

RISK ASSESSMENT

Potential risks to public health related to communicable diseases at the Olympics and Paralympics Games in Rio de Janeiro, Brazil, 2016

10 May 2016

Main conclusions and options for response

Conclusions

Visitors to the 2016 Olympics and Paralympics Summer Games (5–21 August and 7–18 September 2016) in Rio, Brazil will be most at risk of gastrointestinal illness and vector-borne infections. Therefore, they should pay attention to standard hygiene measures to reduce the risk of gastrointestinal illness and protect themselves against mosquito and other insect bites using insect repellent and/or wearing long-sleeved shirts and trousers in regions where vector-borne diseases are endemic.

The risk of colonisation (digestive tract carriage) of multidrug-resistant Enterobacteriaceae should be considered for all travellers, irrespective of contact with healthcare facilities while in Brazil, during the three months following their return from Brazil. Surveillance for communicable diseases should be sensitive enough to detect threats at a stage when interventions are likely to prevent or reduce the impact of outbreaks.

The Games will take place during the winter season in Rio de Janeiro when the cooler and drier weather will reduce mosquito populations. This will significantly lower the risk of mosquito-borne infections for visitors, such as Zika virus, dengue and chikungunya, except in Manaus where some football matches will be held. Although the probability of being bitten by an infected mosquito is expected to be very low during the events, it cannot be excluded that travellers can become infected and return to regions of the EU where competent vectors are active. This may create an opportunity for local vector-borne transmission in the EU.

Over recent years, Brazil has eliminated rubella transmission and, since July 2015, has also interrupted measles transmission. These are diseases which are still endemic in many other countries and could be imported to Brazil by international visitors.

Options for response

Visitors to Brazil should consult the advice for vaccinations issued by the Brazilian health authorities, the Pan American Health Organization (PAHO) as well as their own country's recommendations.

All travellers are advised to arrange comprehensive healthcare insurance before travelling to Brazil. If healthcare is needed, travellers should contact Brazil's healthcare system (Sistema Único de Saúde – SUS) through local hospitals or use their private health insurance at any healthcare provider.

Prior to travelling, visitors to Brazil:

- Should have completed their vaccinations according to the schedule in their EU country of residence including: poliomyelitis, diphtheria, tetanus, pertussis, measles, mumps and rubella.
- Be aware that there is an increased risk of hepatitis A in Brazil compared to the EU and ensure that their vaccination status against hepatitis A is up-to-date.
- Be aware that there is yellow fever in parts of Brazil, and follow the vaccination recommendations for these areas [1,2], especially if planning to attend football matches in Belo Horizonte, Brasília, or Manaus.
- Be aware that there is rabies in Brazil and avoid all contact with stray dogs and cats, consult a doctor regarding the need for post-exposure prophylaxis if they are bitten by an animal; and consider vaccination against rabies before travelling if they plan to stay longer than one month and in rural areas.
- Be aware that malaria exists in parts of Brazil outside of Rio de Janeiro, and consider malaria chemoprophylaxis if appropriate.
- Consider the need for other vaccinations based on lifestyle, activities or underlying health problems. This includes vaccination against influenza (preferably with the 2016 southern hemisphere seasonal vaccine) as the event takes place at the peak of the influenza season in the southern and south-eastern regions.

While in Brazil, travellers should:

- Consider standard hygiene measures to decrease the risk of gastrointestinal illness: use of bottled drinks and mineral water, use of factory-produced ice cubes, consumption of thoroughly cooked meat and fish, serving mixed meals such as *feijoada* (a typical Brazilian dish) or lasagne at temperatures above 60°C, serving salads at below 5°C, and sanitising all fruits and vegetables before consumption.
- Consider the general hygiene conditions when consuming common local products, such as freshly-made fruit juices, coconut water, drinks and cocktails.
- Avoid sexual risk behaviour to decrease the risk of sexually transmitted infections, blood-borne infections, and HIV.

Upon returning from Brazil:

- Travellers should, if requiring hospitalisation in the EU within one year after having been hospitalised in Brazil, report their previous hospital care in Brazil in order to accelerate the ascertainment of possible recent acquisition of antimicrobial-resistant bacteria, and the implementation of appropriate prevention and control measures to prevent spread in the EU.

The information for travellers in ECDC's latest risk assessment on Zika virus published on 11 April 2016 remains valid [3]:

- Pregnant women and women who are planning to become pregnant should consider postponing non-essential travel to affected areas until after delivery. During the Rio 2016, the North and Northeast Regions (specifically the Olympic sites of Manaus and Salvador) should be considered affected, as they are likely to still experience transmission of Zika virus infections.
- Pregnant women who plan to travel to Rio 2016 and pregnant women residing in the affected areas should consult their healthcare providers for advice and follow strict measures to prevent mosquito bites.
- Travellers with immune disorders or severe chronic illnesses should consult their doctor or seek advice from a travel clinic before travelling, particularly on effective prevention measures.
- Travellers to Brazil and EU citizens residing in affected areas should be advised that using condoms could reduce the risk of sexual transmission through semen.

Based on the epidemiological profile for infectious diseases for Brazil and the profile of the visiting populations, ECDC will conduct enhanced epidemic intelligence surveillance for communicable diseases from 1 August to 28 August 2016.

Source and date of request

ECDC internal decision, December 2015.

Public health issue

International mass gatherings pose a risk for communicable disease outbreaks and rapid spread around the world. The aim of this document is to assess the health risks related to communicable diseases and other health threats for European citizens during their stay in Brazil for the Rio 2016 Olympics and Paralympics Summer Games, and the public health implications for European countries after travellers' return to Europe. In addition, the document assesses the risk of disease importation from Europe to Brazil. This assessment provides the basis for ECDC's monitoring of health threats during the Olympics and Paralympics Summer Games in Brazil.

Consulted experts

ECDC authors (in alphabetical order): Ninnie Abrahamsson, Alessandro Cassini, Denis Coulombier, Niklas Danielsson, Tarik Derrough, Alastair Donachie, Silviu Lucian Ionescu, Josep Jansa, Kaja Kaasik Aaslav, Csaba Ködmön, Hanna Merk, Thomas Mollet, Ettore Severi, Gianfranco Spiteri, Edit Szegedi and Hervé Zeller.

