Chapter 7
Surveillance

Surveillance can be defined as a continuous observation of an entity such as a place person group or activities in order to collect data or information that can be analysed and interpreted to determine an outcome.

Health surveillance is the continuous observation, a strategic and systematic collection, analysis and interpretation of health-related data for public health purposes (Fig. 7.1).

WHO defines surveillance as "continuous systematic collection analysis and interpretation of health-related data needed for the planning Implementation and evaluation of public health practice (WHO|Public health surveillance, n.d.)."

7.1 Types of Surveillance

1. **Active surveillance**; this is a system of surveillance that provides the most accurate and well-timed information. It involves individual staff that regularly contact members of the community and collect information regarding health conditions from the communities and/or healthcare providers (Nsubuga et al. 2006). Active surveillance involves close watch and observation of health conditions, including disease occurrence, deaths and any conditions that are out of the ordinary looking for patterns and linking them to outcomes. Active surveillance requires time and resources. It involves community health workers, working within the communities, supervisors collecting information, managers' supervising and coordinating the process, epidemiologists interpreting the information and healthcare workers in the clinics and hospitals that handle and identify cases. Active surveillance is expensive and is a challenge for most developing countries with limited resources. Active surveillance is essential in early detection of epidemics as an early warning and can be used in epidemic response.
2. **Passive surveillance**; this is the type of surveillance which depends on reports from health institutions including hospitals, clinics, pharmacies and any health

Fig. 7.1 From surveillance to decision-making. Surveillance data provides an early warning system for disease outbreaks can be used to identify trends, contributes to decision-making and scientific research
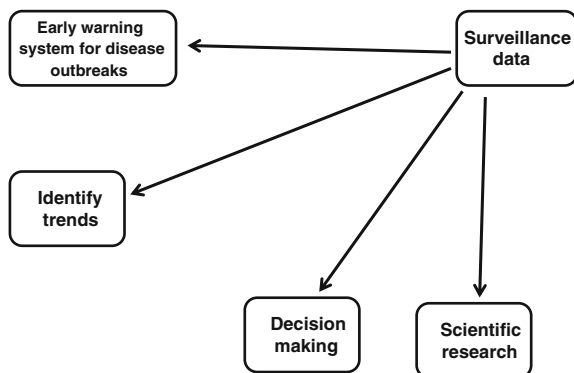
units (Nsubuga et al. 2006). This type of surveillance involves filling in forms by healthcare workers and these forms are collected and the data is analysed. Passive surveillance is relatively inexpensive hence it is widely used. This system of surveillance covers large areas and provides information that can assist in determining the health of communities. Routine health information system which involves regular reports on diseases occurring in health institutions by public health staff and health information management system are also part of passive surveillance (Nsubuga et al. 2006).

3. **Categorical surveillance**; this type of surveillance is focussed on, for example a particular disease or groups of diseases, a particular health condition or a behaviour. It can be active or passive form of surveillance but is very involving as health care workers have to fill in more than one form making it tedious and adding more work. It might not be as efficient at the community and district level (Nsubuga et al. 2006).

4. **Integrated surveillance**; this system gathers information on multiple diseases, using both active and passive systems. This surveillance system integrates the categorical disease programmes thereby improving the timelines on data collection as well as data completion. For example, gathering information on infectious diseases through registers kept at hospitals or clinics and or individual staff collecting information in communities (Nsubuga et al. 2006, 2010).

5. **Syndromic surveillance**; an active and passive system that uses case definitions as well as clinical features as data type. This type of surveillance was the first kind in developing countries where resources are scarce. One would be able to record symptoms that could indicate cases such as diarrhoea, fever, headaches and so on. The challenge of this system is that it is highly unspecific; therefore the common symptoms could mask an underlying emerging disease. Since it does not require laboratory confirmation, syndromic surveillance is fast and inexpensive and easy to adapt in a developing country setting (Nsubuga et al. 2006).

6. **Behavioural risk factor surveillance**; involves surveys that measure behaviours that are known to cause disease, e.g. smoking, alcohol use, risky sexual behaviour and practices and more (Nsubuga et al. 2006). This is achieved through active repeated surveys.

