2.2 Measuring the health impacts of disasters

Author

Ronald Law, Health Emergency Management Bureau, Department of Health, Manila, Philippines; and College of Public Health, University of the Philippines, Manila, Philippines.

2.2.1 Learning objectives

To understand the following key factors relating to measuring the health impacts of disasters:

1. The importance and relevance of measuring the health impacts of disasters.
2. The variety of indicators that characterize the health impacts and risks of emergencies and disasters.
3. Systems and methodologies that can be used to measure health impacts.
4. Challenges and issues in measuring the health impacts of disasters.
5. Strategies to cope with these issues.

2.2.2 Introduction

Between 2008 and 2017, disasters from natural hazards registered in international databases affected, as an annual average, nearly 200 million people, causing nearly 70 000 deaths and leading to economic losses of more than US$ 160 billion *(1)*. A further 172 million were affected by conflict *(2)*. From 2012 to 2017, WHO recorded more than 1200 outbreaks, including outbreaks of new or re-emerging infectious diseases, in 168 countries. In 2018, WHO tracked 352 infectious disease events, including Middle East respiratory syndrome coronavirus (MERS-CoV) and Ebola virus disease. Given the tendency of international disaster data to focus on large-scale events, such data usually omit the large numbers of small- to medium-scale events that also have substantial health, economic, social and environmental effects *(2)*. Measuring the effects of emergencies and disasters and building systems that can facilitate in-depth investigation both of their causes and of their effect on people is imperative to enabling us to better reduce the risks of emergencies and disasters and their ensuing human impact.

Measuring the health impacts of disasters can help in determining the scale and scope of response needed, defining the 'big picture' operationally, quantifying the magnitude of urgent needs, ensuring the response is appropriate and timely, assessing progress, and allowing comparisons to be made among different emergencies and disasters. Epidemiology provides a good foundation for measuring, studying and using indicators that are critical to reducing risks in emergencies and disasters, and helping to ensure that health impacts and outcomes are measured systematically. Epidemiological methods may be used to characterize affected populations, especially vulnerable groups, and assess their vulnerability and exposure, as well as to quantify impacts and generate evidence for public health interventions before, during and after emergencies (See Chapter 2.1).

Public health decision-making for emergencies and disasters relies critically on information about the anticipated or actual health impacts of these events. The ability to measure health impacts should therefore be an integral part of any Health EDRM system. The development of capacities in public health surveillance, epidemiological investigation, laboratory testing and other related technical areas – responsibility for which belongs to the public health sector – supports measurement of the health impacts of disasters, which is crucial to being able to prevent, prepare for and respond to these events appropriately.

Indicators that can be used to describe the impacts of emergencies and disasters are an important area for study. Conventionally, such indicators are measured in terms of human impacts or fatalities, physical impacts through property damage and effects on critical infrastructure, as well as socioeconomic impact indicated by financial losses. Table 2.2.1 shows the indicators that can be used to quantify the impacts of sudden-impact disasters from natural hazards specifically in relation to health (see also Chapter 2.4).

2.2

Table 2.2.1. Common health indicators used to quantify sudden-impact health impacts from natural hazards *(3)*

Effect	Health indicator	Application
Death	Number of deaths among the population	Rough assessment of disaster severity
	Number of impact-related deaths among the population of a given age	Identification of vulnerable groups for further Health EDRM planning
	Number of deaths and number of houses destroyed	Assessment of building structure safety Evaluation of predisaster community rescue training
	Number of impact-related deaths per unit of time after the disaster among the population	Evaluation of self-reliance of community
Hospital admission	Number of casualties among the population	Evaluation of predisaster prevention, mitigation and preparedness measures Evaluation of warning adequacy
	Distribution of reasons for hospital admission	Estimation of emergency care available and relief needs Identification of critical services to be maintained in emergency
	Hospital bed occupancy and duration of stay in hospital	Monitoring of health facilities and medical care needs
	Geographical origin of hospitalized patients	Needs assessment for relief supplies, including field hospitals
Health-seeking behaviour	Number of consultations among the surviving population	Estimation of type and volume of medical relief and resources
	Time distribution of consultations	Scheduling of medical relief

To ascertain health impacts of disasters, it is useful to examine health impacts as a function of risks –that is, the probability and negative consequences of exposure of individuals, communities and the population to a wide range of hazards. Risks may be compounded by vulnerabilities intrinsic to individuals (such as extremes of age, weak immune status, strong familial history of disease) or characteristic of communities (low income level, low educational attainment, poor sanitary practices) and by limited capacities of health systems (weak governance, poor coordination mechanisms, suboptimal investments). Conversely, health risks and impacts can also be reduced by the capacities that can be built into the health system and other sectors at the individual, community and population levels.

