on which an infectious agent lives and/or usually multiplies. Reservoirs include humans, animals and the environment.

A **susceptible host** is a person at risk of being infected. The level of susceptibility depends on age, sex, ethnicity and genetic factors, specific immunity also depends on other factors that affect an individual's ability to resist infection or to limit its ability to cause infection.

A **zoonotic disease** or **zoonosis** is an infectious disease that has jumped from a non-human animal to humans.

Humans.

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How disease is spread (modes of transmission)

Categorisation of **modes of transmission** varies from one agency to another. In addition, some infectious agents can be transmitted by more than one mode. A list of modes of transmission can be found in the key concepts to serve as guidance to better understand the diseases included in this website.

Vector-borne:

- Mosquito bite (mainly of the species *Aedes aegypti* and, to a lesser extent, *Ae. albopictus).*
- The mosquitoes usually bite during the daytime (peak biting periods are early in the morning and in the evening at dusk).

Congenital transmission: From mother to child during pregnancy.

Vehicle-borne transmission: Through organ transplants or blood transfusions from infected donors.

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Incubation period

This time from when infection occurs to the onset of symptoms is called the **incubation period**. It is a range of days and it can be different for each disease.

Four to seven days (range three to ten days).

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Period of infectiousness

Period of infectiousness is the time interval during which an infected person can transmit the infection to other susceptible persons.

Patients who are already infected with the dengue virus can transmit the infection (four to five days; maximum 12) via *Aedes* mosquitoes after their first symptoms appear.

Clinical signs and symptoms

- Up to 75 per cent of people infected with dengue have no symptoms.
- 25 per cent of people have symptoms: biphasic disease which starts with sudden fever, muscle and joint pain and possible additional symptoms (stadium 1).
- Additional symptoms can be severe headache, pain behind the eyes, nausea, vomiting, swollen glands and a rash.
- After 3—5 days of transient fever, a new fever increase marks the begin of stadium 2 with possible rash.
- In some very severe cases (1—2 per cent), dengue fever can cause severe abdominal pain, difficulty breathing and life-threatening bleeding (known as “dengue haemorrhagic fever”). This is particularly the case in consecutive infections of a person with different serotypes. The second infection by a different serotype to the first is thought to be associated with the highest risk of severe dengue, while the third and fourth infections are usually associated with a milder clinical course.

Other diseases with similar clinical signs and symptoms

Zika virus disease, chikungunya, Lassa fever, Crimean-Congo fever, Ebola virus disease, yellow fever, Marburg virus disease, hantavirus pulmonary syndrome, malaria, typhoid fever and other haemorrhagic infections.

Diagnosis

- Nucleid acid amplification tests (NAATs) for detection of virus particles.
- Serologic tests: IgM antibody testing is an important diagnostic tool. However, interpreting the results is complicated by cross-reactivity with other flaviviruses, like Zika virus or yellow fever virus.

Vaccine or treatment

Please refer to the appropriate local or international guidelines for clinical management. All clinical management including the administration of any treatment or vaccine should be conducted by health professionals.

Important therapy principles include following:

- There is no specific treatment to cure dengue fever, but supportive care is important and can prevent complications including death.
- For severe dengue, medical care by physicians and nurses experienced with the effects and progression of the disease can save lives, decreasing mortality rates from more than 20 per cent to less than one per cent. Maintenance of the patient's body fluid volume is critical to severe dengue care.
- Care should be taken to avoid certain medications, such as aspirin or other nonsteroidal anti-inflammatory drugs (e.g. Ibuprofen, Naproxen), which may increase the risk of bleeding.

Dengue vaccine is available (three dose series given six months apart, 9—45 years). However, recent evidence indicates potential long-term safety issues in seronegative individuals when vaccine is used. The current Strategic Advisory Group of Experts' (SAGE) recommendation is that for countries considering vaccination as part of their dengue control programme, a "pre-vaccination screening strategy" would be the preferred option, in which only dengue-seropositive persons are vaccinated. This will require careful assessment at the country level, including sensitivity and specificity of a screening, dengue hospitalization rates, and affordability of pre-vaccination screening. If vaccines are used, it should be considered as part of an integrated dengue prevention and control strategy together with effective vector control and clinical care.

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Immunity

There are two types of immunity:
- **Active immunity** results when exposure to an agent triggers the immune system to produce antibodies to that disease.
- **Passive immunity** is provided when a person is given antibodies to a disease rather than producing them through his or her own immune system.

