Chapter 3

Disaster Deaths

Proposed indicators for monitoring disaster-related mortality

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Executive summary

Disaster deaths serve as an immediate proxy measure of disaster severity and are reported systematically. Data from the Emergency Events Database (EM-DAT) show there are patterns in deaths, and they vary significantly between disaster types and the socioeconomic contexts in which they occur. Stronger evidence on determinants of death, especially at the community level, is needed.

Disaster impact databases that systematically compile physical characteristics and human impacts for all disasters and all countries exist and are used widely. Regional and disaster-specific databases are also available; these are more specialised. Frequency of use by multiple stakeholders and public visibility are a major incentive for data units to maintain quality and encourage sustainability. But the main barrier to reliable data is the lack of standardised terms and definitions of basic concepts such as 'disaster' and the shortage of quantifiable impacts. Two global datasets, EM-DAT and Munich Re, have worked together to harmonise their disaster terms and classification categories, but international norms are a prerequisite for reliable reporting.

Priority areas that require resolution for the mortality monitoring process to be more accurate, credible and comparable are as follows

- Multiple sourcing of mortality data and use of triangulation techniques with different data sources, such as satellite, population grids and sample surveys, will enhance accuracy and reduce bias in mortality indicators.
- Definition of appropriate baselines that represent the counterfactual level of mortality is needed for comparisons for long-term disasters such as droughts or famines.
- Exploration and testing of predictive models in developing country settings are key.

In this chapter, we present an overview of mortality and its drivers in disasters, the main gaps and priorities to improve reliability of mortality data and, finally, six mortality indicators, which can draw on existing data sources.

3.1 Natural disasters: global overview

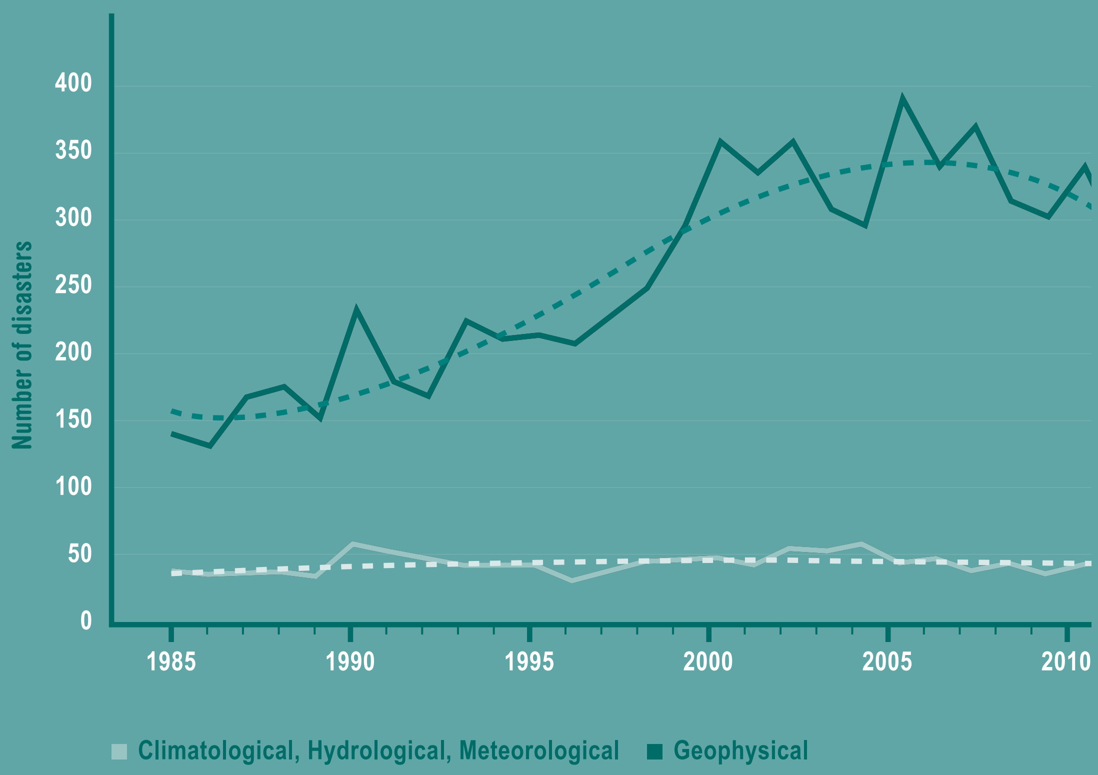
Between 1961 and 2010, natural disasters affected a global annual average of 129.6 million people,[1] according to EM-DAT.[2] These disasters claimed an average of almost 99,000 lives per year – of people who died as an immediate consequence of the event. This figure excludes those who died after the emergency phase, from disaster-related food shortage and disease outbreaks, which could potentially add substantially to the death toll. The greatest share of the increase is claimed by climate-related disasters, which have increased from an annual average of 77% of all disasters in 1980-1989 to 84% from 2000 (Figure 7).

