3.11 Biological risk: epidemics

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3.11.1 Introduction

An epidemic is the widespread, and often rapidly extending, occurrence of an infectious disease in a community or population at a particular time (CCDM, 2008). A pandemic is the extension of an epidemic to many populations worldwide or over a very wide area, crossing many international boundaries and affecting a large number of people (Last et al., 2001). Both epidemics and pandemics can be hugely disruptive to lives, livelihoods, and the political and socioeconomic stability of affected communities. As a result of this capacity for disruption, they constitute a class of disaster, which like other types of disaster, presents risks that can be ameliorated or reduced through risk management. As a class of disaster, epidemics and pandemics possess some unique characteristics. Infectious disease pathogens continue to circulate, extend and evolve during an event and thus present ongoing and changing challenges in regard to assessment, impact and persistence, further complicating risk management, control and recovery (Floret et al., 2006). For example, the emergence of antimicrobial resistance may thwart efforts to effectively treat infectious disease, resulting in more costly health care as well as prolonged illness and mortality.

Unless detected and controlled at a very early stage (when this is possible), epidemics are prolonged, and pandemics more so. Robust and sensitive systems for detection and surveillance therefore form the backbone of risk management strategies.

While many endemic or routine infections have been controlled in developed countries by immunisation, antimicrobials and improved standards of health and nutrition, they may still pose major hazards in developing countries with weaker health systems, fewer resources to devote to health and limited access to care. Such health systems are also poorly equipped to withstand epidemics of emerging infectious diseases, which may be sporadic and far more difficult to predict, and often involve diseases for which there is no cure (Jones et al., 2008). The existing routine surveillance systems may not be able to detect early signs of outbreaks. As many of the severe emerging diseases (such as Ebola, West Nile, Rift Valley fever) are zoonoses, the first signs of such events may not manifest in humans but rather in wildlife or livestock, indicating the importance of strong surveillance in the veterinary sectors, and the critical value of strong linkages between human and animal health surveillance in a One Health approach (CDC, 2016a).

Disease surveillance, preparedness and response mechanisms are essential to enable any health system to respond..

Droughts, floods and other natural hazards such as earthquakes can all contribute to the initiation of outbreaks. Outbreaks of plague can follow earthquakes, as the rodents that carry plague-infected fleas are displaced from their customary habitats and food sources, and come into closer contact with human environments (Ivers and Ryan, 2006). Epidemics of Rift Valley fever often commence when a period of drought is followed by flooding or intense rainfall, so climate perturbations such as the El Niño-Southern Oscillation may herald an increased risk of outbreaks in at-risk regions, and indicate the initiation of preventive measures, such as immunisation of livestock to prevent epizootics, and heightened surveillance for early detection of outbreaks in animals and in humans (Anyamba, et al., 2001). Disruption of water and sanitation infrastructure from earthquakes, storms and floods can lead to outbreaks of water- and food-borne pathogens such as cholera (Ivers and Ryan, 2006). The extractive industries, with their attendant ecosystem disturbance, land-use and demographic changes, have been associated with precipitating outbreaks of severe emerging diseases, including Marburg haemorrhagic fever (Le Guenno, 1997). A recent study identified the top five drivers of infectious disease threats in Europe as travel and tourism, global trade, climate, food and water quality, and natural environment (Semenza et al., 2015). The implementation of measures addressing these underlying drivers could therefore be a cost-effective strategy towards reducing the risk of future disease threats.

The permanent prevention of infection has proven possible but is rare; for example, smallpox was declared to have been eradicated globally in 1979 (WHO, 1980), and the drive to eradicate polio continues to be an international priority (GPEI, 2013). Therefore, the focus is mainly on disaster risk reduction for epidemics and pandemics, which involves reducing risks in advance of an epidemic through preparedness strategies, and the mitigation of risks and hazards during the event. There are usually two general aspects to mitigating an infectious disease outbreak: the care of patients (to alleviate disease and suffering) and the epidemiological investigation of an outbreak to facilitate the response (Ferguson et al., 2006). For both patient care and the epidemiological investigation and response, the laboratory testing of human (and/or animal/vector/environmental) samples for evidence of the pathogen is important to ensure that the correct intervention strategies are employed. The magnitude of testing may be overwhelming for laboratories with specialised testing services (Kumar and Henrickson, 2012), so plans to access such laboratories should be in place before an outbreak.

