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What is the experience from previous mass gathering events? Lessons for Zika virus and the Olympics 2016

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SUMMARY

All previous experiences from different mass gathering show that vaccine preventable diseases is the most important infections like influenza, hepatitis A, polio and meningitis. Three mass gathering held in Africa during the Ebola outbreak accepted participants from West Africa and was able to handle the theoretical risk without any incident. Therefore we believe that the Olympic games in Rio de Janeiro should not be cancelled. The number of visitors to the games is a tiny fraction (1%) of other visitors to Zika endemic countries and it will have no measurable effect on the risk of spreading Zika virus, if the games was cancelled.

Introduction

Prediction is very difficult—especially about the future. Thus we have to look at previous experience to allow an informed estimate to be made of the risk of holding the Olympic Games at the same time as an ongoing epidemic of a vector-borne viral infection.

At the other end of the scale are unintentional 'mass gatherings' such as refugees taking shelter in huge camps, often in cramped conditions with poor hygiene. These are not usually regarded as mass gathering events, but nevertheless they pose the same problem in terms of the transmission of pathogens in the situation of a large number of people in a limited space. Currently the civil war in Syria has displaced many people, and diseases like tuberculosis, cutaneous leishmaniasis, measles, and polio are a risk.[1] Such conditions also increase the risk of transmission of zoonoses, with expected closer contact to rodents compared to normal conditions. Thus a One Health approach is also needed in this situation.[2]

Mass gathering events are theoretically ideal situations for the spread of infections between people from very different and widespread geographical localities, with potentially different immune responses. One of the first events that focused the international health community on mass gathering events was the outbreak of meningitis in 2000–2001 after the Hajj.[3,4] However, the spread of infections is rarely caused by mass gathering sports events.[5]

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The spread of severe acute respiratory syndrome coronavirus (SARS-CoV) from China to Hong Kong and further to Canada was not due to a mass gathering, but to infected individuals travelling late in the incubation period or just after the onset of symptoms.[6,7] The introduction of West Nile virus to North America was probably through wild birds crossing the Atlantic, and it could not have been predicted. Lastly, the outbreak of Middle East respiratory syndrome coronavirus (MERS-CoV) in Korea was caused by a single traveller waiting in an overcrowded hospital emergency room in South Korea.[8] The Korean MERS-CoV outbreak illustrates how difficult it is to predict the future. MERS was estimated to have a low epidemic potential,[9] and it was pointed out in this Journal that the outbreak was identified as being caused by MERS-CoV because it happened in a country with the resources (knowledge and laboratory facilities) to rapidly identify the virus.[10]

Disaster risk reduction

The Sendai Framework for Disaster Risk Reduction (DRR, 2015-203023) is the first of three United Nations landmark agreements approved in 2015. The Sendai Framework has an emphasis on health and gives a clear mandate, emphasizing the need for more integrated DRR that incorporates bottom-up as well as top-down approaches, local scientific and technical knowledge, and draws attention to synergies with other critical policy arenas including health, climate change, and sustainable development. Over the next 15 years, the Sendai Framework has set out to achieve "the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries" – including risk reduction at mass gatherings.[11] The use of science to inform decisions, an integral part of the Sendai Framework, must also be applied to mass gatherings.

Spread of pathogens between healthy, asymptomatic individuals

Some infections like tuberculosis have a long incubation period of several years, and exposure at a mass gathering will not be apparent and may easily be overlooked.[12]

The transmission of multidrug-resistant bacteria, for instance Gram-negative bacteria hosted in the intestine, is another concern that has not been well studied. Asymptomatic individuals are colonized with local bacteria and may be carriers for months.[13]

Africa

A review in the present issue of three mass gathering events in Africa just before and during the Ebola virus disease outbreak in West Africa 2014–2015 (The 2nd African Youth Games, Gaborone, Botswana, May 22–31, 2014; the 2015 African Nations Cup (football), Equatorial Guinea, January 17 to February 8, 2015; the XI All Africa Games, Brazzaville, Republic of Congo, September 4–19, 2015) shows that it was possible to handle the threat without cancelling the events.[14] The events all accepted participants from West Africa.

Kumbh Mela, India

The Hindu Kumbh Mela is a 3-month long religious conglomeration held every 3 years in four different cities of North India by rotation, the most famous being held in Allahabad. This is considered to be the largest human gathering on earth. The last one held in Allahabad in 2013 had 120 million visitors. Kumbh Mela does not involve a fixed human settlement, but the creation of temporary settlements of canvas, corrugated metal sheets, bamboo, nails, and rope in the flood plains of the rivers to house and feed millions of people for 3 months every 3 years. For Kumbh Mela people come by air, road, rail, and foot from within India, making it almost impossible to maintain detailed records of people movements.[15]

The Hajj, Kingdom of Saudi Arabia

The Hajj brings approximately three million Muslim pilgrims from all over the world to Mecca every year. Studies and reviews of surveillance data from returning pilgrims have shown that influenza, rhinovirus, and non-MERS coronavirus are the most common pathogens, and suggest that influenza immunization before departure may be justified.[16–18] General screening for infections in pilgrims visiting the Hajj has been reported in two other studies,[17,19] which found influenza to be the most common respiratory pathogen. Meningococcal disease is now rarely recorded. They also noted that gastroenteritis was common, but this is most probably due to lack of hygiene at the event.

