RAPID RISK ASSESSMENT

Hurricane Irma: risk of communicable diseases in the affected countries

8 September 2017

Main conclusions and options for response

In the aftermath of Hurricane Irma, the most immediate risks in the affected areas of the Caribbean are increased transmission of diarrhoeal diseases related to lack of access to safe drinking water and acute respiratory infection in children accommodated in overcrowded shelters. The risk of an upsurge in cholera cases in areas with previous transmission and flood-specific risks (e.g. tetanus and leptospirosis) should be given priority when adopting mitigating measures. Mosquito-borne diseases represent a delayed risk that should be taken into account in this context.

The prevention of gastrointestinal illnesses is dependent on adequate sanitation, availability of safe drinking water (chlorinated or boiled) and appropriate food hygiene – i.e. regularly washing hands with soap, eating thoroughly cooked food, washing fruits and vegetables with bottled or chlorinated water and avoiding consumption of raw seafood products.

It is also important to prevent the transmission of respiratory infections in crowded settings through early detection, treatment and appropriate infection control measures.

In floods areas where *Aedes* mosquito-borne diseases or malaria are present, health authorities and clinicians should be sensitised to the possibility of a delayed increase in vector-borne disease outbreaks in the aftermath of the hurricane. The best protection from mosquito-borne diseases is preventing mosquito bites indoors and outdoors, especially from sunrise to sunset when mosquitoes are most active. These measures include:

- use of mosquito repellent in accordance with the instructions indicated on the product label;
- wearing long-sleeved shirts and long trousers;
- sleeping or resting in screened or air-conditioned rooms;
- use of mosquito nets.

Measures to address any disruption of national routine vaccination programmes, particularly those for infants, should be considered as part of basic emergency healthcare services. Additional vaccination measures should also be considered:

- Tetanus vaccination and booster doses and the use of tetanus immunoglobulin for those not up-to-date with vaccination (for more information on tetanus prevention after a disaster see US CDC webpage[*]);
- Vaccination and chemoprophylaxis for contacts of meningococcal meningitis cases in accordance with local guidelines;
- Vaccination against food- and waterborne diseases, such as hepatitis A, cholera and typhoid fever for individuals at risk of infection, especially those involved in the cleaning of wastewater and sewage and in charge of re-engineering the clean water system;
- Cholera vaccination, for travellers to areas with active transmission, especially for rescue and community workers [1];
- Vaccination against hepatitis B for workers in rescue and emergency services who may be exposed to blood and other bodily fluids.

Surveillance of infectious diseases in the aftermath of a hurricane is important for the early detection and confirmation of outbreaks. Consideration should be given to setting up a syndromic surveillance alert system if there is a need to reinforce surveillance capacity. Laboratory capacity should be assessed for confirming outbreaks of infectious diseases and a referral mechanism established for testing samples of epidemic-prone diseases, if required.

[*] US CDC webpage on tetanus prevention after a disaster: https://www.cdc.gov/disasters/disease/tetanus.html

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Source and date of request

ECDC Internal Decision, 7 September 2017.

Public health issue

Hurricane Irma, one of the most powerful hurricanes ever recorded in the Atlantic, has hit several countries in the Caribbean region, including some of the EU Outermost Regions (OMRs) and Overseas Countries and Territories (OCTs), resulting in huge devastation across the affected countries. The aim of this document is to assess the health risks for the local population, including EU citizens living the Caribbean, in relation to communicable diseases that may occur in the aftermath of the hurricane.

Consulted experts

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Event background information

On 29 August 2017, the US National Hurricane Center (NHC) reported the formation of the Hurricane Irma in the Atlantic Ocean [2]. On 31 August 2017, Hurricane Irma was classified as category 3 on the Saffir-Simpson hurricane wind scale ranging from 1 to 5 [3], however in the days that followed it gained in intensity. On 4 September 2017, Irma was upgraded to a category 5 hurricane as the wind speed was expected to exceed 252 km/h. The ensuing damage includes a high percentage of homes destroyed, fallen trees and power outages that could last for weeks or months. Irma is one of the strongest hurricanes ever recorded in the Atlantic.

