

# A Brief Introduction to Disaster Epidemiology

Charles DiMaggio, PhD<sup>1,2</sup>

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<sup>1</sup> Department of Anesthesiology, Columbia University, College of Physicians and Surgeons, New York

<sup>2</sup> Department of Epidemiology, Columbia University, Mailman School of Public Health, New York

## 1 Introduction

In a disaster or complex crisis public health measures are as crucial as medical care. Epidemiologists contribute by providing timely information to help guide interventions. The following notes offer a (very) brief introduction to the topic of disaster epidemiology. They are informed by the annotated bibliography of classic articles in the field that follows at the end of the section. Readers are strongly encouraged to supplement this introduction by visiting some of the relevant sites listed on the Links section of this site.

## 2 The Role of Epidemiology in Disasters

A disaster is defined as much by the vulnerability of the local population as by the characteristics of the event itself. A 1971 California earthquake measuring 6.6 on the Richter scale killed 60 people in a population of 7 million. By contrast, a significantly less powerful earthquake (5.6 on the Richter scale) in Managua, Nicaragua one year later caused 5,000 deaths in a population of 420,000. Socio-economic indicators are often clear predictors of the impact of a disaster. Post-disaster cholera deaths are twice as likely in Bangladeshi families with little schooling compared to families with at least one high school graduate. (Sapir and Lechat, 1986)

Epidemiology, as the basic science of public health and prevention, provides the data to make informed decisions about preparation and response. Post-disaster epidemiologic analyses may reveal previously unexpected patterns. For example, in

a Guatemalan earthquake of 1975, the death rate for 5 to 9 year olds exceeded that of 1 to 4 year olds, suggesting that adults were more likely to attend more closely the youngest children. (Lechat, 1984). Nine Minor surgical emergencies predominate in post-hurricane periods, many caused by chainsaw injuries sustained during the clean-up period; 9 out of 10 hurricane deaths are due to drowning not wind.. (Noji, 1993).

Another excellent example of disaster epidemiology is a case-control study that showed 60% of tornado deaths in Wichita Falls, Kansas, when individuals ignored repeated advice not to drive during the storm. This elegant study utilized cast-control techniques by comparing case-proxy information from relatives and friends of deceased person to un-injured controls. Notably, few deaths occurred among people who followed advice to remain indoors. (Glass, 1980)

Even such seemingly incomprehensible events as radiological or nuclear attacks follow predictable (albeit intractable) patterns. The detonation of a nuclear device would be expected to initially cause blast injuries , retinal burns and blindness, soft tissue trauma. The ensuing fallout will likely disseminate in a wind-dependent and ellipsoidal in geographic pattern and be composed primarily of gamma radiation which will at first cause primarily gastrointestinal symptoms in the first hours and days. There is no specific treatment for such radiation illness (Lechat, 1984). Panic and psychological symptoms will likely contribute to an overwhelming surge of patients towards an already overburdened emergency medical system.

There is a clear and continuing need for standardized measures of injury and their associations with different types of disasters. One approach epidemiologist may take is applying Haddon Matrix-like cell elements of human, agent, and environmental factors across the pre-disaster, disaster and post-disaster time periods. For example, discouraging migration to vulnerable urban areas is addressed in the pre-disaster / human cell. This characterization can help guide interventions. (Noji, 1987)

### **3 Disaster Preparedness**

There are 5 phases of disaster management: (1) preparation or all those activities that contribute to prevention, mitigation and preparedness, (2) surveillance and early warning (3) the emergency phase, when saving lives and reducing suffering are paramount (4) rehabilitation or the start of the return to normalcy and self-sufficiency (which may be the most difficult time for victims) and (5) reconstruction or physical re-ordering. (Cuny, 1993)

The keys to disaster management are anticipation, preparedness and mitigation. Quick action is necessary to establish leadership and the order necessary to reassure the public. As defined by Fred Cuny, a disaster relief expert who gave his life

working in a war torn region of Chechnya, emergency preparedness consists of an estimation of post-disaster needs, the development of programs to speed relief, the provision of emergency assistance, and reconstruction. (Cuny, 1992)

Risk analyses should take into account population density, vulnerable structures, potential environmental hazards, and economic impact. Existing resources including infrastructure, equipment, personnel, communication, transport, health services, medical stocks must be inventoried and if possible mapped as part of a geographic information system.

## 4 Disaster Response

The immediate health objective in the post-disaster period is to prevent mortality due to the impact. The critical importance of the immediate response is illustrated by survival proportions associated with extrication times.

Figure 1 below is a plot of data from a 1976 earthquake in Tengshan, China, the y axis represents survival proportion; the x axis represents time to extrication in hours. Up to 24 hours, over 80% of extricated individuals survive. By 48 hours, survival drops to 37%. By 4 days, survival is less than 7%. Information such as this also illustrates how epidemiologic approaches can be put to informative uses documenting and guiding relief efforts. (Lechat, course notes)

Following the immediate post-impact period, attention is directed to preventing mortality due to delays in rescue or lack of appropriate long-term care, shelter, food or water. The first treatment priority is care of the injured. Injuries, particularly those such as burns, may well have a lower probability of survival if sterile conditions can not be maintained.