- Recovery from infection by one dengue virus provides lifelong immunity against that particular virus serotype. However, this immunity gives only partial and transient protection against new infection by the other three serotypes of the virus. The efficacy of the vaccine against laboratory confirmed dengue, measured for 12 months after the last dose, was 59 per cent in the year following the primary series, and 79 per cent against severe dengue fever.

Which interventions are most effective for prevention and control?

The following is a list of activities considered for Red Cross Red Crescent volunteers to take part in. It is not an exhaustive list of all prevention and control activities for the specific disease.

- Communicate risks about the disease or epidemic, not only to share information on prevention and mitigation measures, but also to encourage informed decision -making, positive behaviour change and maintenance of trust in the Red Cross Red Crescent response. This includes the identification of rumours and misinformation around disease—frequent during health emergencies—to manage them appropriately. Volunteers should use the most context-appropriate communication techniques (ranging from social media to face-to-face interactions).
- The most effective interventions to prevent dengue fever are those that eliminate mosquito breeding sites (water bodies where the mosquito *Aedes aegypti* may lay its eggs). These include:
  - Cover water containers (to prevent them from becoming breeding sites).
  - Empty and clean water containers regularly.
  - Reduce any natural water-filled habitats.
  - Remove standing water in flowerpots.
  - Clean up used tyres.
  - Community clean-up campaigns.
  - Avoid accumulating trash; garbage should remain in closed plastic bags.

Targeting males and females separately and being sensitive to their specific gender roles is essential when enlisting their support for vector control.

- Actions to prevent mosquito bites during the day and early evening:
  - Wearing clothes that minimize skin exposure. It is important to assess whether this is culturally accepted, accessible and affordable in the context of intervention.
  - Screening in homes (windows and door screens).
  - Application of “DEET” mosquito repellent to exposed skin or clothing (in accordance with product label instructions). It is important to assess whether this is culturally accepted, accessible and affordable in the context of intervention.
- Indoor residual spraying.
- Outdoor space spraying of flying mosquitoes, on surfaces or around containers where mosquitoes land.
- If a person has been diagnosed with dengue fever is it is important to avoid being bitten by mosquitoes particularly during the first week of infection. Otherwise, the person may transmit the virus to the mosquito, which can in turn infect other people.
- Larviciding, which is the application of insecticides to water bodies, reducing vector density. Note that it is most effective in areas where aquatic habitats (where larvae lie) are easy to identify and are fixed. Larviciding will be costly and less effective in areas where water habitats are predominant, scattered and where their location may vary.
- Social mobilization for vaccination if part of the dengue control programme.

Which interventions have NO evidence and are therefore NOT recommended?

- Bednets are an effective way to prevent mosquito bites; but for dengue fever, these should be used as a preventive measure for those who sleep during the day or those admitted into hospitals. As the mosquito

bites during the day, bednets during the night will not be an effective preventive measure for this disease.

- Mosquito coils and aerosol bug sprays (containing insecticides) are not effective interventions to protect a person or household from the bite of the *Aedes aegypti* mosquito. Research indicated that where mosquito coils and aerosol insecticides were used, dengue fever incidence increased. One explanation as to why this occurred was that householders using coils and aerosols relied solely on these anti-mosquito devices and did not adopt other more effective preventive measures. The cost for these items is another prohibitive factor for their use in widespread community programmes.

Epidemic characteristics and RCRC indicators and targets

The first table below includes data that should be gathered from health authorities and relevant non-governmental actors to understand the progress and characteristics of the epidemic in the specific country and area of intervention. The second table includes a list of suggested indicators that can be used for monitoring and evaluating Red Cross Red Crescent activities; wording of indicators may be adapted to specific contexts. Target values for a specific indicator can vary widely from one context to another and therefore managers should define them based on the specific population, area of intervention and programmatic capacity. Exceptionally, some indicators in this website may include target values when these are globally agreed as a standard; e.g. 80 per cent of individuals who slept under an insecticide-treated net (ITN) the previous night—the normative World Health Organization benchmark for universal coverage with ITNs.

