

**Early detection, assessment
and response to acute
public health events:**

***Implementation of
Early Warning and Response
with a focus on
Event-Based Surveillance***

Interim Version



**World Health
Organization**

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ACKNOWLEDGEMENTS

This document was prepared by the EWAR/EBS Secretariat coordinated by Pierre Nabeth of the WHO Lyon Office. Mr Philippe Barboza served as the Responsible Officer for the development of this guide. An editorial group of scientific experts was convened by WHO in order to provide oversight, expertise and guidance for the project and to ensure its scientific accuracy and objectivity.

LIST OF CONTRIBUTORS

TECHNICAL EXPERTS, PARTNERS AND MINISTRIES OF HEALTH

Dr Ray Arthur, Center for Global Health, Centers for Disease Control and Prevention, United States of America.

Dr Silvia Bino, Control of Infectious Diseases Department, Institute of Public Health, Albania.

Professor Mike Catchpole, Centre for Infectious Disease Surveillance and Control, Public Health England, United Kingdom.

Dr Hugo Lopez-Gatell, National Institute of Public Health, Mexico.

Dr Stela Gheorghita, National Centre of Public Health, Republic of Moldova.

Dr Nada Ghosn, Epidemiological Surveillance Programme, Ministry of Public Health, Lebanon.

Dr Payman Hemmati, Center for Communicable Disease Control, Ministry of Health & Medical Education, Islamic Republic of Iran.

Dr Majdouline Obtel, Directorate of Epidemiology and Disease Control, Ministry of Health, Morocco

Dr Pasi Penttinen, European Centre for Disease Prevention and Control, Stockholm, Sweden

Dr Kumnuan Ungchusak, Department of Disease Control, Ministry of Public Health, Thailand

Dr Yvan Souares, Public Health Division, Secretariat of the Pacific Community, New Caledonia

Dr Denise Werker, Saskatchewan Ministry of Health, Canada

WORLD HEALTH ORGANIZATION

WHO Regional Office for the Americas: Dr Roberta Andraghetti

WHO Regional Office for Africa: Dr Benido Impouma

WHO Regional Office for Europe: Dr Dennis Faix, Dr Asheena Khalakdina, Dr Jukka Pukkila and Dr John Watson

Regional Office for South-East Asia: Dr Vason Pinyowiwat, Dr Graham Tallis

WHO Regional Office for the Eastern Mediterranean: Dr Dalia Samhour

WHO Regional Office for the Western Pacific: Dr Eric J Nilles and Dr Tomoe Shimada

WHO Headquarters: Mr Philippe Barboza, Dr Yolanda Bayugo, Dr Zhanat Carr; Dr Kersten Gutschmidt, Dr Stella Chungong, Dr Sébastien Cognat, Dr Stéphane de La Rocque, Dr José Guerra, Dr Margaret Lamunu, Dr Dominique Legros, Dr Pierre Nabeth, Dr Gerardo Priotto, Dr Johannes Schnitzler, and Dr Isabelle Nuttall.

ACRONYMS

IAEA: International Atomic Energy Agency

CDC: United States Centers for Disease Control and Prevention

CFR: case fatality ratio

EBS: event-based surveillance

ECDC: European Centre for Disease Prevention and Control

EWAR: early warning and response

FAO: Food and Agriculture Organization of the United Nations

FETP: field epidemiology training programme

GP: general practitioner

IBS: indicator-based surveillance

IHR: International Health Regulations (2005)

ILI: influenza-like illness

INFOSAN: International Food Safety Authorities Network

IT: information technology

MoA: Ministry of Agriculture

MoE : Ministry of Environment

MoH: Ministry of Health

MS: Member States

NFP: National Focal Point (IHR)

NGO: non-governmental organization

PHEIC: Public Health Emergency of International Concern

PPE: personal protective equipment

OIE: World Organisation for Animal Health

RRT: rapid response team

SOP: standard operating procedure

SMS: short message service

WHO: World Health Organization

GLOSSARY

Note: *these terms and definitions have been provided for use within the context of this document and may differ from those used in other documents.*

Acute public health event: any event that represents immediate threat to human health and requires prompt action, i.e. implementation of control and/or mitigation measures to protect the health of the public. This term includes events that have not yet led to disease in humans but have the potential to cause disease through exposure of humans to infected or contaminated food, water, animals, manufactured products, environments, or as a result of direct or indirect consequences of natural events, conflicts or other disruptions of critical infrastructure.

Alert: messages / information communicated to partners, communities and the public to help inform about, prevent the spread of, or control an acute public health event. In this document an alert will refer to a public health event that has been i) verified and ii) risk assessed and iii) requires an intervention (an investigation, a response or a communication) (also see signal & event).

Annex 2: the International Health Regulations (2005) (IHR) decision Instrument which all States Parties are required to use to assess events within their territory in determining whether an event may constitute a public health emergency of international concern and hence require notification to WHO in accordance with IHR Article 6.(1)

Chemical event: a manifestation of a disease or an occurrence that creates a potential for a disease as result of exposure to or contamination by a chemical.(2)

Early Warning and Response (EWAR): the organized mechanism to detect as early as possible any abnormal occurrence or any divergence from the usual or normally observed frequency of phenomena.(2)

Epidemic Intelligence: the systematic collection, analysis and communication of any information to detect, verify, assess and investigate events and health risks with an early warning objective.

Evaluation: the periodic assessment of the relevance, effectiveness and impact of activities in the light of the objectives of the surveillance and response systems.(3) Also see monitoring.

Event: the IHR define an event as “[...] a manifestation of disease or an occurrence that creates a potential for disease; [...]”(1) (which can include events that are infectious, zoonotic, food safety, chemical, radiological or nuclear in origin and whether transmitted by persons, vectors, animals, goods/food or through the environment.). In the context of event-based surveillance, an “event” also include those of unknown origin and refers to “a signal” that has been “verified” (see signal and alert).

Event-Based Surveillance (EBS): is defined as the organized collection, monitoring, assessment and interpretation of mainly unstructured ad hoc information regarding health events or risks, which may represent an acute risk to human health. Event-Based Surveillance is a functional component of EWAR; also see indicator-based surveillance & epidemic intelligence.

Filtering: a step of the EBS triage process. The filtering consists in screening out duplicates and EBS information irrelevant for EWAR (i.e. not related to the early detection of acute public health events)

Hazard: an agent or a source that has potential to cause adverse health effects in exposed populations.(4) An example of a hazard is a toxic chemical introduced into a water source. However, the difference between hazard, risk and threat does not translate into most languages (see risk).

Indicator-Based Surveillance (IBS): the systematic (regular) collection, monitoring, analysis and interpretation of structured data, i.e. of indicators produced by a number of well-identified, mostly health-based, formal sources.

National IHR Focal Point: the national centre, designated by each State Party, which shall be accessible at all times for communications and liaison with WHO IHR contact points under the IHR.

Monitoring: in the context of *surveillance* and *response* refers to the routine and continuous tracking of the implementation of planned surveillance activities (monitoring the implementation of the plan of action) and of the overall performance of surveillance and response systems. See *evaluation*

Nuclear event: see *Radiological or nuclear event*

Notification:

- **IHR Notification:** in the context of the IHR, notification is the communication by a State Party to WHO concerning an *event* arising within its territory as stated in IHR, article 6: *“Each State Party shall notify WHO, by the most efficient means of communication available, by way of the National IHR Focal Point, and within 24 hours of assessment of public health information, of all events which may constitute a public health emergency of international concern within its territory in accordance with the decision instrument, as well as any health measure implemented in response to those events. [...]”*.(1)
- **Notification:** is the formalized mandatory communication process through which reportable diseases events or are communicated within national or international surveillance systems.

Point of entry (PoE): in the IHR context this is *“[...] a passage for international entry or exit of travellers, baggage, cargo, containers, conveyances, goods and postal parcels, and the agencies and areas providing services to them upon entry or exit”*(1), including ports, airports and ground crossings.

Public health emergency of international concern (PHEIC): under the IHR this is *“[...] an extraordinary event which is determined, as provided in these Regulations [i.e. IHR] (i) to constitute a public health risk to other States through the international spread of disease and (ii) to potentially require a coordinated international response”*.(1) In the context of a PHEIC a number of extraordinary provisions in the IHR apply in order to minimize risks of international spread and to avoid unnecessary interference with international traffic. Only the Director-General of WHO determines if an *event* constitutes a PHEIC. States Parties report potential PHEICs to WHO under IHR.

Public health risk: the IHR define a public health risk as *“[...] 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.”*(1)

Radiological or nuclear event: a manifestation of a disease or an occurrence that creates a potential for a disease as a result of exposure of human beings, animals or plants or a contamination by a radiological/nuclear source.(2)

Response: any public health action triggered by the detection of a *public health risk* (e.g. *monitoring* of the *event*, information of the public, triggering field investigation and/or implementation of any control or mitigation measures). The nature of the response will have to be adapted according to the nature of the *public health risk*.

Reporting: the process by which health events and health risks are brought to the knowledge of the health authorities.

Risk: the likelihood of an *event* resulting in negative consequences for public health.(2)

Risk assessment: a systematic process for gathering, assessing and documenting information to assign a level of *risk* to human health to an *event*. Risk assessment includes three components - hazard assessment, exposure assessment and context assessment. The risk assessment provides the basis to inform the action to be taken in order to manage and reduce the negative consequences of *acute public health events*. Risk assessment is a continuous process from the detection of the *signal* to the *response* to the *event*.(4) Under the IHR, risk assessment can include assessment of the risk to human health, of the risk of international spread of disease and of the risk of interference with

international traffic. The risk assessment capacities required for all countries are described in IHR Annex 1.

Signal: data and/or information considered by the *Early Warning and Response system* as representing a potential acute risk to human health. Signals may consist of reports of cases or deaths (individual or aggregated), potential exposure of human beings to biological, chemical or radiological and nuclear hazards, or occurrence of natural or man-made disasters. Signals can be detected through any potential *source* (health or non-health, informal or official) including the media. Raw data and information (i.e., untreated and unverified) are first detected and triaged in order to retain only the one pertinent to early detection purposes i.e. the signals. Once identified signals must be verified. When it has been verified, a signal becomes an *“event”*.

Sources of information:

- **Official Source:** any governmental subnational, national or international institution (public or assimilated) accredited to provide information : e.g. National Institute of Public Health, the Ministries of Health, Agriculture, Foreign Affairs and other national sources, the reference laboratories, the international and supranational organizations such as WHO, OIE, FAO, ECDC, US-CDC, other supranational organizations and institutional networks.
- **Formal Sources:** official sources and authorized sources, i.e., non-official and not dependent from a government agency but in direct contact with the event (e.g. Non-Governmental Organizations, hospital and medical sources, clinicians, local laboratories, etc.).
- **Informal Sources:** this source is neither official nor formal. Informal sources include the press and other media (radio, television, etc.), Blogs, twitter®, social network channels (Facebook®) ...

Surveillance: the IHR define surveillance as *“[...] the systematic on-going collection, collation and analysis of data for public health purposes and the timely dissemination of public health information for assessment and public health response as necessary”*.(1)

Selection: second step of the two-step *EBS triage* process (the first step is *filtering*). The selection step consists of sorting out information according to the country's' national priority criteria. For instance, information may be “discarded” if it is regarding a non-prioritized mild disease or a disease expected for a given time period and location.

Syndromic surveillance: a method of *surveillance* that uses health-related data based on clinical observations rather than laboratory confirmation of diagnoses. Syndromic surveillance is used in order to detect outbreaks earlier than would otherwise be possible with laboratory diagnosis-based methods. Case definitions used for syndromic surveillance are based on clinical signs and symptoms, rather than on specific laboratory criteria for confirmation of the causative agent.(5)

Triage: the process of screening out the data and information that are relevant for early detection purposes (i.e. the screening out mild/irrelevant *events* from potential *acute public health events*, and the cleaning to eliminate duplicates and correct obvious mistakes).

Threat: a thing likely to cause damage or danger.(6) A real or perceived danger.(7) Sometimes, “threat” is used in reference to deliberate acts (while *risk* refers more to naturally occurring *events*). However, the difference between *risk* and threat does not translate in most languages. See *Risk*.

Verification: In the context of the IHR (article 1): *“[...] the provision of information by a State Party to WHO confirming the status of an event within the territory or territories of that State Party”*.(1) Under the IHR, all States Parties are required to provide verification upon request by WHO within a limited time period. In the current document, verification is also the pro-active crosschecking of the validity (veracity) of the *signals* collected by *EWAR*, by contacting the original *source*, additional *sources*, or by performing field investigation Verification requires that hoaxes, false rumours, and artefacts are eliminated from further consideration.

Zoonotic event: a manifestation of a disease or occurrence in animals (and animal derived products) that creates a potential for a disease in humans as result of human exposure to the animal source (or vector).(2)

Referenced definitions were taken or adapted from the following sources:

- (1) International Health Regulations (2005), 2nd ed. Geneva: World Health Organization; 2008 (http://whqlibdoc.who.int/publications/2008/9789241580410_eng.pdf, accessed 31 March 2014).
- (2) Protocol for Assessing National Surveillance and Response Capacities for the IHR (2005). Geneva: World Health Organization; 2010 (WHO/HSE/IHR/2010.7; http://www.who.int/ihr/publications/who_hse_ihr_201007_en.pdf?ua=1, accessed 31 March 2014).
- (3) Communicable disease surveillance and response systems: Guide to monitoring and evaluating. Geneva: World Health Organization; 2006 (WHO/CDS/EPR/LYO/2006.2; http://www.who.int/csr/resources/publications/surveillance/WHO_CDS_EPR_LYO_2006_2.pdf, accessed 31 March 2014).
- (4) Rapid Risk Assessment of Acute Public Health Events. Geneva: World Health Organization; 2012, accessed 31 March 2014). (WHO/HSE/GAR/ARO/2012.1; http://whqlibdoc.who.int/hq/2012/WHO_HSE_GAR_ARO_2012.1_eng.pdf?ua=1).
- (5) Communicable disease alert and response for mass gatherings: key considerations, June 2008. Geneva: World Health Organization; 2008 (WHO/CDS/EPR; http://www.who.int/csr/Mass_gatherings2.pdf, accessed 31 March 2014).
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1 INTRODUCTION

1.1 RATIONALE

In the last decades, the world has undergone rapid changes including demographic explosions and massive urbanization, population movement, increase in international trade and travel, emergence of new pathogens, use of techniques which induce new risks, chemical and nuclear accidents, environmental disasters and introduction of the threat of criminal acts and bioterrorism.

To respond to this changing environment, the International Health Regulations (IHR) were revised in 2005. The IHR expands usual infectious disease notification to include surveillance of public health events from various origins (e.g. nuclear, chemical or unknown), and prompts Member States to develop the capacities of their surveillance systems to detect, assess, notify and respond to all acute health events or health risks that may constitute a threat to human health. As the Regulations note, *“To comprehensively meet the early warning and alert requirements of the IHR, there is a need to strengthen and develop both routine, or indicator-based, surveillance and event-based surveillance”*.¹

Conventional surveillance is based on restrictive lists of predominantly infectious diseases. Many countries have already implemented the change to a comprehensive “all hazards” surveillance. However, this approach represents a major paradigm shift that may require significant restructuring of the public health surveillance system. Public health surveillance serves two main objectives:

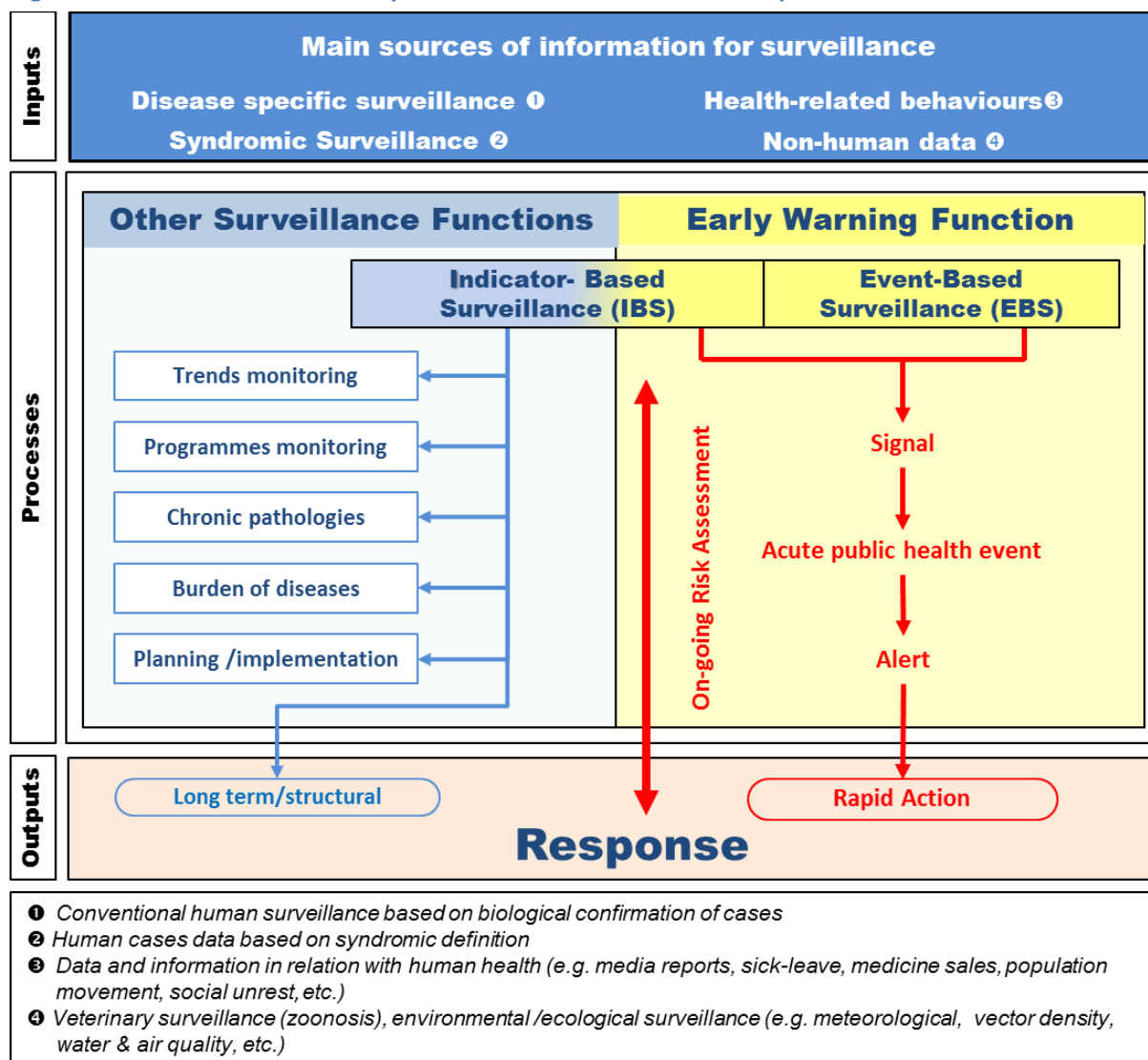
- To measure disease burden, including monitoring morbidity/mortality trends, in order to effectively guide control programmes and the corresponding allocation of resources; and
- To early detect public health events requiring rapid investigation and response, in order to ensure that events of all origins are rapidly detected and controlled. The organized mechanism to reach this objective is referred to as Early Warning and Response (EWAR).

The efficient collection of pertinent information informs and guides the public health response to all acute public health events including: unknown, unusual or unexpected diseases or disease patterns of all origins (i.e. biological, chemical, radiological or nuclear) as well as hazards that could potentially pose a risk to human health such as heat waves, natural disasters or contaminated food items.