Case Study 2.2.1
New technologies to detect and track outbreaks: Early Warning, Alert and Response System in the People's Republic of Bangladesh

Between late August and mid-December 2017, an estimated 655 000 Rohingya women, men and children fled to Bangladesh. In tackling an outbreak of diphtheria among the Rohingya refugees, WHO utilized both old and new public health tools. Contact tracing was used to find all the people who may been exposed to the disease. Diphtheria treatment centres were established to take care of those affected and keep the disease contained. A newly developed computer program known as the Early Warning, Alert and Response System (EWARS) allowed the quick collection of field data, geographical location and affected populations (see also Chapter 2.1). This allowed the response teams to act promptly. EWARS was developed by WHO specifically for humanitarian and emergency settings and is designed to be used by local people in at-risk communities. It works even without an internet connection.

The importance of surveillance systems in Health EDRM cannot be overemphasized. Public health surveillance applied to Health EDRM encompasses continuous, systematic collection, analysis and interpretation of disaster and health data crucial for planning, implementation and evaluation of public health interventions in emergencies and disasters. During emergencies and disasters, health assessments to measure health outcomes make it possible to determine needs and identify related services in the immediate, short and long term. Activation of surveillance systems, and use of relevant data are essential to Health EDRM. Case Study 2.2.1 provides an example of how such surveillance can help.

Although the value and benefits of measuring health outcomes are clear, emergencies and disasters by their very nature present numerous challenges to the functionality of surveillance systems. Starting with the physical effects of disasters on the affected communities, power and communication may be affected by the destruction of lifelines; critical infrastructure such as roads, bridges and airports might also be damaged. Health infrastructure such as hospitals, clinics, laboratories and public health offices might be damaged or destroyed, along with their equipment, materials and supplies. Disasters can also affect healthcare providers and those responsible for health surveillance. Other impacts include high population mobility as a result of displacement and the breakdown of other vital services and insecurity. All of these can constrain the effective, efficient and timely use of epidemiological data for evidence-based action in emergencies and disasters. Methodological issues can also arise because of the lack of baseline data or sample sizes that are too small to provide generalizable findings.

However, the most important challenge may be the resulting prioritization of emergency response and relief operations over assessment and measurement activities. This may mean that public health interventions are not guided by sound evidence, and further health risks may be realized instead of being prevented. However, it is possible to undertake both tasks at the same time, and this should be encouraged.

