

Public health surveillance

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Introduction

The 2014/15 Ebola outbreak in West Africa demonstrated that there is a need to make disease surveillance more effective. This reading pack sets out key features of effective surveillance systems, challenges to building these systems in low resource settings, and some suggested approaches. It places surveillance in the wider context of health systems strengthening, global health security, and the International Health Regulations.

Surveillance systems: key functions and challenges

Routine public health surveillance systems are required in order to (Morgan and Pinner, 2009):

- Quantify the burden of disease by specific population (e.g. children under 5 years of age), and by geographic location, to permit better targeting of prevention and control activities
- Understand normal disease burden thresholds, and identify and rapidly report when the normal threshold has been passed in order to alert decision-makers to a potential outbreak or public health event
- Establish disease trends that help assess the impact of interventions such as vaccination or malaria prevention and treatment
- Identify unexpected public health events caused by emerging infectious diseases, chemicals or nuclear material (e.g. Ebola, toxic chemical spill)

About the authors

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A key point is that surveillance systems must be in place all the time for routine use; they are not just put in place when something unusual happens.

But surveillance systems are often irregular in the reporting and/or collection of data about disease from health facilities and other sources, and lacking in the epidemiological skills needed to manage, analyse, and interpret data. To compound this, countries, especially those that are resource-constrained, are not fully exploiting non-traditional sources of information about disease (including those linked to the internet) that could supplement routine surveillance for timelier alert when normal thresholds are passed, and help detect unexpected public health events.

As a result of these shortfalls, surveillance often does not reach its full potential, and at times fails to signal the need for public health action when required ([Thacker et al., 2012](#)).

Laboratory confirmation of diagnosis in surveillance is also problematic in some countries because of the lack of even minimally equipped and quality-assessed laboratories, and of trained technicians. Information about the cause of disease that informs choices for prevention and control is lacking, as is other more specific information such as the emergence of resistance to drugs such as antibiotics and antimalarials (the Fleming Fund, led by the Department of Health and part of the Ross Fund portfolio, is a major programme (£265m over 2016-21) focused on surveillance of antimicrobial resistance).

Public health surveillance and the International Health Regulations

The revised International Health Regulations (IHR 2005) are an international agreement, with a secretariat at the World Health Organization (WHO), that requires all countries to establish and maintain public health surveillance to detect, confirm, report, and respond to infectious disease outbreaks and other public health events. Under the IHR, countries are required to self-assess their core capacities in public health, and regularly report their current state to WHO. Prior to the Ebola outbreaks in West Africa, approximately 80 per cent of countries worldwide had provided reports to the WHO on the state of their core capacities, but the quality of these reports was highly variable and very few countries had actually met the required capacities. In addition, there was little interest from development agencies in strengthening IHR capacities in countries that needed financial and other assistance ([The Lancet, 2014](#)). Post Ebola, much international attention has been focused on the need to not just strengthen IHR capacities but also to strengthen evaluation and assessment of the IHR. This has been recognised by global political institutions such as the G7 (at the leaders' summits in 2015 and 2016) and the [Global Health Security Agenda](#) (GHSA, a US-led initiative bringing together more than 50 industrialised and less developed countries to share technical and financial resources to accelerate implementation of the IHR). Recently, an IHR Review Committee, the second since 2005, was established to review the IHR and make recommendations for its strengthening. These recommendations, presented to the World Health Assembly in May 2016, emphasise continuous assessment and improvement of IHR compliance and capacity as well as the importance of independent external assessment. Alongside this, the Joint External Evaluation (JEE) tool, bringing together WHO and GHSA methodologies, has been agreed for these assessments, and several countries (e.g. Tanzania and USA) have already had a JEE. An 'Alliance for country assessments for global health security and IHR implementation', to be housed at WHO, is being developed to coordinate the assessments and sharing of data to inform country plans.

Key elements of surveillance systems

Routine health facility-based surveillance

Generally, countries designate health facilities as routine surveillance sites (sometimes referred to as 'indicator-based surveillance'), and the surveillance framework they use is one developed by WHO for

integrated disease surveillance and response (IDSR) in its African region ([WHO, 2014](#); [Kasolo et al., 2013](#)). IDSR has since been adopted by other WHO regions, and has the goals of focusing surveillance on a limited number of priority diseases and/or syndromes to determine trends over time and place, and of the establishment of normal disease thresholds that are necessary for alert and response.