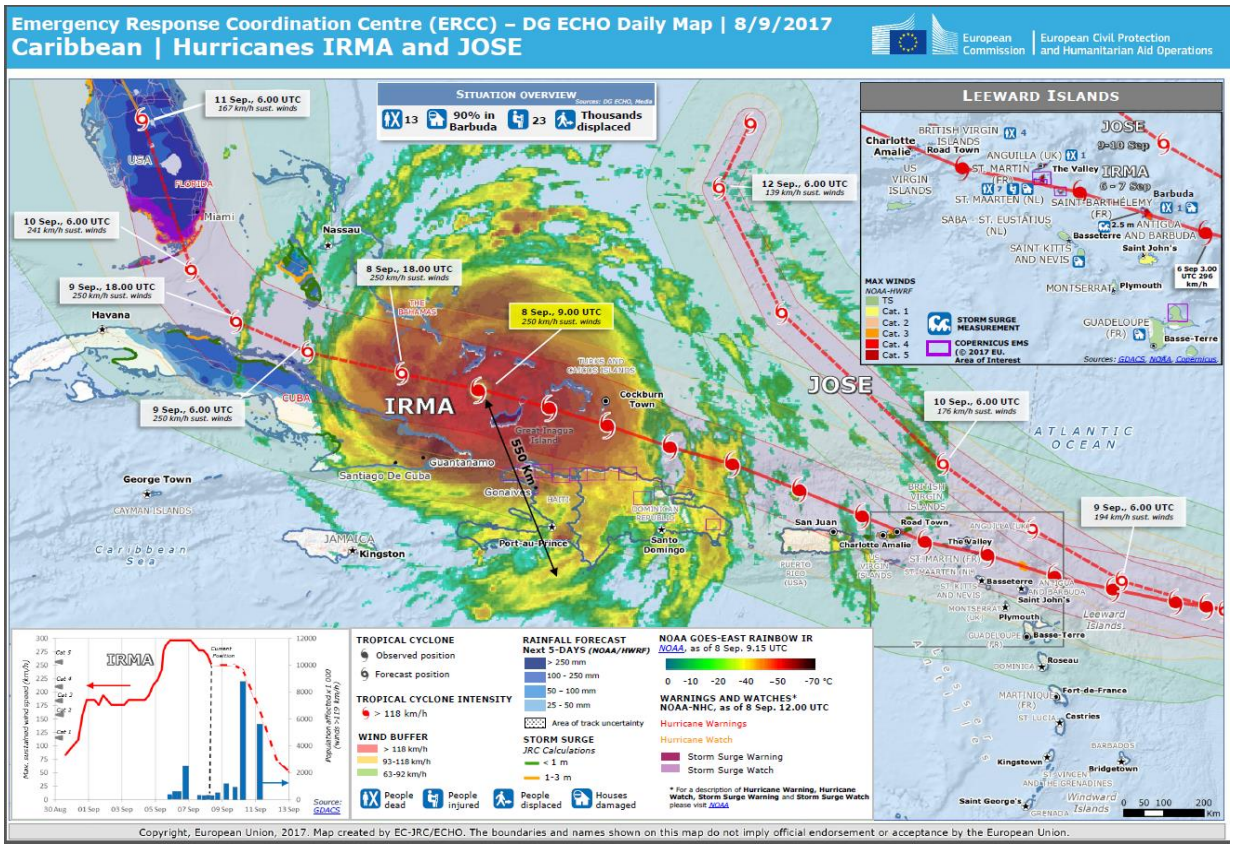
On 6 September 2017, Irma hit several islands in the Caribbean, including the EU OMRs and OCTs of Antigua, Barbuda, the Turks and Caicos Islands, Saint-Barthélemy and Saint Martin island (both parts, Sint Maarten and St. Martin) (see Table 1). According to media, some of the islands have been severely affected by the winds and floods, resulting in fatalities and the destruction of households [2]. Since 7 September, Irma has hit the Dominican Republic, Haiti, the Turks and Caicos Islands, Cuba, the Bahamas and the US State of Florida. The National Hurricane Center has also identified another hurricane named Jose, initially defined as category 3 on the Saffir-Simpson scale but later upgraded to category 4 (1000 AM AST Fri Sep 08 2017) [4]. Hurricane Jose is likely to increase in intensity in the coming days and has been forecasted to partially follow an initial track similar to that taken by Irma (see Figure 2) [5].