Although there has been little increase in the occurrence of geophysical disasters such as earthquakes, data from EM-DAT suggest that mortality per event may be increasing (Guha-Sapir and Hoyois, 2013). Population density in cities and in areas with high geophysical risk has increased since 1950, and half of the large cities in the developing world are vulnerable to floods, severe storms and earthquakes (Noji, 2005; Pelling, 2003). Asia is the region that has the highest numbers of reported disasters and affected populations. Population density, earthquakes and storms are the main drivers of this increase in mortality. On the other hand, numbers of deaths per flood event are increasing, suggesting an escalation in their severity.

Deaths as a result of disasters are used widely as an immediate proxy measure for the severity of the event and therefore reported systematically. Humanitarian aid and aid for preparedness and prevention often use mortality as a lever for decision making and resource allocation. At national and local levels, disaster mortality is a strong incentive for the development of DRR and preparedness programmes. At all levels, operational mortality indicators are highly policy relevant but need to take into account hazard specificities.

Figure 7: Trends in climato-hydro-meteorological and geophysical disasters, 1985-2011

(absolute numbers and polynomial regression lines)



Source: EM-DAT.

3.2 Variations in death tolls

Since the 1980s, the trend in numbers killed and affected by disasters per million population has been increasing (Figure 8). Disaggregated analyses indicate the trend is most pronounced for floods and earthquakes. Many factors play a role in determining the levels of mortality from a hazardous event; some are intrinsic to the hazard, some are a function of the context that makes it a disaster.

Factors that are intrinsic to the hazard and influence mortality

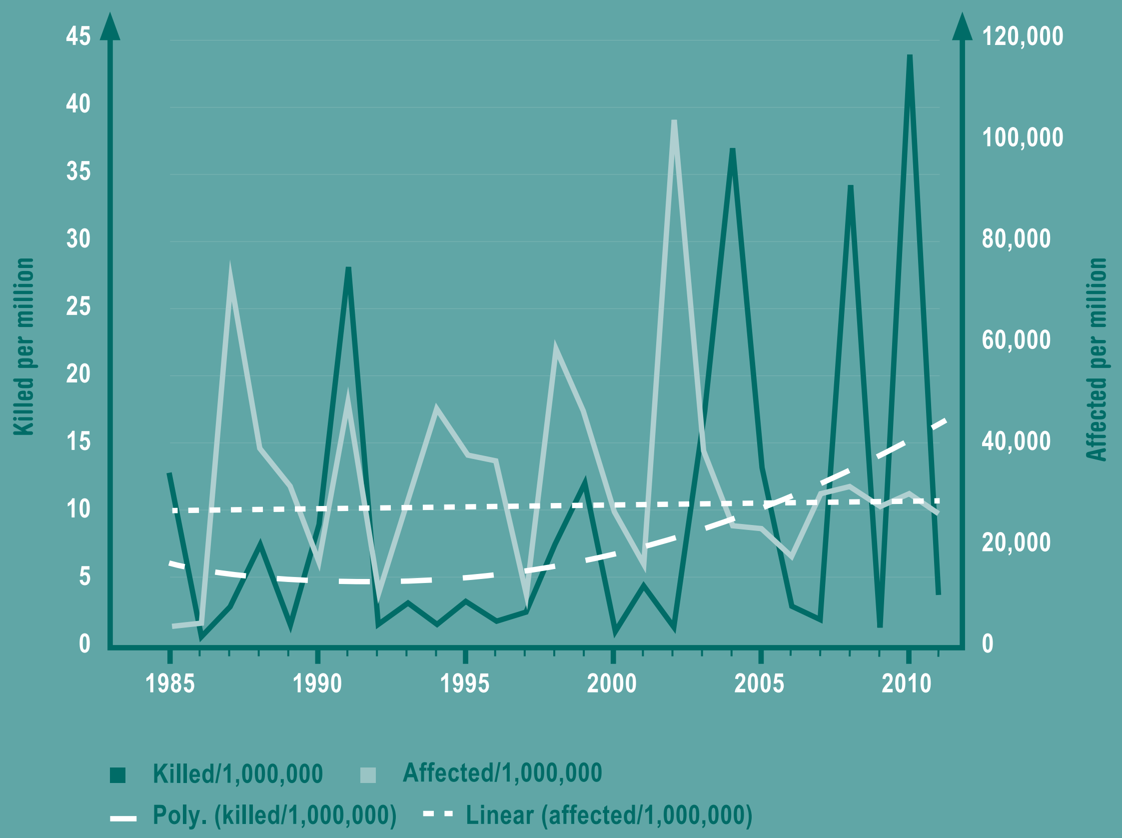
Hazards that bring on a disaster present physical characteristics that have a specific influence on mortality and for which little can be done in terms of primary prevention.