7.2 The Need for Surveillance

Surveillance systems provide information that can be used as early warning system for disease outbreaks and epidemics. In the long term, surveillance data can provide trends that can be useful in understanding disease patterns and or associated behaviours or climatic conditions. Health surveillance, active or passive, provides a window into the health conditions and risks in communities and how these conditions are affecting the populations and their livelihoods. Through surveillance data one can determine the disease risks that are associated with certain livelihoods and how these affect the behaviour of the communities in the long term.

For example, in a certain village in a remote community, children always present with certain symptoms at a certain age and most of them do not grow past the age of 2 years. The villagers believe that some mysterious magical powers and or witchcraft are involved. This continues for the next 5–10 years and the villagers decide to move to another place far from this initial place. There the children grow past the age of two and the mysterious deaths disappear. So why were the children dying in the initial village? If surveillance was carried out and data was collected, the answer would lie in the data. Possibilities include, the surrounding environment, a disease associated with the geographical disposition of the area, could be certain pathogens or toxins that are associated with vegetation in the village or human behaviour associated with the initial village. If surveillance data existed, trends and behavioural patterns could be established that would assist in solving the mystery. Public health surveillance therefore should be designed accordingly to provide accurate and valid information to those in authority so that they can make informed decisions.

For developing countries where resources are limited, most of the surveillance may be conducted through external funding and support from donors. There is need to invest in national surveillance systems that are sustainable, cost effective and inclusive so that the wide population benefits from it. Collaboration of national health surveillance programmes between neighbouring countries and regions could help in infectious disease surveillance. Although there are surveillance networks that have been set up in developed countries, most developing countries are often lagging behind due to lack of resources to support infrastructure and technology required to meet a quality surveillance system. Even though these poor developing countries carry the burden of emerging and neglected infectious diseases that affect billions of people, most are lacking in surveillance. Poor surveillance in developing countries presents a risk of spread of infectious diseases even to countries that have well established surveillance systems. The 2015, Ebola outbreak in West Africa, the SARS and MERS outbreak in Asia are examples of how infectious diseases can easily cross borders and infect people from different backgrounds, and races. It is therefore important that developing countries are able to build surveillance systems that can detect epidemics at an early stage and be able to put in place the necessary steps to prevent further spread of infectious diseases.

Despite the lack of resources, and trained personnel to handle quality surveillance, the problem is further complicated by poor civil registration records.

Civil registration includes vital statistics records required in determining the health and welfare of the population. In most developing countries poor records have resulted in poor implementation of programmes, poor allocation of resources as well as poor decision-making due to inaccurate information.

7.3   Who Should Be Responsible for Civil Registration?

Civil registration is a process where the country is able to keep a continuous record of births, deaths and marriages. In public health, civil registration is important not only because it keeps records of births and deaths but also the cause of death. Knowledge of the cause of death provides a picture of what is the common cause of death in a population as well as the health status of a population (Carter et al. 2012; Taylor et al. 2005; WHO|Civil registration: why counting births and deaths is important, n.d.). Over 67 % of annual deaths are not reported globally. This means that 67 % of the causes of deaths are not reported annually, missing out important details of diseases responsible for these deaths (WHO|Civil registration: why counting births and deaths is important, n.d.). Civil registration is important in designing and running a well functioning health system. Civil registration gives a picture of the populations' health status and a picture of common health issues. Civil registration also accounts for everyone in a country thereby assisting in designing health, labour and welfare policies.

