# Archived Content

# Health Policy Research
## Bulletin



# Emergency Management: Taking a Health Perspective

Events such as the attacks of September 11, 2001, Hurricane Katrina, the 1998 Eastern Canadian ice storm, SARS and the continuing threat of infectious disease pandemics have highlighted the need to be prepared to respond to disasters from a wide range of threats. This issue of the *Health Policy Research Bulletin* focuses on the public health impacts of disasters and draws upon a growing body of research that is helping to strengthen emergency management's capacity to reduce those impacts. In particular, this issue:

- identifies the major types of disasters and explains why threats of similar magnitude may result in a disaster in one community, but not in another

- looks at disaster patterns and trends and explores the factors contributing to their increasing frequency and severity around the world and in Canada

- traces the evolution of emergency management and highlights "real life" case studies that illustrate the "four pillars" of current practice and point to areas for improvement

- examines the health impacts of disasters, explains why some populations and communities are at greater risk than others, and explores strategies for strengthening resilience

- discusses the concept of "surge capacity" and examines the challenges for the health system as well as potential roles for the voluntary sector and other key players

Finally, this issue explores the benefits and challenges of strengthening the research connections between disciplines and sectors, including disaster studies, emergency management, and health and social services. In so doing, it suggests 12 areas for future research and identifies opportunities for collaboration.

## In This Issue

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## Selected Emergency Management Terms

*While several of these terms have relevance to many professions, the definitions below reflect their use in the field of emergency management.[1] Nevertheless, these terms may be subject to some interpretation.*

**Accidents, emergencies and disasters—a continuum:**

- **accident**—an everyday event that has an impact on a small portion of the population and is dealt with using the community's normal response systems and coping resources
- **emergency**—a serious mishap that involves more people, as victims and as responders, than an accident does, but which does not overwhelm the community to the point of being a disaster
- **disaster**—an event that exceeds the ability of the local community to cope with, and respond to, its harmful effects and that requires extraordinary measures

**Coping resources**—the individual and community skills, material, equipment or services that can be used to meet the demands created by an incident.

**Disaster threshold**—the point at which the consequences of an event exceed the level of a community's coping resources, and an emergency becomes a disaster.

**Emergency management**—the professional discipline and process of dealing with extreme, harmful events. Emergency management involves managing the community's vulnerability, resources and environment as a means of making the community safer.

**Extreme event**—an occurrence that can cause severe damage within the community, including personal injuries and property destruction (e.g., a hurricane).

**Hazard**—the potential for a negative interaction between an extreme event and the vulnerable parts of the population that is not addressed by the community's coping resources (e.g., a mudslide resulting from a hurricane).

**Resilience**—the ability of a community to resist the harm of an impact and quickly return to normal.

**Risk**—the product of two components: the likelihood of an event occurring and the potential consequences of the event.

**Vulnerability**—the relationship between the common social and economic characteristics of the population, individually and collectively, and their ability to cope with the hazards they face.

*Please note: Full references are available in the electronic version of this issue of the Bulletin: http://www.healthcanada.gc.ca/sr-sr/pubs/index-eng.php*

# Building Comprehensive, Integrated Systems

*n this issue, Nancy Hamilton, Managing Editor of the* Health Policy Research Bulletin, *speaks with* **Dr. Theresa Tam** *(TT), Director General of the Centre for Emergency Preparedness and Response, Public Health Agency of Canada, and* **Dr. Ronald St. John** *(RSJ), St. John Public Health Consulting International, and former Director General, Centre for Emergency Preparedness and Response, Public Health Agency of Canada.*

**Q** *Over the past few years, many countries have placed an increased focus on emergency management. What are the reasons for this?*

**TT:** The Public Health Agency of Canada was formed following the SARS [Severe Acute Respiratory Syndrome] outbreak, so our focus is on public health emergencies as well as other types of emergencies that have a health impact. SARS was a stark reminder that infectious diseases continue to be a threat and that with global travel they can spread around the world within hours. There is also the heightened risk of terrorism and bio-terrorism, as well as climate change and the increasing frequency of weather-related natural disasters.