Table 1. Caribbean islands affected by Irma, as of 8 September 2017

Island/Territory	Date of impact	Population#
Antigua and Barbuda	6 September	87 858
Anguilla*		12 316
Saint-Barthélemy **		9 279
British Virgin Islands*		30 661
US Virgin islands		102 951
Sint Maarten/St. Martin* **		Overall 77 000: Sint Maarten (NL) 41 000 and St. Martin (FR) 36 000
Puerto Rico		3 651 232
Saba		1 945
Sint Eustatius		3 900
Turks and Caicos islands*	7 September	31 458
St Kitts & Nevis		54 961
Dominican Republic		10 800 857
Haiti		10 604 000
Bahamas	8 September	372 000

**: EU Overseas Countries and Territories, **: EU Outermost Region of EU, #: estimates.*

Figure 1. Hurricane Irma, situation report, European Civil Protection and Humanitarian Aid Operations, as of 8 September 2017



Source: ECHO daily map, 8 September 2017, EC-JRC/ECHO.
Map catalogue of ERCC Emergency Response Coordination Centre portal: http://erccportal.jrc.ec.europa.eu/Maps [6]

ECDC threat assessment

The impact of a hurricane such as Irma poses a serious threat to the health of the local population, primarily resulting in trauma and injuries during the acute phase as well as mental health disorders, however it can also rapidly lead to the spread of infectious diseases as a result of flooding. Floods are associated with an increased risk of communicable disease occurrence and spread through displacement of people, changes in the environment, and increased vulnerability to existing pathogens [7,8]. This may result in increased reports of diarrhoeal diseases in areas with limited access to safe water; acute respiratory infection in overcrowded shelters; leptospirosis and tetanus through exposure to contaminated environment and, at a later stage, dengue, chikungunya, Zika or malaria when receding waters have increased mosquito-breeding sites.

The affected area of the Caribbean is characterised by insular settings with varied population sizes, at different levels of socio-economic development, with varying epidemiological and laboratory capacities, as well as significant population movement via trade, labour and tourism.

The overall risk of infectious disease in the aftermath of Hurricane Irma will depend on the pre-existing epidemiological pattern of infectious diseases in the area, and factors influencing their impact such as:

- the extent of the initial damage caused by the hurricane;
- the size of the affected population, in particular for those with limited shelter facilities;
- the capacity to rapidly restore essential services, access to safe water and appropriate sanitation and provide shelter facilities;
- the capacity to prevent, detect and control the spread of infectious diseases;
- the climatic conditions in the coming weeks that may further affect the region if there are further storms or heavy flooding events.

Outbreaks of communicable diseases previously associated with floods include enteric infections (mainly waterborne infections), vector-borne infections, zoonosis and vaccine-preventable diseases [9].

A description of the epidemiological situation related to communicable diseases in the Caribbean region is available in the 2013 'State of Public Health' report from the Caribbean Public Health Agency (CARPHA) [10]. According to this report,

the prevalence of communicable diseases is decreasing in some areas but increasing in others. Overall, 231 outbreaks were reported in the past 10 years, mostly of food- or vector-borne diseases and respiratory diseases.

In 2009–2010, ECDC conducted a risk assessment related to infectious diseases in the EU Overseas Countries and Territories and published a summary of the infectious disease epidemiology of the OCTs [11]. While the main burden of disease in the OCTs is related to non-communicable diseases, OCTs are nevertheless also vulnerable to infectious diseases outbreaks.

Food- and waterborne infections and zoonoses

Floods can increase the risk of outbreaks of food- and waterborne diseases, such as hepatitis A, typhoid fever, cryptosporidiosis, giardiasis, shigellosis and diarrhoeal disease. An upsurge in cholera cases is a potential risk in areas of Haiti and the Dominican Republic where transmission of *Vibrio cholerae* is known to have occurred recently or to be ongoing.

Leptospirosis transmission occurs when skin (especially if abraded) or mucous membranes are exposed to water, damp soil or mud that has been contaminated with urine or tissue from infected animals, most commonly rats. Heavy flooding leads to the displacement of rodent populations that come in close contact with humans and favours the spread of *leptospira* in the environment. Occasionally, transmission occurs as a result of drinking or inhaling tiny droplets (aerosols) of contaminated water.

Hepatitis A virus (HAV) may be transmitted through the consumption of water with faecal contamination. During floods, hepatitis A outbreaks are usually associated with sewage-contaminated or inadequately treated and disinfected sanitised drinking water. While countries with low to intermediate HAV endemicity can be prone to hepatitis A outbreaks, particularly after floods, in countries with high endemicity most of the adult population is not susceptible to the infection, children experience mild or asymptomatic infection and outbreaks are rare [12,13].

