LOSS MODELLING FRAMEWORK

Predicting and preparing: Innovating for health-system resilience to extreme weather events

Lorcan Clarke

Lorcan Clarke
L.Clarke3@lse.ac.uk

This short piece examines how increasing access to modelling frameworks and tools can improve sustainable and resilient health systems.

In September 2017 hurricanes led to severe impacts across the Caribbean. The passing of Hurricane Irma and Hurricane Maria damaged and destroyed buildings and infrastructure across several countries, causing losses far greater than many yearly economic outputs. These extreme weather events impacted 37.2 million people. 265,000 required humanitarian support in the aftermath. For their health and wellbeing, potential impacts on families and communities could be persistent and catastrophic, particularly if disasters recur rapidly. Direct trauma and exacerbated ill-health from disrupted access to care and medicines are two of many pathways of disaster impact which depress peoples' ability to live secure, happy and productive lives. Rebuilding and preparing for the next major event is now the focus of those impacted by Irma and Maria, but assessing the risks presented to peoples' health and wellbeing remains challenging. Adapting approaches to existing technologies and financial instruments could improve reduction of disaster risks, before, during and after hazardous events.

Adaptive approaches to risks to health could improve loss measures based on asset values, i.e. buildings and infrastructure, that can mislead about the extent to which poor and marginalised groups are impacted by extreme weather events and by disasters. Initiatives such as CatRiskTools, hosted by Oasis and the Insurance Development Forum, could improve awareness and accessibility to tools for measuring and managing disaster risks worldwide. While improving the standardisation and interoperability between the tools of private industry, this can spark new approaches to risk. Approaches could include combining measures of health burden with those for disaster risk, revealing how to better assess and address shocks to peoples' health. This piece explores this opportunity and outlines how disasters affect health and wellbeing, the approaches to statistically modelling disaster risks, and how to adapt approaches to proactively address disease and ill-health.

Disasters Effects on Health and Wellbeing

It is tough to estimate economic costs related to disasters' impacts on health and wellbeing. Evidence on financial stresses to individuals, health systems and the broader economy can be better leveraged in disaster risk reduction activities. Understanding these impacts is the first step to action.

Disasters can disrupt health and wellbeing, whatever the scale. Surges in medical provider requirements and costs from illness, injury and deaths can arise directly or indirectly from hazardous events. These costs constrain what health systems can do and can impart significant

financial burden upon households. If costs are transferred to patients through fees, families can face "catastrophic health expenditures" that take up an unsustainable portion of monthly income and further burden those recovering from disasters. Surges in demands for care from health facilities and personnel following disasters can limit essential services elsewhere for those in need of care. During the 2014-2016 Ebola outbreak in West Africa, for instance, constraints created severe limitations in the availability of maternal and newborn healthcare. These cascading impacts further disrupt health and wellbeing, compounding inequities in access and quality of care available to marginalised groups in society. For vulnerable persons, such as infants and young children, disruption can have lifetime impacts (e.g. stunting from extended malnutrition). At a larger scale, damage and disruption to sanitation infrastructure can increase the risk of outbreaks of water-borne diseases (e.g. cholera), while poor evacuation planning can expose displaced persons to harmful extreme temperatures.

Some disasters isolate effects through human health and, under investigation, offer potential methods for estimating economic losses. For instance, the World Bank estimated that the 2014-2016 Ebola outbreak in West Africa, that directly led to over 11,000 deaths, caused massive economic losses in Guinea ($600m), Liberia ($300m) and Sierra Leone ($1.9bn). These figures are useful, including government budget deficits and changes in commodity prices, but they are still incomplete measures for the toll of loss of life, human capital and community stability.