Most of these threats have international relevance so countries now recognize the need for a coordinated, global approach to emergency management. Moreover, international health regulations require countries to detect, report and respond to events within short time lines. They take a risk assessment approach where you decide whether something is unusual, serious, can spread to other people, or

has economic and trade impacts. And, as SARS has demonstrated, infectious disease outbreaks can have serious economic consequences.

**RSJ:** We've also learned from experience that there are often patterns to how disasters unfold. We began to recognize that we could manage what was happening and take a systematic approach to emergency management.

**Q** *What does the term emergency management mean and what types of activities are involved?*

**RSJ:** Emergency management is a form of risk management. It involves taking steps to avoid destructive events or, if you can't avoid them, you minimize their impacts once they occur. We talk about the four pillars—prevention, preparedness, response and recovery. It's not just about the event and the response to it; it's also about mitigating the impact of the event or preventing it altogether. When you build a canal around Winnipeg to contain the annual flood, you're working to prevent a disaster. When you prepare for an event, you plan, train and exercise. Then, when an event does happen, you have a set

of operational procedures to deal with it. Your response then gradually moves into the recovery phase.

**TT:** I agree. We're not just dealing with the response or even preparedness. We're expected to be one step ahead. We do real-time risk assessments and scan a variety of intelligence so we can detect a possible event as it evolves or stop it from occurring or spreading before it becomes an emergency or disaster.

**Q** *When does an emergency become a disaster?*

**RSJ:** While there is no hard-and-fast rule, many in the field use this rule of thumb—an emergency becomes a disaster when a community's capacity to cope is exceeded. Knowing a community's coping capacity is critical as it determines the threshold at which an emergency becomes a disaster (see article on page 8). The threshold depends on many factors such as the level of individual preparedness, the capacity of the voluntary sector to help and the capacity of community members to come together to help each other (see article on page 34).

**TT:** We tend to use the term "disaster" loosely. Often, it depends on your social context, where you come from and how you are affected. On the legal front, there are declarations or states of emergencies that can apply, whereby financial assistance is made available. For example, when provinces and territories have undergone a substantial event, the federal government can provide support through the Disaster Financial Assistance Agreement.

**Q** *How has emergency management evolved and what has influenced our thinking and action?*

**RSJ:** What has emerged is the concept of an integrated emergency management system that allows you to link activities together. When an event happens, you know who is responsible for doing what, when, where and how. Actually, much of the approach was first developed by California firefighters.

**TT:** While the early systems may have been intuitive to front-line firefighters, they weren't necessarily so for health professionals. So, it's been important to look at different models and adapt them to our needs. The key is **interoperability**—the ability to link activities across jurisdictions to achieve coordination and to increase "surge capacity" (see article page 37).

**RSJ:** Many influences have shaped our thinking. Case studies of real-life incidents have pointed out where we have gaps (see article on page 18). These are tough ways to learn so we've also used exercises, scenarios and role-playing to identify where improvements are needed. Research on vulnerable groups has also helped to show how we can strengthen a community's resilience and coping capacity (see articles on pages 23 and 29).

**TT:** Emergency management requires the involvement of many players. Ten years ago, it was difficult to bring together the public health side and the emergency side. The two spoke very different languages. However, this has begun to change and increasing collaboration is contributing to the field's evolution.

**Q** *What role does the federal government play and how does it work to protect the health of Canadians during an emergency?*

**TT:** In Canada, emergency management begins with a local level response. The federal government is not at the front line initially—that's not our role. When a community is unable to cope with an event, it will call upon its provincial or territorial government which, in turn, may call upon the federal government. Public Safety Canada has overall federal responsibility, with different departments taking the lead on specific functions. For example, the Public Health Agency of Canada and Health Canada have the lead on health functions. The Agency and the Department collaborate when responding to emergencies, notably in the Health Portfolio Emergency Operations Centre.

**RSJ:** Although the Agency and Health Canada may have different responsibilities, as federal partners they have some roles in common. Both offer leadership and national coordination, and deal with issues of interoperability and surge capacity. They also both set guidelines and provide tools to help other jurisdictions respond.