For the past decades, it has been a great challenge to follow the numbers of births and deaths that occur outside hospitals and health centres in Malawi, a poor developing country in Africa. This is a problem shared by most poor developing countries in sub-Saharan Africa as well as other low-income countries globally. Births and deaths that occur in remote villages are rarely reported to civil and health authorities resulting in inaccurate figures. This information is poorly documented and can only be accessed through word of mouth from the community leaders who are the authority and overseers in communities. The lack of written records makes it difficult to follow up and prove facts. With poor records, it is difficult to develop and follow trends on diseases that frequently occur in these communities. Apart from the common malaria and diarrhoea, it is very difficult to track any other infectious and non-infectious diseases that may occur in the communities if the patients do not visit the hospital or health centre. These include sexually transmitted diseases, parasitic skin diseases, measles, cholera and other emerging diseases that may occur exclusively in a particular area. With the health authorities unaware of these occurrences, it is very difficult to control the spread of these infectious diseases. Even if the health authorities try to get information from the community leaders, usually the verbal autopsy (explanation on the cause of death) is so simplified like, "Mr. A died of a headache and Mr. B died of stomach pain". The causes of death being outlined are more or less symptoms of other underlying diseases that could have been the possible causes of death.

Developing countries need to improve systems of registration in place to track behaviour, traditions, diet and other ways of life in order to identify the sources of infections. The registration system should be inclusive; incorporating those births and deaths occurring in remote parts of the country. This requires civic education of the communities emphasizing the importance of civil registration. Depending on how communities function, their cultures and traditions, countries should be able to implement registration systems that are not only practical with the population in question but also sustainable. Training of local authorities such as, traditional birth attendants, community health workers, chiefs and or community leaders on data collection can help in attaining civil registration in rural and isolated communities. Governments should be able to set apart resources and personnel that will be responsible for collecting the primary data from the communities.

Surveillance of common infectious diseases in a particular region is a necessity. Developing countries should set apart resources for infectious disease surveillance network within their countries. The network can be set up by individual countries in collaboration with already existing regional and global surveillance networks to monitor trends and possibilities of disease outbreaks.

To reduce the risk of transmission of disease there is need for;
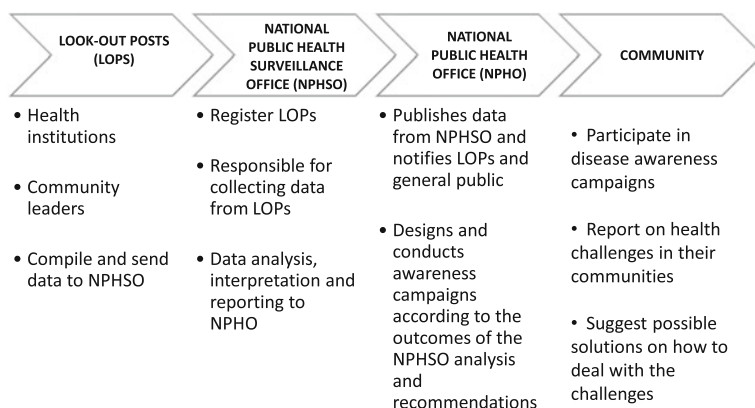
(a) Quality surveillance and record keeping.
(b) Investigation of mysterious deaths, including tracking of affected persons, family, friends, and co-workers in order to identify breeding grounds.
(c) Proper communication and delivery of information to every patient and people in close proximity and the nation regarding diseases including key points such as, mode of transmission, prevention measures.
(d) Create awareness by initiating and conducting public health campaigns including television interviews, radio interviews, community meetings, posters, banners and flyers in all languages applicable in that particular country and in an inclusive manner.
(e) Set up isolation procedures that will be followed in case of infectious disease outbreaks and these procedures should be communicated to communities beforehand to prevent anxiety and misinformation. If communities are told beforehand on what procedures will be carried out to prevent further spread of the disease; they will be able voice out their concerns and solutions can be reached with the authorities before implementation. The solutions should still be able to achieve the goal of disease prevention and control.

7.4 Creating a Surveillance Network

All healthcare institutions including public and private practice, hospitals, dispensaries, private clinics and diagnostic laboratories in a country should be registered and should keep all vital health records including vital statistics. These health personnel should also be on the lookout for strange illnesses and the frequency of occurrence as this is an opportunity for early detection of emerging and or epidemic prone diseases.

