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**WHO Report on Global Surveillance of Epidemic-prone
Infectious Diseases**

World Health Organization

Department of Communicable Disease Surveillance and
Response

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CHAPTER 1

INTRODUCTION

Background

This report focuses on the analysis and interpretation of data collected by WHO on the surveillance of infectious epidemic diseases, the strengths and weaknesses of the data, and how the data can be used and interpreted. There are several aspects of this report that are worth noting. First, time series data for approximately half a century are reported for many of these diseases. Such data allow recent changes to be interpreted in a long-term perspective. Indeed, part of the motivation for including particular diseases in this report is to make these data available to the public, to health professionals and to scholars. One of the surveillance systems discussed in this report, the surveillance system for leishmania/HIV co-infection, is very new. Already this system is indicating that co-infection is a problem in some parts of Europe. For HIV/AIDS, there is a unique set of data from the beginning of the pandemic until the present time.

Second, this volume uses a multiple disease approach, and examines not only the surveillance of (nine) different diseases, but also contrasts and compares their global surveillance systems.

Surveillance has been defined as the continuing scrutiny of all aspects of the occurrence and spread of a disease that are pertinent to effective control.¹ For this, systematic collection, analysis, interpretation and dissemination of health data are essential. This includes collecting information about clinical diagnoses, laboratory diagnoses and mortality, as well as other relevant information needed to detect and track diseases in terms of person, place and time. Surveillance systems must detect new communicable diseases as well as recognize and track diseases that currently are, or have the potential to become, of major public health importance.

Why infectious diseases are still a problem and surveillance is still required

In the 1970s many experts thought that the fight against infectious diseases was over. In fact, in 1970, the Surgeon-General of the United States of America indicated that it was “time to close the book on infectious diseases, declare the war against pestilence won, and shift national resources to such chronic problems as cancer and heart disease”.

Indeed, complacency about the threat of communicable diseases in the 1970s led to less priority for communicable disease surveillance systems. Partly as a result, these systems were not maintained in large parts of the developing world, and this retarded recognition of the magnitude of problems posed by new and re-emerging communicable diseases, and therefore effective action to control them.

During the last two decades, this opinion has been reversed, and there is now a renewed appreciation of the importance of communicable disease. The spread of new diseases such as HIV/AIDS, hepatitis C, and dengue haemorrhagic fever, and the resurgence of diseases long since considered under control such as malaria, cholera, and sleeping sickness, have drawn considerable attention. Infectious diseases cause 63% of all childhood deaths and 48% of premature deaths. Many of these deaths are caused by epidemic infectious diseases such as cholera, meningococcal disease, and measles. There are continuing threats of large epidemics with widespread mortality like the ‘Spanish flu’ epidemic in 1918-1919 which killed an estimated 40 million people worldwide, or the HIV/AIDS epidemic which has caused widespread morbidity and mortality, and reversed hard-won gains in life expectancy in Africa.

In light of this, it is clear that effective public health surveillance is critical for the early detection and prevention of epidemics. There is a clear and urgent need for surveillance of (i) known existing

¹ Last, JM. *A Dictionary of Epidemiology*. Oxford University Press, 1995.

communicable diseases, especially those with high epidemic potential, (ii) early recognition of new infections (over 20 new pathogens have been discovered since the mid-1970s), and (iii) monitoring the growing resistance to antimicrobial drugs.

Global epidemic surveillance

In the modern world, with increased globalization, and rapid air travel, there is a need for international coordination and collaboration. Everyone has a stake in preventing epidemics.

WHO has the mandate to lead and coordinate global surveillance. This includes setting international epidemic surveillance standards, providing technical assistance to Member States in surveillance activities, training in field epidemiology, strengthening laboratory capacity and laboratory networks. WHO also maintains international collaborating networks like the WHO Network of Collaborating Centres for Influenza Surveillance which monitors strains of influenza, the cholera task force which coordinates preparedness and response to cholera outbreaks, and the International Coordinating Group (ICG) on Vaccine Provision for Epidemic Meningitis Control.

In addition, WHO ensures international coordination of epidemic response, particularly for diseases of international public health importance or when countries lack the capacity to respond to an epidemic themselves. Responses can vary from investigating the cause of an epidemic, to verifying and disseminating information, and to providing needed equipment and laboratory supplies.