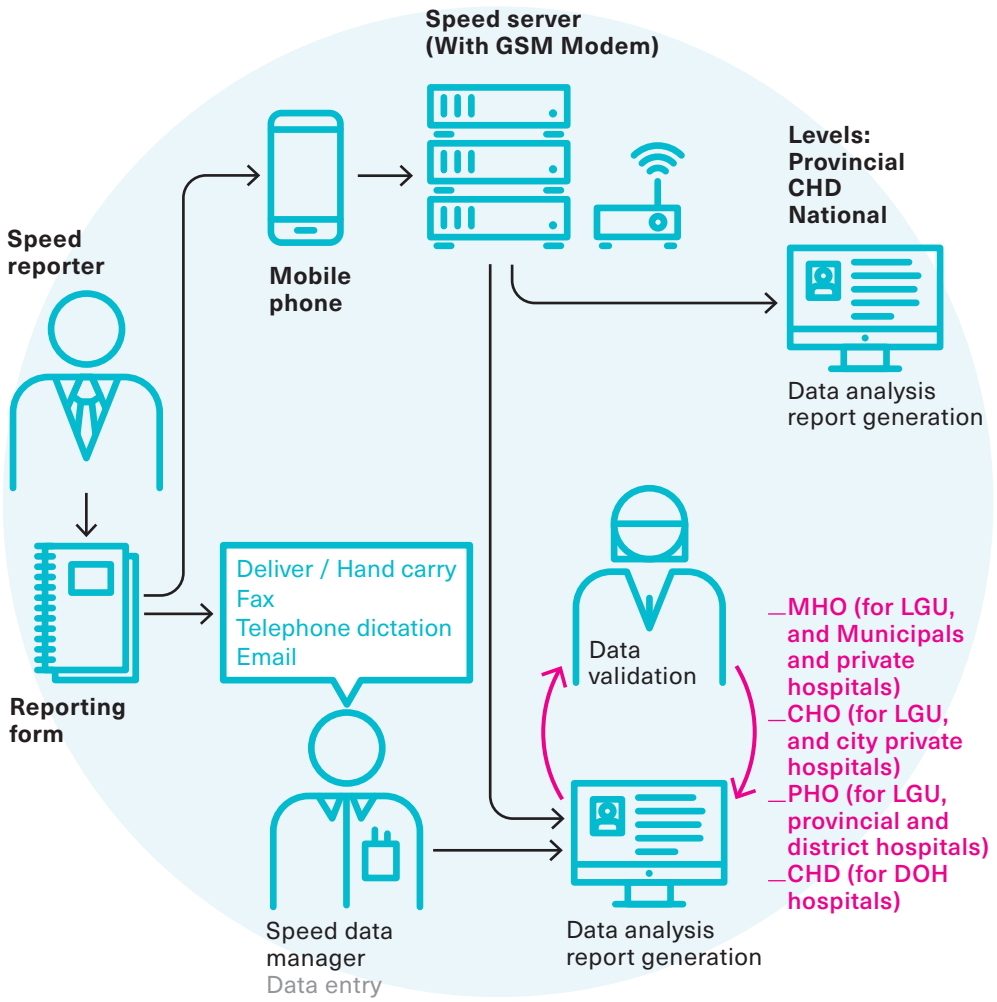
It is also important to evaluate the preparedness of public health systems to conduct real-time surveillance, and measure and count health outcomes and indicators during emergencies and disasters. In some low and middle-income countries, it may be difficult to organize and maintain surveillance and reporting systems. In some cases, baseline data may not be available, there could be significant variation in data that are collected, or it may not be possible to institutionalize surveillance systems because of insufficient technical capacity, or human resource or logistics issues.

2.2.3 SPEED in the Philippines

The Surveillance in Post-Extreme Emergencies and Disasters (SPEED) programme in the Philippines provides an illustrative example of an actual system used by public health authorities to measure and manage the health risks of a disaster to a population. SPEED is an early warning and alert system developed by the Department of Health in the Philippines, which was born out of the country's experience with a range of emergencies and disasters that caused a significant public health burden to the country (see Chapter 1.3 for a description of how a modified version of SPEED was used in Japan). Firstly, it describes the type of health issues emerging in the communities and in temporary shelters after huge population displacements, secondary to the disaster, across the timeline from post-disaster response to recovery. Secondly, it shows how SPEED as a system draws an "operational picture" of the disaster and so guides appropriate public health interventions to manage the health risks that have been measured. This highlights the critical function of such a system not only in measuring but also in managing these health risks. Lastly, this example brings to light some common issues encountered in utilizing the system in the context of emergencies, in order to underscore the importance of prevention and preparedness strategies that aim to build robust health information systems during normal times to support response when it is needed.

SPEED is an early warning surveillance system that monitors consultations for health conditions arranged in syndromes. It assesses health trends and uses web-based software that receives data via short messaging service (SMS) and converts data into customizable reports.

