

Early Warning and Response to Outbreaks and other Public Health Events: A Guide



**World Health
Organization**

Regional Office for South-East Asia

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Abbreviations

IHR	International Health Regulations
EWAR	Early Warning and Response
PHEIC	Public Health Emergency of International Concern
WHO	World Health Organization
Pro Med	Programme for Monitoring Emerging Diseases
GPHIN	Global Public Health Intelligence Network
INFOSAN	International Food Safety Authorities Network

Preface

Having faced severe acute respiratory syndrome (SARS) and now coping with the threat of an influenza pandemic, potential deliberate use of biological and chemical agents and exposure to radionuclear material, the International Health Regulations (IHR) were revised to ensure global public health security.

Globalization is making the world a smaller place, with societies becoming more interdependent and accessible on account of advanced information technology and more affordable modes of transport. Goods manufactured in one country may be sold to consumers around the world. Along with industrialization come the effects of climate change, migration and the large-scale movement of people which influence disease patterns in most countries.

The International Health Regulations require Member States of WHO and the Organization to work together to protect societies from threats of communicable diseases and those related to chemical incidents and food consumption which may classify as a Public Health Emergency of International Concern (PHEIC). Countries, therefore, need to have the ability to detect and respond to outbreaks and other unusual events in a timely manner. Thus, surveillance and response functions (including at stipulated points of entry) must be robust and effective.

To assist countries, the Regional Office South-East Asia has developed an 'Early Warning and Response to Outbreaks and other Public Health Events: A Guide: This is intended as a guide for countries to enhance their existing surveillance systems for communicable diseases. This guide describes signals which may herald an event and describes how to set alert thresholds for detecting abnormal or unusual disease patterns that may lead to a public health alert. There is a section on how to evaluate the effectiveness of the system as well as a checklist of items required for setting up such a system.

The intention was to develop a simple, easy-to-follow practical guide for use in countries, which I trust this fulfils. I hope you will find this a useful tool in your continued efforts to comply with the requirements of the International Health Regulations (2005).

Jai P. Narain
Director
Department of Communicable Diseases
WHO/SEARO

Purpose

These guidelines were developed to provide Member States with the technical information needed to establish an early warning component as part of their existing surveillance systems in order to comply with the core capacity requirements of the IHR.

These guidelines are addressed to:

- Health policy-makers responsible for strengthening the early warning and response mechanisms of an existing surveillance system.
- Epidemiologists at the national, intermediate and local level.
- Rapid Response Teams at the national, intermediate and local level.

Assumptions

These guidelines assume the presence of an existing functional surveillance system in countries within which the early warning component should be a part.

1. Introduction

Emerging pathogens such as Influenza A (H5N1), dengue, Nipah virus and chikungunya represent recurrent threats which can cause considerable human suffering and economic loss. The formal and informal collection of information from disparate sources and the capacity to analyze this information to pickup epidemiological signals to trigger a public health alert is critical to recognize and respond rapidly to such threats.

Surveillance systems already exist in countries of the South–East Asia Region. However, the presence of a routine surveillance system does not imply the existence of a functional and effective early warning component capable of ensuring that the system can detect and respond to Public Health Emergency of International Concern (PHEICs) as required by the International Health Regulations (IHR).

An effective and efficient Early Warning and Response (EWAR) component integrated within a public health surveillance and response system is the basis for national, regional and global health security.

IHR calls for State Parties to utilize and strengthen existing national structures and resources to meet core capacity requirements to detect PHEIC. Specifically, all State Parties should have the capacity as follows:

- At the local level, to detect illnesses and deaths above expected levels and to report information to the appropriate local health personnel.
- At the intermediate level, to verify reported events, implement immediate control measures and report information to the national level.
- At the national level, to assess Error! Bookmark not defined.all health event reports within 24 hours and to report any PHEIC to WHO.

2. What is meant by EWAR?

Early Warning and Response should be an integral part of an existing public health surveillance and response system. It should allow the early detection of any abnormal/unusual occurrence or event so that the event may be verified and confirmed if applicable and measures for its control implemented in a timely manner. Box 1 outlines some examples of what an early warning system might be expected to achieve.

In some cases, this process may initiate an international notification and/or a request for international assistance under the IHR.

