Chapter 9: Monitoring, surveillance, and investigation of health threats

**SUMMARY POINTS**

- Monitoring, surveillance and investigation of health threats are vital capabilities for an effective health system. The International Health Regulations (2005) require countries to maintain an integrated, national system for public health surveillance and response, and set out the core capabilities that countries are required to achieve.

- Systematic monitoring of serious infectious diseases and other conditions is typically achieved through notifiable diseases legislation based on clinical observation and laboratory confirmation. Clinical and laboratory-based surveillance also provides the basis for systematic collection of vital statistics (births, deaths, causes of death), and may extend to the reporting and analysis of risk factors for noncommunicable diseases and injuries. Systematic collection of these data informs the allocation of resources and facilitates evaluation of community-based and population-level prevention strategies.

- Clinical and laboratory surveillance are passive systems that may be enhanced by sentinel surveillance and/or community-based surveillance strategies that rely on a wider range of people, including non-medical personnel. Suspected cases identified in this way must be treated with respect, protected from discrimination, with diagnosis confirmed by qualified health workers at the earliest opportunity.

- A significant degree of stigma may attach to some diseases, such as HIV, sexually transmitted infections and diabetes. Notifiable diseases legislation should require the protection of personal information, and clearly define any exceptions. Concerns about discrimination and breach of privacy may be addressed by requiring certain diseases to be reported on an anonymous or de-identified basis.

- In some countries, legislation or regulations may be used to establish or enhance a comprehensive public health surveillance system. In federal systems, intergovernmental agreements, federal grants and conditional funding agreements may be useful strategies for achieving an integrated system where public health surveillance is, in practice, coordinated at the regional (state or provincial) level.

- The cases of disease or harm captured by effective surveillance systems may reflect a wide variety of public health hazards. Countries may find it useful to establish an intersectoral committee to consider whether existing legislation, regulations and other instruments are adequate to ensure a rapid and effective public health response and to fulfil the obligations set out in the International Health Regulations (2005).

Surveillance and monitoring are critical components of a well-functioning public health system. Public health professionals use surveillance to assist them in performing many of their key functions. These include monitoring, vector control, responding to outbreaks of infectious disease, identifying the source of foodborne illnesses, ensuring the safety of drinking water and national blood supplies,
and tracking modifiable risk factors for noncommunicable diseases in order to develop and evaluate preventive policies.

Public health laws support effective surveillance systems by identifying the diseases and conditions for which reporting is required and designating the persons to whom these reporting requirements apply – with sufficient flexibility so that these requirements can be applied rapidly to emerging diseases and conditions when appropriate. Factors that affect the design of surveillance laws include the purpose of notification requirements, the frequency and severity of disease incidence, the reliability of the diagnosis, and the need for a rapid response. This section briefly identifies different kinds of surveillance strategies, and gives examples of how public health law can establish and maintain these systems. The collection of health information that identifies individuals carries the risk of discrimination and loss of privacy. The management of these risks, through legal requirements to maintain the security, privacy, and confidentiality of personal information, and through legal protection from discrimination, provide the foundation for effective control of communicable diseases. This is discussed further in Chapter 10.

9.1 Clinical and laboratory-based surveillance

A critical function of clinical surveillance is to provide early warning of disease outbreaks that require rapid response at the regional, national or international level. On the front line of surveillance systems are health care providers, who examine patients and diagnose diseases based on signs and symptoms, with or without assistance from laboratory-based tests, rapid test kits or other diagnostic aids.