Figure 2.2.1 The SPEED Reporting System *(4)*

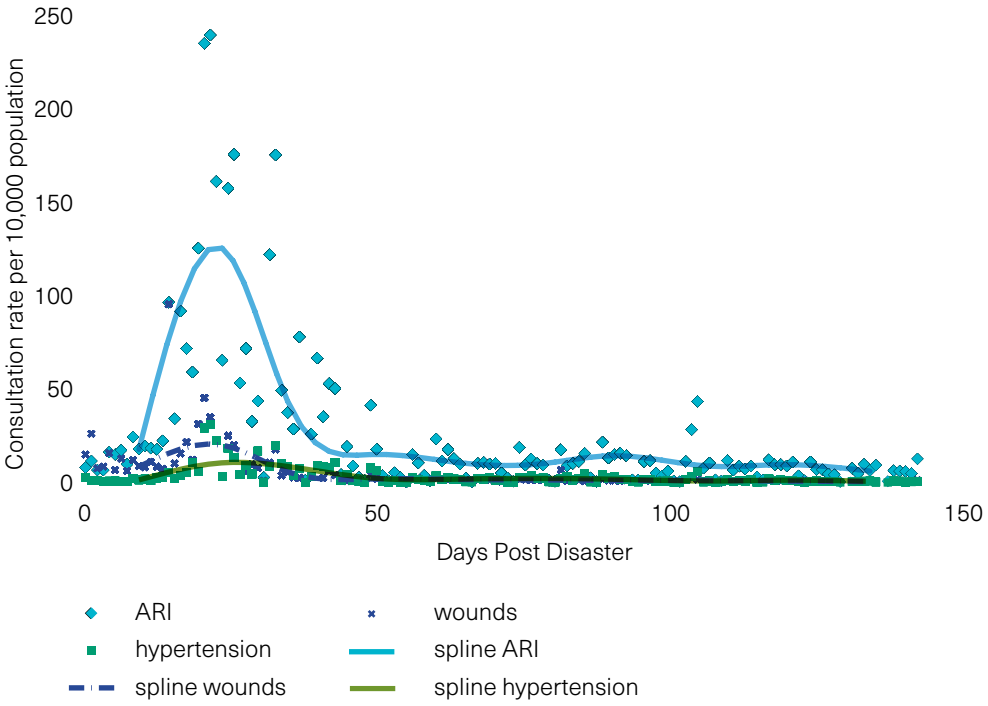


Key: MHO Municipal Health Officer; LGU Local Government Unit; CHO City Health Officer; PHO Provincial Health Officer; CHD: Center for Health Development; DOH Department of Health

In November 2013, Typhoon Haiyan – one of the strongest category typhoons ever to make landfall in the Philippines – ravaged six of the country's 17 regions. Strong winds, heavy rainfall and storm surges led to an unprecedented impact: 6300 dead, 1061 missing and 26 689 injured. The typhoon damaged all health facilities in its path, affected many healthcare workers and disrupted critical infrastructure (water, power, communication). This impaired the delivery of health services to the affected population. As soon as local and international emergency medical teams arrived and started to provide their services, SPEED was activated. The Department of Health prioritized SPEED after having seen the value of early warning systems after extreme events, and implemented it despite several obstacles (such as poor network and communication, lack of health human resources, logistical concerns), using the data and findings it collected to plan the response activities. This led to an analysis of health impacts and gave a clear picture of diseases that ensued in different timeframes. It showed that the most common morbidities were communicable diseases in children and injuries and non-communicable diseases in adults. Important public health interventions such as mass vaccination for vaccine-preventable diseases, logistics and medical supply augmentation for hypertension and diabetes were undertaken to decrease

preventable morbidity and mortality after the disaster. SPEED data indicated that the focus of interventions should be on primary health care rather than specialist care, which helped in team deployment decisions. Furthermore, as well as depicting the severity and magnitude of disruption to the health system (which was fully apparent within two months after the typhoon), it delineated a recovery phase that signalled the transition of the health system from response to recovery. This guided the main recommendation to authorities that external medical teams were no longer needed, because local capacities were sufficient to address the long-term needs.

Figure 2.2.2 Consultation rates per 10 000 individuals for acute respiratory infections, wounds, and hypertension in Typhoon Haiyan, Philippines, 2013 *(5).*



As reported by WHO, there was no outbreak of communicable diseases among the communities affected by Typhoon Haiyan. This was attributed to the contribution made by SPEED to facilitating early and appropriate actions and interventions that reduced health risks after the disaster.

SPEED was also used in the Zamboanga Siege in the Philippines in 2013. It demonstrated its usefulness as an early warning tool for disease prevention during this armed conflict situation on Mindanao Island.

2.2.4 Obstacles to implementation of SPEED during Typhoon Haiyan

Typhoon Haiyan destroyed or badly damaged many of the aspects of the health system that are crucial for measuring and counting (that is, epidemiology and surveillance). Hospitals, laboratories and public health offices were damaged, as were computers, mobile phones, reporting forms and other supplies. Lifelines (that is, communications, networks and power) were out of service for a week after the typhoon. Many healthcare workers were affected. Some were killed by the typhoon, some had their houses damaged, and some had family members or friends missing. Consequently, the routine surveillance system was paralyzed. Besides which, the immediate priority was to save lives, manage the dead and missing, and attend to the needs of the displaced population in evacuation centres, rather than measuring and counting health impacts. The Department of Health, aware of the value of SPEED, activated it. To circumvent problems with power and the communication network, it defaulted to the paper mode of SPEED, using manual documentation and processing. To address the shortage of healthcare workers, the Department of Health oriented and deployed international medical teams to gather SPEED data. It also sought the help of partners to report health data from the SPEED system.