The scope of this report

This report concentrates on the surveillance of nine infectious epidemic diseases that are either new or volatile or pose an important public health threat. All have high epidemic potential and most are increasing in incidence. They include:

- Yellow fever
- Plague
- Cholera
- Meningococcal disease
- Dengue fever and dengue haemorrhagic fever
- Influenza
- African trypanosomiasis
- HIV/AIDS
- Leishmaniasis and leishmania/HIV co-infection

These diseases are difficult to track because of their complicated epidemic patterns, their ability to develop new strains, and their tendency to spread quickly to new locations. Most of these diseases have high case fatality rates and severe symptoms increasing the urgency of fast identification of new occurrences to prevent further transmission.

These nine diseases have several different transmission patterns. Yellow fever, plague, dengue/dengue haemorrhagic fever, African trypanosomiasis, and leishmaniasis are all vector-borne diseases transmitted by the bite of infected insects; influenza and meningococcal disease have airborne transmission routes; while cholera is transmitted by contaminated food and water, and HIV is transmitted primarily through sexual contact. HIV and HIV-leishmania co-infection, and African trypanosomiasis can also be transmitted through contact with infected blood either from blood transfusions, contaminated needles or use of contaminated blood products. Vertical transmission from mother to child occurs in both HIV and African trypanosomiasis.

The remainder of this chapter presents a description of the types of data used in the surveillance of the nine diseases presented. This provides insight into the different types of activities that make up disease surveillance systems, and includes a discussion of the uses and limitations of surveillance data. Next, there are observations about how the modern world is impacting on infectious diseases, using examples from the nine diseases covered in the report. Finally some conclusions are drawn.

Types of surveillance

Table 1.1 presents the types of surveillance data available for the nine diseases covered in this report. This includes the information collected, years covered, type of surveillance, frequency of reporting, and the strengths and weaknesses of the surveillance system.

Reporting cases and deaths

One of the mainstays of communicable disease surveillance is the reporting and confirmation of cases seen in health facilities. This is known as passive reporting (in contrast to active case-finding methods where cases are actively looked for). For passive reporting to be successful, primary health care providers must be able to recognize the clinical manifestations of reportable diseases. This involves having clear, uniform case definitions available at the peripheral level. In addition, laboratories need adequate resources to make the required laboratory diagnoses.

Passive surveillance has many weaknesses. First, in many parts of the world there is very little access to health care facilities, and many people fall ill or die at home without ever visiting a health facility. Thus many cases are not reported. Second, there are problems of under-recognition of diseases, particularly those that are new to an area or those with non-specific symptoms. Third, in many parts of the world the level of laboratory support is inadequate. Fourth, there are common logistical problems in reporting in many parts of the world, over-worked and underpaid staff, lack of motivation for reporting when no feedback is provided, and a need for further training. Overall, there is considerable variation in the quality of reporting systems from country to country, reflecting economic, social, cultural and epidemiological differences.

There are several typical reporting practices used, depending on the control measures needed, and the specific regulations in the country.

Three diseases are currently subject to the International Health Regulations:² yellow fever, plague, and cholera. The regulations, which were first adopted by the World Health Assembly in 1951 and then revised slightly in 1969, are a mechanism to provide security against the international spread of epidemic diseases with a minimum interference with world traffic. These are the only binding international legislation for public health and they require that:

Each national health administration should inform WHO within the first 24 hours of being informed of the first suspected case on its territory of a disease subject to the Regulations. This includes both indigenous and imported cases. All subsequent cases and deaths should be reported to WHO.

For these diseases the report from the health professional to the next higher administrative level is done by a rapid method such as phone, e-mail, fax or telex.

Although all cases and deaths from yellow fever, plague and cholera should theoretically be reported to WHO, this does not always happen in practice. In many instances, countries are unwilling to notify WHO because of the fear of economic and political consequences, such as the loss of tourism and trade, and the imposition of travel restrictions. This causes underreporting and reporting delays.

² The International Health Regulations are currently undergoing substantive revision.

Therefore reported data for the diseases covered by the International Health Regulations need to be interpreted with caution.