Sources of information that can be used for the early warning function go far beyond traditional disease-based surveillance (including laboratory confirmation) and syndromic surveillance. They encompass environmental/ecological surveillance (e.g. vector density, water/air quality, climatic data, etc.) and health-related behavioural information (e.g. monitoring of absenteeism in schools or in workplaces, medicine sales and paramedical product such as insect repellent, activities on internet or social networks, etc.) (Figure 1). EWAR should therefore be designed to be sensitive and to detect and respond rapidly to signals and alerts coming from both formal and informal sources, within and outside of the health sector.

¹ Protocol for Assessing National Surveillance and Response Capacities for the IHR (2005). Geneva, WHO; 2010. (WHO/HSE/IHR/2010.7; http://www.who.int/ihr/publications/who_hse_ihr_201007_en.pdf?ua=1).

Figure 1 - Overview of all hazard public health surveillance and response functions.



Human resources development should be considered a central constituent of EWAR implementation; highly-trained personnel will be critical at all stages of the process. Training will also be crucial to ensure the effective use of up-to-date technologies.

The early warning components of conventional routine public health surveillance systems primarily rely upon information collected in health facilities, and are focused on communicable diseases with a high epidemic potential and/or for which highly effective control measures, such as immunization, exist. Although data provided by conventional surveillance is essential to EWAR, this is often delayed, incomplete, or concerns only a limited number of known public health risks. Emerging or unknown pathogens may therefore be missed, as might rapidly escalating outbreaks or non-communicable events such as those due to toxicological contaminants.

As recognized by the WHO mandate in IHR Article 9 related to the use of other sources of information, the national EWAR should integrate collection and analysis of information from any sources beyond that generated by the health system. This type of surveillance is called “**Event-Based Surveillance**” (EBS). By collecting information before human cases occur or before an event is detected and/or reported through conventional recording and reporting systems, EBS significantly increases the sensitivity of the surveillance system. An effective early warning function ensures a rapid response to acute public health events of all origins, resulting in mitigation of the public health impact. This requires reinforced coordination and close collaboration with all stakeholders within and outside of the health sector.

1.2 SCOPE AND PURPOSE OF THE GUIDE

The goal of this document is to provide national health authorities, and stakeholders supporting them, with guidance for implementing or enhancing the all-hazards EWAR within national surveillance systems. It aims to provide direction regarding the implementation of surveillance capacities, especially EBS, in order to detect and to respond rapidly to all acute health events and risks from any origin.

Country characteristics (including size, population, geography, structure, performance of health-care and surveillance systems, and resources) are specific. The establishment of EWAR, and especially of the EBS component, should take these specificities into consideration. Therefore, the content of this guide should not be seen as a model to implement, but rather a “toolbox” from which countries should select the most relevant elements to address their own needs.

While the variety of country organizational models cannot be covered in this document, the capacities to detect and respond to events should be present at all levels (local, intermediate, and national). The content of this guide focuses on the implementation at national level. The implementation at subnational levels should follow the same guidance while taking into consideration factors such as the country’s size, population, type of administrative framework and levels of devolution.

For a country, the primary objective for EWAR implementation or strengthening is the detection of health risks that could affect its population. Effective implementation of EWAR requires a multisectoral and multi-disciplinary approach. Relevant sectors may include health, agriculture, environment, travel, trade, education and defence. Partnerships between these different sectors are essential to build coherent alert and response systems which cover all public health threats and rapidly mobilize required resources in a flexible and responsive way during an event.

By establishing, strengthening and maintaining the national EWAR, countries will comply with relevant IHR provisions, fulfilling their commitment and contributing to global public health. Enhancing rapid and exhaustive information-sharing through the IHR framework is not only critical to strengthening global health security, but also to the health security of individual Member States.

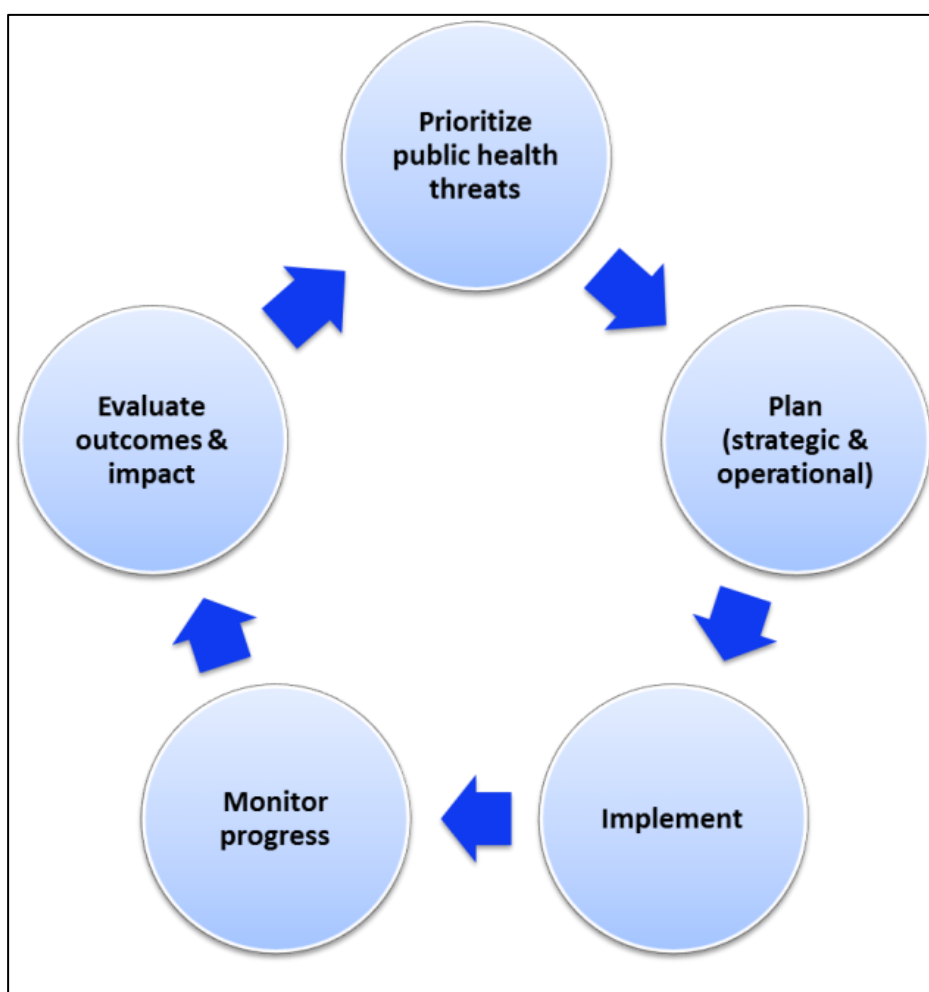
1.3 PLANNING

An approach to implementing and strengthening EWAR is presented (Figure 2). The implementation and strengthening of EWAR require financial, material and human resources. Priority-setting is driven by resource availability, and also by the perceived effectiveness and impact of the planned intervention. In the context of limited resources for health, planning is essential to ensure the efficient use of scarce resources and is key to:

- Ensuring that action is directed to priority areas;
- Enabling rational use of available resources;
- Targeting resource mobilization activities;
- Organizing human resource development; and
- Facilitating the monitoring of progress, evaluation of outcomes and impact of interventions.

Planning should be a dynamic process. A surveillance plan of action should provide the framework for the Ministry of Health (MoH) to implement activities crucial for the early detection, verification, notification, response and containment of public health emergencies, in order to further national and global health security.

Figure 2 - Approach to implementing and strengthening EWAR



2 EWAR: PRINCIPLES AND ORGANIZATION

2.1 PRINCIPLES AND OBJECTIVES

2.1.1 OBJECTIVES

EWAR's general objective is to rapidly detect and control acute public health events of any origin, with particular attention to nationally prioritized health risks. EWAR aims to increase sensitivity of detection, quality of risk assessment, and timeliness and effectiveness of the response to acute public health risks in order to minimize the negative health consequences to the affected population. The specific objectives of EWAR are to:

- Early detect acute health events and health risks;
- Ensure immediate communication of information suggestive of acute health events from local and intermediate to national levels as well as from any source identified at the national level;
- Verify the initial information (i.e. signal);
- Document the nature of the event through, e.g., investigation, characterization, etiological confirmation;
- Perform risk assessment to determine the level of risk posed by the detected event;
- Ensure immediate alerting mechanisms from national and/or peripheral to local levels;
- Consider events in the light of IHR's Annex 2 to decide if notification of a potential PHEIC to WHO is required, or reporting to WHO of an imported or exported human case or contaminated/infected product or vector is necessary under other provisions of the IHR, or consultation with WHO on an event is appropriate;
- Consider any additional legal obligations, or reporting networks, such as those under regional or sub-regional agreements, or for particular diseases or agents, for international communication and/or notification;
- Consider any additional legal obligations, such as those under regional or sub-regional agreements, for international communication and/or notification;
- Ensure prompt investigation as necessary and implement an adequate response through mitigation and control measures, as required by the continuous risk assessment; and
- Alert and maintain communication/coordination with national/international stakeholders.

These components require integration of multisectoral data from multiple sources, both official and informal, which may be presented or reported in a standardized or non-standardized format.

Subnational levels should have the capacity to collate reports from their reporting sites. They should be aware of any information, from any source, that is suggestive of acute health events and/or health risks within their jurisdictions. A risk assessment should be performed prior to reporting to the next level. The national level should collate and integrate EWAR data from all sources, conduct a more detailed analysis and interpretation of the data, and provide feedback to all reporting sites and other stakeholders. The specific capacities required for these functions at each level are listed in the IHR Annex 1.

2.1.2 PRINCIPLES OF EWAR

EWAR is embedded in overall surveillance. Data collected through EWAR must aim to inform and guide the public health response to acute public health events of all origins. EWAR must be **sensitive** to detect signals at the earliest possible stage. This is the rationale for broadening the sources of information through the inclusion of informal sources and relevant sources from outside of the health sector. EWAR must also be designed to reduce, as far as feasible, the delay between the emergence of an acute public health event, its detection and its verification by the system, and then the implementation of control measures. For this purpose, the mechanisms of detection, the

processes of data management and information-sharing - i.e. **epidemic intelligence** - must cover all local priority health risks, potential sources of emergence across the country and other indicators of disease activity. Additionally, systems for acute public health risks preparedness and response must be included to ensure timely implementation of effective control measures.

2.2 EWAR'S EARLY DETECTION COMPONENTS

2.2.1 DEFINITIONS

To ensure efficiency, the EWAR data collection and analysis processes need to be systematized and formalized. In this respect, EWAR will rely on a process: epidemic intelligence and two main channels of information, indicator-based surveillance and event-based surveillance (Figure 3).

2.2.1.1 Indicator-Based Surveillance (IBS)

Indicator-based surveillance (IBS) is defined as the systematic collection, monitoring, analysis, and interpretation of structured data, i.e. indicators, produced by a number of well-identified, predominantly health-based formal sources.

The collection of IBS data is a routine, regular process which is primarily passive. Data are collected according to established case definitions which are either disease-specific or syndromic. They may be collected as individual or aggregated data, and originate from either exhaustive or sentinel systems. Data are analysed in comparison with baseline values and thresholds to determine unusual disease patterns. IBS sources of information are mainly health-based (e.g. health-care structures, health professionals, laboratories), but may also include structured non-human health sources such as animal health data such as zoonoses, meteorological data or entomological data when these are regularly collected and organized for human health purposes.

IBS data are not only employed for EWAR purposes; they are used primarily for achieving other surveillance objectives such as measuring impact of programmes or the identification of priority health problems.

2.2.1.2 Event-Based Surveillance (EBS)

Event-Based Surveillance (EBS) is defined as the organized collection, monitoring, assessment and interpretation of mainly unstructured *ad hoc* information regarding health events or risks, which may represent an acute risk to human health. EBS is a functional component of EWAR. The information collected for EBS is diverse in nature and originates from multiple, often not-predetermined sources both official and unofficial, including rumours reported by the media or ad hoc reports from informal networks. The information collection process is mainly active and carried out through a systematic framework specifically established for EBS purposes.

2.2.1.3 Epidemic Intelligence (EI)

Epidemic Intelligence (EI) is defined as the systematic collection, analysis and communication of any information to detect, verify, assess, and investigate events and health risks with an early warning objective (as opposed to monitoring of disease trends or burdens). EI integrates both sources of information (IBS and EBS) in order to detect acute public health events and/or risks. (Figure 3)

2.2.2 SURVEILLANCE CONTINUUM AND IBS-EBS SPECIFICITIES

IBS and EBS are complementary sources of information, and both contribute to the early warning function critical for a prompt and proportioned response. The two are not necessarily separate surveillance systems; both are processed through a single activity (EI) and some of the surveillance functions might be common to both types. Nevertheless, when considering practical implementation, the definition of the process is essential. While routine surveillance (IBS) principles

are well-known, EBS is a relatively new concept that is not always well-understood. For these reasons, the two surveillance systems will be addressed separately in the present document.

Figure 3 - Indicator-based surveillance, event-based surveillances, epidemic intelligence and EWAR



Both IBS and EBS present intrinsic characteristics in terms of processes and type of the data or information collected. The IBS process is defined by public health professionals for their own specific programmatic use; data/indicators are developed accordingly and are collected and transmitted in routine (i.e. passively). Conversely, in most instances, both content and format of the information collected by EBS was not initially designed for this use (i.e. unstructured information). Some data might have been initially collected in a structured manner, but for a different audience, often with a non-human-health objective. One example might be veterinary data collected for an animal health purpose only.

The process itself is also subject to evolution. As EWAR matures, data collection may become more structured and systematic, and coordination with non-health partners better-organized. In this way, a data collection process initially developed as EBS may progressively be converted into IBS. An example is the way in which the ad hoc EBS-detection of climatic events (e.g. heat or cold waves)

could, over time, move toward a systematic collection and analysis of meteorological data with a definition of thresholds for human health, which then will pertain to IBS.

In many instances, the distinction is straightforward. For example, media always pertains to EBS while mandatory notification of human diseases pertains to IBS. For other data, according to the context, information in relation to the same event can be categorized differently. Some examples are provided (Table 1).

Table 1 - Example of IBS and EBS sources

The formal report by a health worker of an increase in the number of suspected deaths from cholera (as per the national case definition), drawing on health facility records	IBS
The ad hoc report by a community leader of several deaths due to acute watery diarrhoea among adults in his village (i.e. revealing a potential outbreak of cholera)	EBS
The notification by a country of the occurrence of locally acquired cases of dengue fever (a disease not previously present in the country) to neighbouring countries and to WHO	IBS
The ad hoc detection by country X that locally acquired dengue fever has been diagnosed in Country Z (neighbouring and sharing same ecosystem) through the consultation of country's Z MoH's website	EBS
The central pharmacy reports to the health authority that the sale of anti-malarial drugs in non-endemic areas has exceeded the normal pattern	IBS
A local pharmacy mentions to the local health authority that he is facing a shortage of anti-malarial drugs (medication seldom sold in his shop) due to increased demand	EBS
The local water monitoring scheme alerts the health authority about the abnormal turbidity and pH of the local river (no increase in bacterial flora reported) and its adverse effect on local fauna	IBS
Local residents complain to their local leader about the stench from the hundreds of dead fish that appeared in the river yesterday	EBS
In the scope of the National Zoonosis Control Scheme, the national veterinary service reports the occurrence of A/H5N1 Influenza in a large commercial free-range broiler flock	IBS
Unusual die-off of birds is reported by local farmers raising backyard chickens	EBS
National meteorological centre informs MoH that an unusual heat wave will strike the country in the coming weeks	IBS
Media reports note several deaths due to the unusual cold weather in the neighbouring country	EBS
The web-based sentinel self-reporting influenza-like illnesses (ILI) reports to the scheme that the seasonal ILI thresholds have been exceeded	IBS
The monitoring of information exchanges on internet and social networks shows an increase of messages/searches containing the word "flu"	EBS
The accidental pesticide contamination of several batches of cooking oil which have been exported to several countries is reported through IHR	IBS
The possible adverse effects attributed to the consumption of a sliming drug sold through the internet are reported in several international media sources	EBS
The analysis of the pupil attendance data collected by sentinel school programmes reveals an 20% decrease over the past 2 weeks	IBS
A factory director contacts health authorities to enquire about an ongoing outbreak and complains about a constant increase of workers on sick leave that affects the production of his food-processing plant.	EBS

For more information on EWAR:

Early warning surveillance and response in emergencies; Report of the second WHO technical workshop. Geneva: World Health Organization; 2012 (WHO/HSE/GAR/DCE/2011.2; http://whqlibdoc.who.int/hq/2011/WHO_HSE_GAR_DCE_2011.2_eng.pdf, accessed 31 March 2014).

A Guide to Establishing Event-Based Surveillance. Manila: WHO Regional Office for the Western Pacific; 2008. (http://www.wpro.who.int/emerging_diseases/documents/docs/eventbasedsurv.pdf, accessed 31 March 2014).

Early Warning and Response to Outbreaks and Other Public Health Events: A Guide. New Delhi: WHO Regional Office for South-East Asia; 2008 (SEA-CD-178; http://www.searo.who.int/entity/emerging_diseases/documents/SEA_CD_178/en/, accessed 31 March 2014).

Early Warning Systems. A State of the Art Analysis and Future Directions. Nairobi: United Nations Environment Programme; 2012 (https://na.unep.net/siouxfalls/publications/Early_Warning.pdf , accessed 31 March 2014).

Global Early Warning and Response System for Major Animal Diseases, Including Zoonoses (GLEWS). FAO OIE WHO; 2006 (<http://www.glews.net/2008/07/glews-global-early-warning-and-response-system-for-major-animal-diseases-including-zoonoses/>, accessed 31 March 2014).

Decision no 1082/2013/EU of the European parliament and of the council of 22 October 2013 on serious cross-border threats to health and repealing Decision No 2119/98/EC. (<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:293:0001:0015:EN:PDF>, accessed 31 March 2014).

3 ASSESSMENT PRIORITIZATION AND PLANNING

3.1 SCOPE AND PURPOSE

The objective of the assessment, prioritization and planning exercise is to determine the most urgent needs to be covered, and to develop accordingly the most appropriate strategy to achieve a sustainable and cost-effective reinforcement of the overall EWAR adapted to the country's specificities. The exercise should include a situation analysis which reviews the country's characteristics including health system features, a needs assessment, a gap analysis aiming at identifying the priority areas to strengthen and, finally, the elaboration of a plan of action.

3.2 SITUATION ANALYSIS

The aim of the situation analysis is to determine country characteristics that will impact the design and the development of EWAR. In order to provide a broader picture, this situation analysis should be based on a multisectoral approach applied to all phases.

3.2.1 MULTIDISCIPLINARY AND INTERSECTORAL MECHANISMS

The first step will be the identification of existing multi-disciplinary and intersectoral mechanisms, or their establishment with all relevant stakeholders. In order to ensure ownership and commitment of necessary resources, these relevant stakeholders will be involved in all stages of situation analysis, surveillance system assessment, prioritization of health risks (e.g. weighing and scoring each type of health risk), and planning. Membership may include both governmental and non-governmental stakeholders.

3.2.2 COUNTRY HEALTH PROFILE

The second step consists of establishing a set of assessment criteria for the different diseases, hazards and events to be prioritized. For EWAR, this may include: severity of disease, potential for spread, availability of control measures, potential links to travel and trade, international requirements, potential for intentional release and public perception.

The aim is to establish a comprehensive list of all health risks that may generate acute public health incidents in a given country (i.e. national risk profile). This list will serve as the basis for prioritizing events under EWAR, as well as for identifying key sectors to coordinate with and collaborate in EWAR implementation.

