Clinicians are key players in controlling the spread of infectious disease. They are typically the first to see new cases of a disease that could indicate the beginning of an epidemic. They must report these to public health authorities. At times, they are called upon to collaborate with infection control or with public health teams in order to ensure good control practices and to arrest outbreaks of infectious disease. Clinicians are also in a position to recognise changing patterns of non-infectious disease, for example an unusually high number of injuries that may be associated with a change in the built environment. In these cases, clinicians can also play a role in identifying and managing the situation, although the process for doing so may not be as clearly defined as the process of control and management of infectious diseases. Finally, clinicians must be aware that they themselves or the equipment they use can transmit infection to their patients and must take steps to prevent this.

After reading this chapter, you will be able to:

- *Know the defining characteristics of an outbreak and how to recognize one when it occurs;*
- *Demonstrate essential skills involved in controlling an outbreak and its impact on the public, in collaboration with public health authorities as appropriate;*
- *Define an outbreak in terms of an excess of cases, beyond the number usually expected;*
- *Describe and understand the main steps in outbreak management and prevention;*
- *Demonstrate skills in effective outbreak management including infection control when the outbreak is due to an infectious agent;*
- *Describe the different types of infection control practices and justify which type is most appropriately implemented for different outbreak conditions; and*
- *Describe appropriate approaches to prevent or reduce the risk of the outbreak recurring:*
  - *Understand surveillance systems and the role of physicians and public health in reporting and responding to disease.*

see Case Study: Dr. Rao received a phone call

11.1 Detection and Control of Outbreaks

Clinicians are often in the best position to recognize an outbreak of disease; sometimes they see an unusually high number of people with the same disease and at other times patients report that they know other people with similar symptoms. Even if the clinician does not suspect an outbreak, his reporting contributes to the detection of outbreaks. Filling in discharge summaries and death certificates, and reporting cases of notifiable disease all contribute to health surveillance.

Ensuring that the forms are completed accurately and transferred in a timely fashion makes a major contribution to outbreak detection and general health surveillance.

Depending on the type of organism involved, the conditions of spread and the target population, outbreaks can be acute and fast-moving, such as gastroenteritis in a nursery school or long-term care home, or they can evolve more slowly, such as the AIDS pandemic. While public health authorities are ultimately responsible for ensuring the detection and control of outbreaks, clinicians are major players in this area because they are usually the first point of contact with the affected population. Likewise, hospital infection control teams rely on the cooperation of clinicians in preventing infections. The basic steps in outbreak control and management are:

1. Establish the existence of an outbreak
2. Define what constitutes a case and identify cases as they occur
3. Formulate hypotheses on the causes, and implement initial control measures
4. Test the hypotheses through analysis of surveillance data or special studies
5. Draw conclusions and re-adjust hypotheses and control measures if needed
6. Plan for long-term prevention and control.

Stage 1: Establishing the existence of an outbreak

Is it an outbreak?

It is important to identify an outbreak quickly so that it can be addressed before it develops into a full epidemic. However, there is no hard-and-fast rule for defining an outbreak. A cluster of cases could be due to chance or could form the beginning of an outbreak. This is especially true of rare diseases and diseases in small populations, where an absolute increase of a very small number of cases could represent a large relative increase in an illness in the population. For instance, in a community where there are usually two cases of a given disease in one month, four cases in one month (relative increase of 100%, absolute increase of 2 cases) may or may not constitute an outbreak. In such instances, it can be very difficult to decide how much time and money to spend on investigating something that might be just a chance occurrence. Consultation with epidemiologists or statisticians may be required, but the statistical techniques for assessing the influence of chance in disease clusters are still in development.