Epidemic characteristics and progression
Cases of dengue fever per week
Cases of dengue haemorrhagic fever (DHF) per week
Case fatality rate
Indicators for Red Cross Red Crescent activities
Number of volunteers trained on a specific topic (e.g. Epidemic Control for Volunteers (ECV)) ***Numerator****:* Number of volunteers trained in ECV Source of information: Training attendance records
Percentage of population with suspected dengue fever for whom advice or treatment was sought *(NB. This indicator requires the implementation of a system in collaboration with the health facility, whereby health workers specifically asked the patient how they heard about the service)* ***Numerator***: Number of population for whom advice or treatment was sought from a health facility or provider ***Denominator***: Total number of people surveyed

Indicators for Red Cross Red Crescent activities
Percentage of people who know the cause, symptoms, treatment or preventive measures (this indicator can be split into three or four separate indicators) ***Numerator***: Number of people who cite the cause, symptoms, treatment or preventive measures ***Denominator***: Number of people surveyed Source of information: Survey
If supporting vaccination campaigns: Number of households covered during the Supplementary Immunization Activity (SIA) Number of volunteers participating in the SIA Number of vaccinations realized during the SIA *Source of information:* Vaccination activity records

See also:

- For Community Engagement and Accountability (CEA) indicators for activities accompanying ECV actions, please refer to: IFRC *CEA toolkit (Tool 7.1: Template CEA logframe, activities and indicators).* Available at: https://www.ifrc.org/document/cea-toolkit
- For vaccination activities, see: IFRC (2020) *Social Mobilization Guide for Vaccination Campaign and Routine Immunization*. Available at: https://oldmedia.ifrc.org/ifrc/wp-content/uploads/2020/01/1_SM-Guide-RC_version-1.pdf

Impact on other sectors

Sector	Link to the disease
WASH	Inadequate water supply and waste management allow mosquitoes to breed easily. Stagnant water in and around the household such as in flowerpots, vehicle tyres or rock pools contributes to the increase of mosquito breeding sites.
Nutrition	Malnutrition increases the risk for severe dengue fever.
Shelter and settlements (including household items)	People in rural areas and sleeping outdoors during the day are at increased risk of mosquito bites in endemic regions. Different household level actions like screening in homes and covering water containers are a good prevention strategy to decrease the transmission of dengue virus from mosquitoes to humans.
Psychosocial support and mental health	As in the case of a range of other diseases, dengue fever can have several negative impacts on psychological, social and emotional aspects of a person's life, apart from its physical effects only. Psychological reactions may include fear of social stigma, anxiety and worry about the outcome or about the transmission to the foetus, social withdrawal, among others.

Sector	Link to the disease
Gender and sex	There is some evidence to suggest that female children are more likely to have more severe dengue fever disease than male children because of biological reasons, related to a more aggressive immune system response. A greater awareness of a potentially higher risk to girls could lead to more girls being taken earlier for treatment outside the home. This would be particularly important in areas where gender norms such as son preference have created barriers to healthcare outside the home for females. There are a number of clinical reports of adult women and pregnant women with dengue fever experiencing severe vaginal bleeding during menstruation or pregnancy up to life-threatening blood loss. Considerable literature supports the gender-related role regarding vector control activities for dengue. Targeting males and females separately and being sensitive to their specific gender roles is essential when enlisting their support for vector control.
Education	If kindergartens and schools do not have the appropriate equipment, such as window and door screens, mosquito nets for naps or covered water containers, the risk of infection is greater. Children may then be at risk of getting the disease if attending classes, or at risk of losing on education if staying at home because of illness. Importantly, schools and other facilities dedicated to children and youth can offer an important space for them to engage, mobilize and raise awareness around health education issues. With support, trust and appropriate capacity-building, young people can be effective advocates for the adoption of preventive measures during an epidemic and are those best placed to mobilize their peers.
Livelihoods	Illness leads to reduction in productivity as people may not be able to work due to disease. This can lead to a loss of income due to the reduction in work activity and to the diversion of resources to seek medical treatment.

Resources :

- WHO (2007) *Addressing sex and gender in epidemic-prone infectious diseases.* Available at: https://www.who.int/csr/resources/publications/SexGenderInfectDis.pdf \
- Who (2017) *Dengue and severe dengue*. Factsheets. Available at: https://apps.who.int/mediacentre/factsheets/fs117/en/index.html
- WHO (2017) *Updated Questions and Answers related to the dengue vaccine Dengvaxia® and its use*. Available at: https://www.who.int/immunization/diseases/dengue/QA_dengue_vaccine_22Dec2017.pdf