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All experts have submitted declarations of interest and a review of these declarations did not reveal any conflicts of interest.

Health risks associated with mass gatherings

The World Health Organisation (WHO) defines a mass gathering as 'an event attended by a sufficient number of people to strain the planning and response resources of a community, state or nation' [4]. International mass gatherings increase the risk of communicable disease transmission and pose a challenge to public health response [5]. For host countries, these challenges are associated with the introduction of communicable diseases, influx of susceptible individuals, crowding, outbreaks of endemic or imported infectious diseases, opportunistic and often uncontrolled sale of food and beverages, increased risk behaviour associated with alcohol and other recreational substances, language barriers for the dissemination of public information, increased pressure on sanitary facilities, and heightened security levels. The increased sensitivity for identifying potential health threats, coupled with heightened media attention and political pressure, can place a considerable burden on public health functions and decision-making [6].

Documented infectious disease threats associated with mass gatherings in the EU or in other international settings include *Escherichia coli* O157 cases at a music festival in the United Kingdom in 1997 [7], Legionnaires' disease cases during the football Euro Cup in France 1998 [8], *Neisseria meningitidis* outbreaks in returning pilgrims from the Hajj in 2000 and 2001 [9], a norovirus outbreak during the 2006 FIFA World Cup in Germany [10], an outbreak of *Shigella* during a Boom festival in Portugal in 2008 [11], a measles outbreak in Canada in 2010 linked to the Winter Olympics [12] and another in Germany in 2014 associated with a religious gathering in France 2010 [13], and a salmonellosis outbreak following a street festival in Newcastle with more than 400 associated cases in 2013 [14]. No outbreaks were reported during the last Olympic Games in London in 2012, except for a few gastrointestinal and respiratory infections [15]. Similarly, no public health events of potential international concern were reported during the FIFA World Cup hosted by Brazil in 2014.

The public health risks associated with mass gathering events can be classified as follows:

- risks associated with the movement of visitors to the host countries
- risks to the visiting population and the local population due to increased international travel activities related to the mass gathering event
- risks associated with being a participant/spectator at the mass gathering event
- risks associated with the return of participants and visitors from the host country (export of communicable diseases).

Factors that determine the level of risk include:

- demographics, epidemiology and behaviours of the population attending the mass gathering (e.g. age, health status, risk behaviour before and during the event, movement and interaction between host and visiting populations, vaccination status, etc.)
- demographics, epidemiology and behaviour of the host population
- environment, climate, time of year, seasonality of endemic diseases at the location
- risk assessments, planning, preparation, surveillance and preventive public health interventions: pre-travel advice, on-site information at the mass gathering venue (e.g. information campaigns, food inspection, etc.).

Event background information

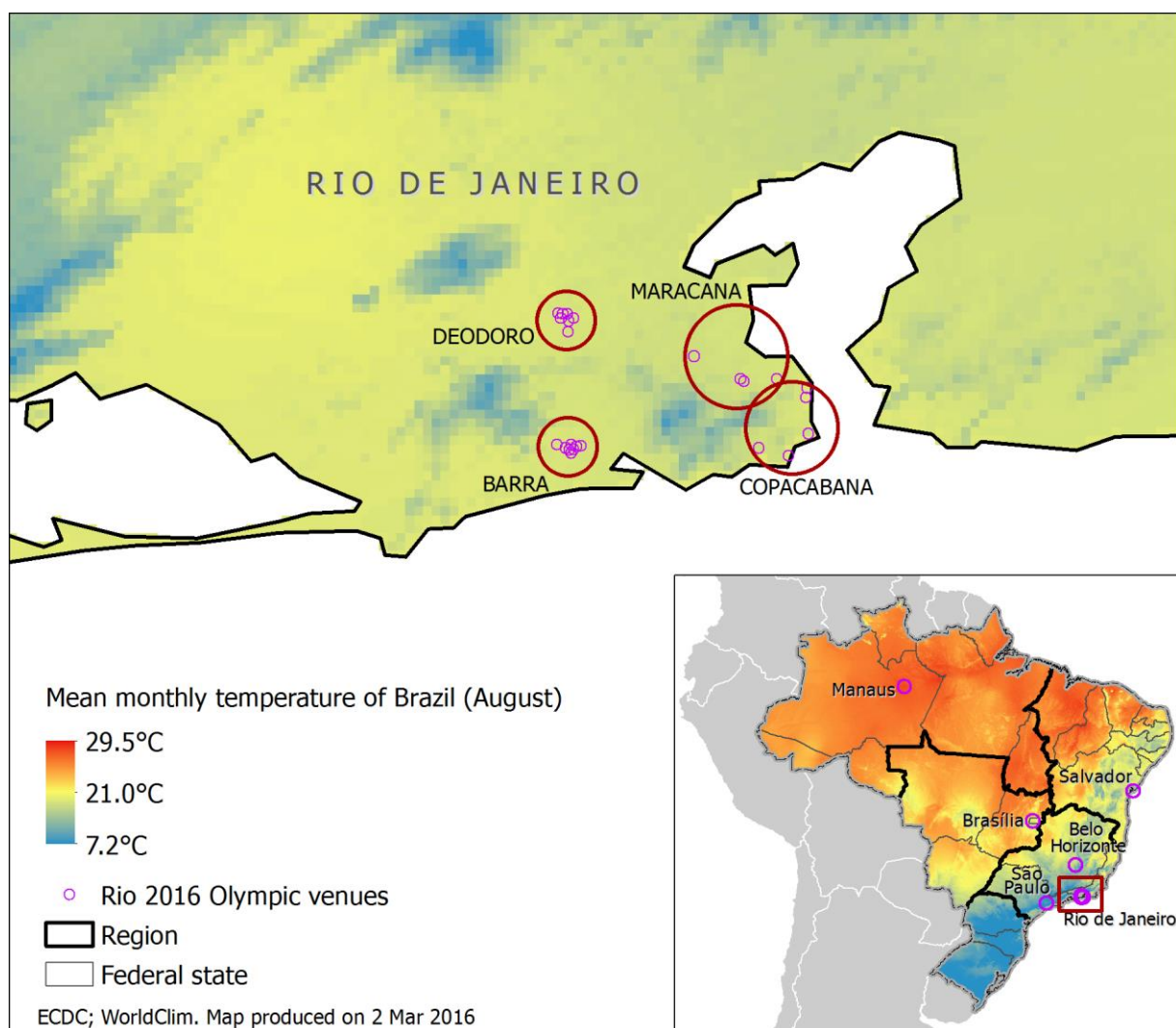
Olympics and Paralympics Summer Games in Rio, Brazil 2016

The 2016 Summer Olympics will take place from 3–21 August 2016 and more than 10 500 athletes from 205 countries will participate. The 2016 Paralympics will take place from 7–18 September, involving 4 350 athletes from 176 countries. More information is available at <http://www.rio2016.com/en>.