The response to an emerging infection disease outbreak may initially be largely dependent on the local public health workforce but the response may soon be directly reliant on the capacity of other health departments and agencies. Again, cross-sectoral collaborative arrangements and planning for surge capacity play a fundamental role. Public health risk communication, which is effective in engaging the communities at risk and cognisant of societal and cultural values, is key to ensuring implementation and compliance with recommended public health controls. Psychosocial as well as physical consequences may also occur in epidemic response and recovery and, therefore, plans must address the management of related psychological distress and mental illness (Moore et al., 2007).

The Sendai Framework (UNISDR, 2015) states that:

"more dedicated action needs to be focused on tackling underlying disaster risk drivers, such as the consequences of poverty and inequality, climate change and variability, unplanned and rapid urbanization, poor land management and compounding factors such as demographic change, weak institutional arrangements, non-risk-informed policies, lack of regulation and incentives for private disaster risk reduction investment, complex supply chains, limited availability of technology, unsustainable uses of natural resources, declining ecosystems, pandemics and epidemics"

The framework goes on to advocate the promotion of 'transboundary cooperation to enable policy and planning for the implementation of ecosystem-based approaches with regard to shared resources, such as within river basins and along coastlines, to build resilience and reduce disaster risk, including epidemic and displacement risk' (UNISDR, 2015).

Of note, the Sendai Framework states the global target need to 'Substantially increase the availability of and access to multihazard early warning systems and disaster risk information and assessments to people by 2030' (UNISDR, 2015). The framework goes on to state that to achieve this it is important 'To enhance cooperation between

health authorities and other relevant stakeholders to strengthen country capacity for disaster risk management for health, the implementation of the International Health Regulations (2005) and the building of resilient health systems' (UNISDR, 2015).

The scope of this subchapter has been limited to viral and bacterial infectious diseases only. A series of well-documented disease epidemics are summarised to demonstrate the complexity of DRM. The value of using the International Health Regulations (IHR) and pandemic preparedness approaches to disaster risk reduction on a global scale is demonstrated, innovations in Early Warning Systems (EWSs) and surveillance are discussed, and the conclusions summarise the key points and recommendations.

3.11.2 Diseases of contention

3.11.2.1 Severe acute respiratory syndrome (SARS)

The first cases of SARS occurred in China in November 2002 (Christian et al., 2004), and the disease eventually spread to 37 countries, with 8 273 confirmed cases (Chinese SARS Molecular Epidemiology Consortium, 2004). The disease caused major outbreaks in Asia and the Americas, with smaller outbreaks in Europe, illustrating how globalisation can contribute to the rapid amplification of disease spread (Coleman and Frieman, 2014). While the overall estimated case fatality rate was estimated at 15 %, the rate increased significantly with age (Chan et al., 2003). Transmission was also amplified between health workers; nosocomial transmission accounted for 72 % of cases in Toronto (Booth et al., 2003) and 55 % of cases in Taiwan (CDC, 2003).

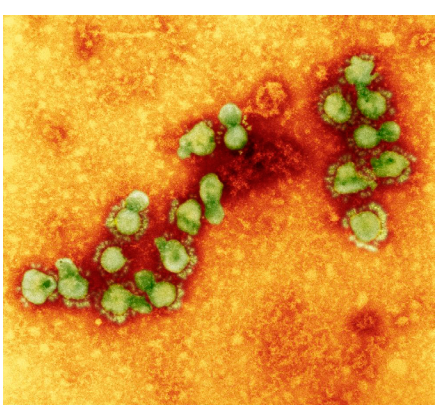
Before the SARS epidemic, coronaviruses were believed to primarily cause minor upper respiratory tract illness in humans (Myint, 1995). With SARS, illness usually begins with a high fever associated with chills and rigors, headache and malaise, followed by respiratory impairment, which, on becoming severe, requires mechanical ventilation (Peiris et al., 2003).

During the early stage of the epidemic, the non-specific presenting symptoms and the lack of access to reliable diagnostic tests made it difficult for clinicians and public health authorities to accurately ascertain cases. Furthermore, the uncertainty around the population health impacts of SARS generated considerable public fear. The need to follow up many thousands of contacts of confirmed cases to check for the development of illness placed an enormous burden on already overstretched public health services. Examples of issues identified included:

- governments investing in highly visible public health activities such as temperature testing at entry to buildings in order to provide a degree of public reassurance, with a major investment made in entry-screening at airports, even though these measures were not evidence based (Bitar et al., 2009);
- the reintroduction of enforced quarantine and isolation practices to prevent transmission, raising ethical and legal questions around the balance between public health measures and individual rights, as well as questions about the effectiveness of such measures and challenges in implementing them at scale (Huang, 2004);
- a lack of availability of hospital negative pressure isolation rooms in countries at the start of the SARS epidemic, which are required to treat ill patients safely (Gamage et al., 2005).