Public health laws typically establish a list of “notifiable diseases” and other conditions that health care providers, hospitals and/or laboratories are required to report to the relevant local or national public health authority. Notifiable diseases generally include infectious diseases that can quickly spread throughout communities and regions via water, food, contact with animals, mosquitoes, airborne droplets, or through sexual contact and other forms of human interaction. Examples of notifiable diseases include diseases preventable by vaccination (e.g. influenza, hepatitis B), sexually transmitted diseases (e.g. HIV, herpes), nosocomial infections (e.g. methicillin-resistant *Staphylococcus aureus* (MRSA)), foodborne illnesses (e.g. botulism), waterborne diseases (e.g. cholera), contagious diseases caused by airborne particles (e.g. tuberculosis), and diseases transmitted by vectors or parasites (e.g. rabies, malaria). The list of notifiable diseases mandated by legislation may vary over time, according to a country’s stage of development and the capacity of its health workforce. In some countries, risk factors for noncommunicable diseases may also become notifiable (Box 9.1).
Box 9.1: Mandatory reporting of noncommunicable disease risk factors: an example from New York City

The surveillance of noncommunicable diseases and their risk factors tends to occur through community-based or voluntary clinical reporting systems, rather than through formal, legislative notification systems. In appropriate circumstances, however, the mandatory reporting of risk factors for noncommunicable diseases may assist in identifying cases and ensuring that affected individuals are offered treatment to prevent the progression of disease. For example, in 2006, New York City expanded notifiable disease reporting obligations to include haemoglobin A1c (glycated haemoglobin), in order to create a registry to map the epidemiology of hyperglycaemia and to identify and offer treatment to the estimated one in three diabetics who are unaware of their disease.

Effective surveillance systems must respond rapidly to cases of emerging epidemic diseases and ensure that they are identified and reported to authorities. Legislative drafters can facilitate this by ensuring that notifiable diseases and other conditions to which reporting obligations apply are included in the schedules or appendices of legislation, or that these can be updated rapidly by executive action. In the early stages of a new epidemic, confirmatory laboratory tests may be unavailable and the best available case definition may be both complex and nonspecific.

In addition to detecting disease outbreaks, clinical surveillance systems perform an epidemiological surveillance function by capturing vital statistics (births, deaths, causes of death), and by monitoring the incidence of other reportable conditions over time, such as perinatal deaths, deaths from specified diseases (e.g. cancer, malaria) and deaths from preventable causes (e.g. burns, drownings, road traffic injuries). Longitudinal surveillance performs a vital role in public health, informing the allocation of resources and facilitating the evaluation of community-based and population-level prevention strategies. In some cases, public health laws may require notification to be made to particular hospitals or other centres of excellence that lead national surveillance and research efforts and host disease-specific registers. Disease registers may record diagnosis, clinical data and outcomes data that facilitate the evaluation and improvement of diagnostic strategies and clinical treatments.

One limitation of clinical surveillance systems is that they are passive systems that only identify cases when patients seek medical assistance or come into contact with the health care system. In countries where large numbers of people lack affordable access to health care services, clinical surveillance systems may underestimate the burden of disease, while also failing to achieve their primary goal of identifying disease outbreaks. The goal of achieving universal access to health services therefore supports efforts to improve clinical surveillance capabilities. One legal strategy for improving surveillance capability in low-resource settings is to impose reporting requirements for suspected cases of epidemic diseases on a wider range of people, including school principals, employers, and village chiefs (Box 9.2). Care should be taken to ensure that suspected cases are treated with dignity, that confidentiality is respected, and that the diagnosis of suspected cases is reviewed by qualified health care workers at the earliest opportunity.
Box 9.2: Improving the front line diagnosis of acutely infectious diseases: an example from Zimbabwe

Public Health Act (Ch 15:09)³

Zimbabwe’s Public Health Act provides that the Minister may, by statutory instrument, declare a disease to be a “formidable epidemic disease” for the purposes of the Act. Section 27 of the Act provides that:

Medical practitioners, principals of schools, heads of families or householders, employers of labour, owners or occupiers of land or premises, chiefs, headmen and others shall report to the local authority or district administrator, as the case may be, the occurrence of any case of illness or death coming to their notice and suspected to be due to any formidable epidemic disease, or with a history of presenting symptoms or post-mortem appearances which might reasonably give grounds for such suspicion.