For diseases not subject to the International Health Regulations, national reporting practices and laws vary across countries. For infectious diseases with potentially high case fatality rates which can spread rapidly (such as meningococcal disease), most countries require rapid reports of the first occurrences of suspect cases. For other diseases, such as pneumonia or AIDS, weekly, monthly, or quarterly case reports are done. Not all infectious diseases are routinely reported, as reporting every infectious disease would place an undue burden on health services.

Some countries have sentinel sites that report more frequently and sometimes on more diseases than the routine reporting system. If these sites are well chosen, they can provide a wealth of information in a timely way – something that would be impossible to expect of all primary health care centres. The disadvantage of relying on sentinel sites alone is that they may not necessarily be representative of the country as a whole.

With the exception of the International Health Regulations which are determined internationally, reporting requirements for infectious diseases are nationally or sub-nationally determined. For example, a disease like leishmaniasis is notifiable in some high risk countries but not in all. Even within countries there may be important differences. For example, reporting of HIV is required in some states in the United States of America but not in others.

As a result there are differences from country to country, and even within countries in how the reporting of each disease is carried out. This makes sense because each country faces a different set of disease related circumstances. However, it does introduce an element of non-comparability into global disease surveillance systems, since information on the same disease is collected in a somewhat different way depending on the country. This must be kept in mind in the analysis of global surveillance data.

Six of the nine diseases in this report depend heavily on reported numbers of cases and/or reported numbers of deaths to track the disease in terms of person, place and time. These include cholera, plague, yellow fever, meningococcal disease, dengue, and leishmaniasis (including leishmaniasis/HIV co-infection).

WHO headquarters maintains disease specific global data bases including the reported numbers of cases and deaths for each country by year. During analysis and interpretation, these data are often supplemented by additional information, and scientific studies. For example, in many instances scientific studies indicate that disease transmission has taken place in a particular country, even though there have been no reported cases. In general, WHO data are adequate to present a broad reflection of disease and mortality trends as is done in this report. More disaggregated data are usually needed for more in-depth analyses.

Surveillance of disease strains

Detection and reporting of disease strains is very important for all infectious diseases, since new strains have the potential to cause new epidemics and pandemics. For some diseases, such as influenza, new strains occur frequently. For influenza a major component of surveillance is to track circulating virus strains, which is key for the development of appropriate influenza vaccines each year. Dengue is another disease where particular importance is given to keeping track of circulating virus strains to assess the potential for outbreaks of dengue haemorrhagic fever.

Surveillance of strains relies on laboratory reports both for the confirmation of clinical diagnoses, and for the assessment of antimicrobial resistance. Good surveillance requires strong laboratory facilities, appropriate resources both human and financial, access to necessary reagents, and strong quality control. Currently, laboratories in many developing countries, particularly in Africa, are not functioning well enough to meet surveillance needs. WHO is making considerable strides in rebuilding infectious disease laboratory capacity in developing countries. In addition, WHO Collaborating Centres and reference

laboratories provide international support for such tasks as identifying outbreaks, and identifying problem specimens.

Population screening

Screening the population for communicable diseases is not often done because it is expensive and potentially invasive of privacy. Sleeping sickness (in particular, gambiense sleeping sickness) is one of the few diseases that uses systematic population screening to find cases. All those who screen positive are referred to treatment centres, where they are re-tested and treated if infected. The certain fatality of untreated sleeping sickness, and the impracticality of other methods of surveillance and control, makes systematic screening of populations living in high-risk areas imperative.

Surveillance of HIV/AIDS

HIV/AIDS surveillance differs from surveillance of other diseases in many ways reflecting transmission patterns, the long latency period, the lack of affordable treatment and cure, high case fatality rates, and the social stigma associated with HIV infection. HIV/AIDS surveillance can be carried out in different and complementary ways. The first surveillance data collected were reported AIDS cases. This was the easiest data to collect, and had the advantage of raising awareness of countries about the disease. In developed countries, AIDS cases were also used for calculating the past prevalence of HIV infection. These data can be detailed enough to provide breakdowns by age, sex and probable mode of transmission. However, because of the long latency period, during which HIV infection is basically asymptomatic, reported AIDS cases reflect infection that occurred many years ago and are not appropriate for tracking current infections. HIV/AIDS surveillance also poses a number of special ethical problems arising mainly from the stigma and discrimination attached to AIDS, and the lack of access of most infected people to treatment. Therefore, unique methods for estimating current prevalence rates have been developed, which involve unlinked anonymous testing. Finally, HIV/AIDS surveillance includes behavioural surveillance, in order to understand trends in behavioural risk factors for HIV.