First, the **type of onset** of a disaster can be a determinant of mortality, as the predictability of a disaster influences the possibilities of evacuation or protective action acts, and therefore also the event-related mortality. Earthquakes are a good example of mortality being high largely because of their short prediction notice and, therefore, time for protective action. In contrast, slower-onset events such as droughts and floods are more predictable and generally cause fewer deaths. However, as start and end periods are difficult to define, longer-term mortality from these events is often underestimated.

Most disaster types can be classified by their onset characteristics and therefore their mortality potential. **Duration** will also influence mortality, as protracted effects of a disaster will increase the exposure of

Figure 8: Trends in killed and affected per million populations, 1985-2011

(absolute numbers and polynomial regression lines)



the population to pervasive morbid conditions and the risk of mortality. Examples include cold and heat waves, ash fall from volcanoes or persistent flood waters. Past disasters indicate that the **physical severity** of a disaster is related to the severity of its impact. An intense storm is likely to kill more people than a smaller one. However, as other non-intrinsic or contextual conditions also contribute to death tolls, severity is not always a reliable predictor of mortality for all types of disasters.

Factors external to the hazard that influence the mortality risk

The 2001 IPCC report estimates that 65% of world deaths from natural disasters between 1985 and 1999 were in countries whose incomes were below $760 per capita (IPCC, 2001). This is further confirmed by the EM-DAT dataset, which shows that 30.4% of total disaster deaths in the past 30 years have occurred in LMICs and 44.5% in LICs. That poorer countries are at a higher risk of negative outcomes from disasters is widely recognised and is intuitively obvious; the reverse would have been surprising. Mortality risks have a multifactor profile; we summarise some of these factors below.

There is growing recognition that population density, urbanisation, demographic profiles and environmental characteristics are context-specific factors that are likely to drive death tolls and victimisation (Brauch, 2003; Jakubicka et al., 2010). However, none of these factors is systematically positively associated with numbers of deaths and damages. Economic conditions or effective preventative measures may substantially reduce the number of fatalities and losses, despite high levels of urbanisation or population density.

Second, the effectiveness of local preparedness measures to reduce the risk of mortality requires evidence on the factors that determine mortality, without which such measures are based on stereotypes. Moreover, preparedness measures such as EWSs must be better linked to early action – a lesson from the 2011 Horn of Africa drought, whose death toll remains to be estimated (Kim and Guha-Sapir, 2012). EWS without community awareness of protection options or effective dissemination also aggravates death tolls, as illustrated by the impact of Cyclone Nargis in Myanmar (Webster, 2008).

Third, demographic characteristics and civil status are important risk factors for mortality. Women, children, the elderly, non-documented immigrants, slum dwellers and the poor may be at higher mortality and morbidity risk, and policies to target them will be required (Bourque et al., 2007; Tierney et al., 2001). Sounder evidence on the indisputable vulnerability of women and children is required, as this group can account for nearly 70% of a developing country population (Doocy et al., 2007). For industrialised countries there are few cause-of-death studies, but studies on the 2003 heat wave in Western Europe (Cadot et al., 2007) and the east Japan tsunami (Tatsuki, 2013) suggest that, in these settings, the elderly may be at particularly elevated levels of risk. The identification of population subgroups that are at a higher relative risk of mortality needs objective evidence through specific and well-designed studies (Sawai, 2011).