Furthermore, there may be biases in documenting an outbreak. When a possible outbreak is suspected, more cases of the illness than usual may be reported. Patients who are worried about the illness may be more sensitive than usual to their symptoms and may seek care (and hence their case gets reported) when they would not normally do so. Clinicians may be more assiduous than usual about requesting laboratory tests and reporting cases. In addition, case-finding or active

surveillance by public health workers will uncover cases which would not ordinarily have been identified.

see Definition: Endemic-Cluster-Outbreak-Epidemic-Pandemic

Great care is needed in deciding whether or not to declare an epidemic: balancing the value of alerting agencies to the need for control measures against possible concerns over causing public panic. National and regional public health agencies are responsible for these decisions. A pandemic can only be declared after careful evaluation by the WHO, which may issue travel advisories and, again, such announcements are taken only after serious consideration because of their potential impact on the economy of regions affected. Just as a local outbreak runs a natural course (see Chapter 7), so does a pandemic and the WHO has proposed a sequence of stages shown in Figure 11.1:

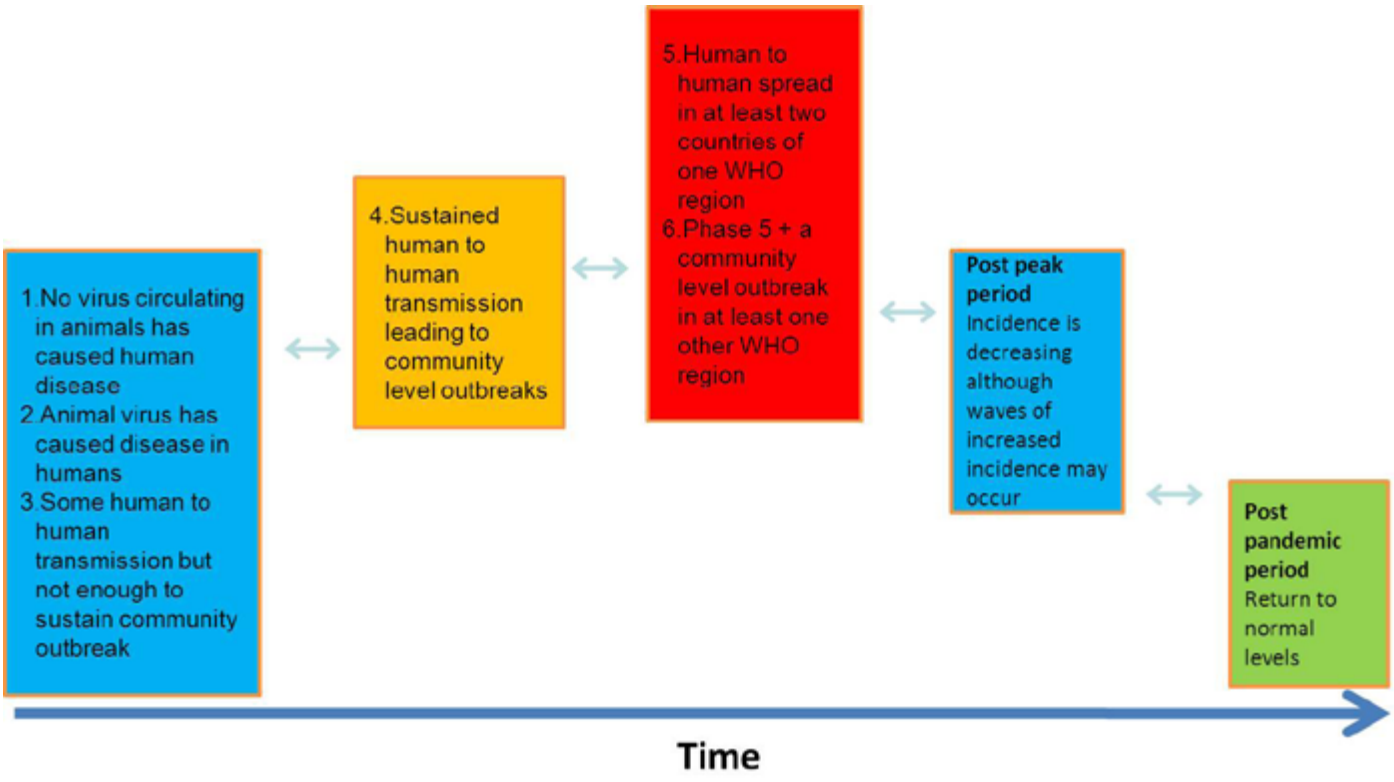

Figure 11.1: World Health Organization levels of pandemic

(Source: www.who.int/)

Infectious disease epidemics can result from:[3]

1. *Increased virulence of the infecting organism*. Micro-organisms have a number of mechanisms to alter their virulence. For example, Corynebacterium diphtheria must be infected with a specific bacteriophage in order to produce the diphtheria toxin that causes diphtheria. Plasmid exchange can confer antibiotic resistance in previously susceptible bacteria. Another example is the virulence of the influenza virus, which varies with its genetic drifts and shifts.