Box 1: Functions of an early warning component

EWAR should help with the early detection of the following events that constitute a public health threat:

- Diseases with high potential for spread (e.g. avian influenza, dengue fever);
- Diseases with high case fatality rates (e.g. Nipah, avian influenza);
- Diseases with severe consequences on trade or travel (i.e. Influenza A (H5N1), SARS);
- Diseases occurring in clusters related to a common source (e.g. Legionella, avian influenza);and;
- Diseases related to the intentional release of biological or chemical agents (e.g. smallpox, anthrax).

EWAR should be capable of detecting signals that indicate changing patterns in disease transmission that may necessitate a change in strategy or public health intervention. Such changes may include:

- person-to-person transmission of avian influenza
- changes in resistance profiles (e.g. malaria).

EWAR should lead to the early detection of PHEICs. PHEICs can be identified using the decision instrument provided in Annex 2 of the IHR and must be immediately notified to WHO.

3. EWAR Framework

The EWAR framework comprises the following five steps:

Step 1. Collection of information.

Step 2. Identification of signals.

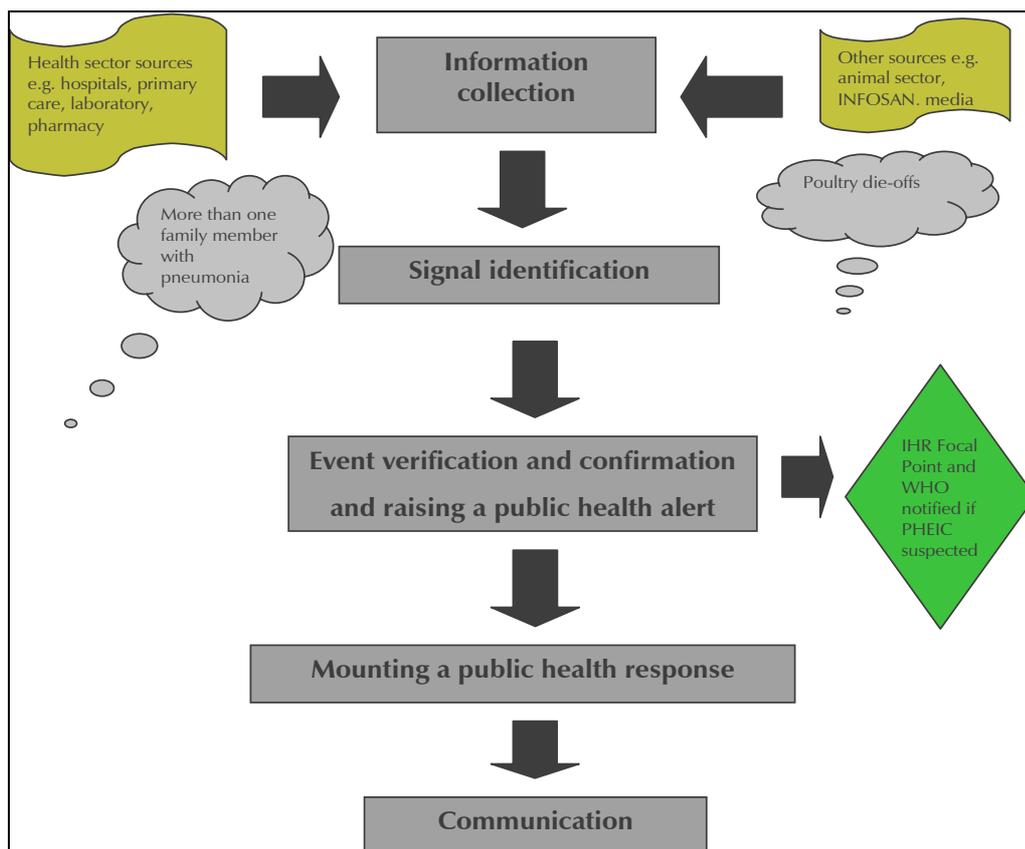
Step 3. Event verification and confirmation and raising a public health alert.

Step 4. Mounting a public health response.

Step 5. Communication.

This sequence represents the backbone of EWAR. To be most effective, the steps should be implemented at all levels (local level, intermediate and national) in a timely manner.

Figure 1: EWAR steps



4. Steps to setting up EWAR

Step 1: Collection of information.