3.2.3 COUNTRY SPECIFICITIES

Because each country's situation is specific, national needs and circumstances that might require specific attention should be identified. These may include:

- **Country structure:** federal or centralized, autonomous or semi-autonomous regions, number of administrative levels
- **Geography:** size of the country, island versus landlocked state, overseas territories, hard-to-reach areas, variability of geographic characteristics
- **Climate / ecology:** tropical country, desert
- **Demographic:** size, population density, homogenous/heterogeneous country's distribution
- **Population characteristics:** ethnic/religious/linguistic minorities, nomadic population, large immigrant/emigrant communities
- **Other:** major tourism/pilgrimage/mass gathering destination, agriculture, industry

3.2.4 HEALTH CHARACTERISTICS

Characteristics of national health systems that influence the organization of surveillance should be identified for the planning exercise. These may include:

- **Type of system:** e.g. type and sophistication of health delivery systems, public and/or private sector, medical density, health-seeking behaviours, socio-economic factors that may predispose to certain health risks and existing laboratory infrastructure;
- **Accessibility to health care:** e.g. geographic accessibility (nationally and in less privileged/developed regions), access to primary secondary and tertiary facilities, financial accessibility, accessibility for special or vulnerable populations (such as minorities, migrants or children) and accessibility to diagnosis capacity (laboratory); and
- **Epidemiological profile :** e.g. national burden of diseases.

3.2.5 NATIONAL LEGAL FRAMEWORK SPECIFICITIES

Administrative organization of the surveillance system must be taken into consideration when implementing EWAR. In most countries, disease surveillance and control is a responsibility of the State, although the private sector may participate. Administratively speaking, it may be structured in two ways:

- The Ministry of Health may be in charge of both surveillance and control activities. In theory, this model allows a close integration of both early warning and response components, and ensures that decision-makers are directly associated with the collection of information for action.
- Surveillance activities may be delegated to an institution, such as a university or a public health institute, while the implementation of public health measures remain directly in the hands of the State. In theory, this model guarantees that the State receives independent scientific expertise.

Organization of EWAR within the surveillance system relies on a set of public health laws and regulations defining the list of diseases under mandatory notification, modes of reporting/notification, and which health professionals are required to notify. Legislative or regulatory modifications could be required in order to reflect changes introduced by integration of EBS components in the surveillance system; this should be considered in the early stages of EWAR implementation.

3.2.6 STRUCTURE OF SURVEILLANCE SYSTEM AND AVAILABLE DATA

The main surveillance components already implemented and the potential sources of early warning need to be determined:

- **Types of routine surveillance implemented:** these may include comprehensive or sentinel surveillance, syndromic surveillance, health-based surveillance, laboratory surveillance, community-based surveillance, hospitalization and mortality surveillance.
- **Domains covered by implemented national surveillance:** these may include infectious diseases, chronic and non-infectious diseases, and environmental and occupational health.
- **Mutualized facilities (networks & international collaborations):** all EWAR core capacities need to be acquired by the country. However, all facilities need not necessarily be physically present within the country. For small and/or resource-limited countries, international initiatives, such as bilateral and supranational agreements or disease-specific surveillance networks, may provide effective and cost effective alternatives. These allow mutualization of resources through inter alia reference laboratories, training and international risk mapping.
- **Alternative sources of information:** there should be a compilation of available sources of information, both health and non-health, which can be used for early detection of health events.

3.2.7 RISK MAPPING

National risk mapping

A review of all relevant data (e.g. surveillance and laboratory data and literature reviews) should be undertaken in order to identify the health risks that may affect the country. This mapping must address all acute health risks, and not be restricted to communicable diseases. The exercise should consider the identification and mapping across the country of, for example, industrial sites, large chemical installations, chemical, radioactive or hazardous material transportation routes, nuclear installations, poultry, meat or seafood processing sites, and areas at risk for flooding or earthquakes.

International risk mapping

Health risks occurring abroad which could represent a potential threat for the country must be identified (Box 1). Identification of health risks that have not yet affected the country is an important contribution of EBS, as it will allow national authorities to anticipate mitigation and control measures), such as:

- Implementing temporary recommendations issued by WHO following the determination of a PHEIC;
- Reinforcing laboratory capacities to diagnose emerging diseases or establish partnerships with other laboratories;
- Adapting case definitions and surveillance modalities;
- Removing contaminated products from the market and/or preventing their importation and exportation;
- Considering temporary blood donor restrictions; and
- Informing the population of the risk and the action to be taken in case of exposure.

Box 1 – Examples of international health risks

- Confirmed cases/deaths of epidemic-prone diseases representing a risk of spread to the country
- Confirmed cases / deaths of emerging pathogens with no or limited knowledge about the mode of transmission, risk of spread and severity
- PHEIC, as declared by WHO
- Contaminated food imported to the country
- Contaminated food exported from the country (and detected abroad)
- Epizootic reported in a neighbouring country or in a country exporting (potentially infected) animals to the country
- Contamination of river flowing into the country
- Radiological and nuclear or chemical incident with atmospheric release of contaminants
- Mass gathering with participation of nationals
- Conflicts close to national borders

International collaboration, particularly regional networks, is well-suited to efficiently mutualize this cross-border risk mapping.

3.3 NEEDS ASSESSMENT AND GAP ANALYSIS

3.3.1 ASSESSMENT OF THE SURVEILLANCE SYSTEM

This assessment aims to identify where available resources, especially EBS, can be best utilized to reinforce EWAR. The process should focus on the evaluation of the surveillance system's performance in terms of early detection of events that pose serious threat to human health and the actions taken to control them. The main indicators to consider are: completeness (including coverage), representativeness, timeliness, sensitivity, positive predictive values and flexibility of the existing system. For more information, refer to Monitoring and Evaluation of IBS in Section 6.2.

The assessment should be based on consensus-building, analysis of existing data, establishment of working groups and conducting in-depth interviews, as required. It should be based on an all-hazards approach and include the assessment of non-communicable diseases and hazards surveillance systems (i.e. those for chemical, radiological, nuclear or natural disasters).

Most existing tools and guidelines are related to the evaluation of the performance of communicable disease surveillance systems. Nevertheless, indicators and methodology can be adapted to the evaluation of non-communicable diseases and health risks.

3.3.2 GAP ANALYSIS

The gap analysis should be performed to complement the situation analysis and the assessment of the surveillance system. It aims to assess the country's specific needs and environment, and to review the strengths, weaknesses, threats and opportunities around the existing national surveillance system in order to identify where EBS and available resources can be best utilized to reinforce EWAR.

Gap analysis does not require that a new or additional formal evaluation be carried out. Providing that they are still representative of the situation and that they were methodologically sound, the results of previous evaluations of the surveillance system could be reused for the gap analysis. If not all information is available, working groups or in-depth interviews with stakeholders at all levels of the surveillance system could be considered.

3.3.3 PRIORITIZATION

Domains potentially covered by IBS and EBS are extremely broad, and it is essential to define precisely country-specific needs and to develop objectives, strategy and scope of health events to be covered. Accordingly, the implementation and strengthening of IBS and EBS should be preceded by an assessment of the country's actual capacities for early detection of acute public health events at the central, intermediate and local levels, in order to ensure better integration within EWAR.

Whenever possible, the strengthening of existing IBS components should be given priority through, e.g., promoting timeliness, extending geographic coverage and increasing sensitivity or specificity. EBS should be considered especially for complementing or covering specific unattended needs of a country including, but not limited, to hard-to-reach regions, specific populations, specific health risks and rare and emerging diseases or hazards. The prioritization exercise should be closely linked to national preparedness planning, which in many countries assesses the existing threats and vulnerabilities to human health within the civil protection or health sectors. It should be coordinated with the list of health risks and be based upon consensus-building.

In order to ensure the most efficient use of resources, the elaboration of the EBS strategy should be based on the prioritization exercise and the results of the gap analysis. It should take into consideration country specificities, the international context, the characteristics of health care, the characteristics of the surveillance systems and its performances. The resulting strategy, adapted to a country's specificities, might be unique, some examples of possible strategies are provided (Table 2).

At the end of the process, the list of priority events for surveillance should be established. Such a list may contain diseases (e.g. measles), syndromes (e.g. haemorrhagic fevers), hazards (e.g. contamination of drinking water source), and unexpected/unusual events (e.g. unexplained mortality). For each selected health risk, EWAR's surveillance objectives need to be specified based on the country's context. The objectives will depend on the characteristics of the disease or hazard (e.g. attack rate, morbidity and mortality, setting), the mode of transmission (e.g. person to person, point source outbreaks, exposure to toxics), and the nature of the public health interventions required to control spread.

Table 2 - Examples of possible of EBS strategies

Example 1: When a comprehensive and efficient communicable diseases IBS is in place across the national territory, focusing EBS on the detection of generic infectious diseases events may yield limited benefits. Conversely, implementing EBS for early detection of threats related to environmental, food safety or contaminated products would significantly reinforce EWAR.
Example 2: When IBS relies mainly on health-based mandatory notification and access to basic health care is limited in hard-to-reach regions, strengthening IBS in hard-to-reach regions will have a limited impact (due to the limited access to health care). However, the implementation of community-based EBS in those in hard-to-reach regions could substantially complement the EWAR.
Example 3: When the current IBS system's acceptability is low (e.g. health care in private sector, poor compliance among GPs, or non-functioning mandatory notification) and where local media are widely accessible, media monitoring can be used to complement the early detection function.
Example 4: In a country where the existing national surveillance system is considered to lack sensitivity and where resources are limited, EBS could focus on detecting domestic health risks.
Example 5: In a country with several open borders, EBS might be used to monitor the health risks occurring in countries' neighbouring provinces that may spread across the border or be imported into the country.
Example 6: A country with large immigrant, emigrant or tourist influxes could implement EBS dedicated to detecting major health threats in the principal countries of origin or destination of migrants or tourists.
Example 7: A country where conditions are prone to the introduction of new vector-borne diseases (introduction of a new vector and or agent) could choose to focus its national and international EBS accordingly.

For more information on prioritization:

Setting priorities in communicable disease surveillance. Lyon: World Health Organization; 2006 (WHO/CDS/EPR/LYO/2006.3; http://www.who.int/csr/resources/publications/surveillance/WHO_CDS_EPR_LYO_2006_3.pdf, accessed 31 March 2014)

3.4 PLAN OF ACTION

Once the prioritization exercise has been completed and all potential sources of information listed, objectives of EWAR will be identified. The prioritization of health risks should guide the development of a plan of action for the implementation of EWAR at the national, intermediate and local levels. The plan of action should be well-integrated with the current surveillance system and EWAR, including a monitoring and evaluation component.

In order for EWAR to be fully functional, the plan of action should prioritize diseases and hazards under surveillance and identify the corresponding sources of information at all levels. It should also define data collection, reporting and analysis procedures and identify investigation and response mechanisms to be put in place. Finally, it should describe the organization of EWAR within the overall surveillance system, including the mobilization of human, material and financial resources and the coordination with national and international stakeholders.

3.4.1 MULTISECTORAL PARTNERSHIP

An inter-agency coordinating committee should be created, including representatives from the central EWAR coordination unit, the IHR focal point and the various agencies and ministries involved in EWAR. These may include directorate of health services, public health agencies, national reference laboratory, agriculture sector, food safety agency, environmental and other agencies involved in chemical risks, radio-nuclear regulatory bodies, and animal health/veterinary services. The committee should meet regularly, on a monthly or quarterly basis, in order to:

- Prepare and regularly review the national public health emergency response plan;
- Exchange information on risk monitoring;
- Monitor stocks of equipment for event investigation and response;
- Assign task forces to address specific problems identified and provide recommendations; and
- Identify and mobilize adequate financial resources to limit disease spread.

In order to promote involvement of all partners, this inter-agency coordinating committee should be conceived to promote multi-directional information exchanges in order to ensure a mutual benefit for all partners across health and non-health sectors. Suboptimal functioning of this type of committee is often related to information flowing only from non-health sectors toward the health sector. It should be emphasized that non-health sectors should equally benefit from information provided by the health sector. In many instances, human cases can be the first indication of a threat to other sectors than human cases. For example:

- Animal health services will be impacted by cases of Congo-Crimean haemorrhagic fever, as cases in humans constitute the primary indicator for viral circulation in animals as infection is asymptomatic in livestock; and
- Information regarding human intoxication would be essential for groups such as environmental services, industry and customs to be able to determine the source of the contamination and to be able to take the corrective measures such as strengthening hygiene measures in food processing plants or withdrawing the contaminated product from the local market or preventing its importation.

Similarly, some stakeholders such as the Ministry of Agriculture (MoA) or the Ministry of Environment (MoE) may develop their own capacities around early warning for detection of events that may represent an immediate threat to their direct interests in addition to human health. Formalized partnerships must be established between the various stakeholders to disseminate EWAR information in a timely and efficient manner.

3.4.2 POLITICAL COMMITMENT

The success of strengthening or implementing EWAR depends upon a strong commitment by national health authorities. This must be supported by a broader political commitment. As EWAR moves beyond detecting and responding to local and national communicable disease threats, it will require the active participation and commitment of multiple sectors outside of health.

3.4.3 OTHER MAIN STEPS OF THE PLAN OF ACTION

The other main steps of the plan of action should include:

- Defining data collection, reporting and analysis procedures;
- Identifying investigation and response mechanisms to be put in place;
- Describing organization of EWAR within the overall surveillance system;
- Ensuring mobilization of human, material and financial resources;
- Organizing coordination with national and international stakeholders; and
- Planning, evaluation and monitoring.

For more information on planning:

Communicable disease surveillance and response systems. A guide to planning. Lyon: WHO; 2006 (WHO/CDS/EPR/LYO/2006.1; http://whqlibdoc.who.int/hq/2006/WHO_CDS_EPR_LYO_2006_1_eng.pdf, accessed 31 March 2014).

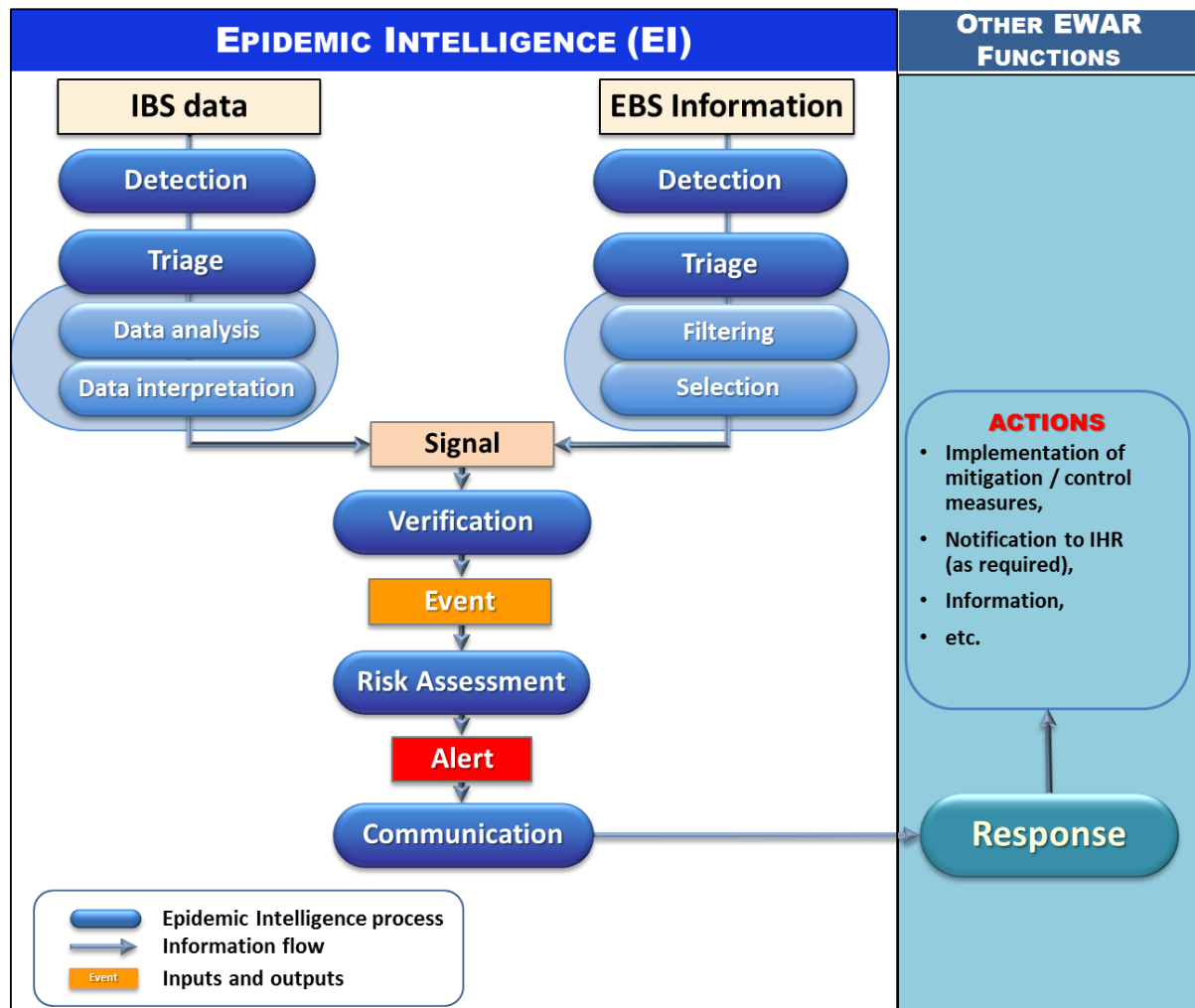
4 IMPLEMENTATION OF EWAR & EBS

4.1 EARLY DETECTION PROCESS: EPIDEMIC INTELLIGENCE

Within EWAR, the collection of data (IBS and EBS) with the aim of detecting emerging health threats is part of a single process called epidemic intelligence. This process should be able to monitor all prioritized health events and acute public health risks within a given country, as well as events reported from other countries and which have the potential to affect the country. Epidemic intelligence can be organized into five main phases (Figure 4):

- **Detection** of raw data (IBS) and of raw (unverified) information (EBS)
- **Triage** of relevant data and information
- **Verification** of signal
- **Risk assessment** of the event
- **Communication**

Figure 4 - Epidemic intelligence process



4.1.1 DETECTION OF RAW DATA AND INFORMATION

The detection phase consists of:

- Defining the modality through which data and information will be collected; and
- Implementing the data collection and information-seeking schemes.

The protocols for detection of raw signals, i.e. untreated information or data, differ slightly depending on whether the original data collection is made through IBS or EBS:

- **Detection (collection) of IBS data:** IBS depends upon the collection of predefined surveillance data to produce indicators. For IBS, the detection phase will consist of defining the type and the modality (such as format of collection or mode and frequency of transmission) of the surveillance data to be collected for early warning purposes.
- **Detection of EBS data:** For EBS, raw information is generally made up of information originating from formal and informal sources that have been collected by a number of mechanisms (e.g. direct communication, internet-based devices, hotlines and literature reviews) that will be defined according to a country's needs.

4.1.2 TRIAGE

Triage is crucial not only to ensure that acute public health events and health risks are effectively detected, but also to avoid overwhelming the epidemic intelligence system. This stage consists of sorting data and information into the categories of "likely to be relevant" and "not likely to be relevant" for early detection of health events requiring a rapid response.

Regardless of the mode of acquisition of information, not all raw (i.e. untreated) data and information, even that primarily detected by IBS, corresponds to genuine acute public health events. Rather, some might correspond to mild diseases or hazards for which no control measure is available, or to the modification of long-term trends for endemic diseases that would require further investigation. Once triaged, relevant data and information become a **signal**.

4.1.2.1 Triage of IBS data

Triage of IBS data can be subdivided into two steps: data analysis and data interpretation.