Cryptosporidiosis, giardiasis, shigellosis and other diarrhoeal diseases are transmitted via the faecal-oral route, particularly through contaminated water. Water can be contaminated through sewage overflows (i.e. from centralised sewerage systems and on-site sanitation systems), storm water run-off or agricultural run-off (including spillage of manure). Wells are more exposed to contamination from surface water during flooding. Consumption of contaminated water can lead to enteric diseases and large-scale outbreaks depending on the water supply subjected to contamination. Exposure to enteric pathogens generally occurs during the acute phase of the flooding. Most of the diseases have incubation periods of around 10 days [14].

Food handling and the possible contamination of water used for agricultural purposes may increase the risk of fresh or frozen fruits and vegetables becoming contaminated, involving hepatitis A and other foodborne infections associated with the consumption of non-heat-treated foods grown in the affected areas. Food contamination and overcrowding are also factors that increase the risk of transmission and outbreaks of viral foodborne infections.

Vector-borne diseases

Floods and high winds associated with Hurricane Irma are likely to lead initially to a decrease in adult mosquito populations and the washing-away of breeding sites. However, subsequently, when water levels recede, the environmental damage caused by the hurricane may increase the amount of stagnant water and the number of breeding sites, resulting in a higher abundance of mosquito populations. In addition, the destruction of infrastructure and households may increase outdoor exposure of affected populations to mosquito bites. Combined with the interruption of routine vector control activities, the increase in *Aedes* mosquito populations in the affected Caribbean islands, particularly *Aedes aegypti,* may lead to an upsurge in the arbovirus diseases prevalent in the region (e.g. dengue fever, chikungunya and Zika). However, it is unlikely that yellow fever will be re-introduced in the post hurricane context. An increase in cases of West Nile virus infections remains possible, as seen in the aftermath of Hurricane Katrina in the regions of Louisiana and Mississippi and sporadic cases after Hurricane Jeanne in Haiti in 2004 [15,16].

Malaria transmission occurs on the island of Hispaniola (Haiti and Dominican Republic) throughout the year. In 2004, flooding in the Dominican Republic led to a malaria outbreak [17]. Therefore, the island of Hispaniola may experience an increase in malaria cases in the coming weeks.

Vaccine-preventable diseases

The affected region has been declared polio-, measles- and rubella-free. Most countries continue to achieve >90% coverage for childhood vaccines [10]. Therefore, the risk of outbreaks of the major vaccine-preventable diseases in the aftermath of Hurricane Irma will be limited in the short term.

The risk of tetanus is known to increase in relation to flooding, as local populations are at greater risk of exposure to tetanus-contaminated soil and water through skin lesions and injuries acquired when engaged in cleaning activities.

Other public health risks

Overcrowding increases the risk of infectious diseases being transmitted among populations temporarily accommodated in shelters, resulting in an increased risk of acute respiratory infection transmission, especially among children under five years, and an increased risk of transmission of meningococcal meningitis.

Floods can affect healthcare facilities, markedly reducing the capability of the healthcare system to assist patients. The potential increase in the number of patients and damage to healthcare infrastructure is likely to temporarily affect the ability to diagnose and confirm infectious diseases, and possibly to care for patients. Power shortages and damage to the electrical grid may also affect the cold chain required for certain drugs and vaccines in healthcare facilities as well as in distribution companies, resulting in a temporary lack of antibiotics and vaccines. However, for limited periods most refrigerated vaccines remain relatively stable at room temperature [18].

Floods could trigger spills from research and diagnostic laboratories located in healthcare facilities and universities. However, the risk of infectious pathogens being spilled and resulting in the onset of outbreaks is low. This risk can be mitigated by securing and containing all biological agents in preparation for a hurricane or sending critical samples to offsite storage, suspending all experiments involving live organisms, autoclaving or inactivating cultures and infectious waste, etc. [19,20].

Key WHO/CDC documents

- Flooding and communicable diseases fact sheet – Risk assessment and preventive measures. World Health Organization.
- Tropical cyclones – Technical Hazard Sheet - Natural Disaster Profiles. World Health Organization.
- Natural disasters and severe weather - Prevent Illness and Injury After a Disaster. Centers for Disease Control and Prevention
- Natural disasters and severe weather – After a Flood. Centers for Disease Control and Prevention.

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