**TT:** For example, the Agency is about to release the **Pan-Canadian Health Emergency Management System** and federal/provincial/territorial governments have approved two agreements—one on mutual aid and one on information sharing during a public health emergency. We also conduct surveillance and outbreak investigations, and we provide surge support in the form of epidemiologists and other professionals, mobile labs, the National Emergency Stockpile System and our health emergency response teams. Health Canada, on the other hand,

addresses a broad range of emergency situations, including emergencies in First Nations communities. It is also the federal lead for radiological/nuclear events and provides support and reach-back for chemical incidents, while the Public Health Agency of Canada is the lead for biological emergencies and natural disasters.

**Q** *They say that disasters don't discriminate, yet certain population groups appear to suffer more health impacts than others. Why are some groups more at risk than others?*

**RSJ:** Disasters can happen almost anywhere. The impacts, however, are not homogeneously distributed. A population has many subgroups and, depending on their characteristics, some may be more or less vulnerable to the impacts of a particular event. For example, during the 2003 European heat wave, approximately 70,000 died—mostly older persons living alone without family and support, so they did not have the capacity to escape the heat. However, it's not just a matter of age or physical functioning. Research is showing that anyone who is marginalized—economically or socially—may be more at risk (see article on page 23).

**Q** *What are some of the key challenges confronting the emergency management field from the health perspective?*

**TT:** While we are dealing with many challenges, such as the gap in surge capacities and a review of the stockpile system, there is an overriding challenge that relates to how we plan. Because emergencies have many things in common, public health professionals are beginning to recognize the need for an all-hazards approach (see article on page 14) where you develop generic preparedness and response plans, regardless of the threat. However, there will always be something driving the need for more specific risk-based planning. For example, since SARS, we've been strengthening pandemic plans. With the Vancouver 2010 Olympics coming up we're now creating plans for emergencies

during mass gatherings. What we recognize is that preparing for different types of hazards may allow us to leverage resources that will contribute to our overall preparedness.

**RSJ:** This relates to what needs to be done "when it's not happening"—in other words, when there is no emergency. This is one of the most important times to invest in planning, training and exercising. Although we need long-term and sustainable investments, unfortunately, they tend to be knee-jerk infusions tied to specific events. And after the event, once the pressure is off, we tend to shift funds to other priorities.

**Q** *Knowing this, what types of research are needed and how will the results be used in decision making?*

**TT:** Having a solid research base is critical to our work. We can only put forward a major piece of policy if we have the evidence. This includes threat-risk assessments, analyses of vulnerable populations as well as the potential impacts of an event, including the health and the economic burdens. We also consider the legal context, the political environment and what other countries are doing. Recently, we've been looking at it from the perspective of the public and have had some interesting feedback about what Canadians believe is important. All of these elements need to be in place and supported by the research. When they are, it will help us move our policies forward and secure the investments we need.

**RSJ:** I'll add to that by pointing readers to the closing article (page 43) prepared by John Lindsay of Brandon University. He takes an overarching look at the research in the field and identifies 12 areas where further work is needed—for example, people at risk, disaster impact investigations, volunteers, community preparedness, changing attitudes and integration of disciplines. These draw on multidisciplinary approaches and will help strengthen the connections between emergency management and health sector research. ■

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# Canadian Disaster Timeline

| | 1916 | 1917 | 1918 | 1936 | 1950 |
|---|---|---|---|---|---|
| **Name/Location** | **Cochrane and Matheson Forest Fire Ontario** | **Halifax Harbour Explosion Halifax, Nova Scotia** | **Spanish Influenza Pandemic** | **Heat Wave Across Canada** | **Red River Flood Manitoba** |
| **Description** | The Cochrane and Matheson fire resulted from small blazes started by lightning and locomotive sparks, which combined to become a firestorm. | The freighter *Mont-Blanc*, loaded with ammunition, collided with a coal freighter. The resulting explosion was the largest pre-atomic explosion in history. | Spanish Influenza hit Canadians hard, affecting more than one quarter of the population. It was the deadliest disaster to affect Canadians. | A two-week heat wave across Canada resulted in temperatures as high as 44.4°C. | A combination of heavy snow cover and rainfall caused the Red River to stay above flood level for 51 days. |
| **Impact** | ▪ 233 dead<br>▪ 8,000 evacuees<br>▪ Estimated cost: $35M | ▪ 1,963 dead<br>▪ 9,000 injured<br>▪ 6,000 evacuees<br>▪ Estimated cost: $386M | ▪ 50,000 dead<br>▪ 2,000,000 injured<br>▪ Estimated cost: $145,000 | ▪ 1,180 dead<br>▪ Estimated cost: Unknown | ▪ 1 dead<br>▪ 107,000 evacuees<br>▪ Estimated cost: $1.093B |