Data analysis :

The analysis of data consists of checking quality and performing descriptive and analytical epidemiology, i.e. to organize data by time and place and to stratify by risk factors (e.g. age or sexual behaviour) or exposures (e.g. travel history or exposure to vectors). This is usually done with appropriate tables, figures and maps. In modern surveillance systems, this can be automated to a high degree. Ideally, statistical methodology is used to verify clustering, patterns or trends in data.

For diseases and hazards, it is necessary to define the surveillance indicators that are best suited to trigger signals and which value of the indicator (the threshold) is considered abnormal or unusual and may require a public health intervention. It is also important to define indicators such as timeliness to better monitor the surveillance process:

- The threshold may be set to one case, as the occurrence of a single case for certain diseases or events may require a public health intervention. Examples might include haemorrhagic fever or the contamination of water sources or food products. This is also the case for those diseases for which immediate notification is required under the IHR: smallpox, wild-type poliovirus, new subtype of human influenza and SARS.
- For more common diseases, thresholds can be set depending upon the rate observed over a given time period (e.g. meningitis in Africa), or based on an increase in comparison with baseline data (e.g. ILI or air pollution). Indicators must be defined in terms of time and place (e.g. number of cases/week/district).

Data interpretation :

Data interpretation is the qualitative assessment of the significance of the detected raw signal. To interpret unusual patterns, different elements need to be considered. These include seasonal, geographical and historical patterns, clinical or biological elements (e.g. changes in antimicrobial resistance profiles, severity, clinical presentation or case fatality rates) and demographic information e.g. identification of group at risk such as a highly affected age group or professions such as health workers, farmers, or a specific industry.

Not all signals detected will correspond to a genuine public health event. This is the price to pay for having a sensitive system capable of identifying all acute public health events requiring immediate public health action. False alerts in routine surveillance may also be due to surveillance biases:

- For individual notifications, biases are often related to the improper use of case definitions leading to false positive diagnosis. In this situation, validation consists of having the suspect diagnosis confirmed or ruled out through further clinical and/or laboratory examination.
- For aggregated notifications, biases can relate to the use of improper denominators or to changes in attendance of health services relating to drug availability, social events or security issues.

A search for such artefacts is an initial step in the unusual health events validation process. It should be emphasized that **data need to be analysed at all levels of the national health structure**, from local to national levels.

4.1.2.2 Triage of EBS information

Because of the nature of the information collected and because it aims to be highly sensitive, EBS is likely to generate a high proportion of rumours as well as duplicate and irrelevant information. The objective of triage of EBS raw information aims both to limit the unnecessary verification and investigation of irrelevant signals, and to ensure that genuine events will elicit an effective response. Triage of raw EBS information can be divided in two steps: filtering and selection.

Filtering :

Filtering is the process of screening out duplicates and information which is not relevant for EWAR. It is made up of:

- **Identifying duplicates**, i.e. the same event reported by the same source. For example, the same cluster of acute respiratory infections among children can be reported by several local and regional newspapers.
- **Identifying and discarding information not relevant to EWAR**, i.e. information that matches the criteria set for early warning or information in relation to a health topic but is irrelevant for early warning purposes. This might include a case of flu in a local football star, or a generic description or review of a disease.

The filtering should be designed to ensure adequate sensitivity; in case of doubt, the signal should be sent to the next step (selection). One example of filtering consists of training secretarial staff to read local and national news and to select relevant health-related articles. These articles will then be sent to the next step, where persons trained in epidemiology can proceed with selection.

Selection :

Selection is the sorting out of information according to national priority criteria, for instance involving “discard” of information and reports concerning non-prioritized mild diseases such as the common cold, or related to an increase of cases consistent with the known seasonal periodicity of a disease.

Selection is the phase that has the greatest impact on the capacity of EBS to provide early detection. It must be performed by epidemiologically-skilled personnel, as it consists of identifying among all signals the ones that should be further investigated (i.e. verified and risk-assessed). The effectiveness of this will rely heavily on the formalization of the EBS process, particularly the use of consistent selection criteria.

In contrast to IBS, the information used for EBS is frequently not primarily designed to inform public health action. Hence, data will often contain only part of the information necessary for assessing their importance for public health. For instance, media or community-based EBS information might not contain elements such as potential diagnosis or disease names. It is more likely to refer to “unknown” and “mysterious diseases” or to non-specific syndromes such as “high fever and muscle pains”. It can also report numbers of “potential cases or deaths” but not discriminate between causes (e.g. “25 villagers died over the past week”).

The difficulty will be to select from the bulk of the raw signal the information likely to be referring to a non-expected or serious event. This selection process will have to be based on the EBS priority list, the reliability of the source and the access to baseline epidemiological data such as expected incidence rates (including at provincial and local levels), usual seasonality and annual variations, regional distribution of diseases, known at risk population and severity of the reported events.

While assessing the raw information, classical pitfalls should be avoided (Table 3):

- A signal referring to a serious life-threatening disease or epidemic-prone disease does not necessarily mean that this event will be relevant for EBS in general and EWAR in particular. For example, a single case of meningitis in a well-known endemic area (covered by IBS) will not require immediate intervention.
- A large number of cases does not mean that an event is necessarily “serious”, while a single case of a new disease could represent a genuine threat.
- A sensationalist report in the press such as “A threefold increase of influenza cases was reported” may actually conform to the known seasonality trend.

Table 3 - Examples of usual and unusual events

Usual	Elevated number of cases but in conformity with what is expected at the beginning of the transmission season Slightly above what expected but within annual variations Below what is expected because the previous years’ viral circulation was low
Unusual	Occurs completely out of the normal seasonal pattern Occurred over a short period of time and in a limited geographic area. Affects a significant proportion of health workers Number of cases as expected but CFR is significantly higher than expected Detection of new features (atypical symptoms, specific population group, resistance, newly imported disease, etc.)

Obviously, other elements in relation to the event would also need to be taken into consideration in the selection process, for instance:

- Risk for other countries, travel and/or trade;
- Risk to the health system; and
- High media attention expected or reputational risk.

4.1.3 VERIFICATION

Verification is an essential step of the epidemic intelligence process that consists of confirming the reality (authenticity and conformity) of the signal and its characteristics. This is done by actively cross-checking the validity of the information using reliable sources, or verifying pertinence in order to confirm and, when possible, to characterize the nature of the event.

It is also an opportunity to collect additional complementary information which will be needed for the risk assessment, such as the number of cases and deaths, place and date of occurrence, presenting syndromes or biological findings. Verification will vary according to the source and the event, but it could consist of:

- Contacting local health authorities;
- Contacting the original source;
- Cross-checking with other sources;
- Collecting additional information; and
- Checking for official information available on the internet.

EWAR staff must be continuously aware of on-going alerts and be capable of initiating and coordinating verification procedures on a short-term basis. Mechanisms for issuing alerts and communicating information with partners within and outside the health sector at all levels (peripheral, intermediate, national and international) are needed to perform this activity in a systematic and prompt manner.

Verification is essential for both IBS and EBS, but is clearly crucial for EBS. Because of its high sensitivity, EBS is likely to detect hoaxes and false rumours. Potential sources of EBS information cannot always be trusted or considered as reliable. For instance, the press and internet media can present information in a sensational fashion or from a biased viewpoint. Therefore, the authenticity of the event needs to be established before embarking in the next stage (risk assessment). The systematic verification of all signals detected through EBS should be set as a prerequisite. Once the signal has been verified, it is called an “**event**”.

4.1.4 COLLECTING ADDITIONAL INFORMATION

All data needed for the assessment and the characterization of the risk might not be present in the initial signal, especially when originating from a non-official source. The search for complementary information is part of surveillance for both EBS and IBS, and contributes to verification and risk assessment processes.

Data to be collected about priority events should be well defined and standardized. Data collected should facilitate the description of the event in term of time and place of occurrence, as well as its nature and magnitude (Box 2).

Box 2 – Type of additional information needed to assess the nature and magnitude of events

- Nature of the event / agent / disease
- Source of event identification
- Location of the event
- Potential origin (infectious, chemical, radiological, nuclear)
- Date of event or date of onset
- Number of cases/deaths, severity of case
- Number of people potentially exposed to the hazard
- Groups affected (e.g. age, occupation, gender)
- Common clinical/laboratory characteristic among affected
- Likelihood of an intentional release
- Likelihood of group intoxication/contamination
- Potential for importation of cases to the country (for international events)

4.2 SOURCES OF EARLY WARNING INFORMATION

4.2.1 SOURCES FOR INDICATOR-BASED SURVEILLANCE

4.2.1.1 Type of surveillance

The type of IBS surveillance selected should be appropriate to diseases of interest, available sources of information, medical standards, characteristics of the country and available resources. Several categories of IBS surveillance exist. They include biological surveillance, syndromic surveillance, comprehensive surveillance and sentinel surveillance. It should be borne in mind that the above-mentioned categories are not mutually exclusive; a sentinel surveillance system can be syndromic for influenza alongside a comprehensive etiologic surveillance system for polio. Furthermore, they can evolve over time: a country's coverage could be sentinel to begin with and slowly evolve into one with more complete coverage as the system matures. Because EWAR should achieve the highest level of sensitivity, cases of diseases reported by health providers to EWAR rely most often on syndromic criteria based on clinical appraisal such as acute watery diarrhoea, fever and rash or acute jaundice syndrome. This information should be supplemented by access to the necessary laboratory capacity to confirm cases during investigation.

Comprehensive routine surveillance:

In a comprehensive routine surveillance system, all identified sources are required to report. This approach is better suited to diseases under elimination or eradication, and to diseases and hazards requiring immediate public health action.

Mandatory notification is part of comprehensive surveillance. For certain diseases or hazards, the occurrence of a single suspected case or death represents an unusual event and must be immediately reported. A single case, if confirmed, is sufficient to trigger a public health action. A list of diseases and syndromes requiring immediate reporting for a single suspected case or death should be agreed upon and distributed at all levels of the health system, including the laboratories. These diseases and hazards could be:

- Emerging or re-emerging communicable diseases (e.g. SARS, avian influenza, MERS-COV);
- Diseases targeted for elimination or eradication (e.g. polio, measles);
- Severe diseases e.g. with high CFR and/or with high potential for spread (e.g. meningococcal meningitis);
- Diseases of public health importance that are never/rarely diagnosed in the country and/or linked to travel and trade (e.g. Rift Valley fever);
- Severe adverse reactions or death following medicine or vaccine uptake;
- Excess exposure to radiation (e.g. faulty X-ray machine, inadequate radiotherapy);
- Contamination of food or medicine; and
- Diseases with potential for intentional release (e.g. anthrax, tularaemia, chemical poisoning).

Sentinel surveillance:

In sentinel surveillance systems, only a fraction of health-care structures are required to report. This approach is more suited for frequent diseases for which the alert will be issued in case of a change in the pattern of the reported cases, for diseases not requiring immediate public health action that targets individual cases to prevent the spread (e.g. influenza), for common epidemic-prone diseases (e.g. vaccine-preventable diseases not targeted for eradication or elimination), and for endemic diseases that are not evenly distributed across the national territory.

For diseases that are seen by particular specialist services, specific surveillance networks can be set up. These may consist of, for example, paediatricians for whooping cough or neurologists for Creutzfeldt-Jakob disease. Such networks are especially well-suited for rare diseases in which specialists are motivated to provide complete and high-quality surveillance data.

Conventional disease-specific surveillance :

This type of surveillance is based on highly specific case definitions that usually include biological, clinical and/or para-clinical (e.g. X-ray) components. Widely applied to communicable diseases, biologically-based surveillance is essential to monitoring the dynamics of events and their potential risks, as well as case management. It is widely applied to discriminate between diseases with similar symptoms, to determine the species of a pathogen and to establish epidemiological links between events occurring in different locations. This type of surveillance is resource-intensive, but it provides validated information that reduces the risk of verifying too many "false alerts". A balance must be struck taking sensitivity, specificity, timeliness and feasibility into consideration.

Syndromic surveillance :

Case definitions used for syndromic surveillance are made up of associations of symptoms without etiological confirmation. Syndromic surveillance needs sensitive, simple and stable case definitions. It permits immediate reporting and, above all, wider surveillance coverage allowing for the early detection of emerging diseases. It is especially suited to monitoring frequent or seasonal diseases for which case management does not require individual etiologic confirmation, such as mumps or seasonal influenza. Syndromic surveillance can play an important role in strengthening surveillance even in low-to-middle-resource countries and thus contribute to fulfilling IHR early detection and response requirements. On the other hand, syndromic surveillance provides lower levels of specificity and is therefore not suited to for diseases requiring long and/or specific treatment or measures, such as tuberculosis, or to those requiring a specific diagnosis including diseases under eradication or elimination such as measles or polio.

4.2.1.2 Sources of IBS data

Several sources can provide IBS data:

- **Health-care facilities** constitute the main sources of IBS data. These include primary health-care centres and hospitals from public and private sectors, as well as childcare centres, military health services, penal health services, refugees camps health centres, poison control centres, and temporary structures set up for mass gatherings.
- **Laboratories**, both public and private, also constitute a primary source of data.
- **Death registers** may show changes in the numbers and patterns of causes of deaths, and thereby provide early indications of an on-going epidemic event, although frontline health-care workers may detect and notify such phenomena in a more timely way.
- **Non-health sources** of information may also be considered for IBS. For instance, meteorological, entomological, school absenteeism or medicine sales data can be used as surrogates to anticipate or to detect the occurrence of an acute health event. In this case, the implemented data collection process must be regular, and case definitions and thresholds must be established.

For more information on surveillance systems:

Technical Guidelines for Integrated Disease Surveillance and Response in the African Region, 2nd ed. Brazzaville, Atlanta: WHO Regional Office for Africa, CDC; (2010)

(http://www.cdc.gov/globalhealth/dphswd/idsr/pdf/Technical%20Guidelines/IDSR%20Technical%20Guidelines%202nd%20Edition_2010_English.pdf, accessed 31 March 2014).

Principles of Epidemiology in Public Health Practice, 3rd ed. Atlanta: CDC; 2012

(http://www.cdc.gov/osels/scientific_edu/ss1978/SS1978.pdf, accessed 31 March 2014).

WHO Recommended Surveillance Standards, 2nd ed. Geneva: WHO ; 1999 (WHO/CDS/CSR/ISR/99/2/EN;

http://www.who.int/csr/resources/publications/surveillance/WHO_CDS_CSR_ISR_99_2_EN/en/, accessed 31 March 2014).

WHO, OIE, FAO. Zoonotic Diseases: A Guide to Establishing Collaboration between Animal and Human Health Sectors at the Country Level. Geneva: World Health Organization; 2008. (<http://www.oie.int/doc/ged/D12060.PDF>, accessed 31 March 2014).

Challenges of Animal Health Information Systems and Surveillance for Animal Diseases and Zoonoses. Rome: FAO; 2011.

(<http://www.fao.org/docrep/014/i2415e/i2415e00.pdf>, accessed 31 March 2014).

4.2.2 SOURCES FOR EVENT-BASED SURVEILLANCE

EBS requires a multisectoral approach and should rely on sources of information beyond traditional health system sources. While these may be directly linked to human health, data can also be provided by the non-human health sector, local communities, media and international sources. The main sources include the following:

Human sources

- **Health providers and laboratories:** *ad hoc* and unstructured reports may be available from primary health services and hospitals from public and private sectors as well as pharmacies, health services at points of entry, military health services, penal health services or major health insurance organizations. These groups may also provide systematic, structured information to IBS as part of the routine surveillance.
- **Community-based medicine, community health workers and traditional birth attendants:** these constitute privileged sources of information due to their connections with the local community and their presence in the field, especially in remote areas where access to primary health care is scarce.
- **Traditional medicine and traditional health practitioners and healers:** in some Asian and African countries, 80% of the population depend on traditional medicine for primary health care. Traditional medicine has been used for thousands of years, and these practitioners may constitute a valuable source of information.
- **Alternative medicine, complementary medicine and non-conventional medicine:** these include health care practices that are not part of that country's own tradition and are not integrated into the dominant health care system; they are gaining in popularity and should be considered as a potential source of health information.
- **Drug supply agencies and pharmacy sales:** medication consumption or sales may be used as a surrogate for disease occurrence. This may help identifying new pathogens or the extension of a pathogen in a new area. The discovery of AIDS in 1981 in the USA is an example of an alert triggered by the abnormal consumption of the drug pentamine, used for the treatment of *Pneumocystis carinii* pneumonia which is one of the complications of AIDS.
- **Points of Entry:** PoE, which are regulated under the IHR, should detect many events of potential interest to national EWAR, including those detected through inspections and other procedures carried out at international ports and airports for arriving ships/aircraft through IHR Ship Sanitation Certificate procedures, through health disclosure requirements for ships in the IHR Maritime Declaration of Health, and the health status and risks reported by arriving aircraft required through the Health Part of the Aircraft General Declaration. These can include the detection of infectious cases disease among arriving travellers, other risks arriving on international ships and aircraft or importation of goods contaminated by biological or chemical hazards.
- **Poison control centres:** these usually operate hotlines and may be the first point of contact for patients exposed to some poisonous substances and seeking advice. Clustered events detected through these calls may represent the first signal of an outbreak.
- **Educational establishments:** the reporting by the school system of unexpected level of absenteeism among pupils or children may be used as a surrogate for disease occurrence.
- **Labour and industry sources:** reporting by labour-related sources, including private enterprises, of unexpectedly high level of absenteeism among workforce may likewise be used as a surrogate for an acute public health event. They may also report unusual chemical accidents or detection of contaminated products.

- **Red Cross / Red Crescent societies, NGOs and fire brigades, as well as Emergency Crisis Coordination Centres:** all of these are important sources of information particularly in case of natural and manmade disasters including flooding, earthquakes, hurricanes, landslides or movements of refugees/internally displaced persons that may represent a potential immediate risk to human health.

Non-human health sources

- **Veterinary services:** changes in animal health might provide early warning for potential threats to human health. This is the case for domestic animals (i.e. poultry die-off and risk of avian flu) as well as livestock (i.e. epizootic of Rift Valley fever in sheep) and wildlife (i.e. primate die-off and the risk of Ebola), or the emergence of new antimicrobial resistance in zoonotic pathogens.
- **Entomological and vector-control services:** vector density and/or the introduction or dissemination of a new vector would indicate an increased risk of vector-borne disease outbreaks.
- **Food safety agencies:** these routinely check food items and other consumer products for quality and potential contamination that could represent a threat to human health.
- **Water supply companies and sanitation authorities:** these carry out health inspections in restaurants and canteens, hotels, buildings, swimming pools and other public structures. Any detection of biological, chemical or radiological and nuclear hazards which represents a health risk in case of human exposure, such as the isolation of legionella in a cooling tower or the detection of biological or chemical contamination of water. must be reported immediately.
- **Meteorological and air quality agencies:** these should report any forecast or observation of extreme temperatures (i.e. heat waves and cold waves) or peaks of air pollution in urban settings.
- **Police, customs and fraud control, and intelligence agencies:** these represent important sources of information relating to contaminated and/or illegally imported products and potential bioterrorist activities.
- **Atomic/ Radiation Safety Authority:** this group reports any accident, contamination or intentional release involving radiological and nuclear hazards, as it may represent a risk to human health.

Community-based sources

- **Community or religious leaders and civil society:** these individuals and groups may provide informal reports of unusual health events or health risks that they witness in their communities.

Media and informal sources

- **Media:** local, national and international media are important source of information for EBS. Events such as clusters of human cases, outbreaks or unexpected deaths may be covered by local newspapers (printed or available through the internet) or radio reports before they are detected and reported by local health services.