2. *Recent introduction of the organism into new setting.* Europeans introduced measles and smallpox to the Americas, where they swiftly decimated the local populations who had no immunity to them. The two diseases were among the causes of the decline of the Aztec empire. More recently, the severity of the 2002-03 North American epidemic of West Nile virus may have been in part due to the lack of immunity of the host birds in the region, as well as the lack of immunity of the human population (see Figure 11.2, Nerd's corner).

see Nerd's Corner: West Nile Virus in North America

3. *Enhanced transmission so that more susceptible people are exposed.* Troop movements and population upheavals during the 1914-1918 war brought many more people than usual into close contact with one another. This enhanced the transmission of the influenza virus that caused the 1918 pandemic.

4. *Change in host susceptibility.* People with HIV infection are particularly susceptible to tuberculosis. The high incidence of tuberculosis world-wide is, in part, due to the HIV epidemic causing a rise in the number of susceptible people.

5. *New portals of entry or increased exposure.* Technical developments in health care that require invasive instrumentation have contributed to the rise in nosocomial infections.

see Illustrative Materials: Walkerton, Ontario[5]

Stage 2: Define and identify cases

A crucial early step in investigating a possible outbreak is to define what constitutes a case, as the case definition will be used in the search for more cases, who will then be questioned about their exposures. The case definition describes precisely the symptoms, signs, history, or test results that indicate a probable case of disease. Clinicians may be asked to help in the search to uncover all cases, and they may also have valuable information linking the cases, which can suggest a possible cause. Because of biological variation, the presenting symptoms and signs for cases of any illness vary. The case definition should neither be too broad nor too narrow. In an outbreak of gastro-enteritis, for instance, some people may only have mild abdominal cramps, whereas others have diarrhoea and vomiting, with or without fever, muscle pain, headache, and dehydration, etc. If the case definition includes people with any one of the full range of symptoms (fever, or muscle pain, or headache, etc), it will be broad enough to include a large proportion of the population, many of whose symptoms may be unrelated to the outbreak under investigation. Conversely, if

only a narrow case definition is used (fever and muscle pain, and headache), it may exclude many cases, hence underestimating the extent of the outbreak and possibly delaying the implementation of extended control measures. If there are indications of a common exposure, for instance if a large proportion of the initial cases say they ate at the same restaurant, the common exposure can be included as a criterion in the case definition to specify the cases involved and the investigation could focus on identifying the particular foodstuff at the root of the problem.

see Links: Sensitivity and specificity

see Definition: Case definition

Stage 3: Formulate hypotheses and implement initial control measures

Using the information gathered in the initial steps of the investigation, public health professionals describe the epidemic in time, place, and person. An outbreak progresses, they may draw an epidemic curve to track its evolution in time (see epidemic curves in Chapter 7). They describe in detail the circumstances of the outbreak and the demographic characteristics of the people affected. Thus, the patterns described usually indicate the likely source of the outbreak and the population at high risk. This is generally sufficient to suggest some initial control measures.

Management of cases

In general, cases in an outbreak are managed by their usual physicians unless the size of the outbreak justifies setting up special clinics. One role of public health officials is to keep the clinicians and the public informed of control procedures. Routine precautions are recommended to reduce the risk of transmission via contact with asymptomatic patients or contaminated environmental sources. Appropriate precautions to address contact, droplet, or airborne transmission are implemented according to the clinical picture and presumed modes of transmission.

Table 11.1: Typical precautionary measures according to route of transmission (recommendations vary according to the organism involved).