| | 1997 | 1998 | 1998 | 2000 | 2003 |
|---|---|---|---|---|---|
| **Name/Location** | **Flooding Southern Manitoba** | **Ice Storm Ontario, Québec and New Brunswick** | **Swissair Plane Crash Peggy's Cove, Nova Scotia** | **Contaminated Water Supply Walkerton, Ontario** | **SARS Outbreak Toronto, Ontario** |
| **Description** | Due to flooding of the Assiniboine, Red and Winnipeg Rivers, over 7,000 military personnel were employed for 36 days to assist evacuees and to prevent flood damage. | Freezing rain fell on a corridor from Ontario to New Brunswick, resulting in power outages for approximately 3.5 million people. It resulted in the largest evacuation in Canadian history. | Swissair Flight 111 flying from New York to Zurich plummeted into the Atlantic Ocean, 10 km from Peggy's Cove, Nova Scotia. | The water supply of the town of Walkerton, Ontario, became contaminated with a highly dangerous strain of *E. coli*. | Toronto had the largest SARS outbreak outside of Asia. More than 27,000 people in and around the city were forced into quarantine. |
| **Impact** | ▪ 0 dead<br>▪ 25,447 evacuees<br>▪ Estimated cost: $817M | ▪ 28 dead<br>▪ 945 injured<br>▪ 600,000 evacuees<br>▪ Estimated cost: $5.41B | ▪ 229 dead<br>▪ Estimated cost: $224M | ▪ 7 dead<br>▪ 2,300 injured<br>▪ Estimated cost: $21M | ▪ 44 dead[3]<br>▪ 438 injured[3]<br>▪ Estimated cost: Unknown |

## Natural

- Hydrometeorological
- Geophysical
- Biological

*International Classification of Natural and Technological Disasters (Centre for Research on the Epidemiology of Disasters).[2]*

Below is a sampling of non-intentional Canadian disasters selected for their human, physical or economic impact, or their historical significance. Unless otherwise noted, all data for this Timeline appear in the Canadian Disaster Database.[1]

## 1953
### Polio Epidemic Across Canada

Polio affected more than 8,000 Canadians across the country.

- 481 dead
- 8,000 injured
- Estimated cost: Unknown

## 1954
### Hurricane Hazel Ontario

Hurricane Hazel struck south-central Ontario and dumped more than 210 mm of rain over two days.

- 81 dead
- 7,472 evacuees
- Estimated cost: $1.031B

## 1979
### Train Derailment Mississauga, Ontario

A CPR train carrying 106 carloads of dangerous chemicals derailed, causing a large explosion.

- 0 dead
- 225,000 evacuees
- Estimated cost: Unknown

## 1979-1980
### Drought Prairie Provinces

Poor wheat yield due to a cereal crop drought that occurred in parts of the Prairies. It was the most expensive disaster in Canadian history.

- 0 dead
- Estimated cost: $5.795B

## 1985
### Plane Crash Gander, Newfoundland

A chartered DC-8 carrying 256 passengers crashed after takeoff, killing all on board.

- 256 dead
- Estimated cost: Unknown

## 1996
### Flood Saguenay-Lac-Saint-Jean Region, Québec

290 mm of rainfall in less than 36 hours washed out homes, roads and bridges, and downed power lines.

- 10 dead
- 15,825 evacuees
- Estimated cost: $1.722B

## 2003
### Northeast Blackout Ontario and Northeastern U.S.

On August 14, Ontario and eight northeastern U.S. states were hit by the largest blackout in North American history. Electricity was cut to 50 million people.

- 11 dead[4]
- 50 million affected[4]
- Estimated cost: US$6B[4] (these numbers are for the U.S. and Canada)

## 2003
### Wildfires British Columbia

Dozens of communities were evacuated due to wildfires started by lightning and human actions, mostly in the interior of the province.