Internet

Most of the potential sources listed below have dedicated websites available both at national and international levels:

National sources include official websites of:

- Ministry of Health, national public health institutes and references laboratories;
- Local and regional health authorities (especially in large and/or federal states);

- Public health agencies in charge of medicine, food products, poison centres, etc.;
- Ministries of Agriculture, Education, Environment, Foreign Affairs, Customs, Labour; and
- Civil society and NGOs.

International official sources: these are used to identify events reported from a foreign country which are considered to be a potential national or international threat to public health, even if they are not (yet) identified as being present in the country. Several international organizations and networks that provide information on outbreaks, exposures and risks may be monitored by national EWAR.

Cross-border initiatives: transnational cooperation can help to ensure a coordinated and expedited detection and response to emerging public health threats.

WHO early warning websites

IHR Event Information Site (EIS)	Secured platform, accessible only to NFP
WHO disease outbreak news	http://www.who.int/csr/don/en/
Global Outbreak Alert and Response Network-(GOARN)	Communications platform for the members of GOARN
Regional Office for Africa	http://www.afro.who.int/en/clusters-a-programmes/dpc/epidemic-a-pandemic-alert-and-response/outbreak-news.html
Regional Office for the Americas	http://new.paho.org/hq/index.php?option=com_content&view=article&id=1239&Itemid=2291&lang=en
Regional Office for the Eastern Mediterranean	http://www.emro.who.int/surveillance-forecasting-response/outbreaks/
Regional Office for Europe	http://www.euro.who.int/en/what-we-do/health-topics/emergencies/international-health-regulations/news
Regional Office for South-East Asia	http://www.searo.who.int/entity/emerging_diseases/en/index.html
Regional Office for the Western Pacific	http://www.wpro.who.int/emerging_diseases/en/index.html

Other international agencies early warning websites

Food and Agriculture Organization United Nations (FAO)	http://www.fao.org
World Organisation for Animal Health (OIE)	http://www.oie.int
International Food Safety Authorities Network (INFOSAN)	http://www.who.int/foodsafety/fs_management/infosan/en/
The International Atomic Energy Agency (IAEA)	http://www.iaea.org/

Examples of disease-specific international websites

Global Influenza Surveillance & Response System	http://www.who.int/influenza/gisrs_laboratory/en/
Meningitis Vaccine Project (MVP), Sub-Saharan Africa	http://www.meningvax.org/mission.php
Polio Eradication initiative	http://www.polioeradication.org/
WPRO A/H5N1 Avian influenza	http://www.wpro.who.int/emerging_diseases/AvianInfluenza/en/
ECDC West Nile	http://www.ecdc.europa.eu/en/healthtopics/west_nile_fever/west-nile-fever-maps/pages/index.aspx

Examples of institutional travel health websites

WHO International Travel Health website;	http://www.who.int/ith/en/
Centers for Disease Control and Prevention (CDC)	http://wwwnc.cdc.gov/travel/
National Travel Health Network & Centre (NaTHNaC)	http://www.nathnac.org/travel/
Department of Health, Hong Kong SAR, China	http://www.travelhealth.gov.hk/eindex.html
Travel Health, Public Health Agency of Canada	http://www.phac-aspc.gc.ca/tmp-pmv/
Ministry of Foreign Affairs, France	http://www.diplomatie.gouv.fr/fr/conseils-aux-voyageurs/
Ministry of Foreign Affairs and Trade, Australia	http://www.smartraveller.gov.au/

Examples of supranational and regional EWAR Websites

European Centre for Disease Prevention and Control (ECDC)	http://www.ecdc.europa.eu/en/press/epidemiological_updates/
Caribbean Public Health Agency (CARPHA)	http://carpha.org/
Pacific Public Health Surveillance Network (PPHSN)	http://www.spc.int/phs/PPHSN/
EpiSouth (Mediterranean and Balkan Countries)	http://www.episouth.org/
EpiNorth (North-Eastern Europe)	http://www.epinorth.org/
Mekong Basin Disease Surveillance Network	http://www.mbdsoffice.com/

4.3 DATA COLLECTION AND PROCESSING

4.3.1 TYPES OF DATA COLLECTION PROCESSES

The data collection process can either be:

- **Passive:** transmission of data to the teams in charge of their analysis is the responsibility of those providing the data and/or may occur automatically through a variety of defined structures. Both collection and transmission should comply with formalized procedures relating to specific case definitions, format of data, and periodicity of transmission. This type of collection applies mainly to IBS.
- **Active:** data are actively collected by the team in charge of their analysis. They are collected according to previously defined criteria, in a normalized format (e.g. in standardized forms) and from a changing number of potential sources.

4.3.2 IBS COLLECTION PROCESS

Collecting IBS data implies establishing case definitions of disease/syndrome, identifying appropriate sources of information, and deciding frequencies and mechanisms for data transmission. IBS data collection process is fully covered in other documents and will not be covered in this section.

For more information on IBS processes, see references provided in Section 4.2.1.

4.3.3 EBS COLLECTION PROCESS

4.3.3.1 Formalize EBS protocol and data collection

Once the EBS priority event list has been defined and the potential sources of information identified, a formalized framework for the collection of appropriate data needs to be established. Data to be collected on priority events should be defined and standardized. It should be no more and no less descriptive than required for appropriate and timely action. In a context of limited resources, collecting too much information can be detrimental to EBS by drowning critical information in a mass of data, and represents a poor use of time and resources. In addition, those reporting to EWAR may quickly become reluctant to supply large amounts of information that they regard as being of no use for the public health decision making.

The nature of data to be collected will influence the collection process. For example, the arrangement for collecting information from the local press is likely to be very different from that used to collect information from local community or from other national stakeholders. It will also be influenced by the resources available in the countries. For example, attempting to monitor local press via internet in a country where access to internet is limited will be of little use. According to the type of information desired, different modalities can be considered.

4.3.3.2 Community-based EBS

Community and religious leaders, as well as community health workers, civil society members, teachers and similar groups could be engaged and trained to report unusual health events or health risks that they witness in their community. Community-based EBS should be implemented in a formalized framework where participants are well aware of what could be considered as unusual type of event to report (e.g. unusual mortality in a village, epizootics, high absenteeism at school, mass poultry die off) and how to report (e.g. through mobile phones or internet). The framework should be supported by dedicated staff and regularly evaluated.

Participatory surveillance methods using direct, syndromic reporting by community members through mobile phones or the internet are being increasingly tested and used for example in

syndromic surveillance of influenza. These methods can be cost-effective and provide added complementary information to other surveillance methods.

4.3.3.3 Hotlines

Channels of communication should use locally available technology (e.g. e-mail, telephone or fax) and be operational on a 24/7 basis for immediate reporting. These should be established and maintained at all levels with the corresponding sources of information. Different hotlines can be considered depending upon their intended users. These may include health staff, trained community leaders and other EBS stakeholders; as well as the general public.

4.3.3.4 Internet

The considerable growth of the internet provides access to alternative EBS sources of information. Events such as an outbreak of a communicable disease in the neighbouring country or emergence of a new disease in a country with a similar ecosystem are often reported in the national or international media before their official notification. To make the best use of this type of information, the systematic monitoring of information available in the media should be implemented at the national level. Providing that a free reporting and available press is a tradition in the country, the monitoring of the local and national media can also be a valuable source of information.

Automated bio-surveillance^{2,3} systems can be used (Table 4). Some providers willingly engage in customising sources and search strategies for local use. If not, newspapers can be scanned manually on a daily basis. There are also a number of private companies specializing in media monitoring on a commercial basis. Rich Site Summary (RSS) feeds are useful for users who want to receive timely updates from favourite websites or to aggregate data from most sites.

Table 4 - Examples of free electronic biosurveillance systems developed to detect health risks through the use of information available on the Internet (including media monitoring)

Global Public Health Network (GPHIN)*	http://www.hc-sc.gc.ca/
HealthMap	http://www.healthmap.org/en/
Medical Information System (MedISys)	http://www.medusa.jrc.it/
Program for Monitoring Emerging Diseases (ProMED-Mail)	http://www.promedmail.org
RSOE EDIS	http://www.hisz.rsoe.hu/

*Freely accessible to national public institutions on request

² Hartley DM, Nelson NP, Arthur RR, Barboza P, et al. An overview of Internet biosurveillance. *Clin Microbiol Infect.* 2013; 19(11):1006-1013. doi: 10.1111/1469-0691.12273.

³ *Concept Plan for Implementation of the National Biosurveillance Strategy for Human Health.* Atlanta: CDC; 2010. (http://www.cdc.gov/osels/phsipo/pdf/Concept_Plan_V1+5+final+for+print+KMD.PDF, accessed 25 March 2014).

4.4 CASE DEFINITIONS AND SELECTION CRITERIA

4.4.1.1 Case definitions (IBS)

Each of the diseases and syndromes under IBS must have a standard case definition. Case definitions depend on the types of diseases, sources of information, medical standards and resources available in-country. A case definition may include clinical (e.g. biological confirmation), para-clinical (e.g. X-ray) and epidemiological (e.g. time, place and person) components. These case definitions must be consistent throughout the surveillance system. This ensures the comparability of the data collected from local to national level. Laboratory confirmation is particularly suited to rare diseases, disease under elimination, and diseases such as malaria for which differential diagnosis is available and necessary for the case management. Alternatively, multilevel case definitions are used in some settings: suspect case, probable case and confirmed case.

4.4.1.2 Selection criteria (EBS)

Selection criteria should be elaborated taking into consideration the national strategy, i.e. the national EBS objectives and the national specificities. Examples are provided below (Table 5).

Table 5 - Examples of criteria for the selection of raw signal

Geographic/population	Severity	Agent
<ul style="list-style-type: none"> ▪ Global health crisis ▪ Risk to affect national territory ▪ Risk of importation in the country ▪ Occurs in a neighbouring area ▪ Affects main migrants' country of origin ▪ Affects a country hosting large national expatriate community ▪ Affects tourists main destinations ▪ Concurrent with other event (large gatherings, pilgrimages) ▪ Emerging phenomenon that could change recommendations (e.g. travellers) ▪ Population density of infected area ▪ Location (rural-urban, isolated zone) 	<ul style="list-style-type: none"> ▪ Number of cases ▪ Incidence ▪ Number of deaths ▪ Case fatality rate ▪ Severity of clinical signs ▪ Hospitalization rates ▪ Sequelae ▪ Dynamic of the outbreak <ul style="list-style-type: none"> • Rapidity of spread • Geographical distribution • Duration ▪ Specific population <ul style="list-style-type: none"> • Health workers • Hospital transmission • At-risk groups 	<ul style="list-style-type: none"> ▪ Known /identified agent ▪ Level of knowledge of the agent ▪ Mode of transmission ▪ Transmissibility ▪ Virulence ▪ Pathogenicity ▪ Potential for spread ▪ Availability of preventive measures (e.g. vaccination) ▪ Availability and feasibility of implementation of control measures ▪ Modifications of agent epidemiologic and biologic characteristics (e.g. resistance)

4.5 TRANSMISSION OF DATA

EWAR ensures the early detection of health events only if data are reported in a timely way. However, EWAR is not restricted to immediate or real-time notification systems. The frequency of transmission should take into consideration the nature of the disease and the urgency of the implementation of the control measures. According to the diseases or syndrome, immediate, daily and weekly reporting can be appropriate and equally contribute to early warning.

To determine appropriate reporting frequencies, a balance must be struck between timeliness and accuracy of the information. It will depend on the nature of the disease/syndromes to be detected:

- Health events requiring immediate reporting include: rare epidemic-prone diseases notified using individual data; diseases posing an immediate threat to the community; unusual clusters of disease; diseases targeted for eradication; and non-health events posing an acute threat to health such as earthquakes, floods and industrial accidents.
- Health events requiring weekly notification include common diseases as well as endemic diseases subject to seasonal variations including non-bloody diarrhoea or flu-like illness. In this case, data may be anonymized and aggregated.
- For diseases under elimination/eradication and for weekly aggregated data, health-care providers may be asked to send a report even if no cases or deaths have been cared for. Instituting a nil or zero reporting procedure helps distinguish between areas which really have no cases and areas which failed to send a report for the period in question.

Procedures for data transmission (type of data, frequency, and modality of transmission) from local, intermediate, national and international levels should be formalized and correspond to the urgency of responding to various threats. These procedures should be widely communicated, practiced and implemented at all levels. Adopted procedures will have to take into consideration the type of disease/syndrome, the frequency of notification and the available resources:

- For immediate notification telephone, fax, VHF-radio and newer technologies (SMS, web-based interfaces, android/IOS-based applications) should be preferred to regular courier or porter (Box 3).
- For daily or weekly notification, direct reporting via internet or fax or SMS should be preferred.
- The reporting of syndromes can be automated based on the aggregation of symptoms entered by clinicians in the electronic patients' file (when available), usually from hospital outpatient departments (OPD) and other sources previously mentioned.

Box 3 - Computerized systems and mobile telephony

These technologies are available today in most parts of the world. Using them selectively and efficiently is highly cost-effective and speeds transmission and analysis of data at all levels. Cellular telephones are often widely available and penetration of mobile infrastructure is constantly growing in most countries, including in countries or regions where access to conventional phone lines and Internet might be limited or inconstant. In such circumstances, SMS can be a simple reporting and formalized method that has proved to be efficient for the early notification of syndromes.

4.6 RISK ASSESSMENT

4.6.1 PRINCIPLES

Under the IHR, risk assessment can include assessment of the risk to human health, of the risk of international spread of disease and of the risk of interference with international traffic. The risk assessment capacities required for all countries are described in IHR Annex 1.

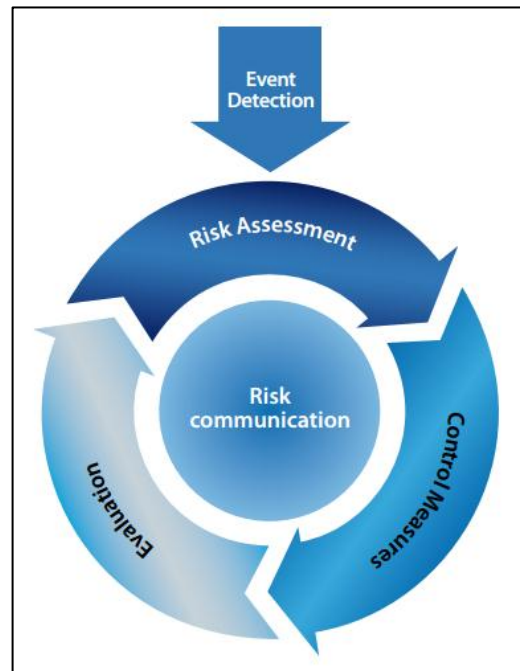
In the context of EWAR, the risk assessment is a systematic and continuous process for gathering, assessing and documenting information to provide the basis for taking action to manage and reduce the negative consequences of an acute public health event.

Not all signals detected through surveillance (i.e. IBS and EBS) will correspond to a genuine event nor require a dedicated response by public health authorities.

Once a signal has been verified, it becomes an event which then needs to be assessed to determine the level of risk to human health and to establish the nature of the potential mitigation and control measures that can be implemented.

It is an ongoing process as the level of risk may change over time. The initial risk assessment should be carried out within 48 hours of signal detection and repeated as new information becomes available (Figure 5).

Figure 5 - The risk management cycle



The risk assessment will help health authorities to:

- Determine additional information and analysis required to fully assess the event;
- Activate surveillance and other special investigations for assessing the extent of the event;
- Estimate likelihood of spread /increase in number of cases and the need to scale up response;
- Implement mitigation / control measures (including preparedness actions in unaffected areas);
- Estimate the potential for political or media attention and define messages of alerts for communication with the media and the public;
- Estimate the potential consequences for travel and trade;
- Determine whether the event needs to be notified through IHR (2005), to other supranational organizations and/or to neighbours; and
- Define communication strategy.

According to the national organization, this risk assessment can be performed at different levels. For example, this could be done directly at the EWAR unit or within the units in charge of IBS and EBS implementation and then transferred to the EWAR unit. The risk assessment process will be similar regardless of the origin of the detection process. However, EBS is likely to detect events that:

- Have not yet affected the country;
- Have not yet generated clinical human cases (e.g. exposure to toxic);
- Might have different impact (e.g. dose effect impact); and
- Require broad multisectoral coordination (e.g. contaminated food could involve ministries such as MoH, MoA, MoE, customs, fraud or civil security).

The level of risk assigned to an event is based on :

- The suspected or known hazard;
- The possible exposure to the hazard; and
- The context in which the event is occurring.

Completing a risk assessment is not always a sequential process with hazard, exposure and context usually assessed at the same time. Although each is assessed separately, there is overlap in the information required to assess each domain.

Table 6 and Figure 6).

Figure 6 - The risk assessment process

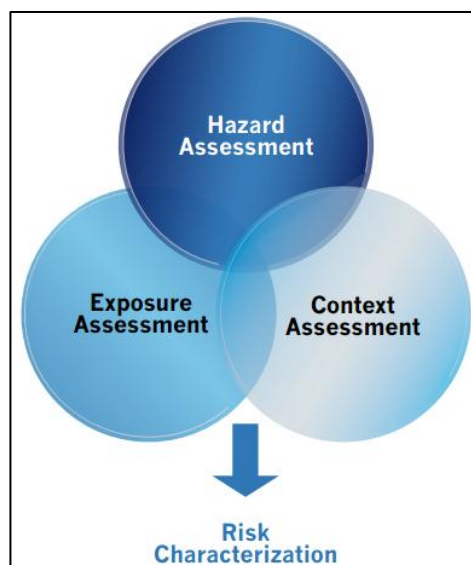


Table 6 - The risk assessment process

Hazard Assessment	
Definition	Hazard assessment is the identification of the characteristics of a public health hazard and the associated adverse health effects. Hazards can include biological, chemical, radiological and nuclear events.
Process	<ul style="list-style-type: none"> ▪ Straightforward when laboratory confirmation of the causative agent is available, or when the event is easily characterized on clinical and epidemiological features. ▪ In all other cases, hazard assessment starts with listing possible causes on the basis of: the initial description of the event; known burden of disease in the affected community; and type and distribution of existing hazards (e.g. the number and location of chemical plants and the chemicals they use).
Exposure assessment	
Definition	Exposure assessment is the evaluation of the exposure of individuals and populations to likely hazards. The key output of the assessment is an estimate of the: <ul style="list-style-type: none"> ▪ Number of people or group known or likely to have been exposed; and ▪ Number of exposed people or groups who are likely to be susceptible (not immune).
Process	Information required to evaluate exposure includes: <ul style="list-style-type: none"> ▪ Mode of transmission (e.g. human-to-human: droplet spread, sexual transmission; animal-to-human; occupational risk); ▪ Information related to the vector (e.g. distribution, density, infectivity) and/or animal hosts (density, prevalence, existing control programmes); ▪ Incubation period (known or suspected); ▪ Estimation of the potential for transmission (e.g. R0 basic reproduction number); ▪ Immune status of the exposed population; and ▪ Dose of exposure (e.g. amount of ingested/absorbed/inhaled heavy metals, salmonella bacteria, radionuclides) and duration of exposure.

Context assessment	
Definition	Context assessment is an evaluation of the environment in which the event is taking place. This may include the physical environment such as climate, vegetation, land use (e.g. farming, industry) and water systems and sources, as well as the health of the population (e.g. nutritional status, disease burden and previous outbreaks), infrastructure (e.g. transport links, health-care and public health infrastructure), cultural practices and beliefs.
Process	Context assessment should consider all factors that can affect the risk of the event. These factors may be social, ethical, technical, scientific, economic, environmental and political. They will include the surveillance system's capacity to detect cases, health-seeking behaviour of the individual groups, the prevalence of malnutrition, environmental conditions favouring the multiplication of vectors and the presence of animal hosts. For instance: <ul style="list-style-type: none"> For measles, the risk of expansion of an outbreak after the detection of the event will depend upon factors including the immunization coverage of the population; the capacity to quickly organize a mass vaccination campaign if the coverage is too low; the local conditions of hygiene; the access to health care; the capacity to detect and isolate cases; and population behaviour. For an event such as contamination of a river by a chemical agent, the risk of human intoxication will depend on factors such as local practices about water use; season (cold or hot, rainy or dry); river flow; capacity to broadcast messages of prevention; and acceptability of control measures.