7.4.1 Example of a Surveillance Network

Each doctor nationwide should register with the office responsible for national surveillance, e.g. National Public Health Surveillance Office (NPHSO). The NPHSO will be reporting to the national public health office, e.g. the National Public Health Office (NPHO). The NPHO will be responsible for reporting and communicating all public health information, including reports from the surveillance by the NPHSO general public. The NPHSO will be responsible for running surveillance networks, collecting and analysing all public health data and reporting the findings to the NPHO (Fig. 7.1). The NPHSO will register and collect data from all health institutions operating in a country. The health officer running the clinic and or dispensary should keep a register of births and deaths including causes of death, and a register for all cases treated at the institution. These health personnel termed 'Guards' need to compile and send data and diagnostic results to the NPHSO for their facility "Lookout Posts" (LOPs) on a weekly basis. The ministry of health (MOH) through NPHSO is responsible for identification of symptoms that have to be monitored each time a patient comes for consultation, in case of symptomatic surveillance as well as selecting diseases that can be monitored through categorical surveillance. A consultation and surveillance form designed by NPHSO and approved by MOH will be used by all the medical personnel during consultation. This form will then be sent to the NPHSO for analysis at the end of each week. The data will then be analysed and published through the NPHO (Fig. 7.2).

LOOK-OUT POSTS (LOPS)	NATIONAL PUBLIC HEALTH SURVEILLANCE OFFICE (NPHSO)	NATIONAL PUBLIC HEALTH OFFICE (NPHO)	COMMUNITY
• Health institutions	• Register LOPs	• Publishes data from NPHSO and notifies LOPs and general public	• Participate in disease awareness campaigns
• Community leaders	• Responsible for collecting data from LOPs	• Designs and conducts awareness campaigns according to the outcomes of the NPHSO analysis and recommendations	• Report on health challenges in their communities
• Compile and send data to NPHSO	• Data analysis, interpretation and reporting to NPHO		• Suggest possible solutions on how to deal with the challenges

Fig. 7.2 Creating an effective surveillance network. A successful surveillance network requires effective communication between various sectors; this includes effective notification from the LOPs, efficient response including data analysis and reporting and record keeping from the NPHSO as well as well-organized and coordinated communication from the NPHO to the community and with all other sectors in the network

7.5 Notification Circuit

One of the major problems in developing countries with regard to disease management is the existence of poor organization and communication gaps and flaws. Creation of a notification circuit known to the population will enhance notification of relevant authorities in due course allowing time to implement the right measures thereby avoiding a crisis. Emphasis should be made on the importance of the notification circuit and the responsibility that each stakeholder in the circuit carries. The circuit will not be able to function properly if one of the stakeholders is not participating or carrying out their tasks properly. Success of the circuit depends on full cooperation of each of the stakeholders (Fig. 7.3).
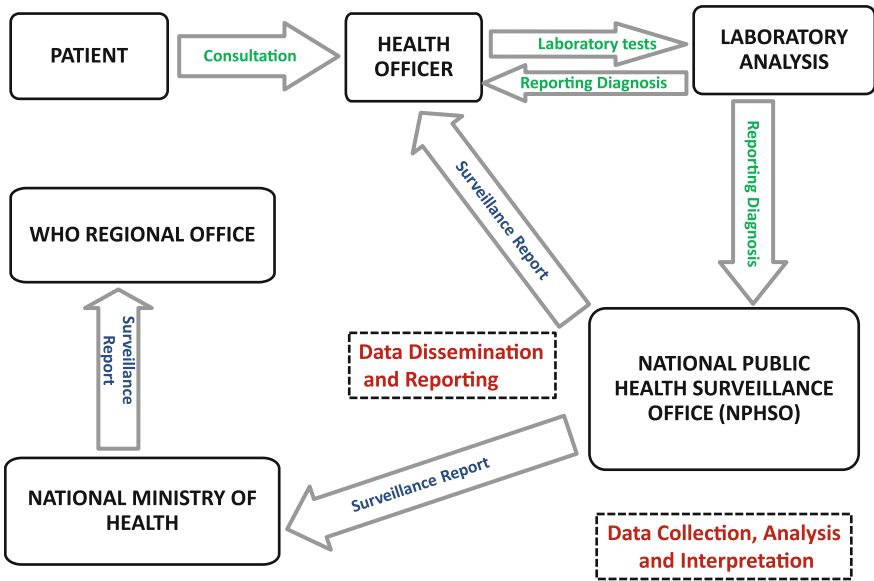
Fig. 7.3 Notification circuit. From the time of consultation, notification of the disease and or symptoms, including public health risks should be effectively communicated to the patient, and to all stakeholders in the circuit; successful notification allows for efficient data collection, analysis and interpretation; it is important that this data is disseminated to the appropriate authorities in a timely manner and that the reporting is also carried out in a timely manner; failure of the notification circuit can allow for a serious public health risks including disease outbreaks