Where available, laboratory confirmation of clinical diagnoses is important to improve the accuracy of surveillance systems. Public health laws typically impose reporting requirements on laboratories in order to confirm clinical diagnoses, or in circumstances where accurate diagnosis requires laboratory investigations. In higher-income countries, legislation may apply the same compulsory notification requirements to laboratories as to physicians; however, this may not be a cost-effective use of limited laboratory resources in lower-income countries. In cases where both clinical and laboratory reporting obligations are imposed, accurate patient identification will be necessary to avoid double counting.

A significant degree of stigma may attach to some diseases, including HIV, sexually transmitted infections, and diabetes. Diagnosis may carry the risk of discrimination, especially when there is weak protection for privacy and confidentiality. Notifiable diseases legislation should require the protection of personal information, and clearly define any exceptions. In order to reduce disincentives for testing, and to improve compliance with treatment regimes, legislation may also require the reporting of certain diseases to health authorities on an anonymous or de-identified basis. This approach may enhance rates of testing among vulnerable groups, including sex workers, injecting drug users, ethnic minorities, and, in some cases, women.

9.2 Sentinel surveillance

Sentinel surveillance provides public health authorities with data on the prevalence of a disease in a particular area or among a particular subgroup. For example, carefully chosen sentinel sites may provide early warning of disease outbreaks as well as prospective monitoring of rates of infectious disease or other health conditions, such as child malnutrition.⁴ Like other passive surveillance strategies, sentinel surveillance only provides authorities with approximate figures, but may be a critical component of an early warning system that triggers an urgent response to public health events of national significance.
9.3 Community-based surveillance and investigations

Since clinical and laboratory-based surveillance is passive (identifying cases of disease only among those who present for treatment), it must be complemented by strategies to identify missing cases, confirm diagnoses and investigate outbreaks within community settings. Rare and new events may not be included in regular, clinical and laboratory-based surveillance systems. In addition, outbreaks of serious or contagious diseases require immediate investigation so that appropriate public health measures (e.g. isolation, contact tracing) can be implemented.5

As illustrated in Box 9.2, community-based surveillance may rely on non-medical personnel to identify potential outbreaks. These may include other health care workers, community groups, community services (e.g. schools, police, and religious organizations) as well as the media. In developing a reporting strategy, governments will need to identify the appropriate balance between sensitivity (identifying all important events), and sustainability (maintaining the reporting capability without undermining other public health functions).6 Since it may have a higher error rate than other types of surveillance, community surveillance is best used where symptoms are easily recognizable and likely to clearly identify a given disease. Governments should ensure that event assessment teams responding to community reports have appropriate powers to carry out event-based surveillance in community settings, and where necessary, to implement public health measures urgently (see Chapter 11).

9.4 Comprehensive surveillance systems

Laws that establish surveillance systems may enable different kinds of surveillance strategies to be implemented simultaneously. This may help to overcome the limitations of each strategy and provide a clearer picture of the burden of disease and the extent of disease spread. For example, Argentina’s Resolution no. 1715/2007, enacted in order to bring its national surveillance capabilities into conformity with the International Health Regulations (2005) (IHR), authorizes and explains the case for each surveillance strategy (Box 9.3). Comprehensive surveillance systems that combine multiple strategies will require coordination between local, regional and national health authorities. For example, clinician and laboratory reporting of a serious outbreak must trigger national – and, following notification to WHO – international response systems to minimize the spread of disease. The surveillance capabilities required at local, regional and national levels are not purely matters of domestic policy but are prescribed in the IHR.7

Box 9.3: Different surveillance strategies used to track and investigate notifiable events

Resolution 1715/2007 of the Ministry of Health of Argentina, on rules for the surveillance and control of diseases or events subject to compulsory notification8

3. Surveillance strategies for events subject to compulsory notification. Different strategies will be used to monitor notifiable diseases, including multiple strategies for the same event. They are:

3-1. Clinical surveillance: shall be universal. Cases are notified on the suspicion of the treating
physician, based on the corresponding definition of a suspect case. This provides the system with sensitivity and timeliness. Suspected cases are confirmed or amended upon laboratory or epidemiologic investigation. Clinical surveillance includes syndromic surveillance, in cases where a number of diseases share similar clinical manifestations.