Mitigating these and other risk factors is feasible if DRM/DRR policies are based on reliable and time series data on impact at global, regional and sub-national levels. Global, regional and disaster-focused databases include the following:

- EM-DAT (www.emdat.be/)
- Munich Re NatCat (www.munichre.com/en/reinsurance/business/non-life/georisks/natcatservice/default.aspx)
- Suisse Re Catnet (www.swissre.com/clients/client_tools/about_catnet.html)
- Dartmouth Flood Observatory (http://floodobservatory.colorado.edu/)
- USGS earthquake catalogues (http://earthquake.usgs.gov/regional/neic/)
- DesInventar (http://www.desinventar.org/)

3.3 Gaps and priorities

Scientifically **sound and harmonised definition of a disaster and its classification** is a main barrier today to reliable disaster impact indicator monitoring. Among the global databases, Munich Re NatCat and EM-DAT have harmonised between them the classification and definition of terms, and Swiss Re joined the discussions in 2011. While many other policy studies and reports use the EM-DAT definition for a disaster, there is undoubtedly a need to review this and other definitions and eventually to reformulate it to reflect global requirements, while still keeping it quantifiable. Although meeting all these constraints is not easy, this should be a feasible goal.

Second, unavailability of **age/sex distributions** of mortality is a major barrier to understanding the risks of mortality, and therefore designing effective DRM/DRR programmes. Field experience indicates that obtaining this information for all disasters in all countries is probably not a realistic option. However, systematic sample surveys could be a powerful tool to fill this gap in knowledge. Experience from the widely used SMART sample surveys (http://www.smartmethodology.org/) in conflict settings could be useful.

Third, **population exposure estimates** by hazard and by country are central to sounder and more accurate calculation of indicators, as using national populations as denominators can be misleading in larger countries. Such estimates should be made available by country and by hazard type for the calculation of indicators.

Fourth, as the severity of an event can play an important role in its impact, **common severity indices or reference guidelines** need to be developed based on currently available severity measurement tools (Annex C).

Fifth, although the severity of a disaster plays an important role as a determinant of mortality, institutional frameworks, governance structures and other developmental characteristics may be stronger drivers of disaster impact (Anbarci et al., 2005; Escaleras et al., 2007; Keefer et al., 2011). Corruption, for example, particularly in the construction sector, is likely to be associated with earthquake mortality, as most deaths owe to building collapse and non-compliance with building codes (Kaisin, 2012).

Table 5: Proposed mortality indicators

Data component	Indicator name	Target	Comment
Crude disaster-related mortality rate	# of dead as a result of all disaster divided by those exposed to all disaster	• 50% reduction in high-frequency disasters in 5 years • 15% reduction in disasters that have low warning potential in 10 year	• Return times of certain disasters such as earthquakes or tsunamis will influence the target • Agreement needed on standard methods to estimate exposed populations
Disaster-specific mortality rate	# of dead per # exposed by disaster type	30% reduction in most frequent disaster in the country in 5 years	Same as above
Composite impact index	Weighted index of death and economic losses	Statistically significant downward trend in index measured every 5 years	Useful for international comparisons and to ensure wealthy countries with high-value assets and low deaths and poor countries with low-value assets and high deaths are compared on a level playing field
Cause-specific mortality rates	% medical causes of death	30% reduction in main causes of mortality from disasters in 5 years. Countries may choose disasters that have the greatest impact	Prevention and preparedness especially for life-saving purposes require an understanding of cause of death from disasters
Age-/sex-specific mortality rates	Deaths by age and sex categories	75% of reports present deaths by age and sex in 5 years	Children (0-15 years), adults of working age (16-50 years) in poor communities), those 50 years and above. Sample surveys could be considered for selected large-scale disasters to establish age/sex profiles
Public infrastructures specific mortality rates	# of dead in specified public infrastructure	75% reduction in 10 years. Downward trend during this time	Schools (children), critical infrastructures (administrations, hospitals, fire brigades etc.)