Modern times, rapid change – how this impacts on infectious diseases

Rapid change is one of the hallmarks of current times. This includes rapidly changing environments for microbes as well as humans. For example, there has been unprecedented population growth, accompanied by rapid, unplanned urbanization. This has resulted in large increases in urban slums without adequate water and waste management. In addition many of the people living in slums are migrants from rural areas, with little immunity to urban diseases. These changes create an excellent environment for communicable diseases to flourish. For example, rapid urbanization combined with lack of vector control (or in the case of South America the cessation of vector control), has led to increased spread of *Aedes aegypti* mosquitos and consequently increased risk of both dengue and yellow fever epidemics.

The aeroplane is another hallmark of modern times. Air travel has become common place, and fast. The result is increased potential for rapid dispersion of infectious diseases to new environments. Other factors of the modern age that have increased the threat from communicable diseases include changes in land use and agriculture, and increased encroachment of people on forest and woodlands areas.

Civil unrest and war contribute to the spread of infectious disease. During wars, troops and equipment as well as displaced persons are constantly moving from one place to another, carrying with them infectious disease organisms and vectors. This is coupled with destruction of the physical and often economic infrastructure of the area. For example, dengue increased in South-East Asia during the Second World War and the immediate post-war period, due to the spread of mosquitos and different virus strains throughout the region. Wars have also been very important in the spread of plague. The deforestation associated with the Viet Nam War in the 1970s, coupled with the collapse of the local

infrastructure, is considered to be the cause of a large epidemic of plague during the 1970s and early 1980s.

Wars also spur widespread mass migrations. Migrants may have no immunity to diseases endemic in the new area; in addition, they may bring with them diseases that are common in their former home but which are not endemic in the new area. Migrants are stressed, often physically and emotionally. This combination of conditions especially in crowded makeshift refugee camps may lead to disease epidemics, such as the cholera epidemic in Goma, Democratic Republic of the Congo, which killed thousands of people in a short period of time during 1994.

Natural disasters, such as earthquakes and flooding often create conditions that are favourable to outbreaks of communicable disease. For example, in 1997, heavy rain and floods in the Horn of Africa were followed by outbreaks of cholera. In 1998 in Central America, unusual weather patterns, including hurricane Mitch were followed by a resurgence of cholera. The 1994 outbreak of plague in Surat, India was preceded by flooding.

On the positive side, there have been tremendous strides in the control and elimination of some communicable diseases especially for vaccine preventable diseases. Smallpox has been eradicated from the world, and major efforts are being made towards the eradication of polio. In many countries, living conditions have improved substantially with associated health benefits. There have also been considerable gains in life expectancy, especially in under-five mortality rates. Scientific knowledge about the disease process has advanced markedly in recent years, especially in areas such as molecular biology.

Contents of disease specific chapters

Each of the following chapters discusses the global surveillance of a particular epidemic infectious disease. It begins with a background of the disease, providing a brief history of the disease, a short description of the transmission process, clinical features, and other characteristics of the disease that are important for surveillance. The available surveillance data are then described, as well as the strengths and weaknesses of the surveillance system. This discussion is followed by a summary of disease trends based on the available surveillance data and a concluding section. A list of references and detailed data tables are provided at the end of each chapter.

Conclusions

1. WHO has long-term data on many epidemic infectious diseases. WHO also has the mandate to lead and coordinate the international effort in global surveillance and response.
2. The data collected serve many purposes. First, the data are used to alert health officials when there is an epidemic of infectious disease. For diseases that spread rapidly, and that have high case fatality rates if left untreated, timeliness is of utmost important. Since the data are collected over a long period of time, they can also be used to provide a general picture of long-term trends in incidence and case fatality rates.
3. The data have many weaknesses. Countries are hesitant to report diseases covered by the International Health Regulations, in part for fear of economic consequences, and its effects on tourism and trade. In addition, for many diseases there is gross underreporting, under diagnosis, and delayed reporting. The quality of reporting varies considerably from country to country. Finally, international data are not completely comparable as reporting systems, case definitions, and the quality and availability of laboratory facilities vary from country to country.
4. Despite these caveats, WHO data can provide a global picture of trends in epidemic infectious disease and case fatality rates over a relatively long period of time.