- 3 dead[5]
- Unknown injured
- 45,000 evacuees[5]
- Estimated cost: $700M[5]

## 2003
### Hurricane Juan Maritime Provinces

One of the most powerful hurricanes to ever affect Canada. The category 2 hurricane packed winds reaching up to 174 km/h.

- 8 dead[6]
- Unknown injured[6]
- Estimated cost: $200M[6]

## 2004
### Hailstorm Edmonton, Alberta

Severe hail and rain battered parts of Edmonton, forcing the evacuation of 30,000 people from the West Edmonton Mall.

- 0 dead
- 30,000 evacuees
- Estimated cost: $74M

## 2005
### Extreme Rain Toronto, Ontario

More than 150 mm of rain fell in a three-hour period in the northern part of Toronto.

- 0 dead[6]
- Estimated cost: $500M[6]

## 2006
### Rain and Windstorm British Columbia

One of the most intense weather systems to impact south coastal BC in several decades resulted in a precautionary boil water advisory and widespread power outages.

- 2 million affected[7]
- Estimated cost: Unknown

## Technological

**Industrial**   **Transport**   **Miscellaneous**

*Please note: Full references are available in the electronic version of this issue of the Bulletin: http://www.healthcanada.gc.ca/sr-sr/pubs/index-eng.php*

# Disasters: A Snapshot of Trends and Issues

**Dr. Ronald St. John**, St. John Public Health Consulting International and former Director General, Centre for Emergency Preparedness and Response, Public Health Agency of Canada; **Peter Berry, PhD**, Climate Change and Health Office, Healthy Environments and Consumer Safety Branch, Health Canada; **Don Shropshire**, National Director, Disaster Management, Canadian Red Cross; and **John Lindsay**, Department of Applied Disaster and Emergency Studies, Brandon University

**W**hether precipitated by natural or technological triggers, disasters can lead to human suffering, damage and destruction. This article looks at disaster trends and explores some of the underlying factors contributing to their increasing frequency and severity around the world and in Canada. The article also discusses the importance of a community's coping capacity in determining whether an emergency becomes a disaster and, in so doing, sets the stage for subsequent articles on emergency management.

Over the past decade, many regions and cities in North America and around the world have suffered the effects of large-scale emergencies and disasters. With 24-hour news coverage, the immediate impacts of these disasters—physical destruction and, in many cases, injury, illness and death—are all too familiar. The longer term impacts, such as infrastructure damage, economic disruptions and population displacements, often garner less attention but may nevertheless have indirect, but profound, public health impacts (see page 12).

## When Does an Emergency Become a Disaster?

Although the terms "emergency" and "disaster" are often used interchangeably in the literature, their definitions differ. An emergency rises to the level of a disaster when its magnitude exceeds the capacity of the community to cope with the consequences[1] (see Figure 1). As a result, a certain event may result in an emergency in one community but a disaster in another.

## How Are Disasters Classified?

Throughout history, disaster classification has evolved as we have learned more about disasters and their characteristics. Disasters are classified as either "natural" or "technological." Technological disasters are those with a non-natural trigger; they can be either accidental or intentional (e.g., terrorism caused by chemical, biological, radio-nuclear or explosive devices). Although there are many subcategories under each, **natural disasters** include hydrometeorological (including climatological), geophysical and biological events, while **technological**

| International Classification of Natural and Technological Disasters | |
|---|---|
| **Natural** | **Technological** |
| **Hydrometeorological** mass movement—wet (avalanche, landslide, etc.), drought, extreme temperature, flood, wildfire, storm | **Industrial** infrastructure collapse, explosion, fire, gas leak, poisoning, radiation |
| **Geophysical** earthquake/tsunami, volcanic eruption, mass movement—dry (avalanche, landslide, etc.) | **Transport** rail, air, road, water |
| **Biological** epidemic, insect infestation | **Miscellaneous** collapse of domestic/non-industrial structure, non-industrial fire, explosion |

Source: Adapted from the EM-DAT Disaster Category Classification for Operational Databases, developed by the Centre for Research on the Epidemiology of Disasters and its partners.[2]

**disasters** include industrial, transport and miscellaneous events.[2] As the *Disaster Timeline* reveals (page 6), Canada has experienced disaster events in most major categories.