Risk Characterization																																																
Definition	Once the risk assessment team has carried out the hazard, exposure and context assessments, a level of risk should be assigned. This process is called risk characterization. If there is no mathematical output from a quantitative model or comparison with a guidance value, the process is based on the expert opinion of the team. The hazard, exposure and context assessments help to estimate the potential consequences of the event. All types of consequences should be considered in addition to the expected morbidity and mortality, and include the long-term health consequences of the event (disability) and the social, economic, environmental and policy consequences.																																															
Process	<p>A useful tool to assist the team is a risk matrix where estimates of the likelihood are combined with estimates of the consequences. (see WHO/HSE/GAR/ARO/2012.1 Rapid Risk Assessment of Acute Public Health Events)</p> <table border="1"> <thead> <tr> <th rowspan="2">Likelihood</th> <th colspan="5">Consequences</th> <th rowspan="2">Risk Level</th> </tr> <tr> <th>Minor</th> <th>Minimal</th> <th>Moderate</th> <th>Major</th> <th>Severe</th> </tr> </thead> <tbody> <tr> <td>Almost certain</td> <td>Low risk</td> <td>Moderate risk</td> <td>High risk</td> <td>Very high risk</td> <td>Very high risk</td> <td></td> </tr> <tr> <td>Highly likely</td> <td>Low risk</td> <td>Moderate risk</td> <td>High risk</td> <td>Very high risk</td> <td>Very high risk</td> <td></td> </tr> <tr> <td>Likely</td> <td>Low risk</td> <td>Moderate risk</td> <td>High risk</td> <td>High risk</td> <td>Very high risk</td> <td></td> </tr> <tr> <td>Unlikely</td> <td>Low risk</td> <td>Low risk</td> <td>Low risk</td> <td>High risk</td> <td>High risk</td> <td></td> </tr> <tr> <td>Very unlikely</td> <td>Low risk</td> <td>Low risk</td> <td>Low risk</td> <td>High risk</td> <td>High risk</td> <td></td> </tr> </tbody> </table>	Likelihood	Consequences					Risk Level	Minor	Minimal	Moderate	Major	Severe	Almost certain	Low risk	Moderate risk	High risk	Very high risk	Very high risk		Highly likely	Low risk	Moderate risk	High risk	Very high risk	Very high risk		Likely	Low risk	Moderate risk	High risk	High risk	Very high risk		Unlikely	Low risk	Low risk	Low risk	High risk	High risk		Very unlikely	Low risk	Low risk	Low risk	High risk	High risk	
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Unlikely	Low risk	Low risk	Low risk	High risk	High risk																																											
Very unlikely	Low risk	Low risk	Low risk	High risk	High risk																																											

For more information on risk assessment:

Rapid Risk Assessment of Acute Public Health Events. Geneva: World Health Organization; 2012 (WHO/HSE/GAR/ARO/2012.1; http://whqlibdoc.who.int/hq/2012/WHO_HSE_GAR_ARO_2012.1_eng.pdf, accessed 31 March 2014).

Operational guidance on rapid risk assessment methodology. Stockholm: ECDC; 2011 (http://ecdc.europa.eu/en/publications/Publications/1108_TED_Risk_Assessment_Methodology_Guidance.pdf, accessed 31 March 2014).

Guide for Application of Risk Analysis Principles and Procedures during Food Safety Emergencies. Rome: FAO/WHO; 2011. (<http://www.fao.org/docrep/014/ba0092e/ba0092e00.pdf>, accessed 31 March 2014).

WHO Human Health Risk Assessment Toolkit: Chemical Hazards. Geneva: World Health Organization; 2010 (<http://www.inchem.org/documents/harmproj/harmproj/harmproj8.pdf>, accessed 31 March 2014).

Food Safety Risk Analysis. A Guide for National Food Safety Authorities. Rome: FAO; 2006. (http://www.fsc.go.jp/sonota/foodsafety_riskanalysis.pdf, accessed 31 March 2014).

4.6.2 EVENT CHARACTERIZATION

Daily briefings should be organized with EWAR staff and experts to examine on-going events and new signals received, using a listing of events. This daily meeting serves as the central forum for risk assessment, decision-making and response coordination for the management of acute public health events. The meeting updates current assessments of events being tracked and assigns responsibility for action. The risk assessment should be revised whenever additional information is available; this may be on a daily basis. The classification of events following the action to be taken should be systematic; for instance: Discard, Monitor, Respond, and Close. Examples are provided (Table 7).

Table 7 - Example of Events classification following the action to be taken

Discard	Events that do not constitute an immediate risk to human health should be discarded.
Monitor	This classification is appropriate when a specific response is not yet called for, but potential exists for serious consequences and a response may become appropriate. This category may include situations in which additional information is being collected, laboratory results are pending, there are international events with potential for importation of cases to the country, health risks exist with no human cases for the time being, etc. Follow-up and additional risk assessments should be repeated based on newly received information.
Respond	Response should occur when further field investigations or control measures are needed to interrupt transmission. The response may be in the form of technical advice, deployment of material, deployment of a team for field support for outbreak investigation and response, or coordination of multi-provincial outbreaks.
Close	Event should be closed when no further action is needed based on risk assessment. For example, the risk to human health may disappear, cases cease to be reported, or laboratory results were negative.

4.6.3 IHR ANNEX 2

At the national level, and following a risk assessment, the Annex 2 decision instrument of the IHR is used by Member States to support whether an acute public health event may constitute a PHEIC and therefore requires formal notification to WHO through the NFP. The purpose of Annex 2 is to increase sensitivity and consistency of the notification process to capture as many relevant events as possible globally. Events to be notified are not restricted to communicable diseases and include events related to contamination with microbes, toxins, chemicals or radioactive material due to environmental disasters, industrial leaks or intentional release (Box 4).

Box 4 - Under Annex 2:

Events that must be notified to WHO within 24 hours are:

- Any event involving one or more cases of four specific diseases (smallpox, SARS, human influenza caused by a new subtype, poliomyelitis due to wild-type poliovirus) irrespective of the context in which they occur.
- All events that fulfil any two of four situational public health criteria:
 - Is the public health impact of the event serious?
 - Is the event unusual or unexpected?
 - Is there any significant risk of international spread?
 - Is there any significant risk of international travel or trade restrictions?

For more information on Annex 2:

WHO guidance for the use of Annex 2 of the International Health Regulations 2005. Geneva: World Health Organization, 2010 (WHO/HSE/IHR/2010.4; http://www.who.int/ihr/revised_annex2_guidance.pdf, accessed 31 March 2014).

4.7 RESPONSE

The outcome of the risk assessment should be used to direct a proportionate response that reflects the risk. Response includes the field investigation of acute public health events and the implementation of public health control measures. The responsibility to trigger the response and to coordinate response activities could be located within the EWAR unit or with partners, depending upon the event. In case of outbreaks of communicable diseases, the investigation of the outbreak, the implementation of control measures and the management of the response to the event will most likely be coordinated by the EWAR unit with support received from the corresponding specialized group within the MoH (e.g. the measles control program in case of measles outbreak). In case of an acute public health event of non-human health origins such as epizootics, chemical, radiological accidents or natural disasters, the coordination and response will most likely be carried out by groups or institutions outside of the MoH with participation of MoH or EWAR staff. The management of large or major events would remain the responsibility of dedicated emergency managers.

4.7.1 FIELD INVESTIGATION OF ACUTE PUBLIC HEALTH EVENTS

4.7.1.1 Investigation steps

The investigation steps will depend upon the event of concern and its scope. The following components are usually present in investigations of events for which the level of risk to human health is considered high by the risk assessment:

- Confirming the diagnosis (assessing patients clinically and obtaining biological confirmation);
- Field investigation, including interviewing first cases and/or outliers;
- Analysing the epidemiological data in terms of time, place and persons;
- Formulating hypotheses about the hazard, the source of exposure, the vehicle of contamination and modes of transmission;
- Testing hypotheses (case-control studies) to identify the likely source of contamination;
- Making recommendations for public health action to control the event;
- Reinforcing or implementing surveillance (case definition, active case finding);
- Communicating with the community and the media (social mobilization, risk communication);
- Implementing initial control measures.

4.7.1.2 Rapid Response Teams (RRT)

The rapidity of the implementation of control and mitigation measures will condition their efficiency. To allow swift deployment of RRT, the identification and the training of potential experts beforehand is essential. EWAR staff will most probably participate in investigations of acute public health events in the field.

Depending on the type of public health events, additional contributions from experts might be needed. Accordingly a roster of specialists with a wide range of expertise should be established and maintained at the national, intermediate and local levels (see Box 5). All RRT members should be trained in outbreak investigation and response, as well as in infection control. Immediate access to the relevant technical resources and standard forms and guidelines, adequate transport, logistics and communication support and financial resources

Box 5 - Type of experts to consider for RRT

- Epidemiologists
- Infection control specialists
- Clinicians
- Toxicologists
- Nuclear/radiation safety specialists
- Laboratory technicians, biologists
- Veterinarians,
- Entomologists, vector control
- Risk communication specialists
- Social mobilization/health education
- Logisticians
- Medical anthropologists
- Environmental specialists
- Water, sanitation & hygiene specialists
- Food safety specialist
- Local authorities
- Local community leaders
- Other ministries (civil protection, police...)

should be ensured for RRT members. These members should also be equipped with communication technology allowing contact from any place in the country where an outbreak may appear.

4.7.2 CONTROL MEASURES

Control measures include measures that are aimed at:

- **Reducing the impact of the acute public health event:** these include immunization, prophylactic medicines and antitoxins, case management, social mobilization and media communication;
- **Preventing spread:** these include infection control and health staff protection, contact tracing and surveillance, environmental control measures, mass prevention, social mobilization and media communication.

At any stage, appropriate control measures should be carried out and adapted according to new information being received. **Control measures should never be delayed because investigations are still ongoing.**

4.7.2.1 Case management

Case management refers to the safe care of patients during an outbreak, usually in a health-care setting, but sometimes in the community. It involves the application of ethical standards of care and practices which maximize the safety of the patient, the health worker, and the community. Some conditions may require that patients be isolated.

4.7.2.2 Infection control and prevention of exposure

Safe health-care practices can prevent and control pathogen dissemination within and beyond health facilities, and are a key component of control measures in outbreak situations. Failure to apply efficient infection control practices in health-care settings favours the spread of pathogens, and increases the risk of disruption to health systems, with an impact on both health-care staff and community health workers. Standard precautions are meant to reduce the risk of transmission of pathogens from both recognized and unrecognized sources. Hand hygiene and sterilization of equipment used in invasive procedures are major components of standard precautions and among the most effective methods to prevent transmission of pathogens associated with health care. Promotion of an institutional safety climate helps to improve conformity with recommended measures and thus subsequent risk reduction. Provision of adequate staff and supplies, together with leadership and education of health workers, patients, and visitors, is critical for an enhanced safety climate. In addition to practices carried out by health workers when providing care, all individuals (including patients and visitors) should comply with infection control practices in health-care settings.

Similarly, safe practices and protection of non-health workers (e.g. those in the fire brigade, civil security, chemical and nuclear facilities) mitigate the impact of hazards. Written infection control procedures may address hand hygiene, safe injection practices and sharps management, post-exposure procedures, use of personal protective equipment, instrument and equipment reprocessing, medical waste management and disposal, management of patients with undiagnosed illnesses, isolation ward standards and patients isolation as well as the follow-up and treatment of health-care and non-health-care workers exposed to health risk. These procedures should be available in all settings.

In addition, the use of personal protective equipment (PPE) should be guided by the disease or hazard's mode of transmission and the extent of contact anticipated with blood and body fluids. For non-infectious agents, the use and the type of PPE should be guided by the hazard.

For more information on infection control:

Infection control standard precautions in health care : Aide memoire. Geneva: World Health Organization; 2006 (EPR/AM2.E7; http://www.who.int/csr/resources/publications/EPR_AM2_E7.pdf, accessed 31 March 2014).

Infection prevention and control in health care for preparedness and response to outbreaks (publications). In WHO/Global Alert and Response [website]. Geneva: World Health Organization (http://www.who.int/csr/bioriskreduction/infection_control/publications/en/, accessed 25 March 2014).

4.7.2.3 Surveillance and contact tracing

In most outbreak circumstances, the reinforcement of existing surveillance (by developing information messages for health providers and implementing specific active surveillance) is necessary to ensure the early detection of new cases and the precise monitoring of the situation. A requirement for conducting active case finding might be indicated in some situations.

Contact tracing is usually carried out for outbreaks of emerging or re-emerging pathogens resulting in severe diseases, such as viral haemorrhagic fevers. Contact tracing aims at identifying individuals who had close contact with infectious cases or with a toxic agent, and who therefore are at risk of developing the disease themselves. Identifying contacts of cases and population exposed to a toxin, and following them up closely (usually for the duration of the incubation period) will allow the early detection and isolation of new cases, hence preventing the further spread of the disease. The definition of a contact will vary according to the pathogen/agent causing the outbreak and its mode of spread. For diseases with possibility of transmission before the occurrence of symptoms, contacts of cases may be advised to restrict their social activities and mixing with others, e.g. home quarantine.

4.7.2.4 Environmental control measures

Environmental control measures aim at reducing the transmission of the disease whenever an environmental source or a vector is involved. They include:

- Disinfection of an environmental source (e.g. cooling towers associated with Legionnaires' disease outbreaks);
- Water chlorination (e.g. cholera outbreaks);
- Vector control measures, repellent or bed nets (e.g. urban yellow fever outbreaks);
- Elimination of rodents (e.g. plague outbreaks); and
- Environmental remediation of areas contaminated by chemicals or radiological and nuclear agents (e.g. outbreaks of lead poisoning or a nuclear accident).

In many instances, the impact of environmental control measures will depend on the promptness of their implementation, with the guidance of environmental health specialists. Sustained action may be necessary for an extended period till the outbreak is brought under control.

4.7.2.5 Mass prevention control measures

Some acute public health events require mass prevention control measures to protect the population and contain the spread of the event, such as:

- Mass vaccination against influenza during a pandemic, yellow fever during urban outbreaks, or epidemic meningococcal meningitis, particularly in the African meningitis belt;
- Mass prophylaxis in the event of a deliberate release of biological agent (e.g. anthrax);
- Prophylaxis with antimicrobials for contacts of cases (e.g. pertussis, diphtheria, meningococcal meningitis);
- Prophylaxis when exposed to radionuclides or chemicals (e.g. iodine prophylaxis); and
- Mass decontamination of population groups exposed to hazardous agents (e.g. chelation therapy for lead intoxication).

Partnerships with implementing agencies, such as NGOs, concerning stockpiles of appropriate drugs and vaccines and other materials should be established in advance.

For more information on preparedness and response:

Preparedness and Response for a Nuclear or Radiological Emergency. Vienna: IAEA; 2012 (http://www-pub.iaea.org/MTCD/Publications/PDF/EPR_IEComm-2012_Web.pdf, accessed 31 March 2014).

Manual for the Public Health Management of Chemical Incidents. Geneva: World Health Organization; 2009 (http://whqlibdoc.who.int/publications/2009/9789241598149_eng.pdf, accessed 31 March 2014)

4.8 COMMUNICATION

The development and maintenance of effective communication procedures with partners, relying on tools adapted to the context, are critical to ensure that events detected at the periphery are verified, assessed and responded to in a timely fashion and that information collected and analysed by EWAR is shared with its partners and the public as required.

4.8.1 NATIONAL CONTACT LIST

Practical information for contacting EWAR officers and reporting information on a 24/7 basis should be widely distributed among all partners. This should include a list of phone numbers, fax, e-mail or other means used for communication with EWAR officers at each level. Similarly, EWAR should ask each partner at the national and intermediate level, within and outside MoH, to identify technical resource persons as the main point of contact for EWAR. These resource persons are likely to be epidemiologists in charge of surveillance, officers in charge of specific control programmes, microbiologists from the public health laboratories and veterinarians from the MoA. The following contact details should be provided:

- Name of designated office (rather than a person) within which the EWAR point of contact is being designated;
- Names of responsible individuals within the designated office; and
- Generic and individual e-mail addresses, telephone and fax numbers.

4.8.2 INFORMATION-SHARING

Information-sharing is key to EWAR being able to meet its objective. Before any decision is made about its sharing, any information collected by EWAR should be systematically classified as confidential, restricted or public:

- Confidential or operational information is only shared among staff of the EWAR coordination unit (e.g. not yet verified information);
- Restricted information may only be shared among specific groups such as the national and provincial partners, and recipients are requested to avoid further dissemination of the information provided; and
- Public information is, by definition, shared with everybody and may be disseminated on the website, or in the form of press releases, scientific publications, etc.

It is recommended that all information be considered public, unless specific needs, such as on-going verification or scientific assessment, make this difficult.

4.8.3 COMMUNICATION SUPPORTS

Various supports may be used to share information within the team (e.g. outbreak tracking list), with partners and the data providers (e.g. feedback, newsletter), and with the public (e.g. bulletin, press release, website).

The outbreak tracking list is a short listing of events that provides updated summarized information on all on-going events monitored or responded to by EWAR. It is usually produced and updated daily in an electronic format for diffusion to and review by EWAR staff. The outbreak tracking list helps ensure that no event is overlooked, provides information for subsequent evaluation (timeliness, type of response) and gives managerial support.

Feedback to information providers is essential to building the relationship between the different levels (national, intermediate and peripheral) and mobilising health workers and partners for surveillance activities. Feedback should be systematic on an ad hoc basis to all partners and health workers providing information. Feedback includes: acknowledging information received, updating information (e.g. with laboratory results, actions undertaken, any new development) and informing about the closure of an event.

A weekly newsletter should also be produced by EWAR and shared with partners. The newsletter should include an update and brief description of on-going events, as well as a list of international alerts of concern for the country. The format should be simple and concise. The newsletter may be in the form of brief summaries or headlines on events, complemented by links to websites which provide more detailed information.

A bulletin (for instance quarterly) may be published with the aim of reviewing the activities of the trimester. This may include a review of the events treated by EWAR and of the types of response provided during the period. The bulletin may also include reports of investigations conducted and important meetings or training organized during the period. The bulletin may be open to external contributions. The bulletin should have a public distribution (website). A pre-defined mailing list of distribution to surveillance stakeholders, policy makers and international partners is also advisable.

4.8.4 COMMUNICATION WITH PARTNERS

If the EWAR coordination unit and the IHR-NFP are not be hosted in the same unit or institution, an active, regular and systematic communication should be established between the central EWAR coordination unit and the IHR NFP, as well as between the EWAR coordination units at all levels and the EWAR point of contact of partners that will contribute to detection, risk assessment and response to events. Established channels of communication with partners are used to:

- Report to EWAR all signals which may constitute an acute public health risk, as well as any measure implemented in response - a continuous communication should be maintained;
- Consolidate the information available through data provided by partners to analyse the public health event and associated risk;
- Disseminate information during unexpected or unusual public health events to the IHR NFP and to relevant partners, including those responsible for surveillance and reporting, points of entry, public health services, clinics and hospitals and other MoH departments;
- Consult experts and other relevant information sources on appropriate health measures; and
- Respond to EWAR requests for information and verification.