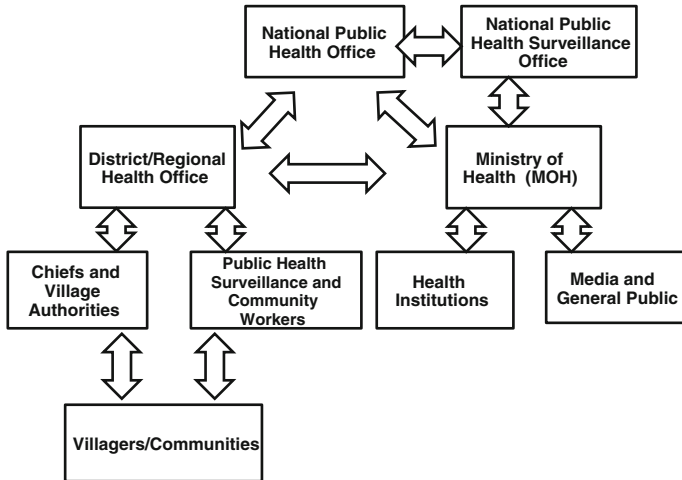## 7.6   Information Dissemination

Public Health information is very important for the health and safety and development of a population. Health problems affect all sectors of a nation be it the health, social welfare, labour and economic development sectors. Poor health affects people's livelihoods, a financial capabilities and labour output. Understanding the health issues that surround communities and communicating these issues back to the community is important. What use is knowledge when it cannot be communicated and when the knowledge is not communicated how can the general population understand? Without knowledge people perish. Lack of information regarding disease prevention and control within communities'; results in people dying from diseases that are treatable and preventable and allows for spread of infectious diseases. Even though the Ministries of Health and the governments have policies and strategies of how to combat health problems, unless these strategies are properly communicated to the communities, there will always be avoidable health problems affecting communities. Although the strategies are available but if these policies and strategies only exist on paper, there will be no progress in combating infectious diseases and other health problems in developing countries.

7.6.1   Mode of Communication

With varying literacy levels in developing countries, it is significant to consider the mode of communication. For example if the majority of the population is not able to read and write, they will be able to see the pictures on posters and flyers but will not be able to read the words. In countries where there is more than one language spoken, information should be disseminated to the communities in the language that is understood clearly otherwise misinformation and misunderstandings may occur. During the 2015, Ebola outbreak in West Africa where Guinea, Liberia, Sierra Leone, Senegal, Mali and Nigeria were affected, one of the key points that helped control the spread of the outbreak in Nigeria, Senegal and Mali was communication. Public awareness campaigns helped reduce anxiety and brought better understanding of the Ebola disease. Poor communication instilled fear rather than reassure the masses and led to further spread of the disease in Liberia, Sierra Leone and Guinea (WHO|One year into the Ebola epidemic: a deadly, tenacious and unforgiving virus, n.d.).

Lack of knowledge has contributed to the loss of many lives especially for the poor communities in developing countries. Promoting the use of information and data in public decision-making is cardinal in managing infectious diseases and controlling disease outbreaks. It is therefore necessary that there is a proper line of communication established between the government authorities, health workers, and the community. It is critical that communities are fully involved when

Fig. 7.4 Information dissemination at national level. In most developing countries, communities are often sidelined with regard to information dissemination; a two way communication as shown by the *arrows* allows for flow of information from top to bottom and bottom to top which is necessary for effective disease prevention and control

designing strategies that will affect them. A bottom-top approach is necessary to understand the health issues that affect the communities. In engaging the community, policy makers will be able to understand the problems and needs faced by the communities instead of imposing what the policy makers assume the community needs. Dialogue and two way communications between stakeholders at national level will assist in achieving better health for rural communities which are often sidelined in developing countries (Fig. 7.4). Designing communication strategies that are inclusive could assist in achieving better health for the population in a country.