FIGURE 3.50

SARS
Source: PHE EDAM



Severe acute respiratory syndrome (SARS) demonstrated the need for systems for early detection and global information-sharing.

In its wake, the health-care and national economic systems of some countries were seriously disrupt-

ed. The dramatic reconfiguration of health systems in response to the epidemic, as well as the amplification of transmission in high-technology settings, caused significant disruption to normal service delivery (Wenzel and Edmond, 2003). Trade and tourism were also significantly affected, with the global cost to economies estimated to be in the region of EUR 38 billion (McKibbin and Lee, 2004). However, the basic strategy that eventually controlled SARS outbreaks worldwide was effective surveillance and containment.

3.11.2.2 Ebola

Ebola Virus Disease (EVD) is a severe haemorrhagic fever caused by viruses belonging to the genus Ebolavirus in the family Filoviridae (Gatherer, 2014). Bats are thought to be the hosts of Ebola viruses in nature, from which other wild animals such as chimpanzees and monkeys become infected (Reddy, 2015). Ebola is introduced into the human population through close contact with infected animals. It then spreads through human-to-human transmission via direct contact with the blood, secretions, organs or other bodily fluids of infected people (Feldmann and Geisbert, 2011).

Symptomatic patients experience a sudden onset of fever, muscle pain and chills accompanied by vomiting and diarrhoea, which in approximately one-fifth of cases is followed by haemorrhagic complications. In severe cases, multiple organ failure may lead to death (Hartman et al., 2010). Transmission can be interrupted through early diagnosis and the institution of effective public health measures, such as patient isolation and care, contact tracing and safe burial practices (Bausch et al., 2007).

Since 1976 when Ebola was first identified, more than 25 Ebola outbreaks have occurred in sub-Saharan Africa (Gostin et al., 2014). The recent West African Ebola epidemic (2013-16) in Guinea, Liberia, Nigeria, Senegal and Sierra Leone was the most widespread outbreak of EVD in history, resulting in 28 616 cases, of which 11 310 are reported to have resulted in death (CDCb, 2016). Owing to the collapse in the ability to deliver other essential health care, a significant rise in mortality due to other, normally treatable, disease was also observed.

On 8 August 2014, the WHO declared the epidemic a 'public health emergency of international concern' (PHEIC) (WHO, 2014a). Despite an understanding of the control measures required to limit the spread of the outbreak, the initial response was slow, which allowed the epidemic to gain momentum. Reasons for the slow response included the wide geographical spread of cases, the weak local health infrastructure and poor laboratory capacity to diagnose infection, the lack of expertise in containing the epidemic and treating those infected (Bell, 2016), and the delay of political leaders in calling on international assistance early on for fear of creating panic and disrupting economic activity (Moon et al., 2015). Italy, the United Kingdom and Spain were the only European countries to have imported cases of Ebola linked to the West African outbreak (WHO, 2016a).

FIGURE 3.51

Ebola
Source: PHE EDAM

Lessons identified from the outbreak included:

- the need for stronger event-based surveillance systems in developing countries for early detection and response, to detect and stop infectious disease threats;
- the importance of engaging local communities in the response;
- the need for stronger international surge capacity and the mobilisation of rapid assistance when countries are overwhelmed by an outbreak;
- strengthening infection prevention and control in health-care settings

given their potential to become 'amplification points' for spread of EVD, placing health workers at significant risk (Bell, 2016; Gostin et al., 2014).