It is estimated that over 400 000 tourists will attend the Olympic and Paralympic Games in 2016 from outside of Brazil[16]. However, this number could be surpassed. Most European travellers will reach Brazil using commercial airlines and will mainly visit the venues in Rio de Janeiro (Figure 1), but may also visit other parts of Brazil. Domestic travel in Brazil will be mostly by commercial aircraft or by public/private ground transportation near the event venues. The 2016 Olympic Games will take place during the austral winter, with tropical heat in the north and chilly temperatures in the south of the country. Some areas will be dry while it will be rainy season in other areas [17,18].

In addition to Rio de Janeiro, football matches will be held in Belo Horizonte, Brasília, Salvador, São Paulo, and Manaus, cities that hosted matches during the 2014 FIFA World Cup. (Figure 1)

Figure 1. Venues for the Rio 2016 and average monthly temperature in August



Brazil: communicable disease epidemiology

Food- and waterborne diseases

In 2015, the waters of Olympic aquatic venues in the Guanabara Bay, in the Rodrigo de Freitas Lagoon and in the waters of Copacabana Beach were found to be highly contaminated with sewage [19,20]. While efforts are being made to also complete the remedial infrastructural work for mitigation and pollution abatement in the one Olympic venue that required more substantial interventions, testing protocols are being refined to minimise the risk of gastrointestinal and respiratory illnesses caused by waterborne pathogens to athletes competing in these venues.

Foodborne outbreaks are a public health concern during mass gatherings [21]. Although important advancements in food and water hygiene in Brazil have been implemented during 2000 to 2013 [22], the Brazilian Ministry of Health reports an average of 665 foodborne outbreaks per year [23]. Causative agents of these infections were, in order of frequency, *Salmonella* sp., *Staphylococcus aureus*, *Escherichia coli* and *Bacillus cereus*. The settings most often associated with these outbreaks were private residences, followed by food outlets and pastry shops [22]. A study in travellers returning from Brazil identified *Campylobacter* and *Giardia* spp. as the most frequent pathogens associated with gastrointestinal illness [17]. Furthermore, in the last two decades, the cause of diarrhoeal diseases in the general population shifted from bacterial infections through the faecal-oral transmission to viral infections through person-to-person transmission [24]. WHO classifies Brazil as a country with intermediate endemicity of hepatitis A and therefore prone to such outbreaks [25]. Typhoid and paratyphoid fevers are rarely reported in Brazil [17,26,27]. Brazil has been cholera-free since 2005 [28].

Emerging and vector-borne diseases

Zika virus infection

In May 2015, autochthonous transmission of Zika virus was confirmed in the states of Bahia and Rio Grande do Norte in Brazil. However, it is likely that Zika virus had been circulating earlier [29]. Since February 2015, Brazilian states and the Federal District have reported autochthonous cases of Zika virus and the virus is currently a major public health concern in Brazil. The Brazilian Ministry of Health has estimated that between 0.5 million and 1.5 million people were infected by Zika during 2015 [29].

Links between Zika virus infection in pregnancy and microcephaly of the foetus have been under investigation since October 2015, when the Brazilian Ministry of Health reported an unusual increase in cases of microcephaly following the Zika virus outbreak in the north-eastern states. Since 1 February 2016, Zika virus infection and the clusters of microcephaly cases and other neurological disorders have constituted a Public Health Emergency of International Concern (PHEIC). Based on a growing body of research, there is strong scientific consensus that Zika virus is a cause of microcephaly and Guillain–Barré syndrome (GBS) [30]. Several studies have documented steps in the chain of an intrauterine infection; from symptomatic Zika-like infection in a pregnant mother residing in a Zika-affected area, to detection of microcephaly with brain calcifications in the foetus, and detection of Zika virus either in the amniotic fluid, in the cerebrospinal fluid of the newborn, or in the central nervous system of an aborted foetus or a dead newborn. The magnitude of the risk that Zika virus infection during pregnancy will result in malformations in the foetus is under investigation, but remains unknown at present.

In addition, several countries, including Brazil, have reported an increase of GBS during Zika virus outbreaks. In a recent communication [31] WHO concluded that there is enough evidence to establish causality between Zika virus infection and GBS.

Dengue fever

Dengue fever remains a major public health problem in Brazil. Disease incidence and severity have increased in the past two decades. From 2000 to 2009, 3.5 million cases of dengue fever were reported [24]. Since the beginning of the year and as of 1 April, 799 048 probable and confirmed dengue fever cases have been reported in the Americas and Caribbean region, according to the Pan American Health Organization (PAHO) [32,33]. Brazil accounts for 557 121 (nearly 70%) of all cases in the Americas. Dengue transmission in Brazil occurs all year round but is most intense from February to June. There is considerable variation in the dengue risk in Brazil, depending on the part of the country and its climate zone. The risk of being bitten by *Aedes* mosquito vectors decreases during the winter months in southern parts of Brazil including the Rio de Janeiro area, but likely remains in other more northern areas.

Chikungunya

In December 2013, chikungunya emerged on the island of Saint Martin in the French Caribbean and quickly spread to North, Central and South America. This was the first documented autochthonous transmission of chikungunya virus in the Americas. Since the beginning of the year and as of 1 April January 2016, 38 196 suspected and confirmed cases of chikungunya virus infection and two deaths have been reported in the WHO Region of the Americas [32]. Brazil accounts for 9.3% of all cases reported in the Americas so far this year. On 22 December 2015, local health authorities in Brazil confirmed the active circulation of chikungunya virus in the municipality of Rio de Janeiro following the detection of a locally-acquired case [34].