EWAR relies on information gathered from two sources: the health system and “other” sources.

Health System sources include the following:

Health care services

Health-care facilities constitute the main source of morbidity and mortality data. These notifications are derived from primary-care physicians, staff in health posts, health centres and hospitals.

Surveillance systems can also receive information from the private sector as well as military health services, prison health services, health insurance organizations, and occupational and school health services.

Laboratories

Laboratories constitute a primary source of morbidity data and contribute by confirming the clinical diagnosis for individual patients and identifying specific diagnoses of public health interest.

Death registers

Death registers may provide a signal when a change is noticed in the numbers and patterns of deaths.

Activity of health services

Emergency room admissions may serve as an early signal of an unusual or lethal event for both communicable and noncommunicable diseases, e.g. several patients presenting themselves to the emergency room or outpatient department with respiratory symptoms secondary to smoke inhalation following a chemical explosion or clusters of pneumonia cases, and others.

Drug consumption

A sudden change in drug consumption patterns evidenced by sales volumes of particular medications may provide a signal of an unusual disease occurrence.

Health- care providers

Community health workers, traditional healers, traditional midwives and those working in the private sector should provide informal reports on unusual health events in the community. Awareness raising among private health-care providers is often needed to encourage them to report as well as in finding a practical way to do so.

Other sources of information

These include community workers, community and religious leaders, administrative authorities, other government or private sectors (e.g. food, water and sanitation), nongovernmental organizations and the media.

Community

At the community level key figures and opinion leaders of the community such as school teachers, village leaders, traditional medical practitioners, religious leaders and other key informants may act as sources of informal communication in the event of anything unusual such as:

- Crow die-offs for West Nile or avian influenza
- Poultry die-offs for avian influenza
- Rat fall for plague
- Dog bites for rabies
- Any sudden and unusual increase in morbidity and mortality observed within the community.

Other sectors

Agencies from several sectors routinely collect information pertaining to exposures that may result in outbreaks. Some are listed below:

- **Veterinary services:** Changes in animal health might provide early warning signals for a potential threat to human health. This is usually the case for domestic animals (i.e. poultry die-offs especially in the winter months; anthrax in cattle)

- **Food agencies:** Food items are routinely checked for quality and potential contamination. Food agencies undertake risk assessments on all matters linked to the food chain and food safety, including animal health and welfare and plant protection
- **Water supply companies:** Routine water quality monitoring may detect possible contamination
- **Environmental/sanitation agencies:** These agencies carry out health inspections in restaurants, hotels, buildings (cooling towers), swimming pools and other public structures. Quarantine services in countries carry out inspections of ships, airplanes and other conveyances. Any potential exposure presenting a threat to public health must be reported immediately through the EWAR

Media

Unusual health events are often reported by the media long before they are detected and reported through the formal surveillance system. Routinely and actively scanning the media can provide early signals of a public health alert. Establishing a relationship with key media sources and encouraging media professionals to inform the EWAR staff of unusual events is useful for early detection and also for the necessary communications during an outbreak.

International sources on morbidity and mortality

The national IHR Focal Point should regularly access the following sources of international information on outbreaks and other public health risks to better monitor situations that may present a risk for their country and its neighbours. Listed below are common sources of information:

- WHO disease outbreak news: **www.who.int**
- ProMED-Mail (Programme for Monitoring Emerging Diseases) www.promedmail.org

- GPHIN (Global Public Health Intelligence Network) access requires a subscription
- INFOSAN (International Food Safety Authorities Network) www.who.int

Meteorological centres

These may provide warnings of impending floods, tsunamis, etc.

What happens to the information collected?

Once unusual events are detected they should immediately be reported for verification and fed into the existing surveillance system for action.

Existing reporting channels should be used as appropriate. It is clear that there are many sources of available data. The challenge lies in centralizing this data from disparate sources together in order to get a more complete picture of the situation. Responsible officials should ensure that there is a mechanism in place for gathering information from all relevant sectors to be reported to the Ministry of Health's surveillance officers.

Step 2: Identification of signals

A signal is something that could indicate the impending occurrence of an event. For example, in clinical terms a transient ischaemic attack could trigger a stroke. An earthquake, on the other hand, could herald a tsunami. Signals can be detected if they are actively sought and if the system has a mechanism to detect when the number of cases of a disease exceeds what is normally expected (threshold). A system needs to have a pre-set mechanism for setting disease thresholds.