A study from Australia looking at pre-travel prevention among pilgrims found that 80% were immunized against influenza, 30% against pneumococcus, and 30% against pertussis. Concern about contracting disease at Hajj was the most cited reason for vaccination (73.4%). Those who obtained pre-travel advice were twice as likely to be vaccinated as those who did not seek advice.[20]

Since the 2000 and 2001 outbreak, bacterial meningitis has been a high priority for the Kingdom of Saudi Arabia. Several studies have looked at carrier rates of *Neisseria meningitidis* in Hajj pilgrims, and overall carriage rates of 5–10% were found, comparable to the rate found in populations in non-epidemic settings.[21] In 2000 and 2001, 338 and 316 cases of laboratory-verified *Neisseria meningitidis* were reported; this fell dramatically to 2–4 cases per year (2013–2015) following the introduction of mandatory immunization with the quadrivalent vaccine.[22] The quadrivalent ACWY polysaccharide meningococcal vaccine has been a visa requirement for Hajj and Umrah since 2002. At the same time the Saudi authorities introduced a vaccination programme for children and adults living in Mecca and Medina, healthcare workers, and government personnel serving the pilgrims.[23]

A recent study of bacterial infections and resistance to antibiotics in hospitalized Hajj pilgrims in Mecca found that *Escherichia coli* was the most common bacterium (28%), followed by *Klebsiella pneumoniae* and Pseudomonas. Methicillin-resistant *Staphylococcus aureus* (MRSA) was found in 9.6%.[24] The potential spread of bacterial infections between Hajj pilgrims – whether symptomatic or not – is also a concern because of the unrestricted prescription of antibiotics by local pharmacies to the pilgrims.[25]

Other mass gatherings

The most common outbreaks at mass gatherings, including religious mass gatherings other than Hajj, sports events, and outdoor festivals, have involved vaccine-preventable infections, mainly measles and influenza, but also mumps and hepatitis A.[16]

The psychology of individuals participating in mass gatherings

The individual participant behaves in the context of their understanding of the norms associated with the group, and the relationships between group members become more trusting and supportive. Understanding these two behavioural changes is key to understanding how and why mass gathering participants may

behave in ways that make them more or less vulnerable to the transmission of infection.[26]

Tools for the control of infections at mass gatherings

Vaccines are an important preventive tool for mass gatherings and should include the basic coverage provided by childhood immunization programmes, supplemented where appropriate with protection against meningitis and influenza, and yellow fever for mass gathering participants coming from yellow fever endemic countries. A review in this issue discusses the need for vaccines for mass gatherings and draws attention to immunization against pneumococcal infections in elderly pilgrims and highlights that polio may be a risk.[27] An important vaccine for Hajj pilgrims, and the Arabian Peninsula in general, is one against MERS-CoV. The engineering of live attenuated vaccines has been facilitated by the development of reverse genetics. Using one of these methodologies, viruses deleted in the small envelope (E) protein have been developed. These viruses have been attenuated and have induced protective humoral and cell-based immune responses in hamsters and mice after SARS-CoV challenge.[28]

A meta-analysis on the use of face masks and the reduction in risk of upper respiratory infections found a modest effect.[29] Compliance is always higher during a study than in the real-life situation, and making face masks mandatory at mass gatherings is not presently recommended.

From all this experience, what are the implications for the August Olympics in Rio de Janeiro?

Clearly there is a risk of Zika virus (ZKV) infection, but ZKV is already present in more than 60 countries and the risk of spread already exists with or without the Olympics. ZIKV spread from Africa to Southeast Asia without any mass gathering event being involved, as far as we know, and its further spread to South America and between countries in South America has not been linked definitively to any mass gathering event.

From the review of mass gathering experience in this special issue of the Journal, vector-borne infections have not previously appeared as a particular risk, but experience also shows that potential health risks at a mass gathering can be mitigated effectively if they are recognized and planned for. The health authorities in Brazil are aware of the vector-borne risks and have already managed several mass gatherings without evidence of significant international spread (e.g. annual Rio Carnival, World Cup 2014). The estimated 500 000 visitors to The Olympic Games constitute less than 1% of visitors to the ZKV endemic countries (and many of these travellers will come from countries already affected by ZKV), so limiting travel to the Olympics will not substantially affect the risk of ZKV spread.[30] Pregnant women should avoid visiting the Olympics and those at risk of pregnancy should use contraception.

For the individual non-pregnant traveller, ZKV is a short febrile illness that leaves no sequelae. There is a small risk of complications like Guillain–Barré syndrome, but there is also a risk of ordinary influenza turning into severe double pneumonia requiring ventilator treatment, but we do not routinely immunize travellers to the tropics with year-round influenza transmission. Travellers should be advised to follow standard precautions against insect bites, including applying repellent, wearing impregnated clothes, and using bed nets if they do not sleep in an air-conditioned room.

The available evidence does not support cancelling, postponing, or moving the 2016 Olympic Games and we hope that the Games in Rio de Janeiro will be successful for the athletes and enjoyable for the public.

Conflict of interest: The authors declare no conflict of interest.

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