The use of SPEED proved to be greatly advantageous in this context and subsequent enhancements were made. These included revision of criteria for activation and deactivation, inclusion of disease syndromes and revision of thresholds, updating of the format for SMS, revision of data entry and online reporting forms, and enhancement of maps and graphs.

It is also apparent that many predisaster strategies and systems are needed to support SPEED. For example, SPEED should be operationalized in such a way as to complement routine surveillance systems, as analysis of predisaster data and baseline information alongside SPEED data would provide a richer context for planning. There is also a need for continuous training to address the rapid turnover of SPEED-trained personnel. Software and hardware developments are also a priority in order to improve SPEED.

2.2.5 Conclusions

Measuring the diverse health impacts of different types of emergencies and disasters at health system, population and individual levels is critical in order to understand how people's health and health systems are affected by the interaction of hazards with their respective exposures, vulnerabilities and capacities. This understanding provides vital information to develop and implement Health EDRM strategies to reduce the risks and consequences of emergencies and disasters. The use of health trends in different post-disaster settings across time has helped guide public health managers in planning and implementing the response to, and recovery from, the affected population's varying health needs. The examples of WHO's EWARS and the Philippines' SPEED show the importance of measuring and managing the health risks of a disaster as an important public health function. Likewise, the examples show the effects of emergencies and disasters on the functioning of the health system and the need to make necessary adjustments and find solutions to address these challenges and assure continued functionality.

2.2

2.2.6 Key messages

- **Measuring the health impacts of disasters at health system, population and individual levels is critical in order to enable appropriate and timely public health interventions in emergencies and disasters.**
- **Various indicators should be measured to characterize the health impacts and risks of emergencies and disasters. Relevant data should be collected and analysed so that it can be used for various purposes and actions before, during and after emergencies and disasters.**
- **It is crucial to build capacities for epidemiology, laboratory testing, public health surveillance and information management as part of Health EDRM as these will provide the foundation for accurately measuring health impacts during emergencies and disasters.**
- **Although the effects of an emergency or disaster may make measuring health impacts particularly difficult, putting in place predisaster prevention and preparedness measures, operational readiness, back-up systems and contingency plans can prevent or overcome these obstacles.**

2.2.7 Further reading

Garfield R. Measuring humanitarian emergencies. Disaster Medicine and Public Health Preparedness 2007;1(2): 110-6.

Khan Y, Schwartz B, Johnson I. Surveillance and epidemiology in natural disasters: a novel framework and assessment of reliability. PLoS Currents Disasters 10 February 2014; 6.

Logue JN, Melick ME, Hansen H. Research issues and directions in the epidemiology of health effects of disasters. Epidemiologic Reviews 1981;3(1): 140-62.

Salazar MA, Law R, Pesigan A, Winkler V. Health consequences of Typhoon Haiyan in the Eastern Visayas region using a syndromic surveillance database. PLoS Currents Disasters 6 February 2017; 9.

2.2.8 References

1. Yaghmaei N. Disasters 2018: Year in Review. CRED Crunch Issue. 2019; 54.
2. WHO. Disasters and emergencies. 2019 www.who.int/surgery/challenges/esc_disasters_emergencies/en (accessed 30 December 2019).
3. Chan EYY. Public health humanitarian responses to natural disasters. 2017. Routledge.
4. Surveillance in post extreme emergencies and disasters (SPEED) operations manual for managers. Philippines Department of Health. 2011.
5. Salazar MA, Law R, Pesigan A and Winkler V. Health Consequences of Typhoon Haiyan in the Eastern Visayas Region Using a Syndromic Surveillance Database. PLoS currents. 2017: 9, ecurrents.dis.4a3d3b4474847b2599aa5c5eefe3a621. doi.org/10.1371/currents.dis.4a3d3b4474847b2599aa5c5eefe3a621