In practice, signals can be:

- A report of a condition that is on the list of immediately notifiable conditions, e.g. a case of haemorrhagic fever, a cluster of two or more persons presenting with manifestations of acute lower respiratory illness of unexplained cause.

List of immediately reportable conditions

- Smallpox
- SARS
- Human influenza – novel strain
- Cholera
- Plague
- Yellow fever
- Viral haemorrhagic fevers
- West Nile fever
- Dengue
- Rift Valley
- Meningitis

- Routine surveillance data that indicate numbers in excess of what are expected for a certain place or time period , e.g. an excess number of weekly cases of bloody diarrhea; an excess number of weekly deaths due to influenza; or changes in the epidemiology of the disease, such as a shift in age distribution or an increase in mortality.
- Informal information of an unusual event, e.g. the rumour of health care workers developing unexplained acute lower respiratory illness, phone calls from individuals about sudden high school absenteeism in one village, a media report on a number of deaths in a remote district, communication from a community leader about people working with animals presenting with unexplained acute lower respiratory illness and the like.

Signals may not always correspond to a public health alert. For example, an earthquake will not always result in a tsunami. This is the price to pay for having a sensitive system capable of identifying all public health events requiring immediate public health action.

How to set thresholds for detecting signals:

Thresholds are values of indicators above which the disease pattern is considered abnormal or unusual and may require a public health intervention. There are some standard thresholds in existence. Where these do not exist it is possible to create them based on the data from the particular country.

For most epidemic-prone diseases under immediate notification, the threshold is set to one as the occurrence of a single case requires immediate reporting and needs immediate public health intervention (e.g. acute flaccid paralysis, smallpox, cholera, Nipah, rabies, plague, suspected H5N1 in humans, measles during eradication programmes, etc.).

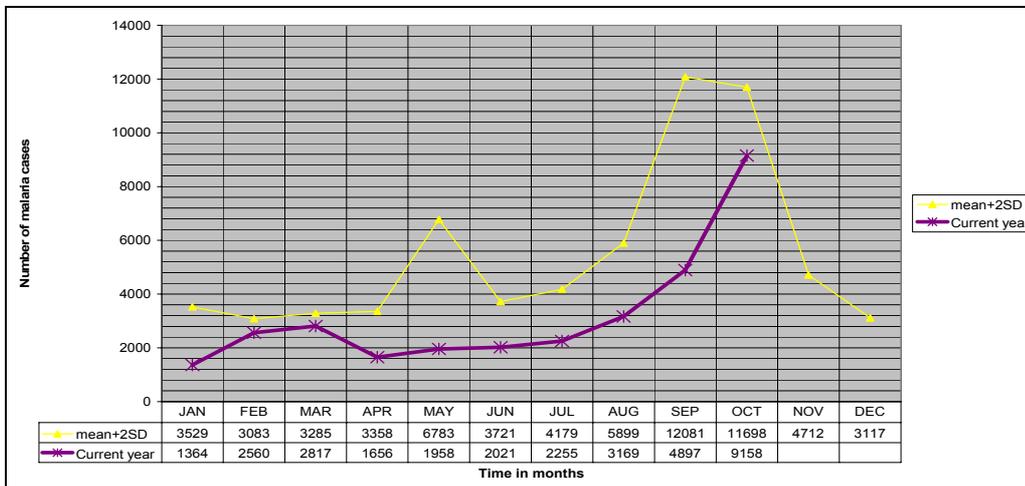
Thresholds may be established according to geographical location. For example, cases or deaths clustered in a village or county should be considered a signal, as in the case of sudden deaths of villagers after ingesting a local tonic or water. This requires the vigilance of villagers and community members who should know how to report such events.

Thresholds may be set based on the rate observed over a given time period (usually using data from the last five years) to obtain baseline data. Identification of abnormal events over time may be straightforward for rare diseases requiring immediate notification. However, for diseases such as tuberculosis, malaria and diarrhoeal diseases the use of statistical methods (e.g. p values < 0.05 ; x standard deviations above the mean) are necessary to differentiate truly abnormal events from the expected normal variations observed with these diseases. Such thresholds are useful for diseases not requiring an immediate response. Detecting a change in the rate over a set threshold happens relatively late in the course of events and is not so easy to distinguish from normal signal noise unless the threshold is set very high. This type of threshold setting will not detect human to human transmission of a new influenza strain in time for effective containment.