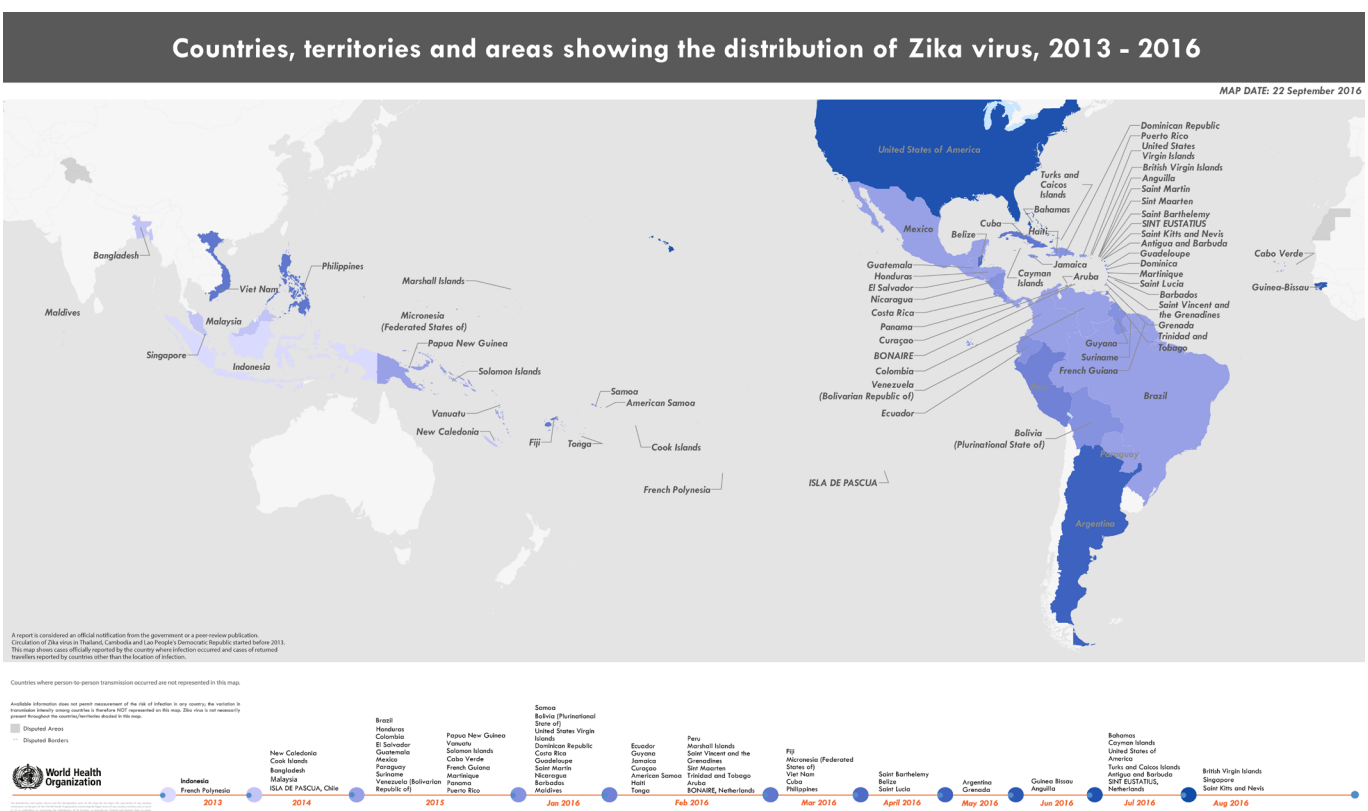
The epidemic also highlighted the need to fast-track the development of effective tests, vaccines and medicines. The final results of a trial have just been published, confirming the protective efficacy of an Ebola vaccine, which may prevent future Ebola outbreaks from having as devastating consequences (WHO, 2016b). A new WHO initiative, the blue print to accelerate Research and Development (R and D) for severe emerging diseases with no or insufficient control measures, has been established. Furthermore, the Coalition for Epidemic Preparedness Innovations has recently been established with an initial investment of EUR 431 million from the governments of Germany, Japan and Norway, and from the Bill and Melinda Gates Foundation and the Wellcome Trust in the United Kingdom. This alliance aims to finance and coordinate the development of new vaccines to prevent and contain infectious disease epidemics.

3.11.2.3 Zika

Zika is caused by a flavivirus, from the group of viruses that cause dengue, yellow fever, WNV and Japanese encephalitis. The main vectors of Zika are Aedes aegypti mosquitos, which are common in dwellings and carry other viral infections. Zika virus was first recognised as a cause of human disease in 1953, but only usually produced a mild and self-limiting illness without lasting consequence (Macnamara, 1954). However, in December 2015, reports were emerging of an epidemic of microcephaly in Brazil (ECDC, 2015a).