Malaria

Malaria is present in the Brazilian Amazon, northern and central-western regions, with less than 150 000 cases reported in 2014. *Plasmodium vivax* accounts for 83% and *Plasmodium falciparum* for 16% of all cases [17,35]. Although the city of Rio de Janeiro is malaria-free, the central part of the Rio de Janeiro state, in the forested mountainous areas, reports on average around six cases of locally-acquired malaria per year – four were reported in 2014 [36,37].

Yellow fever

Yellow fever is endemic in most parts of Brazil [1]. While Brazil reports a low number of yellow fever cases annually, cases do still occur despite the implementation of vaccination programmes. Brazil has not reported a case of urban yellow fever since 1947 [2,36] so vaccination is not recommended for travellers whose itineraries are limited only to Rio De Janeiro.

Leishmaniasis

Cutaneous and mucosal leishmaniasis are endemic in 18 countries in the Americas, with 78.8% of the cases reported from Brazil. In 2013, 37 402 cases were registered in Brazil and the Andean sub-region. Visceral leishmaniasis is a growing problem, with an average of two cases per 100 000 population reported each year [24]. Between 2001 and 2013, 45 490 cases of visceral leishmaniasis were recorded in the Americas with Brazil accounting for 96.0% of cases [38]. Leishmaniasis is not considered endemic in Rio de Janeiro or Rio de Janeiro state.

Chagas disease

The implementation of an intensive vector control programme in 2006 has eliminated the main vector of Chagas disease in Brazil and interrupted vector-borne transmission. Around 3.5 million people in Brazil still have the chronic form of the disease and congenital transmission continues because of Chagas disease's long latency period [24,39]. Although Chagas disease is not considered endemic in Rio de Janeiro or Rio de Janeiro state, autochthonous transmission of Chagas disease has been previously documented. [40]

Schistosomiasis

An estimated four to six million individuals are infected with *Schistosoma mansoni* in Brazil [33], with highest endemicity found in the north-eastern region. Over recent decades, there has been an increasing incidence of schistosomiasis cases in urban and coastal areas [33].

Rabies

Human rabies in Brazil has been associated with transmission by dogs, cats, foxes, monkeys and vampire bats, with most human cases transmitted by wildlife. PAHO recently issued an alert on rabies recommending prompt use of post-exposure prophylaxis to prevent human cases. Between early 2014 and June 2015, one case of human rabies was reported in Brazil and one case of canine rabies in the previously unaffected state of Mato Grosso do Sul state [41].

Sexually transmitted and blood-borne infections

HIV/AIDS

In Brazil, HIV notifications have remained stable since 2000. The estimated mean national sero-prevalence is less than 0.6%, with approximately 600 000 people infected. Since 1996, Brazil provides universal access to antiretroviral therapy free of charge. In large urban areas, the incidence of AIDS-related illnesses declined remarkably, however, in small and medium municipalities, low-level transmission is still ongoing [24]. Between 1996 and 2006, the HIV incidence in the northern and north-eastern regions increased from 2.7 to 4.6 per 100 000 population, and from 3.0 to 3.3 per 100 000, respectively [42].

Prevalence of HIV among specific risk groups is higher with reported rates of 6.2% among sex workers, 13.6% among men who have sex with men and 23.1 among people who inject drugs [43].

Notification of sexually transmitted infections (STIs) in Brazil is mandatory for AIDS, HIV in pregnant women and exposed children, syphilis, and urethral discharge syndrome in men. Despite the compulsory notification, there is considerable under-reporting of cases. A multi-centre sero-prevalence study from the Brazilian Ministry of Health estimated that the sero-prevalence of either syphilis, gonorrhoea or chlamydia was 13.5% in pregnant women, 6.2% in industry workers, and 19.7 % in people attending healthcare clinics for STI [44]. The GeoSentinel study identified three cases of syphilis, three cases of urethritis, one case of lymphogranuloma venereum and one undefined case of STI in travellers returning from Brazil [17].

Viral hepatitis

A hepatitis B survey conducted among a representative sample of the population in the north-eastern and central-western regions and in the Federal District of Brasília showed a prevalence of HBsAg of less than 1%. There was no statistically significant difference in prevalence across geographical areas. Brazil is considered a low endemicity country for hepatitis B [45]. Hepatitis B is most commonly spread from mother to child at birth (perinatal transmission), or through horizontal transmission (exposure to infected blood). Hepatitis B is also spread by percutaneous or mucosal exposure to infected blood and various body fluids, including through saliva, menstrual, vaginal and seminal fluids. Sexual transmission of hepatitis B may occur, particularly in unvaccinated men who have sex with men and heterosexual persons with multiple sex partners or contact with sex workers [46].

A Brazilian nationwide hepatitis C (HCV) sero-prevalence study conducted in 2005–2009 in the state capitals of the five Brazilian regions showed a weighted prevalence of HCV antibodies of 1.4% (95% CI 1.12%–1.64%). Seropositivity varied from 0.7% in the north-eastern region to 2.1% in the northern region. [47] The hepatitis C virus is a blood-borne virus. It is most commonly transmitted through injecting drug use through the sharing of injection equipment, in healthcare settings due to the reuse or inadequate sterilisation of medical equipment, especially syringes and needles, or through the transfusion of unscreened blood and blood products. Less frequently, HCV can be transmitted sexually and can be passed from an infected mother to her baby. Hepatitis C is not spread through breast milk, food or water or by casual contact such as hugging, kissing and sharing food or drinks with an infected person [48].

Vaccine-preventable diseases

Measles and rubella

Endemic transmission of measles in Brazil was interrupted in July 2015, and the transmission of rubella was eliminated in 2009. However, measles continues to circulate elsewhere in the world, and countries in the Americas have reported imported cases. Therefore, there is a risk that infected travellers can enter Brazil during the Olympic Games.

