Revisiting the public health consequences of natural disasters through an epidemiologic perspective

by
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ABSTRACT

A synopsis of recent epidemiologic activities in disaster settings is presented for 1999, the fifth year of the involvement of the Centers for Disease Control and Prevention (CDC) in the United States - Japan Natural Resources Panel on Wind and Seismic Effects. The objectives are to: 1) describe the mission of disaster epidemiology at CDC in the context of emergency management; 2) outline different methods and field activities conducted by CDC; and 3) provide a framework for public health and epidemiology in the emergency management of natural disasters, particularly wind and seismic events. A conceptual framework using the goals of epidemiology in disaster settings and the phases of the emergency management cycle has been developed to address the public health consequences of natural disasters. For each selected goal and phase, epidemiologic assessments or studies may be conducted to answer questions posed by public health officials and emergency managers. The framework may provide a basis for direction for collaborative work between the U.S. and Japanese-equivalent public health sectors for UJNR activities.

KEYWORDS: public health, natural disasters, epidemiology

1. INTRODUCTION

Since 1995, the Centers for Disease Control and Prevention (CDC) has been a member of the United States - Japan Natural Resources (UJNR) Wind and Seismic Panel. The objectives of this participation are to stimulate an awareness of public health perspectives in addressing wind and seismic events, and to address public health issues in multi disciplinary studies that concern human health and safety. At the 27th Joint Panel Meeting in 1995, CDC presented an overview of epidemiology in disaster settings (1); in 1996, a study on the risks of deaths in wind and seismic events as related to structural collapse (2); in 1997, rapid needs assessment following Hurricane Marilyn in the US Virgin Islands (3); and in 1998, a description of the American Red Cross - CDC Health Impact Surveillance System for Natural Disasters (4). These presentations have provided a representative cross-section of the various activities conducted by CDC in disaster settings.

At the UJNR 29th Joint Meeting in 1997, the US-Japan Panel on Wind and Seismic Effects recognized that the public health sector could provide a significant perspective on multi disciplinary planning needed for mitigation of and recovery following natural disasters. In line with this recognition, the US-side proposed to develop a public health component that

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Table 5 Analysis of variance of inconvenience of daily life according to the occurrence of indirect health effects within 6 months after the earthquake

Indirect health effects within 6 months after the earthquake (excluding those due to injuries)		Mean ± SD	P-value
1) Visiting a doctor more than once	Yes	1046±1182 (N=677)	
	No	683±684 (N=1137)	P<0.001
2) Being sick in bed and stay at home	Yes	1069±995 (N=384)	
	No	744±752 (N=1403)	P<0.001
3) Being hospitalized	Yes	1148±1197 (N=78)	
	No	806±903 (N=1714)	P<0.01

would address health-related issues as they apply to wind and seismic hazards. The goals for including this component were to reduce the human impact of disaster and to improve the quality of human life. To achieve these goals, the Panel suggested two areas of investigation: 1) Field assessments. These assessments, performed by both the engineering and public health sectors, may be improved by developing and testing scientifically and statistically valid methodologies for rapidly gathering information after natural disasters. 2) Human outcome studies. The risks for outcomes -- such as deaths, diseases, injuries, disabilities, and behavioral reactions -- may be described by demographic, health, behavioral, meteorological, geological, environmental, and engineering data to obtain an understanding of how and why people are affected by natural disasters. Development of these topics under the direction of the UJNR would coalesce the engineering and public health sectors to further these goals.

For 1999, the fifth year of CDC involvement, we present a synopsis of recent activities as they pertain to the role of CDC in public health and the disaster cycle (also called emergency management cycle). The objectives of this synopsis are to: 1) describe the mission of disaster epidemiology at CDC in the context of emergency management; 2) outline different methods and field activities conducted by the National Center for Environmental Health (NCEH) at CDC; and 3) provide a framework for public health and epidemiology in the emergency management of natural disasters, particularly wind and seismic events. We hope that the objectives of this synopsis may assist in establishing a foundation for collaborative ties with Japanese counterparts whose work involves public health and with potential U.S. and Japanese collaborators in multi disciplinary fields.

2. EPIDEMIOLOGY IN DISASTER SETTINGS

Epidemiology is the study of the causes and determinants of health-related events in human populations (5). Methods from this discipline can be used to compare fatalities with survivors to learn how and where they differed, to identify risk groups of persons, time, and place by exposure, with the aim of preventing the occurrence of death, injury, or illness. The mission of disaster epidemiology therefore is to promote health and quality of life by service, research, and dissemination of information in preparing for, responding to, and recovering from a disaster event. The goals of this mission include: 1) to provide *service* to communities and organizations, e.g., initiate or conduct surveillance and needs assessment during preparedness, response, and recovery; 2) to conduct *research*, e.g., conduct studies on health effects from specific disaster events, conduct prevention effectiveness studies, refine surveillance and other methodologies; and 3) to *disseminate the knowledge base* to the community at large, state/local/foreign health departments, other Federal agencies, professional interest groups, academic institutions, and international organizations.