Examples of how to set thresholds:

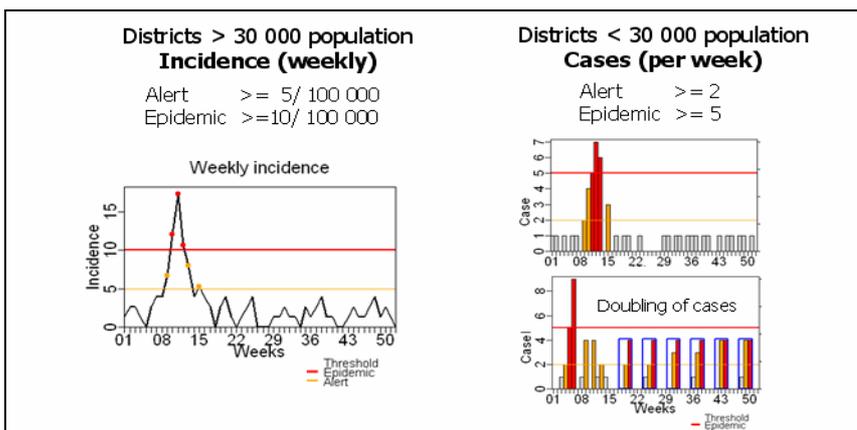
- (1) The use of the mean plus two standard deviations as a threshold in dengue surveillance. The current year's data is compared against the mean plus two standard deviations (see Figure 2). This was derived using a tool.

Figure 2: Graph showing number of malaria cases with the threshold line set at 2 standard deviations above the mean of the last 5 years



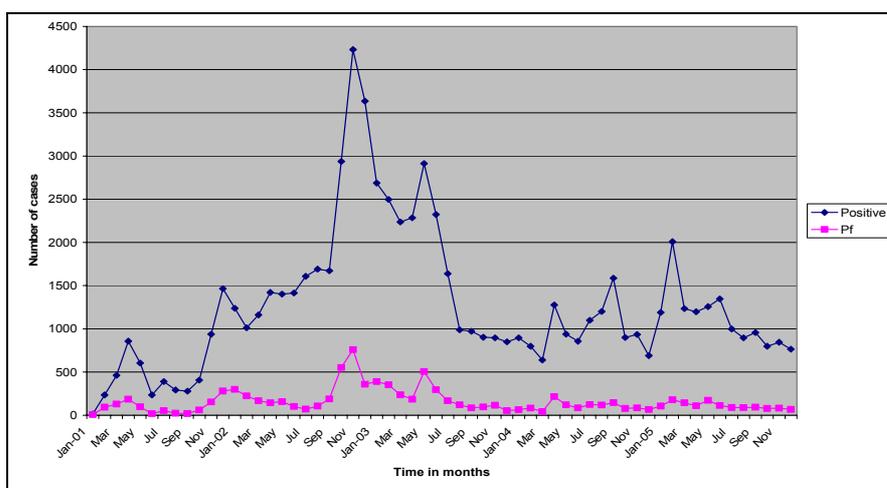
- (2) In districts with more than 30 000 inhabitants, an epidemic alert is defined as the occurrence of five or more cases per 100 000 population per week and an epidemic is defined as ten or more cases per 100 000 population per week. In districts with less than 30 000 inhabitants, the thresholds are based on absolute numbers. An alert is defined as the occurrence of two or more cases per week and the epidemic as five or more cases per week. Figure 3 illustrates this.

Figure 3: Thresholds for meningitis in the meningitis belt



- (3) The use of an average of five years' monthly data as a threshold. For example, the average of five years' data for a particular disease for a particular month is used as the threshold for that disease for that month. See Figure 4. The average of the number of cases for July, for example, over five years may be used as the threshold for reviewing the number of cases in July in the current year.

Figure 4: Graph showing 5 year's data for malaria by month



Step 3: Event verification and raising a public health alert

Event verification entails sifting through a large number of false alarms and imprecise information. However, any rumour which reaches the surveillance officer/health care worker and is indicative of a PHEIC must be verified within 24 hours following its notification.