Table 1.1 Types of surveillance and their strengths and weaknesses for nine epidemic infectious diseases

Disease	Years covered		Type of surveillance	Reporting frequency	Strengths and weaknesses of reporting system
Cholera	1970	1998	Passive reporting of cases and deaths	As soon as possible for first suspected case ²	<p>Cholera is subject to the International Health Regulations, as with other such diseases, there is reluctance to report outbreaks because of a feared loss of tourism, and trade or travel restrictions</p> <p>Often cholera is reported to WHO as acute watery diarrhoea in order to avoid the perceived negative consequences of reporting cholera</p>
African trypanosomiasis	1902	1998	Active case-finding by systematic population screening in high risk areas	Continually	<p>Currently only three to four million of the 60 million people at risk of sleeping sickness are under surveillance (either under active population screening programmes or living within the catchment areas of treatment services). This means that the reported number of cases is far below the actual number of cases</p>
Meningococcal disease	1966	1999	Passive reporting of cases and deaths	As soon as possible for first suspected case	<p>Because of the long epidemic cycles of meningitis, it is important to have a relatively long time series to be able to monitor major trends. WHO has national data for over 30 years, which is adequate for monitoring broad trends</p> <p>Weekly reporting of cases during the meningitis season in African meningitis belt countries has been put in place to facilitate the procurement and distribution of adequate supplies of vaccines. This has been working well, providing much more detailed and more comparable data than previously available for these countries</p>

Table 1.1 Types of surveillance and their strengths and weaknesses for nine epidemic infectious diseases

Disease	Years covered		Type of surveillance	Reporting frequency	Strengths and weaknesses of reporting system
Dengue	1955	1998	Passive reporting of cases and deaths	Routine reporting	<p>Dengue surveillance is difficult to set up and maintain. Dengue fever (DF) is difficult to recognize clinically because it has non-specific symptoms</p> <p>Diagnosis of DF cannot be done on clinical judgement alone. There is a lack of adequate laboratory infrastructure for dengue surveillance</p> <p>Data from Africa are missing from the global database</p> <p>A web-based system of reporting is under development that would allow the collection of more complete data</p>
Influenza	1947	2000	Reporting of strains of influenza from isolates	Weekly	<p>The surveillance system for influenza is a long-running, well-functioning, laboratory-based system, used as the basis for the composition of influenza vaccine</p> <p>It has been expanding in recent years, and there are now separate recommendations for composition of the northern and southern hemisphere vaccines. Further expansion is necessary, especially in parts of Asia and Africa where there is little or no coverage by the WHO network of national influenza centres</p> <p>A web-based reporting system known as 'FluNet' has been established, which has greatly facilitated the reporting of outbreaks and isolates</p>

Table 1.1 Types of surveillance and their strengths and weaknesses for nine epidemic infectious diseases

Disease	Years covered		Type of surveillance	Reporting frequency	Strengths and weaknesses of reporting system
HIV/AIDS	1981	1999	Passive reporting of AIDS cases Reports of sero-positivity for HIV from unlinked anonymous testing of women in antenatal clinics and other population subgroups Behavioural surveillance	Annually Annually Ad hoc reports	The spread of HIV and the development of the AIDS pandemic are being closely monitored worldwide. For most purposes precise data are not needed, as long as the general trends and the range or order of magnitude of the existing infection can be measured
Leishmaniasis Leishmania/ HIV coinfection	1997	1999	Passive reporting of cases	Annually	Global surveillance of leishmaniasis is very weak. Data are not systematically reported to WHO There is a new surveillance system for monitoring leishmaniasis/HIV co-infection. This system is expanding, although currently most of the centres are in southern Europe The surveillance system is beginning to document the extent of the co-infection problem in the catchment areas of network centres

¹Passive reporting is the reporting of cases that come to health services for treatment.

²Yellow fever, plague and cholera are subject to the International Health Regulations.