FIGURE 3.52

Distribution of Zika virus
Source: WHO



Microcephaly is a severe neurodevelopmental disorder caused by a failure of the brain to grow normally in the foetus, leading to an abnormally small head and impaired development (PAHO/WHO, 2015). The epidemic was confirmed to be caused by the Zika virus, which was new to Brazil (Campos et al., 2015). In addition to microcephaly, Zika causes a range of neurological and other congenital abnormalities in the developing foetus (WHO, 2016c), and severe neurological complications have also been observed in some adults and children, including Guillain-Barré Syndrome, which requires specialised intensive support (Oehler et al., 2014). Zika was declared a PHEIC under the International Health Regulations in February 2016 (WHO, 2016d).

Zika requires urgent prevention investment and control measures, which will take time to fully develop.

Zika is now spreading in the Americas to several other countries in South America, Central America and North America, and imported cases have been recorded in Europe (ECDC, 2015a, 2015b, 2016; Hennessey et al., 2016). Although in November 2016, it no longer had the status of a PHEIC, questions remain unanswered on the best means of controlling the virus and its impacts. The disease is spread by mosquitos, which are very difficult to control using conventional vector control methods (Yakob and Walker, 2016). This has required a major investment into accelerating novel vector control strategies, which will require years of intensive testing, evaluation and regulatory oversight (Daudens-Vaysse et al., 2016). Work is under way to speed up the development of vaccines, which will have to be safe for pregnant women and women of child-bearing age, effective with one dose, cheap and scalable to large volumes of production (Maurice, 2016).

The social consequences of the severe complications of Zika are formidable. The congenital abnormalities are a cause of fear and anxiety among women who are, or may become, pregnant. In some cultures, women who have children with abnormalities are isolated or stigmatised in their communities (WHO, 2016e). Family planning services may be weak, difficult to access or not culturally acceptable in some areas, and many countries do not allow abortion even for medical reasons, so the impact on affected women and their families, and the need for longer-term social provision and disability services, must be addressed (WHO, 2016f).

3.11.2.4 Human immunodeficiency virus (HIV)

Human immunodeficiency virus HIV is a type of retrovirus that is transmitted by the exchange of body fluids (breast milk, blood, semen and vaginal secretions) from infected individuals. The virus attacks and destroys infection-fighting CD4 cells of the immune system and weakens the host's defences, leading to Acquired Immune Deficiency Syndrome (AIDS). Even without treatment, there is often a long time lag (on average 10 years) between the acquisition of infection and the onset of AIDS (Poorolajal et al., 2016). Immunodeficiency increases the susceptibility of individuals to a variety of infections, many of which are not dangerous to people with strong immune systems, necessitating early diagnosis and appropriate treatment (WHO, 2016g).

Human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) provides an example of the problems in managing a pandemic when early detection is poor.

HIV was first identified in 1983 and was definitively linked to AIDS patients in 1984 (Blattner et al., 1988). A reluctance to address the common transmission factors directly through effective social engagement may have impeded early efforts to limit the extension of the epidemic, which is now a pandemic. To date, approximately 75 million people have been infected with HIV and it is considered that 36 million people have died from HIV-related causes (WHO, 2016h). Despite the predominance of HIV/AIDS cases in sub-Saharan Africa, recent reports state that eight out of 12 countries in Eastern Europe and Central Asia have experienced increases in new cases of HIV infections (UNAIDS, 2016).