It is worth noting that in war, damage and disruption is the goal. Terrorists have the added goal of affecting behavior by sowing panic and confusion. Yet, despite occasional reports to the contrary, such experienced disaster responders as Dr. Stefano Lazzari of the World Health Organization, are clear that Generalized panic, paralyzing trauma or anti-social behavior rarely occur after major disasters An added emotional issue is care of the dead. Most disaster experts believe there is clear evidence that the dead pose no threat to the living and that survivors may be accorded the necessary time to grieve. As Michel Lechat states The danger of decomposing human bodies has been grossly misrepresented as a source of epidemics. It should be stressed that unless a person has died from a communicable disease such as cholera or plague, a corpse represents no risk of spreading epidemics. (Lechat, 1984)

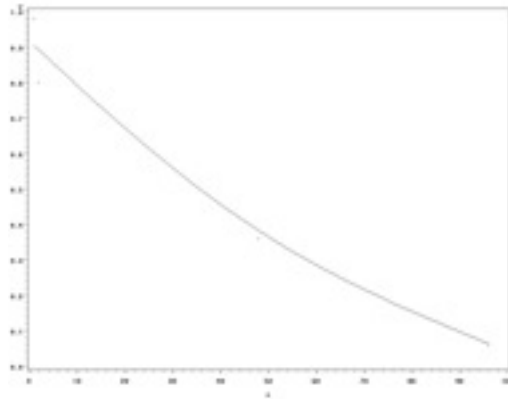


Figure 1: Survival by time to extrication, Tengshan, China, 1976

## 5 Annotated Bibliography

The following articles, though sometimes several decades old, are never out of date, and form the basis for an understanding of disaster epidemiology today as much as when they were printed. I remain indebted to the late (and deeply missed) Dr. Neill Oster for providing reprints of these sometimes difficult to find articles.

### 5.1 Cuny FC. Introduction to Disaster Management. Lesson 1: The Scope of Disaster Management.. Prehospital and Disaster Medicine. 1992; 7(4): 400-408.

The first in a series of articles by a disaster relief expert who lost his life in service to war-torn Chechnya. Key point: Disaster management occurs before, during and after the event. Key quote: Disaster management can be defined as the range of activities designed to maintain control over disaster and emergency situations, and to provide a framework for helping at-risk persons to avoid or recover from the impact of the disaster

### 5.2 Cuny, FC. Introduction to Disaster Management. Lesson 2: Concepts and Terms in Disaster Management. Prehospital and Disaster Medicine. 1993; 8(1): 89-94.

The second in the series. Key concept: There is a difference between a disaster and the event that caused it; events are natural phenomena, human endeavors contribute to disasters. Key quote: Participation in constructive activity is one of the

most effective means of coping, and disaster victims usually are highly active and thoroughly dedicated relief workers

### **5.3 Dineen J. Building for Calamity. Environment. Nov 1986.**

Contains a very good review of major natural catastrophes. Key point: Vulnerability is the product of risk and the probability of damage. Key quote: (Five years after a 1974 hurricane killed 8,000 Hondurans and left 100,000 homeless) there was no statistical difference between recipients and non-recipients of aid with reference to being better off financially

### **5.4 Glass, RI. Craven RB et al. Injuries from the Wichita Falls Tornado: Implications for Prevention. Science, 1980. 207: 734-738.**

The investigators interviewed families of deceased and seriously injured people 2 weeks after the Wichita tornado of 1979 and compared their responses to a randomly chosen group of uninjured controls. Key point: 60% of deaths and 30% injuries occurred in individuals who drove to get out of storms path (ignoring advice not to), most of the homes they left were unscathed. Few deaths occurred indoors.

### **5.5 Lechat MF. Natural and man-made disasters. In: Holland WW, Knox G,. eds. Oxford Textbook of Public Health. Vol 1: Oxford University Press; 1984.**

A comprehensive overview by a seasoned expert. Key point: Disasters follow predictable patterns. Epidemiologic data is necessary to decipher those patterns. Key quote: the sacrifice in promptness required to collect the information necessary to provide apt and well-directed aid is more than justified by the improved results.

### **5.6 Noji EK and Sivertson KT. Injury prevention in natural disasters. A theoretical framework. Disasters; 1987. 11: 290 296.**

Basically has taken the Haddon matrix and adapted it to disasters. Key points: Can categorize disaster in a matrix with 3 phases (pre-disaster, disaster and post-disaster) and 4 factors: human, engineering/technological, physical environmental and socioeconomic, Key Quote: We must know for certain how and where injuries occur in disasters, along with a profile of who is injured, the type of injuries and a description of severity.

**5.7 Noji E. Analysis of medical needs during disasters caused by tropical cyclones: anticipated injury patterns. Journal of Tropical Medicine and Hygiene 1993, 96, 370-376.**

A clear and compelling argument for the essential role of epidemiology in disaster preparedness. Key point: Data is necessary to make informed decisions. Key quote: availability of injury surveillance questionnaires that are prepared before a disaster and can be modified quickly will assist in efficient data collection

**5.8 Sapir DG and Lechat MF. Reducing the impact of natural disasters: why aren't we better prepared? Health Policy and Planning. 1986. 1(2): 118-226.**

[<http://heapol.oxfordjournals.org/cgi/content/abstract/1/2/118>]

An excellent article with many key points relevant to BT preparedness. Key points: (1) impact of disasters as much a function of local environment as of the disaster itself; much greater in poorer area (2) emergency aid often too late, wasteful and inappropriate; better to use aid to improve local capabilities Key Quote: It has been observed that families, friends and neighbors search, evacuate and extricate their own in the immediate aftermath of a disaster and that by the time external relief teams are functional on site, a very large majority of the total dead have already died.