In November 2015, the American Region's regional verification committee determined that the region cannot be declared measles free because Brazil has had sustained transmission of a single measles virus strain for >1 year [49]. During the period 2013–2015, imported cases resulted in ongoing measles transmission in several states, including in Pernambuco and Ceará with 971 confirmed measles cases [50]. Measles transmission was reported to have ended in Brazil in July 2015, following a vaccination campaign [51].

Meningococcal disease

From 2000 to 2009, Brazil reported 1.5 to 2 cases of meningococcal disease per 100 000 population. Since 2002, a substantial increase has been observed in the proportion of cases attributed to *Meningococcus* serogroup C, currently responsible for most cases of meningococcal disease in Brazil [52]. Several outbreaks of meningococcal disease have been reported in Brazil in the last decades, some of which with a very large number of cases [24,52]. In 2010, Brazil was the first country in Latin America to introduce the meningococcal C conjugate (MCC) vaccine routinely into its immunisation program [53].

Influenza and other respiratory virus infections

Influenza cases occur throughout the year in Brazil. In the south-eastern region, higher numbers of influenza detections are reported from April to September, peaking in June and July [54]. Influenza A(H7N9), influenza A(H5N1) and Middle East Respiratory Syndrome coronavirus (MERS-CoV) cases have never been reported in Brazil.

Tuberculosis

WHO defines Brazil as a tuberculosis (TB) high-burden country, with an estimated 90 000 new cases of TB in 2014 (44 cases per 100 000 population). Higher TB rates have been reported in association with urban areas, population density, poor economic conditions and household crowding [42]. About 18% of the TB cases are estimated to be co-infected with HIV. Six percent of individuals with TB in Brazil are estimated to be infected with strains resistant to isoniazid and 1.4% with strains resistant to both isoniazid and rifampicin [43].

Antimicrobial resistance and healthcare-associated infections

In general, there is a paucity of data on antimicrobial resistance and healthcare-associated infections in Brazil. There are only a few publications on extended-spectrum beta-lactamase (ESBL)-producing *Enterobacteriaceae* and methicillin-resistant *Staphylococcus aureus* (MRSA) from Brazilian hospitals [24,55,56]. Carbapenem resistance is widespread in *Pseudomonas aeruginosa* isolates. Half of these carbapenem-resistant isolates harbour the Sao Paulo metallo-beta-lactamase (SPM) [56]. Infections due to antimicrobial-resistant bacteria represent an important problem in Brazil, in particular in hospitals.

Other health risks

Accidents and injuries, mostly caused by motor vehicle crashes, are the leading cause of death among travellers under the age of 55 years. Flash floods and landslides, especially in urban areas, have been a frequent cause of accidents. Travellers to Brazil frequently report sunburn.

ECDC threat assessment

Almost all EU/EEA countries are participating in the Rio 2016 and a large number of EU travellers will visit the country during the event. The Games take place during the southern hemisphere winter, and climate/weather conditions will vary significantly in Brazil, ranging from the tropical warmth in the northern and north-eastern regions to chilly weather in the southern region.

The following health threats and their associated risks were assessed (Annex, Table 1):

- an infection imported to Brazil by EU travellers
- an infection imported to Brazil from an ongoing event of international concern
- a disease affecting an EU traveller during their stay in Brazil
- an infection imported to the EU after a traveller's return to Europe.

Risks of infection importation to Brazil from EU travellers to the Rio 2016 Olympics and Paralympics Games

The overall risk of food- or waterborne disease importation from Europe to Brazil is very low. There is a significant risk of importation for measles through infectious EU travellers from countries where transmission is ongoing. The risk of importation is low for other vaccine-preventable diseases. Finally, there is a very low risk of importation of antimicrobial resistant strains to Brazil through infected EU travellers. The risk of importation increases slightly if those travellers are hospitalised.

Risk of infection importation to Brazil from events of international concern

Recently, there have been six infectious disease-related events raising wide concern at the international level: influenza A(H7N9), influenza A(H5N1), Ebola virus disease, Middle East respiratory syndrome coronavirus (MERS-CoV), wild poliovirus[57] and Zika virus infection [30].

Avian influenza

The A(H7N9) influenza outbreak in China started in February 2013. As of March 2016, there have been more than 700 cases, all linked to China [58]. A seasonal pattern has emerged with only a few cases being reported between June and October. So far, neither EU Member States nor Brazil have reported any cases. The risk of introduction of human cases of A(H7N9) to Brazil is considered very low.

Between 2003 and March 2016, over 840 human cases of influenza A(H5N1) have been reported to WHO. In 2015 Egypt reported 136 cases, China 5 cases and Indonesia two cases. The observed seasonal pattern has since 2004 shown few reported cases with onset between July and October[58]. So far, neither EU Member States nor Brazil have reported any A(H5N1) cases. The risk of introduction of A(H5N1) to Brazil is considered very low.

There are also other avian influenza subtypes that have been detected in Asia in the last two years, A(H5N6), A(H9N2), A(H10N8) and A(H9N2) in Egypt. The risk of introduction to Brazil is very low.

Moreover, most human cases of avian influenza report exposure to animals prior to infection and sustained human-to-human transmission has not been observed.

Ebola virus disease

In 2014–2015, a large outbreak of Ebola virus disease occurred in Guinea, Liberia and Sierra Leone. In 2016, only sporadic cases of Ebola virus disease have been detected. The outbreak has been declared over in all three West African countries. The risk of exportation of Ebola virus disease to Brazil is considered extremely low.

Middle East respiratory syndrome coronavirus

Since 2012, Saudi Arabia, the United Arab Emirates, Jordan, Qatar, Oman, Iran and South Korea have reported non-travel related MERS-CoV cases. There is growing evidence that the dromedary camel serves as host species for MERS-CoV [59] [60]. Although most MERS-CoV cases have been reported from the Middle East, the outbreak in South Korea showed that importation of cases from the Middle East can cause significant outbreaks in previously unaffected countries. All the countries that are recent countries of infection or that have reported MERS-CoV cases with camel contact in 2015–2016 will participate in the Olympic Games and travellers from the region can be expected. The risk of importation of MERS-CoV to Brazil cannot be excluded but is assessed as low.