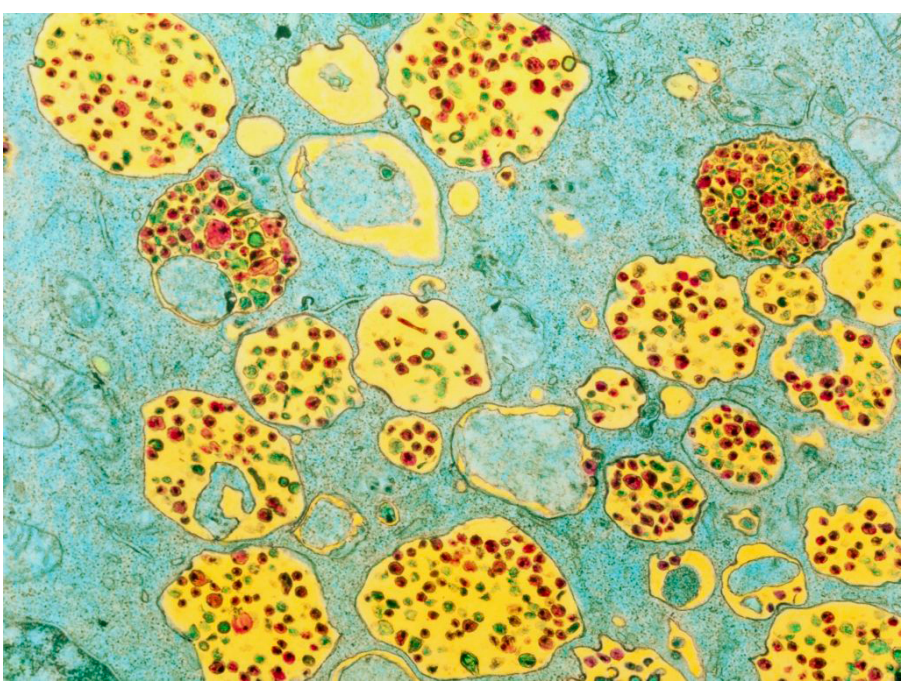
Even with extensive education programmes, the social, economic, political and environmental structural factors that increase susceptibility to HIV infection and undermine prevention and treatment efforts continue to pose challenges (Seeley et al., 2012).

HIV infection risks include men who have sex with men, unprotected sex outside a stable relationship and injecting drug use. Safe infection control practices are crucial to prevent transmission in health-care settings. Fear of stigmatisation and discrimination can prohibit access to health services (Mahajan et al., 2008). Women are also particularly vulnerable in cultures where they have little power over their sexual behaviour (Tsasis and Nirupama, 2008). Conditions correlated with safe behaviours include knowing an individual's HIV status, possessing skills for implementing safe sex, perceiving risk accurately and having peer support to build safer behaviours (Coates et al., 1988).

The economic impact of HIV is also significant. Although no definitive figures for Europe have been found, it is estimated that, on average, the epidemic causes a reduction in GDP of 2-4 percentage points across affected African countries (UNDESA, 2001). Annual HIV/AIDS mortality has reduced from 2.3 million in 2005 to 1.5 million in 2013 as a result of the introduction of highly active antiretroviral therapy (Granich et al., 2015). This effective treatment increases survival by up to 25 years following infection (Poorolajal et al., 2016). Global treatment coverage reached 46 % at the end of 2015. However, in Eastern Europe and Central Asia, only 21 % of those living with HIV are receiving treatment, owing to a lack of resources and political will (UNAIDS, 2016). Further work has been proposed by the United Nations General Assembly High-Level Meeting on Ending AIDS to terminate the AIDS epidemic by 2030. Intensified efforts are required to reach this target, including the strengthening of HIV therapy with pre-exposure prophylaxis, ensuring that people with HIV know their status, filling the treatment gap and reaching and protecting vulnerable groups such as women and children through an improved surveillance system (WHO, 2016i). Increased efforts should also be directed at strengthening human rights and combatting stigma and discrimination against people with HIV infection.

FIGURE 3.53

HIV virus
Source: PHE EDAM



3.11.3 The International Health Regulations and pandemic preparedness

Currently, there are two international mechanisms that have been created by the WHO to respond rapidly to international health emergencies: the Global Outbreak and Response Network (GOARN) and the International Health Regulations IHR (2005).

The Global Outbreak and Response Network GOARN has its secretariat in the WHO and is a worldwide partnership of agencies, institutions and networks, with expertise to support the response to epidemics wherever they may occur. Since 2000, it has co-

ordinated over 130 international public health operations (WHO, 2015).

The International Health Regulations (2005) is an international legal instrument which is key to the Sendai Framework for DRR and its implementation and provide a comprehensive framework of definitions, principles and responsibilities that are 'designed to prevent the international spread of disease' (WHO, 2005). The IHR set out State Party obligations to develop certain minimum core public health capacities in surveillance and response at the local and national levels. Within the European Union, the European Centre for Disease Prevention and Control (ECDC) is responsible for identifying, assessing and communicating current and emerging threats to human health posed by infectious diseases. WHO Europe and the ECDC work together to develop a single European reporting and response system, and the ECDC assists EU Member States in certain aspects of IHR implementation, via Decision 1082/2013/EU.