3. THE DISASTER CYCLE

The public health response to disaster

events, including wind and seismic events, addresses activities that occur before, during, and after the events, or "preimpact," "impact," and "postimpact." Epidemiologic methods which provide the basis for the response likewise are applied in each of the phases. The temporal sequences of these phases, lasting anywhere from seconds to months or years, have been translated for practical purposes into the "disaster cycle," also known as the emergency management cycle (6,7). The cycle consists of 5 phases: 1) non-disaster phase, in which hazard prevention and disaster preparedness measures are taken; 2) predisaster, or warning phase, which involves forecasting and early warning, evacuation of vulnerable populations; 3) impact phase, in which death, injuries, and destruction may occur; 4) emergency or relief phase, in which relief and assistance are provided to casualties, e.g., search and rescue, first aid; and 5) recovery or reconstruction phase, in which normal services are restored and damaged buildings and facilities reconstructed. Although the phases may overlap, each has a specific purpose and provides a basis for the next. In public health, these phases are often abbreviated into 3: preparedness, response, and recovery.

4. THE MATRIX

To illustrate the role of disaster epidemiology before, during, and after a disaster event, we present a matrix that outlines appropriate activities pertaining to application and service, research, and dissemination of knowledge, as shown on the horizontal axis, during preparedness, response, and recovery, indicated on the vertical axis (Figure 1). Each cell of the matrix presents epidemiologic activities that may be conducted as they apply to a particular goal of the mission of disaster epidemiology during a specific phase.

The main epidemiologic activities are described as follows:

1. Surveillance

Surveillance is the ongoing and systematic collection, analysis, and interpretation of health data used for planning, implementing, and evaluating public health interventions and programs. Surveillance data are used both to determine the need for public health action and to assess the effectiveness of programs (8). Commonly used surveillance systems in the post-disaster setting include those for disease, injury, and death. Examples are drawn from responses to Hurricanes Marilyn and Opal in the U.S. Virgin Islands and the southeastern United States in 1995, respectively (9); a severe ice storm in Maine in 1998 (10); and the American Red Cross-CDC Health Impact Surveillance System for Natural Disasters (4).

2. Rapid needs assessment

Rapid needs assessment refers to a collection of techniques -- epidemiologic, statistical, anthropological -- designed to provide quickly and at low cost, accurate population-based information about an affected community's needs after a disaster in a simple format to decision-makers (11). Examples include recent responses to a severe ice storm in Maine in 1998 (10); Hurricane Georges in the Dominican Republic in 1998 (12); and Hurricane Mitch in Honduras, Nicaragua, El Salvador, and

Guatemala in 1999 (13).

3. Descriptive and analytic studies

Both descriptive and analytic epidemiologic studies may be designed and conducted to determine risk factors that predispose the disaster-affected to a particular health condition or to evaluate the effectiveness of an intervention program. For example, a study of risk factors contributing to carbon monoxide (CO) poisoning after a major ice storm identified generators as a major CO source and generator location as the strongest risk factor (14). In another example, an evaluation of the health status of displaced communities in camps with and without water and sanitation services after an earthquake in Bolivia demonstrated that the presence of running water and latrines and the treatment of household water were each independently associated with a lower incidence of illness (15). Analyses of the costs, cost-benefits, and cost-effectiveness of interventions may also be performed.

5. CONCLUSIONS AND RECOMMENDATIONS

A conceptual framework using the goals of epidemiology in disaster settings and the phases of the emergency management cycle has been developed to address the public health consequences of natural disasters. For each selected goal and phase, epidemiologic assessments or studies may be conducted to answer questions posed by public health officials and emergency managers.

As such, the framework may provide a basis for direction for collaborative work between the U.S. and Japanese-equivalent public health sectors for UJNR activities. An initial step is to identify a public health-equivalent counterpart from the government sector and to list agencies having a potential interest in natural disaster reduction and health-related impacts for each selected goal and phase of the matrix. Finally, it is hoped that the matrix may stimulate ideas of comparable systems or frameworks in Japan for a joint public health collaborative effort for the UJNR Panel on Wind and Seismic Effects.

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Figure 1. Conceptual matrix for epidemiology in disaster settings and emergency management

	Preparedness	**Response**	**Recovery**
Application and Service	■ Surveillance - degree of preparedness e.g., health outcome: prevalence of use	■ Surveillance e.g., health outcome: burden of disease, injury, and death ■ Rapid needs assessment (RNA)	■ Surveillance e.g., burden, type and circumstances of disease, injury, and death ■ Rapid needs assessment (RNA)
Research	■ Cost-effectiveness studies of prevention interventions e.g., sirens, weather radios, other watch and warning systems health outcome: -# lives saved ■ Comparison studies of warning systems (e.g., heat indices) ■ Descriptive studies of disasters (e.g., tsunamis, landslides and avalanches) ■Studies updating information on previously-described disasters (e.g., lightning) ■Theoretical perspectives on emergency management	■ Development of RNA methods ■ Refinement and evaluation of RNA methods ■ Comparison of RNA methods across disasters (intra- and interdisaster) ■ Development of training techniques for RNA (e.g., better training of volunteers) ■Descriptive and analytic studies of impact-related effects (e.g., wind-related injuries)	Specific disaster types: ■ Floods - respiratory outcomes related to mold/mildew, effectiveness of remediation techniques - health outcomes associated with flood-affected well water - effects of technological disasters initiated by flooding ■ Earthquakes -coccidioidomycosis -injury and hospital length of stay -stress-induced myocardial infarction ■ Hurricanes -Dengue fever disaster responders

Dissemination	Preparedness information: ■ Development of curricula - state/local health departments/Ministry of Health - public community - professional interest groups - academia ■ Development of training materials - outlines - literature - case studies - slides	Transmit methods to state/local health departments - on site - World Wide Web sites - other forms e.g., special workshops	Training sessions Consultations Presentations