An initial filtering of reported health events is always required to:

- Eliminate obvious false rumors, hoaxes or reports from unreliable sources
- Recognize events requiring immediate intervention or verification

After filtering the health events, the verification process will allow the surveillance officer to review and use the information for further action. A

public health alert is raised when a verified health event or an unusual disease pattern has been found to require public health action. Such events can be classified as:

Events related to occurrence of disease in humans: These include clustered cases of disease, unusual disease patterns or unexpected deaths as recognized by health workers and other key informants in the country.

Events related to potential exposures for humans: These include events relating to diseases in animals, contaminated food or water, and the environment.

Any unusual health event detected must be validated within 24 hours following its detection. In some cases, this process may lead to an international notification process and/or a request for international assistance under the IHR.

Step 4: Mounting a public health response

Response in this framework refers to the public health action taken as a result of the event verification and subsequent raising of a public health alert. Response begins as soon as a signal has been assessed and considered a public health threat.

Response measures may include outbreak investigation, clinical management to minimize morbidity and mortality, outbreak communication, and specific public health interventions to control the event as would be expected with a routine surveillance system. These should be executed as any response and control measures would normally be carried out, but with timeliness being a critical factor.

Step 5: Communication

Reporting lines are a key component of EWAR. The procedures for communication must be written in standard operating procedures and made known to all those who will need to use them. Necessary equipment to support early warning and response should be accessible at all times with the required means of communication, e.g. fax, email or dedicated phone

number. Reporting may take a number of forms, for example verbal, through email or short messaging service, but the key element is timeliness in all cases.

A written record of all notified events and investigation reports and outcomes should be kept for reviewing the usefulness and effectiveness of the system.

5. Monitoring and evaluating EWAR

Monitoring ensures the continuous performance of the system; evaluation reviews the ability of the system to detect outbreaks and abnormal events. Performance indicators to determine the effectiveness of the system mainly refer to timeliness and effectiveness.

Some indicators which may be used:

- Proportion of events requiring a public health response that were picked up by the early warning system.
- Proportion of unusual disease patterns/events verified within 24 hours of notification.
- Time from verification to raising a public health alert.
- Time from verification to initiating control measures.

Positive predictive value for usefulness of designated signals

Examples:

The PPV for determining the usefulness of using an earthquake as a signal for a tsunami would be:

$$\text{PPV} = \frac{\text{Total number of earthquake alerts confirmed as tsunamis}}{\text{Total number of earthquake alerts}}$$

If the PPV is high, it means the signal chosen is a good indicator of the event. In this example, by changing the signal to an earthquake of a higher magnitude may result in a higher PPV.