7.7   Why Global Surveillance

Global surveillance and or cross-border surveillance plays a key role in tracking imported infections and pathogens including drug-resistant pathogens. Collaboration between governments that share borders in disease surveillance is very important. This will reduce the risks of spread of diseases across porous borders and assist in identifying and tracking diseases and disease causing pathogens across borders.

7.7.1 Lessons from the Past

Some of the lessons from 2003 SARS outbreak in China, the 2014 Ebola outbreak in West Africa and the MERS outbreak in South Korea, illustrate how porous borders and international travel can easily allow the spread of pathogens between countries. Collaboration in disease surveillance between countries that share borders is a priority that developing countries need to invest in. Since most developing countries lack the finances and infrastructure to carry out surveillance on their own, collaborations can help in investing in methods that will benefit the involved parties. Countries should be able to identify their strengths and weaknesses in their healthcare systems and try to support one another to fight infectious diseases.

For example, Senegal, Nigeria, Gambia and Mali are close neighbours to Liberia, Sierra Leone and Guinea; the latter being countries that were heavily affected by the 2014 Ebola outbreak in the West Africa region. Senegal, Mali, Nigeria and the Gambia have the laboratory facilities that allowed for rapid testing of Ebola samples as well as surveillance systems that allowed for efficient contact tracing of cases. Their neighbours were completely overwhelmed by the outbreak and lacked the facilities and efficient contact tracing. If there was better collaboration and or partnerships between these countries regarding case testing as well as surveillance, maybe the picture could have been different. Second, if there was collaboration in surveillance as well as contact tracing between the countries, the infected personnel who had contact with the initial cases in Guinea, could not have been allowed to cross borders, there would have been no possibility of repatriating infected bodies from one country to another as was the case when two bodies of individuals who had died from Ebola in Guinea were repatriated to Sierra Leone (WHO|One year into the Ebola epidemic: a deadly, tenacious and unforgiving virus, n.d.). This repatriation put at risk everyone who handled the bodies during the repatriation process including the vehicles used for transport. This was a risk that could have been avoided if there was collaboration between countries in disease prevention and control. Despite the availability of International Health Regulations by WHO, which focus on public health emergencies of international concern (PHEIC), the response from WHO and international community were quite contrary. Finally, developing countries where infectious diseases are rampant lack resources to establish good surveillance systems; developed countries who are working to prevent diseases have better and well advanced surveillance systems. It is in this regard that developing countries have to work together to combat these challenges which can be better understood by the affected countries. Response from the international community during the 2014 Ebola outbreak was slow and this allowed for further spread of the virus, as the affected countries were overwhelmed by the shock. This calls for efforts from developing countries to set out strategies to combat similar outbreaks in the future. These strategies include: developing capacity in disease surveillance, community awareness and involvement, and improve the healthcare systems as well as develop infrastructure to improve the health and livelihoods of their populations.

Developed countries are working on preventing infectious diseases from entering their countries while developing countries have to work on early detection and fighting the existing and emerging infectious diseases in order to reduce mortalities. Therefore, some of the strategies set out by developed countries to combat infectious diseases might not work as efficiently in developing countries as the purpose of the strategies are different. Developing countries ought to work together to set up strategies that will allow for reduction of infectious diseases including disease prevention and control. Rural communities in developing countries, which are the most affected with infectious diseases, should be the focus when setting up these strategies. Ample consultation of these communities is required in order to identify effective ways of combating infectious diseases.