Polio

Two countries that are reporting wild poliovirus transmission, Afghanistan and Pakistan, are both participating in the Games. The risk of a visitor to Brazil from one of these two polio-affected countries introducing wild polio virus to Brazil is considered very low due to the high vaccine coverage and the lack of wild polio virus circulation [24]. It is nonetheless important that people travelling from polio-affected countries to Brazil are vaccinated according to the recommendations made by WHO [57].

Zika virus infection

Over the past two months, and as of end of March 2016, autochthonous cases of Zika virus infection have been reported from 39 countries or territories worldwide. It is likely that Zika virus infections will still be transmitting in some parts of the Americas and beyond, and therefore, the risk of a viraemic traveller arriving in Brazil is significant. However, the risk of further mosquito borne transmission in Rio de Janeiro will be low at the period of the Olympic and Paralympic Games. A list of countries and territories with documented autochthonous transmission during the past two months is available on the ECDC website.

Yellow fever

There is an ongoing yellow fever outbreak in Angola but the risk of introduction of the virus through viraemic travellers to Rio de Janeiro is not higher than introduction from endemic areas in Brazil.

Health risks for EU travellers during their stay in Brazil

Surveillance data of gastrointestinal infections in Brazil suggest that foodborne outbreaks may occur during the Olympic Games. EU travellers to Rio 2016 may encounter locally endemic infections and challenges related to mass gatherings, e.g. salmonellosis, STEC infections, campylobacteriosis, giardiasis, and viral gastrointestinal illness [61].

The risk of being infected with *Salmonella* typhi in Brazil is very low and mostly related to unvaccinated travellers from the EU visiting the Northern and Northeast Regions [26,27,62]. There is virtually no risk of cholera infection to travellers [28].

EU travellers to Rio 2016 are at risk of hepatitis A infection. The majority of European countries are classified by WHO as very low or low HAV endemicity countries. Brazil is an intermediate endemicity country and prone to HAV infection outbreaks [24,25].

The risk of dengue, chikungunya and Zika infection for EU travellers is likely to be moderate in the North and Northeast Regions of the country [18,63]. The risk will be low in the Southeast Region (including Rio de Janeiro), and very low in the South and Central-West Regions (Figure 1). Rio de Janeiro municipal authorities are scaling-up vector-control measures as the Games are approaching.

The malaria risk is moderate for travellers to the North and Centre-West Region (Figure 2). Travellers who are considering attending the football matches in Manaus as part of Rio 2016 or travelling throughout Brazil should be advised on prophylaxis [64].

Figure 2. Malaria transmission in Brazil



ECDC. Map produced on 29 Apr 2016. Administrative boundaries: ©EuroGeographics, ©UN-FAO

Data modified from US CDC <http://wwwnc.cdc.gov/travel/yellowbook/2016/infectious-diseases-related-to-travel/yellow-fever-malaria-information-by-country/brazil#4751>

The risk of yellow fever is very low but it is present in rural and peri-urban areas in most of the country (<http://wwwnc.cdc.gov/travel/yellowbook/2016/infectious-diseases-related-to-travel/yellow-fever-malaria-information-by-country/brazil#4751>).

The risk of leishmaniasis (both cutaneous and visceral), schistosomiasis and lymphatic filariasis is mostly associated with rural and deprived areas of the Northeast Region. It should be very low for travellers visiting and staying in non-deprived urban areas.

The risk of being infected with rabies during the Olympic Games is very low for EU travellers, but can be moderate for unvaccinated travellers visiting rural areas or deprived urban areas where canine vaccination is low [41].

There is a very low risk of TB transmission for EU travellers, unless they stay in overcrowded indoor spaces in deprived communities.

There is a very low risk of HIV infection for EU travellers to Rio 2016, mostly limited to travellers exposed to risk behaviours (unprotected sex, particularly with sex workers and among men who have sex with men and injecting drug use) [43]. Unprotected sex also exposes travellers to risk of other sexually transmitted infections including gonorrhoea and syphilis.

There is a low risk of HBV transmission, mostly limited to travellers who engage in unprotected sex.

There is a very low risk of meningococcal disease and other vaccine-preventable diseases for EU travellers to Brazil.

The risk of being infected with influenza will be moderate for travellers to the Southeast Region of the country.

EU travellers requiring hospitalisation or medical care in Brazil have a low risk of acquiring healthcare-associated infections, including infections caused by antimicrobial-resistant bacteria, if standard precautions and other infection prevention and control measures are complied with in hospitals and other healthcare facilities in Brazil. Visiting or staying in deprived urban areas may increase the risk of communicable disease transmission.

Risk of infection importation from Brazil to the EU after a traveller's return

A study based on the GeoSentinel information system identified dengue as the first cause of febrile systemic infections in returning travellers from Brazil [17]. Dengue and malaria were also among the most common reasons for hospitalisation in the same study population. Travellers will return during the European summer when vectors are present and active. Consequently, there is a very low risk of introduction of dengue or malaria in Europe. The risk of introduction of other vector-borne diseases into Europe is very low as well.

The risk of importation of vector-borne diseases to EU is very low as Rio 2016 will take place in the month where mosquito activity is naturally low. Based on a modelling study the risk for Zika virus infection for tourists visiting Rio during the three weeks of the Olympic Games in August are one to eight cases per million tourists [63].

Recent studies found that returning travellers who had not been in contact with healthcare while on travel were often colonised (digestive tract carriage) with multidrug-resistant Enterobacteriaceae; 21% when returning from South and Central America (considering study periods from 2010 onwards) [65] to 31% when returning from Latin America [66]. In the latter study, the proportion of carriers decreased to 5.7% one month after return, 2.9% after two months and 1.7% after three months [66]. Based on this observation, there is a moderate to high probability of importing antimicrobial-resistant bacteria, including those novel to the EU, e.g. producing the Sao Paulo metallo-beta-lactamase, from Brazil to the EU [67]. However, antimicrobial-resistant bacteria only becomes a threat to the colonised carrier in the rare event of developing an infection [66]. Hence, the impact is low and the risk for the EU is therefore considered low. This risk is higher for EU travellers who have been hospitalised while in Brazil.