## Global Patterns and Trends

Disaster data have presented a number of challenges, including the lack of standardized collection and definition methodologies (see *Using Canada's Health Data*, on page 47). Disaster databases, however, have improved over the past 25 years; this has facilitated the study of disaster patterns and trends at the global and country levels.

**When Does an Emergency Become a Disaster?**



A disaster occurs when the impact on a community exceeds its normal coping resources. The disaster threshold can be shifted to the right by either reducing the impact on the community (mitigation), for example building dikes in a flood-prone area, or by developing and readying response and recovery actions (preparedness), thereby raising the level of the community's coping resources.

**Coping resources** describe the individual and community skills, materials, equipment or services that can be used to meet the demands created by an incident.

**Level of community's coping resources**

**Consequences**

The **disaster threshold** is the point at which the consequences of an event exceed the level of a community's coping resources, and an emergency becomes a disaster.

**Coping Resources**

**Accident**     **Emergency**     **Disaster**

**Magnitude of Disruption**

Source: Federal/Provincial/Territorial Network on Emergency Preparedness and Response, 2004.[1]

### *Global distribution patterns*

Over the past century, the greatest number of disasters has occurred in Asia (see Figure 2). While Asia's larger land mass may provide part of the explanation, other factors may also explain this:

- *An elevated risk of earthquakes and tsunamis around the Pacific "ring of fire."*[3] Between 1998 and 2007,
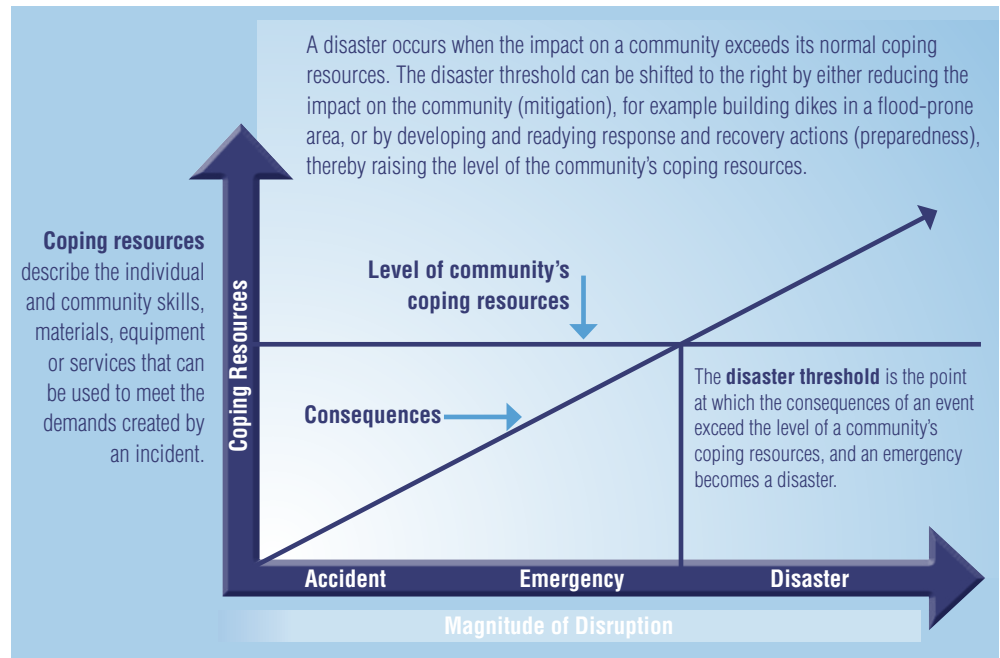
for example, Asia accounted for 57% of the world's earthquakes and tsunamis.[4]

- *Concentration of major population centres in flood-prone areas, particularly in the Indian sub-continent.* Floods are the most predominant disaster type worldwide, including in Asia.[4]

- *Increasing population densities in both urban and rural areas, resulting in increased exposure to technological hazards.* For example, during the last decade (1998 to 2007), Asia accounted for 72% of industrial accidents, 46% of miscellaneous accidents and 39% of transport accidents worldwide.[4]

It is also interesting to look at the proportion of different types of disasters across continents (see Figure 2). While hydrometeorological disasters make up the greatest proportion in the Americas (61%) and Oceania (79%), technological disasters comprise the greatest proportion in Africa (55%). Geophysical disasters, on the other hand, make up the smallest proportion in all continents, but are among the deadliest of all disaster types.[5]