At present, post-disaster assessments typically don't estimate economic losses associated with shocks to health and wellbeing, at an individual or societal level. Due to frequency and capacity, estimates on asset losses are far more prevalent. Comprehensive and accurate measures are essential for informing a global insurance industry which underwrote $135 billion in losses due to disasters from natural hazards in 2017. This is reflected in the Sendai Framework for Disaster Risk Reduction 2015-2030, a 15-year voluntary non-binding agreement that was adopted by UN Member States in 2015 and aligns with the 2030 agenda. It is a clear commitment to reducing disaster risks and building resilience. Sendai includes targets to monitor reduction in economic losses that only encompass "direct" figures, reflect impacts to assets such as buildings, infrastructure and physical capital stocks. The absence of "indirect" loss measurements offers an avenue for innovation. The problem of indirect losses is significant. A recent World Bank report estimated losses to consumption (i.e. economic activity) from extreme weather and other natural hazards (e.g. earthquakes) were 60% higher than physical asset losses - potentially costing $520 billion annually across the study's sample of 117 countries.

Lorcan Clarke
L.Clarke3@lse.ac.uk

Statistically Modelling Disaster Risks

Improved understanding of losses related to health and wellbeing can build on current approaches to disaster risk. Methods that can already inform public and private disaster risk management and loss assessment. These approaches rely in part on statistical tools, like those hosted by Oasis Hub, to mathematical model hazardous events and physical asset impacts.

Catastrophe risk mapping and modelling has applications that include informing urban planning, building more resilient structures and insuring physical assets. In brief, calculations involve computer models using information about the local environment, both built and natural, to estimate and map the extent of hazard risks. Structures, known as "exposure", respond to potential catastrophic events ("perils"), such as earthquakes or extreme weather events, with respect to how vulnerable they are to the local intensity of that peril. Structural vulnerability is measured by the ratio between the cost of repair to the cost of replacement ("mean damage ratio"). This combines with assets values to provide loss estimates as the catastrophe modelling output. Vulnerability measures can then reduce risks through informing choice of location, more resilient or adaptive design or via refining risk-transfer to fund repair and reconstruction (e.g. insurance instruments).

Adapting Approaches to Proactively Address Health Risks

Catastrophe risk mapping and modelling already supports health systems resilience to crises, particularly through measures to understand and support resilience in critical hospital, primary care and supply chain infrastructure. However, public and private actors could take this a step further. Targeted modelling of health impacts can improve resilience planning and building on innovative financial instruments.

Health emergencies, particularly from disease outbreaks, already have the attention of the catastrophe modelling industry and beyond. AIR Worldwide's Pandemic Model guided risk assessment for the World Bank's Pandemic Emergency Financing Facility release of "Pandemic Bonds". These "bonds" act like insurance for major infectious disease outbreaks and can rapidly release funds for in-country response to mitigate pathogen spread and impact. RMS also includes infectious disease modelling as part of its portfolio of tools.

Combining catastrophe modelling with information about the status of health in communities and of vulnerable groups could foster more holistic approaches to address disaster risks. Though systems for comprehensive collection of health statistics remains limited in many at-risk settings, population health risks could still be assessed from estimated disease prevalence (e.g. global

burden of disease), available databases (e.g. department of health statistics) and surveys (e.g. demographic and health surveys).

Data can bridge expertise between the disaster risk reduction and health communities. It can foster novel conversation and collaboration. Integrating disaster risk modelling approaches with health assessments could create benefits beyond the catastrophe modelling and insurance industries. Innovative efforts could support the intersectoral collaboration and improved disaster information called for by the Sendai Framework. Oasis Hub, as an open platform for improving the quality and availability of these modelling tools, offers a pathway to engage parties outside of the industry and bring together different methods and goals. Supporting innovative projects and fostering conversation between those working on disasters and health could catalyse significant improvements to managing and protecting people's welfare.

For more information on the challenges posed by disasters for improving health and wellbeing. Please see Shocks, stresses and universal health coverage: pathways to address resilience and health.

Lorcan Clarke
L.Clarke3@lse.ac.uk

About the Author:

Lorcan Clarke is a research assistant and MSc candidate in the Department of Health Policy at the London School of Economics and Political Science. Lorcan has supported improving data, monitoring and evaluation for disaster risk reduction through roles with Public Health England and the Overseas Development Institute, and more broadly as current Data Focal Point for the Science-Policy Interface Platform of the United Nations Major Group for Children & Youth (UN MGCY).

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