In addition, travellers who have been hospitalised while in Brazil and are hospitalised in an EU Member State, upon return or in the months following their return from Brazil, may represent a risk for transmission of antimicrobial-resistant bacteria to other hospitalised patients. This risk is similar to that posed by patients admitted from any foreign hospital (within or outside the EU to a hospital in an EU Member State). Such patients should be screened for carriage of antimicrobial-resistant bacteria, and implementation of appropriate infection prevention and control measures should be ensured.

The risk of importation of cases with respiratory infections to the EU, such as seasonal influenza, is deemed moderate.

There are a number of diseases and infections that are highly unlikely to occur during Rio 2016 but are still important for monitoring because of their severity and high case-fatality ratio. These include viral haemorrhagic fevers and diseases that could result from intentional release, such as anthrax, plague and smallpox. Outbreaks and spread of vaccine-preventable diseases are of particular concern during mass gatherings but there is no evidence that the risk is higher than usual.

ECDC's mass gathering surveillance support

During the 2014 Brazil World Cup, ECDC activated enhanced epidemic intelligence activities by having a dedicated mass gathering officer evaluating the information regarding events relevant to the 2014 FIFA World Cup. During the monitoring period close to 40 000 events related to the event and fitting the classification table in the risk assessment were detected through MedISys of which 76 were determined to have direct relevance for the 2014 FIFA World Cup. Of the 76 events, 33 occurred in Brazil and were related to respiratory infections (7 reports), vaccine preventable illnesses (5 reports), sexually transmitted diseases (1 report), vector borne illnesses (15 reports), zoonosis (2 reports) and food and water borne illnesses (3 reports).

The overall approach to surveillance during the Rio 2016 will be 'enhanced business as usual' as during previous mass gathering monitoring. We will adapt ECDC's routine epidemic intelligence process for a defined period of time starting on 1 August (one week before the beginning of the Rio 2016) and ending one week after the closing ceremony. Routine epidemic intelligence activities will be enhanced by expanding the information sources, using a targeted and systematic screening approach, tailoring tools (i.e. MedISys), determining validation sources, establishing a daily analysis and communication process with regular and specific public health partners, and developing topical reports.

ECDC will also issue daily reports of information gathered through scanning a wide range of sources. ECDC will share these reports with the European Commission, WHO headquarters, WHO Regional Office for Europe, PAHO, and the Brazilian Ministry of Health.

The following criteria will be used to evaluate information regarding public health relevance for the Olympic Games:

- suspected or confirmed cases of communicable diseases of public health relevance in Brazil (risk to EU visitors/participants, risk of importation to the EU)
- incidents in Brazil related to international security, such as the possible intentional release of biological agents or nuclear and chemical events
- suspected or confirmed cases of communicable diseases of public health relevance for Summer Games in countries with national teams participating in the Summer Games and in countries bordering Brazil (risk of exportation to Brazil and local spread)
- incidents in Brazil which attract media attention in the EU, such as outbreaks in tourist areas, crowd injuries, spread of communicable diseases among visitors or participants.

Conclusions and options for response

Conclusions

Visitors to the Olympic Games in Rio, Brazil will be most at risk of gastrointestinal illness and vector-borne infections. Therefore, they should pay attention to standard hygiene measures to reduce the risk of gastrointestinal illness and protect themselves against mosquito and other insect bites using insect repellent and/or wearing long-sleeved shirts and trousers in regions where vector-borne diseases are endemic.

The risk of colonisation (digestive tract carriage) of multidrug-resistant Enterobacteriaceae should be considered for all travellers, irrespective of contact with healthcare facilities while in Brazil, during the three months following their return from Brazil. Surveillance for communicable diseases should be sensitive enough to detect threats at a stage when interventions are likely to prevent or reduce the impact of outbreaks.

The Olympic Games will take place during the winter season in Rio de Janeiro when the cooler and drier weather will reduce mosquito populations. This will significantly lower the risk of mosquito-borne infections for visitors, such as Zika virus, dengue and chikungunya, except in Manaus where some football matches will be held. Although the probability of being bitten by an infected mosquito is expected to be very low during the events, it cannot be excluded that travellers can become infected and return to regions of the EU where competent vectors are active. This may create an opportunity for local vector-borne transmission in the EU.

Over recent years, Brazil has eliminated rubella transmission and, since July 2015, has interrupted measles transmission. These are diseases which are still endemic in many other countries and could be imported to Brazil by international visitors [24].

Options for response

Visitors to Brazil should consult the advice for vaccinations issued by the Brazilian health authorities, the Pan American Health Organization (PAHO) [68] as well as their own country's recommendations[69].

All travellers are advised to arrange comprehensive healthcare insurance before travelling to Brazil. If healthcare is needed, travellers should contact Brazil's healthcare system (Sistema Único de Saúde – SUS) through local hospitals or use their private health insurance at any healthcare provider [22].

Prior to travelling, visitors to Rio 2016 in Brazil:

- Should have completed their vaccinations according to the schedule in their EU country of residence including: poliomyelitis, diphtheria, tetanus, pertussis, measles, mumps and rubella.
- Be aware that there is an increased risk of hepatitis A in Brazil compared to the EU and ensure that their vaccination status against hepatitis A is up-to-date
- Be aware that there is yellow fever in parts of Brazil, and follow the vaccination recommendations for these areas [1,2] [70], especially if planning to attend football matches in Belo Horizonte, Brasilia, or Manaus.
- Be aware that there is rabies in Brazil and avoid all contact with stray dogs and cats, consult a doctor regarding the need for post-exposure prophylaxis if they are bitten by an animal; and consider vaccination against rabies before travelling if they plan to stay longer than one month and in rural areas.
- Be aware that malaria exists in parts of Brazil outside of Rio de Janeiro, and consider malaria chemoprophylaxis if appropriate[64].
- Consider the need for other vaccinations based on lifestyle, activities or underlying health problems. This includes vaccination against influenza (preferably with the 2016 southern hemisphere seasonal vaccine) because the event takes place at the peak of the influenza season in the southern and south-eastern regions.