3-2. Laboratory surveillance: is complementary to clinical surveillance, it provides specificity and supplies diagnoses of etiologic agents, natural reservoirs, and/or vectors. Its main objective is to contribute to knowledge of health events caused by the disease agent, determining the frequency of various microorganisms, their geographical and temporal distributions, and identifying patterns of behaviour of different agents.

3-3. Sentinel surveillance: three variants of this strategy have been implemented within the country: units, physicians, and sentinel groups. The sentinel site strategy is not currently in use.

3-4. Special studies: epidemiological studies are performed periodically to monitor trends in reportable events. These are generally cross-sectional studies of prevalence used to obtain baseline data and then conducted at a particular frequency to track changes in relation to implementation of control measures. Examples include a survey tracking risk factors for noncommunicable diseases, or Chagas seroprevalence in children under 5 years of age (and in other age groups), etc.

9.5 Developing integrated national capabilities for surveillance and response

The IHR\(^5\) require countries to meet a number of “core capacity requirements” for surveillance and response at local, intermediate and national levels (Box 9.4). At the local community or primary public health response level, core capacity requirements include the ability to detect events involving disease or death above expected levels for the particular time and location in all areas within the territory of the country, and to report all available essential information to local community health care institutions or the appropriate health personnel, or to the intermediate or national response level, depending on organizational structures.\(^10\) At the national level, core capacity requirements include assessing all reports of urgent events within 48 hours, and notifying WHO immediately of all events that may constitute a “public health emergency of international concern”, via a national IHR focal point.\(^11\) States Parties to the IHR must also inform WHO within 24 hours of receipt of evidence of a public health risk identified outside their territory that may cause international disease spread, as manifested by human cases, vectors carrying infection or contaminated goods that have been exported or imported by that State Party.\(^12\)

Box 9.4: Core capacity requirements for surveillance and response under the International Health Regulations (2005)\(^13\)

A. Core Capacity Requirements for Surveillance and Response

4. At the local community level and/or primary public health response level

The capacities:
(a) to detect events involving disease or death above expected levels for the particular time and place in all areas within the territory of the State Party; and

(b) to report all available essential information immediately to the appropriate level of healthcare response. At the community level, reporting shall be to local community health-care institutions or the appropriate health personnel. At the primary public health response level, reporting shall be to the intermediate or national response level, depending on organizational structures. For the purposes of this Annex, essential information includes the following: clinical descriptions, laboratory results, sources and type of risk, numbers of human cases and deaths, conditions affecting the spread of the disease and the health measures employed; and

(c) to implement preliminary control measures immediately.

5. At the intermediate public health response levels

The capacities:

(a) to confirm the status of reported events and to support or implement additional control measures; and

(b) to assess reported events immediately and, if found urgent, to report all essential information to the national level. For the purposes of this Annex, the criteria for urgent events include serious public health impact and/or unusual or unexpected nature with high potential for spread.

6. At the national level

**Assessment and notification.** The capacities:

(a) to assess all reports of urgent events within 48 hours; and

(b) to notify WHO immediately through the National IHR Focal Point when the assessment indicates the event is notifiable pursuant to paragraph 1 of Article 6 and Annex 2 and to inform WHO as required pursuant to Article 7 and paragraph 2 of Article 9.