The IHR also specify procedures for the determination by the Director-General of a PHEIC and the issuance of corresponding temporary recommendations (WHO, 2005). In the case that a potential PHEIC is notified, the IHR sets out the procedure for the establishment of an Emergency Committee of relevant experts selected by the Director General that will provide views on whether the event constitutes a PHEIC (and when it ceases to be) and on recommendations to be given on health measures to prevent or reduce the international spread of disease and avoid unnecessary interference with international traffic (WHO, 2005). During a PHEIC or any other public health event, countries may require and request assistance with the management of the epidemic. However, the overall capacity to control and prevent the occurrence of epidemics or a pandemic is only as good as the weakest link in the chain and, similarly, the effectiveness of an international alert system will only be as good as its implementation.

The 2009 H1N1 flu virus pandemic marked the first use of the IHR 2005 to address a global public health emergency (Katz and Fischer, 2010). Although this pandemic saw significantly fewer fatalities than the 1918 'Spanish flu' pandemic (Morens and Fauci, 2007), it still resulted in significant pressures on responding organisations (particularly health systems), coordinating governments and the public (Girard et al., 2009).

Pandemic influenza differs from the more routine epidemics of seasonal influenza that populations face on a regular basis in a number of ways:

- a pandemic is, by definition, a global epidemic, affecting all countries across the world at the same time (Cox et al., 2003);
- a pandemic can occur at any time of the year, unlike the more predictable seasonal epidemics (Lipsitch et al., 2009);
- most of the population will be susceptible to the pandemic influenza virus owing to the novelty of the virus compared with previous circulating strains, rather than the typical at-risk groups of those at extremes of age or with known clinical risk factors (Cox et al., 2003);
- a pandemic could occur in multiple waves (Ngyuen-Van-Tam and Penttinen, 2016).

The International Health Regulations specify the core capacity requirements of countries to prevent the international spread of disease, one of which is preparedness. The challenges with preparedness planning for a pandemic are manifold and reflect the uncertainties in how such an event could manifest, as well as the potential impact.

Pandemic preparedness varies across states and is influenced by many underlying factors. These include the resources available to plan for and respond to something as unknowable as a pandemic, where limited resources are understandably targeted towards known immediate challenges such as childhood immunisations, HIV/AIDS or clean water (Nicoll et al., 2016; Oshitaniet al., 2008). Even if a country is developing robust pandemic preparedness arrangements, ad hoc or unexpected events can cause activity to be derailed, postponed or abandoned, such as an outbreak of another disease or a major natural disaster (Campigotto and Mubareka, 2015; CCDM, 2008).

Pandemic preparedness and response goes much wider than health-care systems. While the link with social care is easily recognised, maintaining the business continuity of other essential services (such as emergency services, schools, fuel, power, education, prisons, etc.) is necessary to mitigate any further unintended or unanticipated impacts on the health response. On account of the need for cross-sectoral involvement, and the potential broad disruption that a severe pandemic might generate, pandemic planning may be considered a model for large-scale disaster planning.

While all sectors of society are involved in pandemic preparedness and response, the national government is the natural leader for overall coordination and communication efforts. Public perceptions of the state can therefore influence the success of the response; during the 2009 H1N1 pandemic, health authorities were viewed as trustworthy in the United Kingdom, while in Spain, there was public speculation that the vaccine was driven by the economic interests of the pharmaceutical industry, which led to poor vaccine uptake (Henrich and Holmes, 2011; Prieto et al., 2012).

As in all disaster preparedness scenarios, there are a number of key essential elements that underpin robust pandemic planning (CCDM, 2008; Fineberg, 2014; WHO, 2009):

- having national, subnational and local strategic, tactical and operational plans;
- working across multi-agency partnerships, including the private and voluntary sector organisations;
- planning for a risk-based and flexible response;
- testing and exercising plans, and ensuring that staff are appropriately trained;
- using routine surveillance to ensure early warning of pandemic arrival in the country;
- ensuring that communication routes are effective for a range of audiences (including the public, health-care workers and politicians);
- providing access to effective and appropriate clinical counter measures;
- providing access to appropriate personal protective equipment for health-care workers;
- ensuring that essential services and business have considered their business continuity arrangements;
- planning for special groups and settings (such as the justice setting, migrants and persons in transit, and hard-to-reach populations);
- planning to cooperate with international partners, and how to manage any border issues;
- planning for recovery.