**Global Distribution of Disasters, by Continent and by Class, 1900–2008**
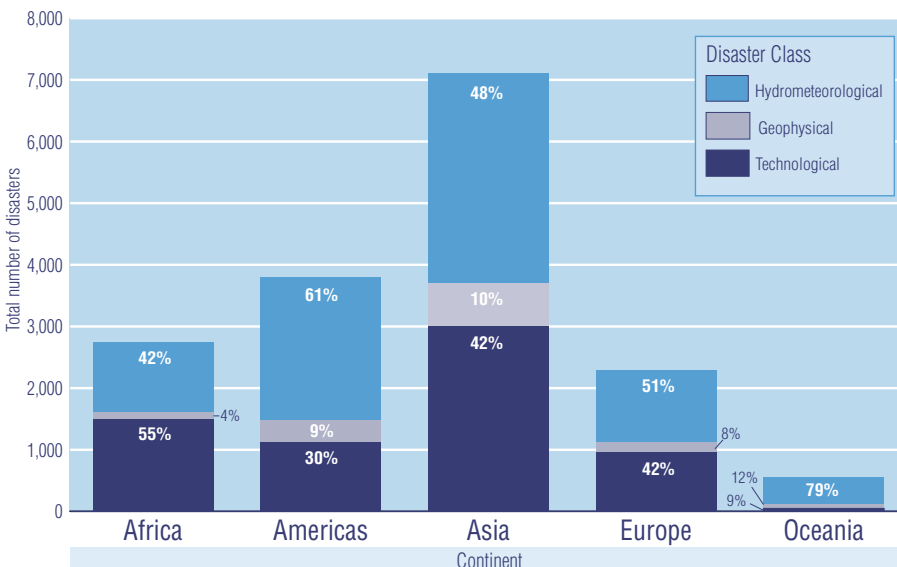


Note: Percentages may not total 100% due to rounding.
Data source: Centre for Research on the Epidemiology of Disasters.[5]

## Frequency and some impacts on the rise

In looking at the frequency of disasters and their impacts over the past 60 years, some interesting trends emerge (see Figure 3). Of the two major categories of natural disasters, the number of hydrometeorological disasters has increased significantly in recent decades, driven by an increase in extreme weather events.[5] In comparison, the number of geophysical disasters has remained low, with only minor increases in the past three decades. Not surprisingly, the number of technological disasters remained low and relatively constant until the "post-war" boom in the 1960s and 1970s.

In terms of impacts from all disaster types, we see increasing trends in both the total number of people

"Anywhere it struck, Mitch would have been deadly. But, only poverty can explain why it was so deadly in Nicaragua. In poor countries, people crowd onto marginal land, in flood plains or on the slopes of menacing volcanoes. They denude the hills, making mudslides more likely. The flimsy houses have no basements or foundations. Upriver, dams are old, poorly built, infrequently inspected. Poor countries lack the technology to track storms, the communication systems to send alarms, the resources to stage large-scale evacuations."

*Washington Post,* November 4, 1998

affected and the economic damages, but a modest decline in the number of deaths up until the last decade. The earlier decreases were encouraging and were probably accounted for by the decrease in famine deaths in Africa as a result of better food security measures and the construction of water reservoirs; reduced earthquake fatalities due to more rapid local disaster responses; and decreased deaths as a result of improved cyclone-warning measures.[6] On the other hand, the past decade has seen disaster deaths rise, with approximately 600,000 deaths from the 1995 to 2002 famine in the Democratic People's Republic of Korea; 226,000 deaths from the 2004 Indian Ocean Tsunami; 75,000 deaths from the 2005 South Asia earthquake; and 70,000 deaths from the 2003 European heat wave.[7]