**Public health response.** The capacities:

(a) to determine rapidly the control measures required to prevent domestic and international spread;

(b) to provide support through specialized staff, laboratory analysis of samples (domestically or through collaborating centres) and logistical assistance (e.g. equipment, supplies and transport);

(c) to provide on-site assistance as required to supplement local investigations;

(d) to provide a direct operational link with senior health and other officials to approve rapidly and implement containment and control measures;

(e) to provide direct liaison with other relevant government ministries;

(f) to provide, by the most efficient means of communication available, links with hospitals, clinics, airports, ports, ground crossings, laboratories and other key operational areas for the dissemination of information and recommendations received from WHO regarding events in the State Party’s own territory and in the territories of other States Parties;

(g) to establish, operate and maintain a national public health emergency response plan, including the creation of multidisciplinary/multisectoral teams to respond to events that may constitute a
Ensuring an integrated, national system that meets the core capacity requirements for surveillance and response is an important part of each country’s obligation to fully implement the IHR. Some countries have used legislation or executive orders to establish or to enhance a national public health surveillance system (**Box 9.5**). However, federal countries may need to ensure that the division of regulatory power between national, state and local/city governments does not create impediments to the rapid sharing of information between different levels of government, or to national coordination of surveillance activities throughout the country. Even when federal governments have adequate legislative powers that could be used, intergovernmental agreements may be a more practical way of establishing a national system in countries where public health surveillance is, in practice, coordinated at the regional (state or provincial) level.14

**Box 9.5: Establishing Colombia's public health surveillance system**

In Colombia, the public health surveillance system was established by Presidential decree. The decree identifies the Ministry of Social Protection, departmental, district, and municipal health directorates, and a number of other agencies as the entities that are responsible for the implementation and development of the system, and sets out their respective functions. The functions of the Ministry of Social Protection include analysing information from the surveillance system to identify public health priorities and to guide public health responses.15 The functions of the municipal health directorates include ensuring the infrastructure and human resources required to carry out surveillance at the municipal level, organizing the community in appropriate community-based surveillance activities, identifying cases and contacts and investigating disease outbreaks within the municipal area.16 The functions of reference institutions and entities generating primary data, including laboratories, blood and organ banks, and health service providers, are also set out. The decree establishes a National Intersectoral Commission for Public Health Surveillance to provide high-level guidance to national ministries overseeing the system.17 Public health surveillance committees are also established to assist the health directorates at departmental, district and municipal levels.18

In some countries, the most pressing difficulty is likely to be that surveillance and response capabilities are degraded or non-functioning in particular regions of the country. Options available for federal governments include the provision of financial assistance to strengthen regional surveillance systems, or more generally, the provision of conditional funding. For example, federal grants to regional governments may contain conditions that require the harmonization of regional surveillance systems in order to meet the core capabilities set out in the IHR.19

The cases of disease or harm that are captured by effective surveillance systems may reflect a wide variety of public health hazards. WHO has pointed out that “different public health risks (e.g. infectious disease, food safety, risks of chemical accidents or contamination, radionuclear safety, or animal health issues which may affect humans) are addressed in different laws or regulations, and often by different ministries, departments and governmental levels”.20 For this reason, WHO has
recommended that countries establish an intersectoral committee for legislative assessment that includes representation from all government sectors and, if appropriate, other interest groups affected by the IHR.\textsuperscript{21} The task of such a committee would be to assess whether “existing legislation, regulations and other instruments cover all the subject areas and functions of the IHR (2005)”\textsuperscript{22} For example, identification of cases of a serious foodborne illness (e.g. botulism) through a clinical and laboratory surveillance system should trigger an urgent investigation of the likely source. In turn, this will require public health personnel to have adequate powers to enter food businesses, remove samples, recall products and require the removal of products from sale, temporarily close businesses, and issue public health alerts.

The IHR have a particular focus on the international spread of disease. They therefore require countries to meet core capacity requirements for managing international traffic and responding to potential health risks at designated airports, ports and ground crossings.\textsuperscript{23} WHO has published a toolkit to assist countries to assess their national legislation and regulations against the specific requirements of the IHR.\textsuperscript{24} These matters are discussed further in Chapter 11.

**REFERENCES\textsuperscript{1}**

\textsuperscript{3} Public Health Act (No. 19 of 1924) (as amended) (Zimbabwe).

\textsuperscript{1} All references were accessed on 1 May 2016.


