CRITICAL ELEMENTS OF LABORATORY SUPPORT TO OUTBREAK DETECTION & INVESTIGATION

BACKGROUND PAPER

Introduction

Laboratory diagnosis is an essential element of communicable disease surveillance, both for routine confirmation of infections and for the rapid identification of the cause of outbreaks and epidemics. Initially the cause of SARS was thought to be an influenza virus; this serves to remind us that the diagnosis of infection on the basis of clinical symptoms alone may be misleading. A wrong diagnosis can have serious and expensive consequences such as inappropriate treatment or wastage of vaccines. In many instances, only the laboratory can provide definitive identification and characterization of an infectious agent and, in the event of an outbreak, this is the public health laboratory’s key role. Laboratory functions also include the assessment of food safety and water quality, and the examination of environmental specimens.

Annex 1 of the revised International Health Regulations (2005) states that countries should have the capacity to provide support to the response to a public health emergency of international concern (PHEIC) through specialized staff, laboratory analysis of samples (domestically or through collaborating centres) and logical assistance (e.g. equipment, supplies and transport).

In terms of laboratory support, the challenge to countries is to identify rapidly and correctly the microbial cause of an outbreak which is of potential international public health concern.

To meet this challenge, the public health laboratory needs to be ‘in the loop’, i.e.

- know that there is an outbreak
- receive appropriate specimens
- provide, or provide access to, reliable laboratory expertise and facilities (in-country or through international reference centres)
- communicate the laboratory findings to the appropriate persons dealing with the outbreak.
Thus the role of the public health laboratory is mainly reactive, rather than proactive. However, laboratories should also be involved in ongoing surveillance of infections in the population and able to ‘flag up’ an increase in the number or nature of particular infections and thus trigger investigations.

**Critical elements of laboratory support**

The main areas to be considered in the laboratory involvement in response to PHEICs are:

1. **Communications**
2. Specimen collection and transport
3. Specimen processing, identification of pathogens, interpretation of results, data management.

### 1. Communications

Most importantly, two-way communications must be established between the outbreak investigation team and the laboratory. In addition, veterinary/agricultural/food safety investigations may be handled in different laboratories, thus effective intersectoral communications are important.

a) The laboratory must be informed
   - when there is a suspected outbreak, and
   - the nature of that outbreak (haemorrhagic, diarrhoeal, etc).

b) The laboratory must communicate results of investigations promptly and accurately to the outbreak investigation team (and to others, depending on communications protocol established).

Furthermore, the laboratory must have an established mechanism for communicating the results of routine surveillance of infections to the appropriate authorities.

### 2. Collection and transport of specimens and accompanying data from the outbreak to the laboratory
In order to provide appropriate advice and materials, and to ‘gear up’ the laboratory to handle large numbers of specimens, the laboratory needs information about the outbreak. In addition, the laboratory may provide a suitably-trained laboratory specialist at the outbreak site to organize specimen collection and transport. It is important that the laboratory has a budget dedicated to provision of materials (and costs of transport).

a) The laboratory needs to know:
   • the nature of the outbreak (therefore type of specimens to be collected)
   • approximate number of specimens
   • approximate timing of specimen collection and despatch to laboratory.

b) The laboratory should provide:
   • materials for the safe collection and transport of specimens (including laboratory request forms)
   • guidance* on:
     o what to collect, how to collect and how much, safe handling of specimens
     o how to package and transport, and where to transport to (i.e. to laboratory or directly to international reference centre).

(*N.B. Although specimen collection and transport guidelines should be permanently available to the outbreak investigation team, these can be reinforced verbally in communication with the investigation team).

3. Specimen processing, identification of pathogens, interpretation of results, data management

For compliance with IHR (2005), ‘countries should have the capacity to provide support to……laboratory analysis of samples (domestically or through collaborating centres)….’

Thus, in theory at least, all laboratory investigations could be performed outside the country. In practice this is unlikely to be efficient or effective and it is desirable that each country has
the laboratory capacity to provide at least a basic level of specimen processing and identification of pathogens. The definition of this basic level of provision will vary from country to country, as will the organization of laboratory services (e.g. at different levels: central, intermediate, peripheral; including hospital and private labs; etc).

Furthermore, a laboratory cannot function only for the investigation of outbreaks; it must have an ongoing activity in processing specimens and identifying pathogens. The laboratory has an important role to play in the routine surveillance of pathogens causing the more common infections, and should be able to ‘flag up’ the emergence of new serotypes or antibiotic resistance patterns. Thus a dedicated budget for laboratory services is essential.

It is important for outbreak investigation team (and others) to recognize that the laboratory cannot investigate every specimen for every potential pathogen; it must focus the investigation based on information about the nature of the infection and range of tests available in the laboratory. Effective communications between the laboratory and the outbreak team are critical. Therefore each country needs to define a list of the most common causes of outbreaks and decide whether it has/can develop the capacity in at least one laboratory to identify these aetiological agents. This list in turn helps to define the needs in the laboratory in terms of media, equipment, etc. In addition, the laboratory needs to define how it will handle the rare and emerging infections, cases of which may be imported and may constitute a PHEIC.

In countries where the public health laboratory system has laboratory capacity at different levels (e.g. central, intermediate, peripheral), the level at which specimens from outbreaks are to be investigated should be defined (this may depend on the nature of the outbreak; peripheral laboratories would not be expected to have facilities for microbial culture).

For possible causes of outbreaks for which laboratory capacity is lacking, protocols should be established for despatching specimens to outside the country to collaborating centres or other international reference centres.

**Minimum requirements in the laboratory**
There should be at least one laboratory in each country with capacity to identify the most common causes of outbreaks in that country (e.g. cholera, meningitis). It should be housed in a suitable building with reliable services (water, electricity, communications system, and it must have:

- An adequate supply of appropriate media, equipment and other materials (including surge capacity for dealing with large outbreaks 24/7).
- Staff trained in laboratory investigations of the common causes of outbreaks in the country and able to produce reliable results (negative results; e.g. ‘it is not cholera’ are as important as positive).
- A laboratory manager able to ensure effective operation of investigations and sound financial management of the laboratory.
- Sufficient ongoing input of specimens to ensure capacity to perform reliable identification of priority pathogens on a day-to-day basis; reliable identification implies necessity for regular quality assurance.
- Mechanisms established for sending to specialized international laboratories specimens for investigation and microbial isolates for further characterization.
- A functional data management system
- Good links with the national surveillance system; communication channels and information flow between outbreak investigation team and laboratory, and between this laboratory and others involved in investigation (e.g. national lab network, veterinary labs, international reference centres).
- Financial resources sufficient for the maintenance of all the above.

**Issues to resolve**

In many countries public health laboratories exist but do not participate effectively in the investigation of outbreaks or public health emergencies of international concern. The reasons may include some or all of the following:

- Lack of national strategic plan and budget for laboratory services.
- Low profile of many public health laboratories; not integrated into the national public health system (not considered important; under-funded; under-staffed).
Laboratory services are not ‘in the loop’ and are not automatically involved in outbreak investigations (epidemiologists don’t think lab).

Poor communication between labs (at different levels/different geographical locations); ‘turf issues’; lack of information-sharing.

Lack of authority – laboratory cannot produce reliable results in a timely manner (results cannot be trusted and may be ignored; ‘lab couldn’t produce the right result last time we investigated an outbreak so we won’t bother sending specimens this time’).

Laboratory does not receive specimens on a regular basis. Labs cannot be geared up just to respond in event of an outbreak; must be involved in ongoing surveillance of infections within the population, receive specimens and report results on a routine basis.

These will need to be addressed if IHR (2005) are to be implemented fully.