While IDSR emphasises integration of data, in reality there are a number of more vertical surveillance networks that crisscross the world or specific regions. They include surveillance networks for polio, influenza, meningitis, rotavirus, and vaccine-preventable diseases such as measles. Since they report vertically, the information they collect may or may not be incorporated in the IDSR framework at the national or regional level.

The current experience with Zika virus infection in Brazil, and its link to congenital malformations in babies, demonstrates that public health surveillance must go beyond infectious diseases, and that it is important to be able to link across different systems (in this case across infectious disease surveillance and registries or other records of congenital malformations).

Despite this fragmentation of surveillance, with a mixture of vertical and integrated surveillance, most countries regularly produce a national feedback bulletin with aggregate totals of cases and deaths from all surveillance systems, and results of performance indicators such as timeliness of reporting. These bulletins also provide updates about emerging health events and outbreaks, laboratory reports, and current status of response actions, but the quality, completeness and timeliness of information is variable, and the information itself is often unreliable. Likewise, the capacity of countries to interpret information, and to confirm diagnosis through laboratory testing, varies.

Event-based surveillance

Traditional sources of information such as health facilities and vertical health programmes can be supplemented with other information to identify unusual or unexpected disease and other public health events. Event-based surveillance is the organised and rapid capture of information about events that are a potential risk to public health. This information can be rumours and other ad-hoc reports transmitted through formal channels (i.e. established routine reporting systems) and informal channels (e.g. media, communities, health workers, NGO reports). It is focused on the reporting of unusual 'events' – such as clusters of deaths or diseases with particular symptoms in a community. For example, community event-based surveillance was an important element of the Ebola response.

The expansion of access to the internet has increased the possibilities for event-based surveillance, – though most countries have not yet exploited this. Innovative event-based surveillance systems search the diverse data streams on the internet that provide early awareness or detection of public health events, often before they are reported through the formal IDSR system. Such systems use scanning technology to gather and analyse data about internet searches, social media posts and online news stories; and they often include other sources of information such as community hotlines, NGOs and the private sector. While these systems may be more challenging to introduce in low resource settings, the increasing availability of smartphone technology in these settings suggests that this route to enhanced surveillance should not be discounted.

Some ministries of health, exemplified by the Ministry of Health in Uganda, follow social media accounts such as Twitter for early indications of events and emerging disease outbreaks nationally and in neighbouring countries (see <http://www.newsfultoncounty.com/life-style/news/278030-uganda-using-twitter-to-detect-disease-outbreaks>). Once an event is identified, a rapid response is mounted and if international support is required, a call for support is made, either bilaterally or through international organisations such as WHO.

Event-based surveillance strengthens national alert for important public health events, and often leads to a more timely and rapid response than IDSR alone, thus complementing disease reporting systems.

Opportunities to strengthen public health surveillance

Options for strengthening public health surveillance will inevitably vary depending on the context of the country and the availability of resources. In general terms, key elements of a functioning surveillance system include:

- An appropriately trained workforce.
- Diagnostic capability – including laboratories (and access to a reference lab)
- Data systems to capture, analyse, and report information
- Stewardship to ensure key reporting is seen by public health decision-makers, and then acted on (including appropriate reporting to WHO as set out in the IHRs)

These are clearly linked to other elements of health systems strengthening. A key element in deciding priorities for investment will be an understanding of the weaknesses in the existing systems. Is the main weakness, for example, a lack of ability to collect data at source? Or is it the inability to share data? Or is the main challenge the ability to analyse and use the data to improve health?

Linking the answers to these questions to the resources available will help decide on the range of measures that might be adopted to improve surveillance capacity.

Such measures could then include:

Public health workforce

- Understanding of tasks and strengthening of skills of public health workers could be enhanced by training at each level of the surveillance system through pre- and in-service training programmes
- Training and mentoring programmes in field epidemiology and public health laboratory support could be developed and supported
- Essential equipment and supplies sufficient for rapid response to public health events of national and international significance could be provided and maintained

Operational logistics

- Portals with high-quality internet capacity could be established at all surveillance sites with electricity to enhance reporting, and to ensure the feasibility of establishing event-based systems
- Secure and designated laptop or handheld devices for recording and analysing surveillance data could be provided to all health facilities with internet portals and electricity, and where surveillance activities are based
- Public-private partnerships could be established with local phone companies to provide health staff with mobile telephones and toll-free numbers for reporting routine and event-based health information; this could also include more sophisticated mobile technology and surveillance apps

Partner Coordination

Development agencies and other donors could avoid funding parallel surveillance systems, or if they continue to do so could ensure that they feed into the ISDR framework at the time of analysis.