While in Brazil, travellers should:

- Consider standard hygiene measures to decrease the risk of gastrointestinal illness: use of bottled drinks and mineral water, use of factory-produced ice cubes, consumption of thoroughly cooked meat and fish, serving mixed meals such as feijoada (a typical Brazilian dish) or lasagne at temperatures above 60 °C, serving salads at below 5°C, and sanitising all fruits and vegetables before consumption.
- Consider the general hygiene conditions when consuming common local products, such as freshly made fruit juices, coconut water, drinks and cocktails [22].
- Avoid sexual risk behaviour to decrease the risk of sexually transmitted infections, blood-borne infections, and HIV.

Upon returning from Brazil:

- Travellers should, if requiring hospitalisation in the EU within one year after having been hospitalised in Brazil, report their previous hospital care in Brazil in order to accelerate the ascertainment of possible recent acquisition of antimicrobial-resistant bacteria and the implementation of appropriate prevention and control measures to prevent spread in the EU.

The information for travellers in ECDC's latest risk assessment on Zika virus published on 11 April 2016 remains valid [3]:

- Pregnant women and women who are planning to become pregnant should consider postponing non-essential travel to affected areas until after delivery. During Rio 2016, the North and Northeast Regions (specifically the Olympic sites of Manaus and Salvador) should be considered affected, as they are likely to still experience transmission of Zika virus infections.
- Pregnant women who plan to travel to Rio 2016 and pregnant women residing in the affected areas should consult their healthcare providers for advice and follow strict measures to prevent mosquito bites.
- Travellers with immune disorders or severe chronic illnesses should consult their doctor or seek advice from a travel clinic before travelling, particularly on effective prevention measures.
- Travellers to Brazil and EU citizens residing in affected areas should be advised that using condoms could reduce the risk of sexual transmission through semen.

Based on the epidemiological profile for infectious diseases for Brazil and the profile of the visiting populations, ECDC will conduct enhanced epidemic intelligence surveillance for communicable diseases from 1 August to 28 August 2016.

Annex 1

Table 1. Focus of ECDC surveillance activities during 5–21 August and 7–18 September 2016 and one week before/after the event

Diseases	Risk import to Brazil	Risk transmission /outbreaks during Olympic Games	Risk of export to EU	Enhanced surveillance required.	Remarks + Very low or no risk ++ Low risk +++ Moderate risk ++++ High risk
	(+, ++, +++, +++++)	(+, ++, +++, +++++)	(+, ++, +++, +++++)	(Yes / No)	
Antimicrobial resistance and healthcare-associated infections					
Multidrug-resistant <i>Pseudomonas aeruginosa</i> #	+	++	++	Yes	All visitors, irrespective of having been received hospital care or not while in Brazil, that require hospitalisation in the months following their return should report previous travel in Brazil and should be considered for testing for carriage of antimicrobial-resistant bacteria
Multidrug-resistant and carbapenem-resistant <i>Klebsiella pneumoniae</i> #	+	++	++	Yes	
Meticillin-resistant <i>Staphylococcus aureus</i> (MRSA)#	+	++	++	Yes	
Extended-spectrum beta-lactamase-producing Enterobacteriaceae#	+	++	++	Yes	
Food- and waterborne diseases					
Salmonellosis [£]	+	+++	++	Yes	
<i>Campylobacter</i> infections [£]	+	+++	++	Yes	
Hepatitis A	++	++	++	Yes	
Norovirus [£]	++	+++	++	Yes	Frequent cause of outbreaks during mass gatherings
VTEC/STEC/ <i>E. coli</i> infections [£]	++	+++	++	Yes	
Food poisoning, unspecified	-	+++	+	Yes	Frequent cause of outbreaks during mass gatherings
Yersiniosis [£]	+	+	+	Yes	
Dysentery/bloody diarrhoea	+	++	+	Yes	
Shigellosis	+	++	+	Yes	
Botulism [#]	+	+	+	Yes	
Legionnaires' disease [#]	+	++	+	Yes	
Zoonoses					
Rabies	+	++	+	Yes	Rabies endemic
Leptospirosis	+	+	+	Yes	
Trichinosis	+	+	+	No	Low risk of local transmission, no human-to-human transmission
Avian influenza (A(H7N9), A(H5N1), others)	+	+	+	No	
Vector-borne diseases					
Malaria	+	++	++	No	
Dengue	+	++	++	Yes	Moderate in northern and north-eastern regions; very low in the southern and central-western regions
Yellow fever	+	+	+	Yes	Yellow fever is endemic in parts of Brazil
Chagas	+	+	+	No	
Leishmaniasis	+	+	+	No	
<i>Schistosoma mansoni</i>	+	+	+	No	
Lymphatic filariasis	+	+	+	No	
Chikungunya	++	+	+	Yes	Due to the ongoing outbreak
Zika	+	+	+	Yes	

Diseases	Risk import to Brazil	Risk transmission /outbreaks during Olympic Games	Risk of export to EU	Enhanced surveillance required.	Remarks + Very low or no risk ++ Low risk +++ Moderate risk ++++ High risk
	(+, ++, +++, +++++)	(+, ++, +++, +++++)	(+, ++, +++, +++++)	(Yes / No)	
Sexually transmitted diseases					
HIV	+	++	++	No	Long incubation, no use of event surveillance
Syphilis	+	++	++	No	Long incubation, no use of event surveillance
Gonorrhoea	+	++	++	No	
Chlamydia	++	++	++	No	Very common STI across EU, limited benefit of monitoring.
Hepatitis B	+	++	++	Yes	
Hepatitis C	+	+	+	Yes	
Vaccine-preventable diseases					
Polio	+	+	+	Yes	
Rubella	+	++	+	Yes	
Measles	++	+	+	Yes	
Mumps	+	+	+	Yes	
Pertussis	++	++	++	Yes	
Invasive meningococcal disease	+	++	++	Yes	
Typhoid fever	+	+	+	Yes	
Respiratory diseases					
Influenza	++	++++	++++	No	
MERS-CoV	++	+	+	Yes	
Tuberculosis	+	+	+	Yes	
Leprosy	+	+	+	No	

Surveillance due to implications of severity, but low risk

£ Higher risk than indicated incidence rate, takes into consideration increased probability of temporary food providers and increased risk due to season.

Low risk, but enhanced surveillance recommended due to implications of severity and possible spread in hospitals and other healthcare facilities

Annex 2

Figure 3. Regions and states in Brazil



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