4.8.5 INTERAGENCY COORDINATING COMMITTEE

Specific communication support should be established to regularly keep partners informed. These supports should be developed to secure multisectoral exchanges of information, thereby allowing the health sector to receive information but also to share health relevant information with non-health sectors. The regular organization of intersectoral meetings, workshops and seminars, inviting all EWAR actors, also constitutes a good opportunity to share information and advocate for active participation in EWAR.

4.8.6 INTERNATIONAL SURVEILLANCE NETWORKS

The participation in regional and international surveillance networks will facilitate the country's contribution to global health security and strengthen the qualities of national EWAR. Such networks offer opportunities for small or isolated states to share resources in areas such as laboratory, training or expertise in epidemiology. They allow exchanges of information between member countries and can provide technical and scientific support to national EWAR.

Disease-specific networks allow for the detection of outbreaks involving more than one country, such as travel-associated Legionnaires' disease or salmonella infections caused by food products. Such networks also provide laboratory support or guidance for establishing standard surveillance tools such as case definitions.

Building partnerships is especially important for laboratories to confirm rare diseases or to perform isolation, typing or resistance profiles of strains using sophisticated techniques which are not routinely available. WHO has established a worldwide network of reference laboratories which can provide support to Member States in their specific domain of expertise (the database of WHO Collaborating Centres in microbiology can be consulted at <http://www.who.int/collaboratingcentres/en/>). Other international networks exist, including the IAEA Response assistance network RANET for emergency preparedness and response to nuclear or radiological emergencies/incidents available at <http://www-ns.iaea.org/tech-areas/emergency/iaea-response-system.asp>.

4.8.7 COMMUNICATION WITH THE PUBLIC

Communication with the public should go beyond the publication of the quarterly bulletin. A dedicated website and press releases can be used to inform about an on-going event or to release alert and prevention messages.

During outbreak responses, risk communication activities should help to mobilize communities (i.e. social mobilization), share information with the public and support the implementation of control measures. For example, they might describe simple measures that individuals can take to protect themselves and their communities during flu season.

Written procedures should be prepared, and spokespersons at the intermediate and national level should be designated in advance for the accurate and timely release of information to the public. Communication plans and strategies must be elaborated before a crisis and maintained between crises.

EBS could also play a significant role in detecting events likely to generate substantial unfounded risk perception that could result in serious public health damages, such as groundless concerns regarding vaccine safety that result in low immunization coverage. Early and active communication from national health authority to respond and place these types of events in their genuine context could prevent escalation and minimize rumours, exaggerated concerns and apprehension. This aspect should therefore be integrated into the EWAR communication scheme.

For more information on communication:

Communication for Behavioural Impact (COMBI). Geneva: World Health Organization; 2012 (WHO/HSE/GCR/2012.13; http://apps.who.int/iris/bitstream/10665/75170/1/WHO_HSE_GCR_2012.13_eng.pdf, accessed 31 March 2014).

Outbreak communication guidelines. Geneva: World Health Organization; 2005 (WHO/CDS/2005.28; http://www.who.int/csr/resources/publications/WHO_CDS_2005_28en.pdf, accessed 31 March 2014).

Crisis Emergency and Risk Communication. Atlanta: CDC; 2012 (http://www.bt.cdc.gov/cerc/pdf/CERC_2012edition.pdf, accessed 31 March 2014).

Communication with the Public in a Nuclear or Radiological Emergency. Vienna: IAEA; 2012. (http://www-pub.iaea.org/MTCD/publications/PDF/EPR-Communcation_web.pdf; accessed 31 March 2014).

PAHO/WHO Information Management and Communication in Emergencies and Disasters Manual for Disaster Response Teams. Washington, D.C.: PAHO/WHO; 2009 (http://reliefweb.int/sites/reliefweb.int/files/resources/753BA3EC98D0AE21852576A40078B90C-PAHO_CommGuide_ResponseTeams_dec09.pdf, accessed 31 March 2014).

4.8.8 SOCIAL MOBILIZATION

Lessons learned from dealing with outbreaks have shown that an outbreak is promptly brought under control only when communities actively participate in control and prevention activities, and are ready to adopt and sustain preventive and mitigation behaviours.

Social mobilization interventions focus on affected communities and participatory approaches, viewing affected communities as partners in finding solutions to control outbreaks. Health information campaigns raise awareness and educate people about the measures to protect individuals, families and communities.

Public health communication interventions during outbreaks should demonstrate an in-depth understanding of the needs of people, communities and agencies; it should also explicitly state the behavioural and social results required for the prevention, control and mitigation of the outbreak. The role of EWAR could be in particular to:

- Establish national/regional operational networks of social mobilization experts and institutions;
- Build links between social mobilizers and all sectors involved in the response to acute public health events;
- Document existing evaluations and lessons learned and share best practices; and
- Develop and field-test relevant social mobilization tools and checklists in close collaboration with social mobilization specialists.

For more information on social mobilization:

Social mobilization in public health emergencies: Preparedness, readiness and response. Report of an informal consultation. Geneva: World Health Organization; 2010 (WHO/HSE/GAR/BDP/2010.1; http://whqlibdoc.who.int/hq/2010/WHO_HSE_GAR_BDP_2010.1_eng.pdf, accessed 31 March 2014).

4.8.9 CRISIS COMMUNICATION

Effective media communication is a key responsibility of public health professionals and information officers, especially during acute public health events. In preparation for emergencies, communication officers and public health staff should be trained in crisis communication.

As part of the response team, communication officers should develop clear, concise and targeted messages for the public and identify the corresponding most effective media outlets. Well-

constructed and properly delivered media messages can inform and calm a worried public, reduce misinformation, provide much-needed information, encourage cooperative behaviours and focus attention on what is most important. Poor communication can create undue panic, fan emotions, disrupt economies and undermine confidence of the public in the authorities.

Effective media communication requires trust and understanding between public health officials and the media which should be viewed both as a crucial means of conveying information and as a component of outbreak response (i.e. in terms of implementing behavioural measures to the public).

While there are commonly accepted best practices for communicating effectively through the media, these should always be tailored to local needs and traditional means of mass and interpersonal communication.

For more information on media communication:

Effective Media Communication during Public Health Emergencies: A WHO Handbook. Geneva: World Health Organization; 2005

(<http://www.who.int/csr/resources/publications/WHO%20MEDIA%20HANDBOOK.pdf>, accessed 31 March 2014).

Effective Media Communication during Public Health Emergencies. A WHO Field Guide. Geneva: World Health Organization; 2005

(<http://www.who.int/csr/resources/publications/WHO%20MEDIA%20FIELD%20GUIDE.pdf>, accessed 31 March 2014).

5 RESOURCES FOR EWAR

The organization of the EWAR and the resources needed must be adapted to the country's context. It should be stressed that there is no recommended formula that would result in the implementation of an "ideal EWAR". The following section should be regarded as a functional description rather than an organizational recommendation.

EWAR requires human, technical and financial resources. The provision of resources can be undertaken by a mix of public, private and non-governmental organizations, and community groups, as appropriate to each country situation.

A specific budget should be earmarked for EWAR in order to cover both investment and recurrent costs. Investment costs could include guidelines and SOPs development, informatics tools, logistics and communication material; recurrent costs involve staff, training, maintenance of vehicles, documentation and communication, and coordination. In addition, a budget should be secured for outbreak investigation and response. A revolving fund may be a suitable mechanism to ensure availability of funds, as the dedicated budget line can be replenished after each investigation or response.

The implementation of an effective EWAR will also correlate with the development of human resources. The identification of resource persons, their adequate training and the maintenance of their expertise are key to successful implementation.

5.1 EWAR COORDINATION

Coordination of the EWAR is essential to achieving and maintaining efficient and resilient early warning function. A unit responsible for EWAR coordination should be identified at the national and intermediate levels to ensure a single entry point for reporting, analysing and triaging information, verifying signals, assessing risks, and monitoring and responding to acute public health events.

The shape of this unit in terms of composition (e.g., number of persons, required expertise, and integration with IHR NFP) will have to be adapted to the national context. In some countries, all public health surveillance related activities are implemented directly by the MoH. In this case EWAR coordination and IHR NFP functions are usually attributed to a single unit, allowing an optimisation of the resources utilization and a better integration. Other countries have assigned the responsibility of public health surveillance to an institution, such as a university or a public health institute, while the implementation of public health measures remains the responsibility of the MoH. This model is expected to provide a more independent scientific expertise, but reduces the capacity of integration of public health surveillance. In any case, this function should be cross-cutting across public health control programmes.

The unit in charge of EWAR coordination should be capable of receiving, triaging, analysing and sharing information 24 hours a day, seven days a week whenever possible, and have the capacity at all levels to:

- Capture, triage and interpret reports on health events or health risks;
- Assess and monitor acute health events or health risks;
- Record and track events using relevant IT tools;
- Support outbreak preparedness, investigation and response;
- Develop and maintain a roster of experts for outbreak investigation and other health threats (e.g. chemical exposure) and response ;
- Coordinate with partners within and outside the MoH;
- Provide feedback to data providers; and
- Advocate for EWAR.

In addition, the EWAR coordination at the central level should have the capacity to:

- Develop / update the relevant documentation (forms, guidelines, SOPs, advocacy material);
- Coordinate the development and maintenance of emergency preparedness plans;
- Participate in regional and international surveillance/alert networks; and
- Communicate information to the public (epidemiological bulletin, alert messages, website).

The coordination of EWAR requires dedicated staff at national and intermediate levels. At the national level, the amount of core staff will have to be determined in regard to the size of the country and available resources (Box 6). For medium and large countries, the recruitment of staff dedicated specifically to EWAR will be necessary; for small countries, EWAR activities might have to be integrated with other public health activities.

Box 6 – Example of resources (national level) for a medium-sized non-federal country

- 1 senior public health officer as coordinator
- 4 epidemiologists (alternatively 2 senior epidemiologists supported by FETP fellows)
- 2 data managers / data entry clerks
- 1 IT specialist
- 1 communication specialist / spokesperson
- 1 secretary

At the intermediate level, the hiring of additional staff may not be required. Designated public health officers for EWAR may also be engaged in other public health activities while serving as focal point for all components covered by EWAR, including detection, reporting, risk assessment and response. A data entry clerk should be in charge of data entry in the electronic information data management system (alternatively, this could be centralized at the national level). Additional administrative support may be needed. A system of duty officer should also be established at each level.

In case of emergencies, a dedicated command and control operations centre should be used or established to coordinate and monitor outbreak operations and other public health emergencies, at the central and intermediate levels. This command and control centre may fall under the responsibility of the EWAR coordination unit or, alternatively, of the Emergency Crisis Coordination Centre or equivalent. In any case, the corresponding adequate human, financial and material resources should be made available at all levels. This centre could be used as the platform both for operational staff and policy meetings.

Event management procedures should be established in advance to support the coordination and monitoring of outbreak and other public health emergencies operations. These include:

- Identification and definition of roles and responsibilities of each stakeholder at national, intermediate and local levels;
- Coordination mechanisms within MoH and with non-MoH partners during acute public health events, including for the deployment of logistical support and staff;
- Standardized procedures for managing event-related communications and documentation of actions;
- Plans for specific events such as deliberate events, rapid containment and mass gatherings; and
- Conducting regular simulation exercises to test all levels and update response planning (See §6.6.4.2, below).

5.2 EBS EXPERTISE

To date, EBS is scarcely included in epidemiologist or public health professional curriculum and the specifically required expertise will mostly rely on in-service training. Nevertheless, EBS requires particular skills and relies heavily on the expertise of its personnel.

While for the verification and risk assessment phases, subject matter experts (i.e. specialists) could be involved, the triage phase will rely solely on the expertise of the epidemiologists. Notably, EBS analysts will have to deal with different and constantly changing diseases and/or hazards and under time pressure.

Although profiles will have to be adapted to the context and to the national EBS activities, at national level the EBS analysts should be epidemiologists or public health experts with a generalist profile (i.e. a wide array of general expertise in public health as opposed to subject matter experts). The main requisite skills and characteristics are listed in Box 7.

Box 7 – National level epidemiologist/analyst

Requisite skills

- Advanced epidemiology/public health training and related analytical skills.
- General public health expertise.
- Previous experience in infectious diseases surveillance or environmental health.
- Good knowledge of the national public health structure and mechanisms.
- Good knowledge of the international public health and mechanisms (when applicable).
- Good written and verbal communication skills for preparing and presenting reports.
- Interpersonal skills to interact with different stakeholders including subject matter experts.
- Good knowledge of data management, and of existing IT tools, particularly Internet searches.

Additional desirable skills and attributes

- Good knowledge of infectious diseases, particularly zoonotic diseases.
- Flexibility & adaptability to cope with a wide range of health events and tasks.
- Ability to work under time pressure.
- Well organized and able to handle high volume of information.
- Good knowledge of geographic medicine (when applicable).
- Curious and always eager to learn.

5.3 HUMAN RESOURCES DEVELOPMENT

Human resources development should follow the overall principle of sustainability for the long-term practice of public health surveillance and response at all levels of the health system. It should ensure surveillance and response training across all categories of personnel (e.g., physicians, nurses and laboratory technicians) and disciplines (e.g., clinicians, microbiologists, epidemiologists, clinical toxicologists and environmental health officers) involved in the IHR framework. Strengthening public health actors within the system through the development of appropriate knowledge, skills, and competence is critical for effective IHR implementation.

When implementing EWAR, special attention should be given to human resources development and training activities because of the changes introduced in the national public health surveillance system. Operators of EWAR should be targeted by specific courses during the implementation process, and staff of the EWAR coordination unit in particular should be properly trained for their surveillance tasks. An initial integrated all-hazards approach training, including field epidemiology and action-oriented surveillance as a topic, should be integrated into the curricula of schools of medicine, nursing and other medical and paramedical professions. This initial training should be complemented with regular shorter training courses targeting all staff involved in EWAR to develop and maintain the level of expertise. In addition, in-service training including field epidemiology training programmes (FETP) and laboratory training programmes should be implemented, if feasible.

FETPs can provide future senior epidemiologists with surveillance and response skills that are critical for performing EWAR activities.

There is also an added value associated with training sessions associating experts from different disciplines such as epidemiologists, clinicians, microbiologists, veterinarians, entomologist, environmental health officers and social mobilization specialists. Such sessions simulate the conditions of an outbreak response operation and help groups to understand one another's approaches to surveillance and needs. Adult learning techniques such as case studies, enacting scenarios and problem-solving approaches should be preferred in this context. Case studies should be based on real epidemics having occurred in the country or in neighbouring countries sharing the same epidemiological context. Simulation exercises are also valuable; these provide staff training to test detection and event-management communication systems and protocols and to practice interagency coordination and cooperation.

5.4 INFORMATION TECHNOLOGY TOOLS

An electronic data management system for EWAR (software and hardware) using reliable Information Technology (IT) tools is critical to facilitate the transmission of information within EWAR, to partners and the public. The system should cover data reporting, entry and analysis, and include geographic information system (GIS) capabilities. It should be developed (or purchased) and maintained for use at all levels. The purpose of such electronic tools is to support and facilitate the event management process from detection through triage, risk assessment and response, and to inform and record key decisions and actions taken in response to events.

Users should include EWAR staff at all levels, as well as a focal point for EWAR within partner institutions at the national and intermediate levels. Various user profiles should determine access to information and functionality within the system. As such, the system will permit information-sharing and dissemination among partners, and will also provide an historical record of event-related data, decisions, communications and operational activities that may be used for reporting, feedback or training purposes.

An event tracking system for use by EWAR staff should be developed and maintained as part of the electronic data management system to keep track of the decisions made and of the actions undertaken. Essential data should be recorded for each signal detected (Box 8).

The system will also help identify duplicates (detection of the same event from two or more sources, such as a primary health facility, a newspaper and a public health laboratory), using type of event, names, location, time of occurrence, etc. This is particularly relevant for EBS which only requires a limited amount of data to be transmitted.

The implementation of an electronic data management system for EWAR requires that close support be provided to users, especially during the implementation phase. This consists in developing a user manual and ensuring easy access to a hotline in case problems are encountered.

As a first step, however, the performance of existing hardware and equipment in the country should be taken into account because this may constrain the implementation of such an electronic data management, especially in countries with limited resources. Alternatively, electronic reporting of data can also be achieved through dedicated websites or by email. In less developed settings, data can be transmitted by phones, faxes radios or SMS where infrastructure is weak and resources for electronic transmission are not available.

Box 8 – Minimum dataset for event tracking system

- Date of detection
- Date of reception
- Results of the risk assessment
- Status of the event
- Dates of change of status
- Decision made
- Actions taken.

5.5 MATERIAL

5.5.1 DOCUMENTS

Manuals, guidelines and SOPs should be developed and regularly updated. They should be distributed across the country at all levels and referred to during training sessions.

The minimum reference documents are listed in Box 9.

Box 9 –Minimum reference documents

- Surveillance & control of priority diseases
- Outbreak investigations
- Management of acute public health events
- Case management, including management of a mass casualty event
- Decontamination of patients & environment
- Infection control practices
- Protection, monitoring & treatment of workers

5.5.2 EQUIPMENT

In preparation for any public health emergencies, material and equipment could be prepared in the form of “outbreak investigation kits” (Box 10). The equipment, medical and non-medical supplies should be stored, pre-positioned and maintained, with appropriate inventory and stockpile management systems, at the central, intermediate and health-care facility level.

Isolation wards for the management of patients with highly infectious diseases should be mapped across the country. The contact details, location, bed capacity, level of expertise, and type of patients/diseases to be hospitalized should be listed in details and regularly updated.

Box 10 –Items to consider for national stockpile

- Personal protective equipment (i.e. gloves, eye protection, masks, gowns, etc.)
- Disinfectants,
- Medicine for priority diseases
- Chemical-toxin antidotes
- Radiation emergency equipment
- Vaccines
- Sample collection, storage and transport kits, including forms for sample shipment
- Diagnostic reagents and kits

5.6 LABORATORY SUPPORT

Laboratory services are essential to public health surveillance systems for rapid confirmation of the causative agent during the early phase of outbreaks and hazards, and continuous monitoring during response. Laboratory services should be part of every phase of EWAR (Box 11). Special attention should be given to enabling close interaction between the laboratory services and the public health surveillance system. Laboratory services include human, animal, chemical and radioactivity measurement laboratories.

Box 11 – Role of laboratory in EWAR

- Confirming clinical diagnosis
- Characterizing the agent causing outbreak/hazard
- Identifying the etiology of unusual events
- Detecting emerging pathogens and toxics
- Detecting changes in trends or patterns
- Determining the source of contamination
- Locating reservoirs in the environment
- Identifying asymptomatic carriers, ...

The provision of means and guidance will be essential to secure the appropriate, safe collection and transport of specimens and the access to specialized laboratories for specific biological, chemical radiological or nuclear testing (including the network of WHO Collaborating Centres’ and other specialized laboratory networks such as IAEA Response assistance network RANET).

SOPs should precisely define biosafety procedures for collecting, packaging, labelling, shipping, manipulating and discarding samples and all laboratory staff should be trained accordingly. SOPs should be implemented and disseminated at all levels (including private laboratories) to define:

- **What** type of sample (for which diseases/hazards);
- **Where** samples should be sent (which laboratory);
- **How** to securely prepare samples;
- **Who** (which transporter) will transport the sample; and
- **When** samples should be collected and sent out.

In the national public health laboratory or the reference laboratories, microbiologists should be the focal point for EWAR. There could be several focal points, e.g. for bacteriology, parasitology and virology. The laboratory technicians should be trained for analysis and reporting of data.