Finally, while past impact data help establish risk factors and provide insights into trends over the past decades, their ability to predict future scenarios is limited, especially for certain types of disasters. Simulation models based on sets of assumptions can provide valuable support in targeting preparedness and prevention. Earth scientists, engineers and meteorologists have made much progress in these areas (e.g. Coburn and Spence, 2006; Wald et al., 2005). In general, these models are tested against observed data to establish their precision and accuracy. These models need to be further developed with multidisciplinary inputs, and specifically for low-resource settings or urban areas in the developing world. Uncertainties need to be well described to ensure investments in low-resource setting obtain the maximum value for money. DRM/DRR policies that combine observed data with predictive models can substantially enrich monitoring and prevention of mortality.

3.4 Proposed mortality indicators

In this section, we propose a set of mortality indicators for global monitoring of disaster-related mortality. These have realistic data requirements and would provide a credible evidence base for policymaking. A primary target of DRM should be to reduce disaster-related deaths, and mortality indicators are a direct reflection of the success of such programmes. The indicators below should provide the minimum information required to assess whether a disaster-prone region is reducing the mortality impact of natural hazards.

Concerning the target for monitoring mortality indicators, generally, death tolls from disasters as a broad concept can be **understood similarly** by the media, politicians, communities and other stakeholders. It is only at detailed analytical levels that the concepts can become more complex. Often, these complexities can be academic and of less relevance for operational purposes. Disaster mortality rates can be communicated clearly in **simple terms, in this case numbers of dead per population group.** Societal sensitivity to disaster mortality makes this target **highly acceptable** to stakeholders, including politicians in most forms of government. With such undeniable readability, the focus on death tolls and on their reduction can be a **strong incentive to tailor** DRM/DRR with broad support of exposed communities.

With regard to the proposed targets, high disaster death tolls in poor populations and their subsequent impact on survivors (Cas et al., 2011; Rodriguez-Llanes et al., 2011) make **effective disaster mortality reduction a priority in poor countries,** especially from developmental perspectives. In these settings, capturing the full cost and implications of disaster mortality is crucial so that disaster losses can be weighted correctly against competing priorities of a more immediate nature.

Concerted action between health, social services, public infrastructure and civil society can make a substantial difference in terms of mortality reduction in all types of economies, one that can be measurable. Focusing on reductions by age/sex will also contribute to a **reinforcement of human rights.** Reducing deaths by a certain percentage or targeting a declining trend in disaster-related mortality should **be simple to understand** for politicians and community members.

With regard to indicators, disaster mortality rates have to be adequately standardised to allow for comparisons across countries and time. At this time, **data** exist to allow calculation of most of the indicators proposed, but much can be done to fill important gaps (harmonised methods, age/sex data, exposure estimations), discussed above. **Transparency of disaster mortality** is an issue, since increasing tolls to heighten the chances of attracting international aid or reducing them for political expediency cannot be excluded. Triangulation of data sources, proposed earlier, is one way to increase transparency. **Capacity to measure progress** will depend on the technical capacity of the data source organisation. It will require sustained expertise to ensure objective collection and validation of data and the production of useable analysis over the long term. Ideally, DRM/DRR programmes should provide measurable inputs and baselines for benchmarking progress.

There needs to be further research with regard to ways in which the indicators should be formulated and presented. Multi-year mortality rates or moving averages could be more useful than annual rates, since these will smooth high annual variability and diminish the impact of infrequent return period disasters. Another example would be use of an indicator calculated on 'conditional' mortality that uses rates only from disasters over a specific severity, such as mortality from storms above a wind strength threshold. These types of indicators would then focus only on events above defined thresholds of hazard severity scales.

Finally, different regions and different disasters may require different formulations of indicators. For example, the mortality risks for earthquakes are not the same as those for river floods, and may require different indicators – especially if they are to serve policy on preparedness and prevention.

3.5 Conclusion

Establishing targets and monitoring indicators presupposes a strong and reliable data system with scientifically robust methods and definitions. That said, most countries that pay the highest price for disasters in terms of lives and livelihoods have few resources to undertake and maintain credible data systems. Therefore, a solution that is realistic for such countries and sustainable in the long run should be envisaged. A joined-up regional effort that uses a combination of approaches – systematic data collection, simulation predictive models of impact, systematic sample surveys – can ensure credible monitoring of progress.

Chapter 3 Endnotes

1 Natural disasters are triggered by a natural hazard and alter severely the normal functioning of a community or a society requiring immediate emergency response and possible external support for recovery. Without severe alteration, the event cannot be considered as a disaster. See IPCC (2012)

2 EM-DAT defines a disaster as an event that has either 10 killed or 1, 000 affected, or a call for international assistance.