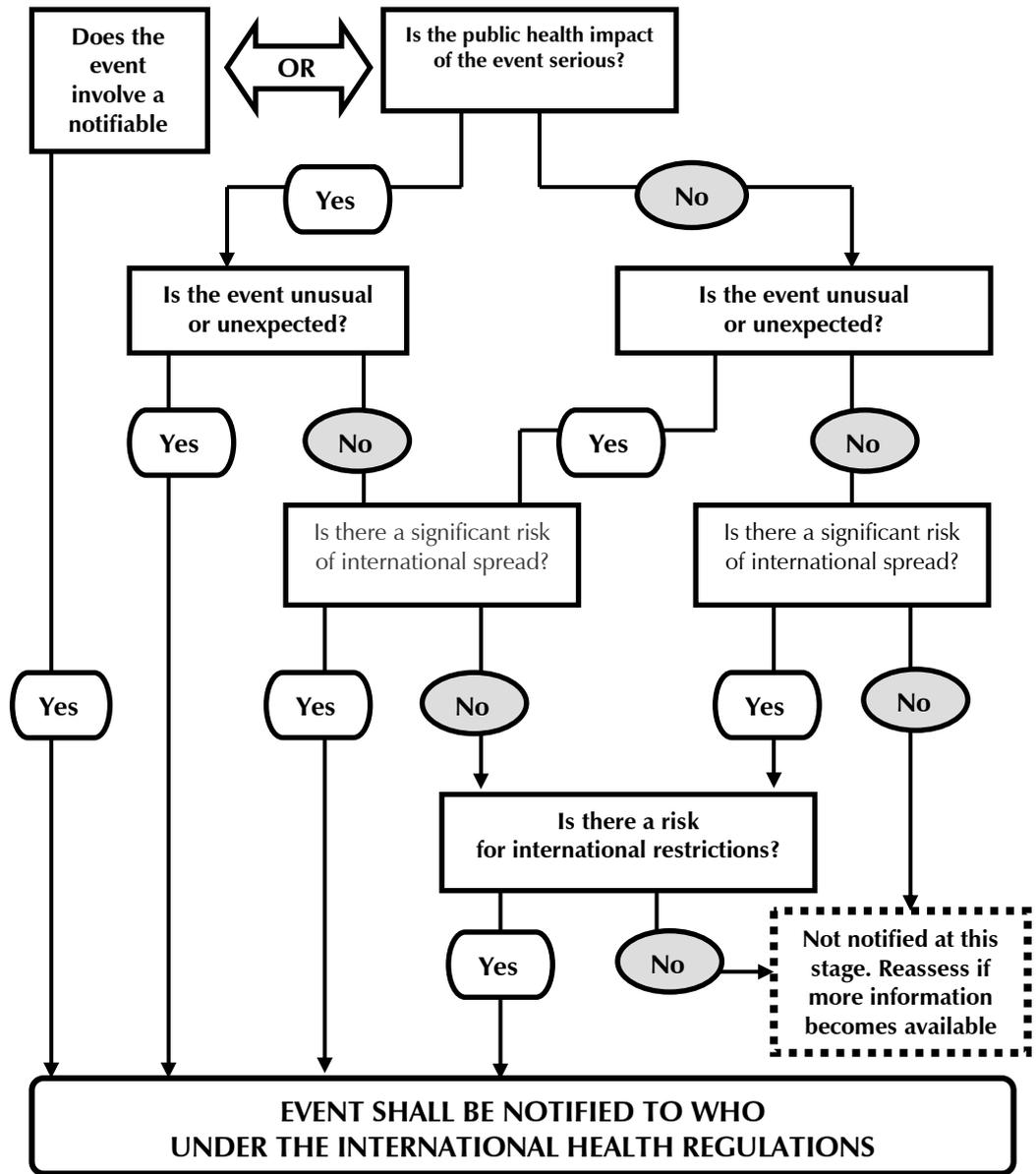
Or

The PPV for determining the usefulness of verifying rumours to detect significant PH events

$$\text{PPV} = \frac{\text{Number of rumours confirmed as significant PH events}}{\text{Number of rumours detected and verified}}$$

Annex 1

IHR Decision Instrument



Annex 2

Checklist for setting up EWAR

	Step	Requirement
1	Information collection	<ul style="list-style-type: none">• Existing routine surveillance system with standard case definitions and priority diseases defined• Linkages exist from health system sources and other sources to existing surveillance system• Trained staff in place• Community awareness and participation in local level event identification• Recording and reporting mechanisms in place
2	Signal identification	<ul style="list-style-type: none">• Thresholds set and signals identified• Staff trained in identifying signals• Staff trained in how to recognize if set thresholds are exceeded• Community awareness about what signals to look for in the local context
3	Event verification and raising a public health alert	<ul style="list-style-type: none">• Staff trained in recognizing a PHEIC• Reporting lines exist and written in SOPs• IHR Focal Point included in reporting lines• System in place to record all events that were verified and those that were subsequently confirmed
4	Mounting a public health response	<ul style="list-style-type: none">• Standard response and control measures identified and in place• Rapid response teams identified and trained in outbreak/event investigation• Supplies and equipment accessible at all levels and SOPs are in place to ensure their rapid distribution

	Step	Requirement
5	Communication	<ul style="list-style-type: none">• SOPs in place and known to those who are part of the system• Equipment (fax, email, telephone) to support timely communication in place

References

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Routine surveillance systems that report cases of diseases or syndromes often fail to provide timely information to detect outbreaks and other important public health events. By ensuring that Early Warning and Response functions are an integral part of the routine surveillance systems countries will be able to detect any abnormal/unusual occurrence or event and if applicable implement control measures in a timely manner.

These guidelines will provide health policy-makers, epidemiologists and rapid response teams with the technical information needed to establish an early warning component as part of their existing surveillance systems.



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