WHO through the establishment of international Health Regulations (IHR 2005), brought the concept of international collaboration in order to combat infectious diseases and any public health risks which may cross international borders. Through IHR, WHO member states and involved parties are required to collaborate with each other in order to facilitate the implementation of the IHR. For countries to successfully implement IHR there is need for a well-established and functioning national surveillance system and response infrastructure that can allow for detection, notification of events and effective response to public health risks. WHO can, upon request of countries, assist countries in mobilizing financial support and provide technical support to build, strengthen and maintain the capacities (WHO| Ten things you need to do to implement the IHR, n.d.).

7.8   International Health Regulations (IHR)

The IHR, are an international agreement aimed at protecting the community from public health risks and emergencies across international borders. The first regulations, International Sanitary regulations were published in 1951, followed by the 1969 (World Health Assembly 1983). The 1969 IHR had six quarantine diseases that were outlined and was amended in 1973 particularly with regard to cholera and further amended in 1981 to exclude smallpox after its eradication in 1979. The 1973 and 1981 IHR had three quarantine diseases namely, cholera, yellow fever and plague. On 1 January 1982, IHR containing interpretations and recommendations made by the previous WHO assemblies including committee on International Surveillance of Communicable diseases (formerly the committee on International Quarantine) were published. In 1995 there was a call for revision of the IHR and in 2005, the current IHR (2005) were finalized and these are legally binding in 194 countries (States Parties), including all WHO Member States. The current IHR were implemented on 15 June 2007 and these direct and govern the State parties to contribute to global public health security (WHO|Ten things you need to do to implement the IHR, n.d.; WHO|International Health Regulations (2005): Areas of work for implementation, n.d.).

7.8.1   IHR Purpose and Scope

The purpose and scope of IHR 2005 states:

> to prevent, protect against, control and provide a public health response to the international spread of disease in ways that are commensurate with and restricted to public health risks, and which avoid unnecessary interference with international traffic and trade.

The current IHR are broad and not limited to specific diseases or mode of transmission. The member states have the obligation to develop certain minimum core public health capacities and to notify WHO of any events that may constitute public health emergency of international concern (PHEIC) (WHO|International Health Regulations (2005): Areas of work for implementation, n.d.).

Of the seven areas of work for IHR, four are highlighted and are split in two goals;

Goal 1: Areas that will strengthen national capacity through

(a) Strengthening national disease prevention, surveillance, control and response systems.
(b) Strengthen public health security in travel and transport.

Goal 2: Prevent and respond to public health emergencies (PHE)

(a) Strengthen WHO global alert system.
(b) Strengthen the management of specific risks.

7.8.2   Definitions in IHR

1. *Disease*—an illness or medical condition, irrespective of origin or source, that presents or could present significant harm to humans.
2. *Event*—a manifestation of disease or an occurrence that creates a potential for disease.
3. *Public health risks*—a likelihood of an event that may affect adversely the health of human populations, with an emphasis on one which may spread internationally or may present a serious and direct danger.
4. *A public health emergency of international concern* (*PHEIC*)—an extraordinary event which is determined to constitute a public health risk to other States through the international spread of disease and to potentially require a coordinated international response.

7.9 Conclusion

Health surveillance is a window into the health status of a population. Despite the huge burden of disease, lack of resources in developing countries has contributed to poor investment in health surveillance and civil registration. Developing countries need to improve the existing registration systems in order to identify trends and sources of diseases within their population. Countries have to set aside resources for infectious disease surveillance at national level. Setting up a functioning surveillance network nationwide will assist in collecting vital health information. Public health information is fundamental for the health and safety of a population, and notification circuits within the country can disseminate this information.

Surveillance of infectious diseases and related public health risks is a requirement to prevent and control the spread of these diseases. Governments should ensure that their countries have set up surveillance systems that can allow for early detection of diseases and prompt response to outbreaks. Countries need to set up strategies that are applicable and can be effectively managed at a national level. These strategies have to be inclusive respecting the culture and traditions of communities to allow for compliance. Communities should be notified of the disease prevention and control strategies and be allowed to contribute their opinions on how to combat the public health issues faced in their communities. Adopting and implementation of IHR would assist in avoiding catastrophes like those experienced during the 2014 West Africa Ebola outbreak.

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