Type of transmission	Precautionary measures
Routine:	Hand washing, barrier precautions: gloves and gowns if spread is via contact or contamination, masks and eye protection if splash or spray
Contact spread:	Gowns, gloves for direct patient care; dedicated equipment; hand washing
Droplet:	Surgical mask, eye protection or face shields
Airborne:	Negative pressure ventilation (like a laboratory fume hood, air is sucked into the patient's room and then vented outside, rather than flowing from the room into the corridor and other rooms), isolation, N95 respirators, gowns, gloves, protective eye wear for procedures.

Population management

The public health service is responsible for managing outbreaks in the community; in hospitals, the infection control team is responsible. Clinicians are often called upon to collaborate in the management. People at risk from the outbreak that is, those exposed or likely to be exposed to the probable source are identified. People at risk need

- *Information about their risk and how to reduce it.* For instance, forestry workers should use adequate clothing and know the symptoms of Lyme Disease so they seek treatment early
- *Personal preventive measures.* For instance, close contacts of meningococcal meningitis should have antibiotic prophylaxis; health care workers may need HIV prophylaxis after a needlestick injury; contacts of people with a disease for which there is a vaccine could be immunized; sexual partners of people with sexually transmitted infections may require treatment
- *Reducing the risk of propagation.* For instance, this can be done by putting asymptomatic contacts into quarantine for the duration of the disease's incubation period, or by asking people to "cough into your sleeve" during the flu season. Adequate treatment of the infection also reduces transmission.

see Illustrative Materials: An outbreak of mumps in the Maritimes

Stage 4: Test hypotheses through analysis of surveillance data or special studies

Once there is a hypothesis about the cause of the outbreak, it should be tested. If removing the suspected source is followed by a decline in the outbreak, the hypothesis may be correct, although the decline could still be serendipitous. Cross-sectional studies can be carried out in the case of food-borne outbreaks in a limited population. For instance, in the case of an outbreak associated with a social gathering, guests can be asked about symptoms and about foods eaten to identify particular foods that are likely to have been contaminated. Case-control studies may also be necessary, and clinicians may be required to contribute in case-finding or by providing data on their patients.

see Illustrative Materials: The Broad Street Pump

Stage 5: Draw conclusions and re-adjust hypothesis and control measures

Once the cause of the outbreak has been confirmed, the initial control measures may need to be adjusted. If the source cannot be identified, more epidemiological detective work may be required. Based on the results of the outbreak investigation, it may also be possible to recommend action to prevent future similar outbreaks.

Stage 6: Plan for long-term prevention and control

Outbreak investigations should be designed to indicate the possible long-term preventive actions and ways of improving response to future similar outbreaks. When available and safe, active immunization is a very successful way of preventing outbreaks of infectious disease. As long as the vaccine provides lasting immunity, the person remains protected, at least to some degree. Vaccines have created an opportunity for eradication of disease. Smallpox, a virulent and once common illness that afflicted humans for centuries, was eradicated in 1977. Currently, the World Health Organization is working to eradicate polio, which, in 2010, is endemic in only four countries, although still appears in epidemic form in twenty-three.

see Links: Immunisation

Other measures for long-term control may also be needed. The 2008 outbreak of listeriosis in Canada resulted in discussions about legislative control on food manufacturers. In the case of the water borne illnesses in the Kashechewan First Nations community, recommendations to prevent further problems included upgrading the water treatment plant as well as the water treatment processes, training of personnel, and improved procedures if water quality does not meet the set standards.

11.2 Transmission of Infectious Disease

Knowledge of the natural history of infectious disease is important in controlling its transmission. Contacts of a case should be monitored for the duration of the incubation period of the disease. It might be necessary to isolate cases and quarantine contacts for the period of communicability. Other ways of preventing transmission can be identified using the agent-host-environment model described in Chapter 2:

Agent

1. Destruction or weakening of the agent outside the body (e.g., by cleansers, incineration)

2. Destruction or weakening of the agent inside the body (e.g., use of appropriate antibiotic or antiviral for an appropriate length of time)

Host

1. Physical barriers (e.g., masks, long trousers when hiking in regions that have Lyme Disease)

2. Decrease opportunity for transmission (e.g., by isolating infective cases, quarantine of contacts, coughing into one's sleeve, prompt adequate treatment of cases)

3. Increase specific resistance (e.g., immunization, prophylaxis)

4. Increase general resistance (e.g., nutrition, exercise)