Directions for the future

National

Governments must become fully engaged in strengthening the core public health capacities in their country, based on the commitment they made to the IHR. They must budget appropriately, and channel loans, grants and bilateral development support to these capacities, and they must hold themselves accountable.

Regional

Regional surveillance structures such as the Mekong Delta Project based in Bangkok, the surveillance network being planned by the West African Health Organization (WAHO) based in Bobo Dioulasso, and those provided by WHO regional offices, maintain reporting networks within their member countries. These regional structures provide opportunities for stronger and standardised IDSR, and more timely and effective event-based alert and response. Some of them provide opportunities for public health laboratory strengthening as well.

International

There is growing international concern among industrialised countries about health security, and in particular, the goal of the GHSA is to provide resources for essential infrastructure, training, and communication; through the GHSA and other mechanisms yet to be defined, the G-7 countries have committed to offer support to at least 60 countries to strengthen IHR compliance, and concrete planning is beginning.

With resources such as these, countries can make progress towards IDSR and event-based surveillance. Collaboration with agricultural sectors to improve awareness of zoonotic diseases and coordination of human and animal health surveillance information ('one health') is of great importance, and governments must ensure that they regularly meet and work together on surveillance, risk assessment and other common activities to ensure the best possible public health ([McCloskey et. al., 2014](#)). The Human Animal Infections and Risk Assessment Group (HAIRS) in UK provides an example of a well-functioning health platform.

In today's globalised world all countries share an enduring and collective obligation to create and sustain capabilities for integrated disease surveillance and response, including event-based surveillance that can enhance early detection of public health problems so that timely confirmation, investigation, and response can lead to the improved health and welfare of their citizens.

Key readings

Reading 1: Morgan O, Pinner R. Surveillance of Infectious Diseases. In: Moselio Schaechter, editor. Encyclopedia of Microbiology. 3 ed. Oxford: Elsevier; 2009. p. 759-74.

Reading 2: Thacker, Stephen B.; Qualters, Judith R.; Lee, Lisa M. Public health surveillance in the United States: Evolution and challenges. *Morbidity and Mortality Weekly Report*. 2012; 61(3):3–9. http://www.heart-resources.org/doc_lib/public-health-surveillance-united-states-evolution-challenges/

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Reading 4: Kasolo, F., Yoti, Z., Bakayita, N., Gaturuku, P., Katz, R., Fischer, J. E., & Perry, H. N. (2013). IDSR as a Platform for Implementing IHR in African Countries. *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science*, 11(3), 163–169. http://www.heart-resources.org/doc_lib/idsr-platform-implementing-ihr-african-countries/

Reading 5: Heymann DL, Howard E, Keeping our world safe by integrating public health and global security: Chapter 11; Transforming Public Health Practice (in press)

Reading 6: Kumnuan U, Heymann DL. Public Health Surveillance. Palgrave Macmillan Hand Book on Global Data for Policy (in press)

Reading 7: Reporting of communicable diseases under the International Health Regulations (Hardiman M). Pages A1 – A9, Control of Communicable Diseases Manual, 20th Edition. Heymann DL editor, 2015.

Questions for discussion

- How can health system strengthening initiatives be used to strengthen countries' ability to manage, analyse and interpret data? The ability to use public health data better is also a potential benefit for improving health programmes across the board by supporting better monitoring and evaluation of programmes and their outcomes.
- Do we fully consider public health needs when we invest to strengthen hospital systems? Do we include consideration of how hospital laboratories, for example, will use and share information as part of the core requirement for laboratory strengthening?
- Often, new events of significance, such as an unusual illness or pattern of illnesses, are noticed first at local community level but those who notice them don't have the skills or expertise, or the access to the right expertise, to evaluate the significance of what they are observing. How can health system strengthening programmes improve the ability of primary or community level health workers to act as public health surveillance points?
- Bilateral or multilateral programmes on specific diseases (e.g. malaria, HIV, and polio) often include the development of parallel vertical surveillance systems; should international aid agencies insist that such programmes consider how they will integrate their surveillance with the country's national surveillance systems? Can we use the vertical programmes as a training resource to develop national surveillance capacity?

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