Responding to a severe influenza pandemic is potentially one of the biggest challenges for the health sector, as well as wider society. Even if a severe pandemic never occurs, all the planning and discussion around some of the potential issues can help to inform responses to other incidents.

3.11.4 Innovative approaches for early warning and surveillance

As advances in technology and communications have increased the opportunities for international travel and trade, both of which are recognised drivers of the emergence and re-emergence of human pathogens (Suk et al., 2008), so have they increased the opportunities for surveillance to enable the rapid detection and assessment of threats, and the sharing of intelligence across international borders. Key advances that have improved surveillance capacities include:

- increases in computing power and storage capacity, enabling the rapid analysis of large disease incidence datasets;
- developments in electronic communications systems and information standards enabling machine-to-machine data transfer and rapid sharing of information, nationally and internationally (Guglielmetti et al., 2005);
- internet-based search and retrieval applications that scan for media and other informal reports that might indicate the emergence of an infectious disease epidemic (Keller et al., 2009; Anema et al., 2016);
- Geographic Information Systems (GISs) that enable the analysis and display of information that can assist in identifying clusters or assessing environmental determinants of exposure (Freifeld et al., 2008).

Infectious disease modelling that integrates data on environmental variables with health and disease data may also help to anticipate future disease threats, thereby providing support tools for decision-makers (Suk et al., 2014; Semenza et al., 2013). The emergence of the field of digital epidemiology, which is the science of conducting epidemiological studies using data

from digital tools and data sources from the internet such as social media, is already having an immediate impact on the operational activities of public health agencies worldwide (Salathe et al., 2012). There are, however, considerable challenges, such as filtering large volumes of unstructured data, and ethical issues around data-sharing and use (Brownstein et al., 2008).

Informal sources for event-based surveillance can provide very early signals of significant health events, sometimes before they are detected through official indicator-based channels.

An important innovation in the 2005 revision of the IHR was to change the focus of the regulations from one limited to specific diseases to one applicable to health risks, irrespective of their origin or source (WHO, 2005). This has a number of key benefits in terms of the early detection of epidemic threats, including not only the broadening of the scope of infections (and other potential causes of PHEICs) covered, but also removing a dependency on awaiting definitive (laboratory) confirmation of the aetiology of a detected case or incident of potential international concern before reporting. As a consequence, monitoring of the evolution of diseases and factors affecting their emergence and transmission can occur at an earlier stage than in the past.

3.11.5 Conclusions and key messages

Epidemics and pandemics are types of disasters that are capable of overwhelming health systems, disrupting communities and challenging political leadership, and that often have devastating societal, economic and psychological impacts. Infectious diseases can behave unpredictably and have a capacity to evolve and adapt to exploit population susceptibilities, thus posing a perpetual challenge in the context of DRR and DRM.

The recommendations below have been structured according to the pillars of the DRMKC, namely partnership, knowledge and innovation. The DRKMC has been developed in order to support the translation of complex scientific data and analyses into usable information, providing science-based advice for DRM policies, as well as timely and reliable scientific-based analyses for emergency preparedness and coordinated response activities.

Partnership

Multidisciplinary working is essential in order to reduce the impacts of epidemics and pandemics. Information-sharing between sectors (e.g. animal health, veterinary, transport, environmental health, food, water and sanitation) is key to preventing the spread of infection and assessing evolving risk through surveillance, particularly as many emerging infections are zoonoses and may first manifest in livestock. As infectious diseases do not respect borders, strong collaboration and coordination between national and international structures is fundamental to limiting morbidity, mortality and societal disruption. Comprehensive preparedness planning involving multi-agency partnerships can also make the transition from disaster to recovery more effective.

Knowledge

Control measures should be evidenced-based when possible, and preparedness plans should be clear, flexible and regularly tested in order to provide a timely, appropriate and effective response. Countries should also be supported to comply with the International Health Regulations which set out the core competencies that countries should have with respect to their national surveillance and response, and their obligation to report events that constitute a PHEIC.

Innovation

Syndromic surveillance and the use of innovative methods to collect event-based data, for example through the internet, may assist in the early detection of disease outbreaks. In the absence of existing effective treatment or preventive measures, investment is required into research to develop new preventive and/or therapeutic strategies; two recent examples of this are the WHO blue print for accelerating Research and Development and the evaluation of an effective vaccine against Ebola, and the formation of the Coalition for Epidemic Preparedness Innovations.

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3.11 Biological risk: epidemics

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