The listing and capacities of the laboratories should be mapped and regularly updated in details at the national and international levels for the diagnostic of infectious agents, chemical agents and biosimetry and radiation bioassays (for radiological and nuclear emergency events).

Each country should organize its diagnostic capacities. The laboratory framework should be in the position to maintain a high level of expertise to carry out the rapid confirmation of new and emerging pathogens and hazards, but also to ensure the capacity to process a large number of specimens of all origin as needed.

Nevertheless, this does not imply that all countries must acquire and maintain, within the country, all the necessary diagnostic capacities required to cover all of these risks. International reference laboratories and networks may represent a cost-effective solution to access to high quality diagnosis required to identify uncommon causative agents such as rare or emerging infectious diseases, unusual chemical compounds, or where the capacity is limited or absent at national level. In these settings, formal agreements need to be implemented with the foreign laboratories to secure rapid treatment of national samples, especially in case of emergency. Likewise, agreements in compliance with international regulations for specimen transport need to be formalized and regularly updated.

For more information on laboratories:

Laboratory quality management system: handbook. Geneva: WHO/CDC; 2011

(<http://www.who.int/ihr/publications/lqms/en/index.html>, accessed 31 March 2014).

Laboratory capacity requirements for International Health Regulations and their implementation in the WHO African Region. Brazzaville: WHO Regional Office for Africa; 2013 (<http://www.afro.who.int/en/clusters-a-programmes/dpc/integrated-disease-surveillance/features/3951-lab-capacity-requirements-for-ihr-and-their-implementation-in-the-who-afro.html>, accessed 31 March 2014).

Asia Pacific strategy for strengthening health laboratory services (2010-2015). New Delhi: WHO Regional Office for South-East Asia & Regional Office for the Western Pacific; 2010

(http://apps.searo.who.int/PDS_DOCS/B4531.pdf, accessed 31 March 2014).

The core functions of State Public Health Laboratories. Silver Spring: Association of Public Health Laboratories; 2010

(http://www.aphl.org/AboutAPHL/publications/Documents/COM_2010_CoreFunctionsPHLs.pdf , accessed 31 March 2014).

Core functions of microbiology reference laboratories for communicable diseases. Stockholm: ECDC; 2010

(http://www.ecdc.europa.eu/en/publications/Publications/1006_TER_Core_functions_of_reference_labs.pdf , accessed 31 March 2014).

6 MONITORING & EVALUATION

6.1 GENERAL PRINCIPLES

Monitoring and evaluation are integral to successful implementation, ongoing operations and improvement of EWAR, protecting EWAR from failure and ensuring achievement of desired outcomes and overall objectives.

- **Monitoring** refers to the routine and continuous tracking of the implementation of planned surveillance activities and of the overall performance of surveillance and response systems.
- **Evaluation** is the periodic assessment of the relevance, effectiveness and impact of activities in the light of the objectives of the surveillance and response systems.

Monitoring and evaluation of both IBS and EBS components of EWAR help to ensure the continuous performance of the system and should be established when designing the system. Special emphasis should be placed on the exhaustive collection, reporting and analysis of quality data on events and on the promptness of event reporting, data verification, analysis and response. Several guidelines addressing monitoring and evaluation of conventional surveillance, i.e. IBS, have already been published. This chapter will focus on specificities related to EWAR and EBS.

As a general principle, indicators used for monitoring and evaluation can be grouped into categories: input, process, output, outcome and impact indicators. At the beginning of implementation of EWAR, emphasis should be placed on the input and process indicators. As the system stabilizes over time, the emphasis shifts systematically to outcome, output and impact indicators.

6.2 MONITORING AND EVALUATION OF IBS

Monitoring and evaluation of IBS will rely on collection and analysis of indicators. Indicators are variables that can be measured repeatedly (directly or indirectly) over time and provide measures of change in a system. They deliver information on the quality of the system and flag areas that need improvement (Box). They are usually expressed as simple counts, proportions, rates or ratios.

These measurements should be interpreted in the broader context, taking into consideration other sources of information (e.g. supervisory reports and special studies), and supplemented with qualitative information.

Box 12– Main attributes used for monitoring and evaluation of IBS

- Acceptability
- Completeness
- Flexibility
- Representativeness
- Simplicity
- Timeliness
- Usefulness
- Sensitivity
- Specificity
- Positive Predictive Value

For more information on IBS monitoring and evaluation:

Communicable disease surveillance and response systems: Guide to monitoring and evaluating. Geneva: World Health Organization; 2006 (WHO/CDS/EPR/LYO/2006.2; http://www.who.int/csr/resources/publications/surveillance/WHO_CDS_EPR_LYO_2006_2.pdf, accessed 31 March 2014).

Buehler JW, Hopkins RS, Overhage JM, and al. Group Framework for evaluating public health surveillance systems for early detection of outbreaks: recommendations from the CDC Working Group. CDC; MMWR Recomm Rep. 2004 May 7;53(RR-5):1-11. (<http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5305a1.htm>, accessed 31 March 2014).

Protocol for the Assessment of National Communicable Disease Surveillance and Response Systems. Geneva: World Health Organization; 2001. (<http://apps.who.int/iris/handle/10665/66787>, accessed 31 March 2014).

Updated guidelines for evaluating public health surveillance systems. Atlanta: CDC; 2001. (<http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5013a1.htm>, accessed 31 March 2014).

Protocol for assessing national surveillance and response capacities for the International Health Regulations (2005) in accordance with Annex 1 of the IHR. Geneva: World Health Organization; 2010. (http://www.who.int/ihr/publications/who_hse_ihr_201007_en.pdf, accessed 31 March 2014).

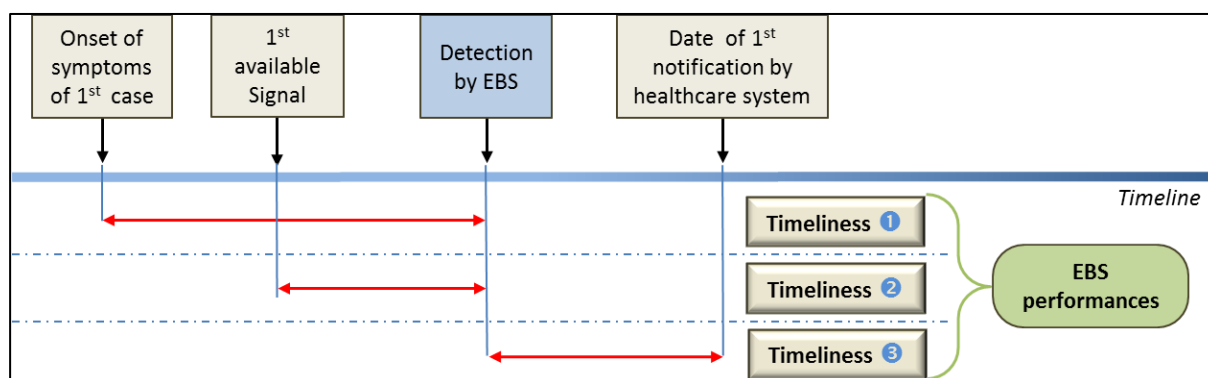
6.3 MONITORING AND EVALUATION OF EBS

Although the global framework is similar, the attributes used for monitoring and evaluation of IBS need to be adapted to EBS specificities. Some of the IBS attributes such as the quality of reporting (completeness of reporting, timeliness of reporting) or the acceptability (willingness of reporting) are not relevant for EBS. Others indicators are applicable but first need to be adapted, most pertinent indicators are timeliness, sensitivity, positive predictive value, representativeness and flexibility.

6.3.1 TIMELINESS

The early detection of health risks is EBS' chief objective, and therefore, timeliness that measures the time interval between the different phases - from onset of symptoms through notification - is the main attribute. (Figure 7) Intrinsic and extrinsic timeliness can be distinguished.

Figure 7 - Indicators of Timeliness according to available information



Intrinsic timeliness of detection :

- 1 Timeliness can be applied to the estimation of the interval of time between the detection of an event and the occurrence of the first case. This will provide a reference value, a baseline through which EBS's progresses of can be compared. It is a simple and straightforward method that can be easily applied retrospectively. Its main limitation is that it will not be applicable to all events (e.g. exposure to toxics).

- ② An alternative approach involves determination of the interval of time between the detection of the event and the first available **signal** related to this event. This method is more complex and resource-intensive as it requires a retrospective search for any possible signal that could have been missed by the EBS. However, it is the only method that can be applied to events for which human cases have not been detected. It can be implemented through surveys carried out over a short period of time and regularly repeated.

Extrinsic timeliness :

- ③ Extrinsic timeliness determines the interval of time between the detection of an event by EBS and the official notification of the same event by an official source (e.g. health system detection or other official reporting source). Extrinsic timeliness allows documenting the added value of EBS compared to conventional method. EBS' objective is to contribute to EWAR and to complete IBS framework, hence EBS should be able to more early detect acute health events. However, measuring extrinsic timeliness require a reference which might not be available in all settings

Although timeliness is a key attribute for the evaluation of EBS, it should not be used alone to assess EBS performance. Rather, timeliness should be considered in conjunction with other attributes taking into consideration the number of events that would not have been detected by the health system.

6.3.2 SENSITIVITY, POSITIVE PREDICTIVE VALUE

Sensitivity, specificity and positive predictive value are closely associated. In practice a cut-off point must be defined between a very sensitive system that will require treating very large amount of information including numerous “false positives”, and a very specific system that will detect only real events but will miss many genuine health risks.

Sensitivity can be defined as the ability of EBS to detect health risks. Sensitivity refers to the proportion of health risks that were effectively detected through EBS among all health risks that occurred for a given period of time.

$$\text{Sensitivity} = \frac{n \text{ events detected by EBS}}{(n \text{ events detected by EBS} + n \text{ events not detected by EBS})}$$

Only health risks under EBS surveillance should be considered (e.g. if EBS aims only at detecting non-communicable health risks, only non-communicable events should be included in the denominator).

The **Positive Predictive Value (PPV)** reflects the probability for a raw signal detected through EBS to correspond to a genuine health risk. Estimation of PPV requires keeping detailed records of all collected signals and not only of verified events).

$$\text{PPV} = \frac{n \text{ signals corresponding to a genuine event}}{(n \text{ signals corresponding to true events}) + (n \text{ signals not related to true events})}$$

Estimation of PPV is particularly crucial for EBS, as the calculation of specificity will usually not be feasible. Calculation of the specificity would require collecting a large volume of information of no use for surveillance in order to determine the “true negative”, i.e. information not related to the detection of health risks. Measurement of PPV allows assessing the “cost” (i.e. workload, personal. etc.) of detection of health risks, and eventually it underlines the needed adjustment of criteria and objectives. According to the national strategy, the type and the number of events, the collection of data for estimation of PPV can be continuous (yearlong) or not. A high PPV value indicates a high probability for the signal to correspond to a real event (i.e. not a false rumour), but is likely correlated with reduced sensitivity (i.e. not all events are detected). Conversely, a low PPV might correspond to a higher sensitivity.

6.3.3 REPRESENTATIVENESS

Some events might be more easily reported than others regardless of their public health significance. For instance:

- Because of its extreme clinical manifestation, a suspect case of haemorrhagic fever is more likely to be detected than a human infection by a new influenza strain.
- Major industrial pollution, even with a moderately toxic agent, will be easily detected while more insidious pollution with heavy metals might remain undetected.

Representativeness is therefore defined as the capability of EBS to accurately reflect the occurrence of health risks over time, and their distribution in the population by place and person. To estimate representativeness, two characteristics need to be taken into consideration:

- **Geographic coverage:** a representative EBS would be able to detect evenly health risk across the geographic area of reference (i.e. global, regional, national and sub-national) according to objectives.
- **Subject matter:** a representative EBS would be able to detect evenly all health risks that have been targeted (e.g. communicable diseases, chemical risks).

6.3.4 USEFULNESS

Usefulness reflects the contribution of EBS to the detection, the prevention, the mitigation and the control of acute public health events. A simple way to assess EBS's usefulness is to determine the proportion of health events that were detected primarily through the EBS function.

6.4 MONITORING AND EVALUATION OF EWAR

6.4.1 ON-GOING EVALUATION AND MONITORING

The monitoring and evaluation of EWAR, whether internal (by EWAR officers), external (by external consultants) or mixed, should be planned on a regular basis, for example 12 to 24 months after the inception of the system, and then every two to five years. Furthermore, post-event response evaluations should be systematic. The evaluation should cover all aspects of EWAR and assess its capacity to rapidly detect and control events of all origins. Specifically, the focus should be on the capacity of EWAR to:

- Early detect and capture information related to acute health events or health risks;
- Ensure immediate reporting of data from peripheral to national and international levels and analysis at each level;
- Perform on-going signal verification, data analysis and risk assessment;
- Ensure prompt investigation and response as required; and
- Coordinate with participating national and international stakeholders.

A regular complete external evaluation of EWAR will help reassess the sensitivity, timeliness and usefulness of the system, its capacity to enhance the surveillance and compliance with IHR (2005) requirements, its acceptability by different stakeholders and partners and the flexibility that helps on the actual management of confirmed outbreaks. The evaluation should also assess the level of integration of EWAR within the existing public health surveillance systems. Some key indicators to be evaluated are provided in annex 1.

6.4.2 SIMULATION AND OTHER EXERCISES

The effectiveness of planned activities (such as command and control, communications, technology and agreements) needs to be regularly verified. Simulation exercises have shown to be a practical, efficient and cost-effective way for organizations to evaluate response procedures and to prepare for

emergency response. Exercises evaluate an organization's ability to carry out one or more portions of its generic response plan. They provide experience and practice to those who may be involved in a response. They allow people identified in the plans to perform their functions in a lower stress environment and give them opportunities to explore their roles and the expectations of response plans. Within the exercise, staff and managers may identify and correct knowledge gaps and functional inconsistencies. This can lead to targeted training or improvements in the planning process after the exercise.

Conducting regular simulation exercise will allow testing the resilience of the implemented EWAR structure. Especially it will permit staff and managers to:

- Test and evaluate organizational, plans, policies and procedures;
- Expose any weaknesses and identify any resource gaps that may be present;
- Train the key persons involved, i.e., those who would be responsible for planning and implementing the plan and clarify roles and responsibilities; and
- Strengthen the interdepartmental, interagency and intersectoral links between the various organizations that may be involved;

Lessons learned and gaps identified from working through an exercise should be used to revise the plan as well as to identify training needs. There are five main types of exercise which range from simple to complex, and from the least expensive to the most costly.

- **Orientation:** this is the simplest and cheapest. It aims to familiarize participants with plans, roles and procedures.
- **Table-top:** officials and key staff are gathered together to examine scenarios and to attempt to resolve problems. It can take anywhere from a few hours to a few days. Equipment and resources are not deployed and time pressures are not introduced. The exercise depends on a series of written events. Many of these require little planning and coordination. However, a large-scale and rigorous table-top exercise requires dedicated planning resources.
- **Drill:** this is used to develop and maintain a skill in a single response procedure such as communicating critical information, practice of a specialized emergency skill. It is limited in its scope and focuses on training and supporting specific skills and procedures as part of a larger organizational response.
- **Functional:** this exercise concentrates on the policy and interactive elements of management of an emergency. It is interactive, and conducted under time constraints and in a facility designated for coordination and management of a real event so that existing tools and technologies are available for use and can be evaluated.

Full-scale: this exercise focuses on the operational capacity of response and management systems. It should be conducted to simulate reality without causing risk to the public and staff. It is more resource-intensive than a functional exercise.

For more information on simulation exercises:

Emergency planning exercises. In Federal Emergency Management Agency/emergency planning exercises [website]. Washington D.C.: FEMA. (<http://www.fema.gov/emergency-planning-exercises>, accessed 31 March 2014).

Emergency Exercise Development. Manila: WHO Regional Office for the Western Pacific; 2009. (<http://influenzatraining.org/documents/s17618en/s17618en.pdf>, accessed 31 March 2014).

A Guide for Conducting Table-top Exercises for National Influenza Pandemic Preparedness. New Delhi: WHO Regional Office for South-East Asia; 2006. (http://apps.searo.who.int/pds_docs/B0381.pdf, accessed 31 March 2014).

Exercise Development Guide for Validating Influenza Pandemic Preparedness Plans. Manila: WHO Regional Office for the Western Pacific; 2006. (http://www.wpro.who.int/emerging_diseases/documents/docs/EDTedDRAFT1ExerciseDevelopmentGuide.pdf, accessed 31 March 2014)

ANNEX 1 - KEY INDICATORS TO CONSIDER FOR EWAR EVALUATION

Overall organization of EWAR	<ul style="list-style-type: none"> ▪ Specific EWAR operational coordination unit in place ▪ EWAR units fully resourced with staff, material and finance ▪ Identification of information sources for prioritized acute public health events ▪ Closely related to IHR NFP and other important international agreement related to protection of public health ▪ System and procedures in place for capturing, registering, monitoring public health events
SOPs / Reference documents	<ul style="list-style-type: none"> ▪ Availability of a list of priority events under surveillance ▪ Availability of case definitions for priority events under surveillance ▪ Development and availability of SOPs or equivalent for all key functions of EWAR (detection of signals, triage, risk assessment, response,...) ▪ Definition of baseline estimates, trends and thresholds for alert and action ▪ Development and availability at all levels of national SOPs compatible with international guidelines for the collection and transport of clinical specimens ▪ Development and availability at all levels of national SOPs compatible with international guidelines for infection control practices in health-care settings and with IHR
Timeliness	<ul style="list-style-type: none"> ▪ Routine assessment of timeliness and SOPs implemented ▪ Timeliness of reporting of signal and events by all health-care facilities (target at least 80% of all reporting units should routinely report on time) ▪ Timeliness of verification and risk assessment of signal and alerts detected (all signal should be verified within 24 hours and assessed within 48 hours) ▪ Timeliness of the deployment of ORT (Multidisciplinary ORTs should be deployed within 48 hours from first report of an acute public health event) ▪ Timeliness of notification to WHO (all events that meet criteria for notification under Annex 2 of IHR should be notified by NFP to WHO within 24 hours of conducting risk assessment) ▪ Timeliness of NFP responses to WHO request for verification (the NFP should respond to 100% of verification requests from WHO within 24 hours)
Response	<ul style="list-style-type: none"> ▪ Development and availability of SOPs for event investigation and response ▪ Use of deviations or values exceeding thresholds for action ▪ Accessibility to stockpiles of medicines, vaccines and material, including sample collection and transport kits, for responding to priority biological, chemical and radiological events and other emergencies at relevant sites ▪ Delivery of viable clinical specimens from investigation of acute public health events to appropriate laboratory within 48 hours of collection for testing or shipment to international reference laboratories ▪ Training of staff for the safe shipment of infectious and toxic substances according to international standards ▪ Implementation and regular monitoring of biosafety and biosecurity procedures in laboratories and health-care settings
Coordination with partners	<ul style="list-style-type: none"> ▪ Definition of the roles and responsibilities of relevant authorities and stakeholders at all levels ▪ Multisectoral and multidisciplinary coordination and communication mechanisms in place and functional and in conformity with IHR ▪ Establishment of a network of national and/or international laboratories to meet diagnostic and confirmatory laboratory requirements and support outbreak investigations ▪ Reception of information on events from key partners (veterinary services, food safety) in a timely manner to inform decision-making and action ▪ Reception of laboratory test results from the diagnostic laboratory in a timely manner to inform decision-making and action
Communication	<ul style="list-style-type: none"> ▪ Development and availability of risk communication SOPs according to different levels Accessibility to regularly updated information sources for the media and the public ▪ Dissemination of regular feedback of surveillance results to all levels and relevant stakeholders ▪ Development of policies, SOPs or guidelines on the clearance and release of information during a public health emergency ▪ Training of staff on risk communication.