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# Global Public Health Disease Surveillance Systems, Now and in the Future

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Communicable disease surveillance is a legal requirement of each member state under the World Health Organization's International Health Regulations (2005) and provides for both the early detection of infectious threats to public health as well as a mechanism to monitor the effectiveness of control programmes[1]. Ireland is a signatory to these and the Health Protection Surveillance Centre is responsible for national infectious disease surveillance.

In practice, population-based surveillance is based on a defined list of "notifiable diseases" along with a mechanism for notifying "unusual" patterns of disease which includes new pathogens. Clinicians and laboratories report these and they are usually entered into computerised surveillance systems. In Ireland, Clinical Directors of Laboratories and Medical Officers of Health are legally responsible for reporting infectious diseases. The Computerised Infectious Disease Reporting System (CIDR) is the national infectious disease surveillance system which was introduced in 2004[2].

Disease surveillance is essential to recognising the introduction of a new pathogen which has pandemic potential and allows early containment. However, early detection can be challenging as emerging infections may have similar presentations to existing infections, meaning that they are unreported by health professionals until case numbers increase quickly.

This may have been a factor with SARS CoV2, a disease which is highly transmissible with less severe mortality rates than diseases like SARS or MERS. Delays in detection were evident, with accounts of virus circulating for months before initial reports[3]. A disease with a wide clinical spectrum can avoid notice for some time.

The performance of current surveillance systems should not be surprising, given that a World Bank report from 2017 on pandemic preparedness financing found that countries chronically underinvest in disease surveillance[4]. Barriers to investment included competing needs in the health sector, difficulty in demonstrating the benefit of events 'avoided', and the sheer complexity of the international coordination and cooperation needed to put such systems in place.

Complexity should not be such a barrier. A global system for security of a different type exists for crime; Interpol has a secure network (I-24/7) which allows countries to contact one another and access databases and services in real-time all over the world. A similar system for sharing infectious disease data does not yet exist, although plans are now in place to establish a new hub for Pandemic and Epidemic Intelligence in Berlin which will hopefully address this[5].

In Ireland, the Health Information and Quality Authority (HIQA) published a review of the CIDR system in November 2019[6]. A key finding was that there was no high level HSE forum for strategic development of the system. In practice, during the COVID-19 pandemic, the system, like many other systems internationally, had experienced technical difficulties processing the large daily case volume. Additionally, the system does not provide a "real time" data which is a priority in a rapidly evolving emergency.

Considering the aforementioned limitations of the Irish and international surveillance systems currently in place, it is evident that future development needs to consider the following factors: It is essential that primary and secondary healthcare information systems are linked, which requires an Individual Health Identifier for patients. This may enable earlier detection of diseases with a wide clinical spectrum as well as linkage of cases which may be dispersed across different geographic areas and healthcare settings.

New surveillance systems need to employ innovative methods to increase sensitivity. Internet searches for symptoms and using satellite imagery to measure changes in hospital traffic have been trialled[7,8]. Expanding surveillance to move beyond laboratory notifications will increase sensitivity to changes in incidence, but these must be designed to maximise actionable information.

Countries which have the highest risk of being the source of a novel pathogen may not have the resources to develop or maintain surveillance systems. A global approach to financing and establishing infrastructure and capacity is essential to provide adequate coverage and contribute to global health equity. It is essential that country systems can "communicate" and share data as required and this requires harmonisation of disease classifications as well as defined technical standards for information technology. This also requires international coordination.

Systems should also be designed to measure equity stratifiers such as race or socioeconomic status as these factors can affect disease incidence and outcome. This type of monitoring of inequalities is legally required in Ireland[9]. This type of data is not consistently collected in Irish healthcare data systems, which means that it is difficult to quantify risk in different groups.

Surveillance systems should report in a way that allows decision makers and the public to have access to information about the health risks in their environment. The calls for more transparency have increased during the pandemic, and accessible reporting of health threats should become the norm.

Finally, in designing these systems it is important that an "all-hazards" approach is employed. All-hazards mean that environmental threats are included as well as infectious diseases. With the immediate focus on infections due to the pandemic, there is a real risk that the opportunity will be missed to put integrated surveillance systems in place for environmental threats such as contamination of land, water, and air as well as the effects of climate change such as flooding and drought. Climate change remains our largest threat to health and, indeed in itself, impacts on patterns and frequency of infectious disease. For example, there may be changes in the distribution of disease vectors or increased transmission of temperature sensitive pathogens like Salmonellosis that thrive in warmer weather[10].

The infrastructure that needs to be put in place at a national and global level is not inconsiderable, but the devastating health, societal, and economic impacts of the pandemic has reinforced the value of global health security. This is even more urgent now that the frequency of epidemics and pandemics are set to increase with population growth and encroachment of natural habitats.

It is critical that future public health surveillance systems are sensitive and timely, integrated, measure inequity, have global coverage, and measure all threats to health. Only then will global public health be protected into the Anthropocene.

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