**Figure 3** Disaster Impacts Throughout the World, 1950–2007



*Legend:*
- Total disaster-related damages ($US)
- Total number of people affected* by disasters
- Total number of disaster deaths
- Technological disasters
- Geophysical disasters
- Hydrometeorological disasters
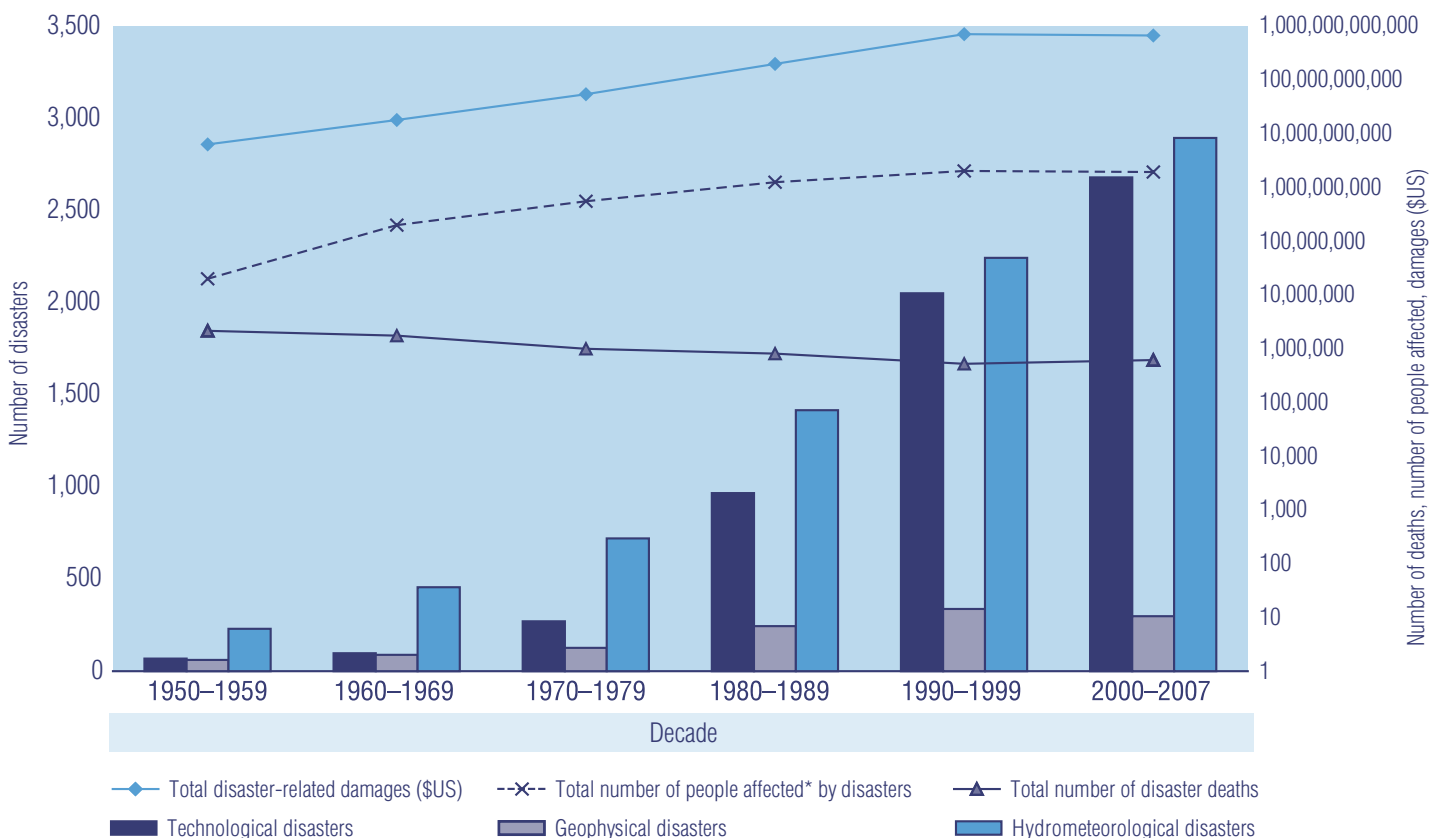
*Sum of injured, homeless and people requiring immediate assistance during an emergency; it can also include displaced or evacuated people.
Data source: Centre for Research on the Epidemiology of Disasters.[5]

## Underlying factors

The magnitude of an event does not solely account for the harm created by a disaster; the social and economic contexts as well as the level of response capacity are also important. For example, the 1989 Loma Prieta earthquake in California registered a magnitude of 6.9 and killed 63 people,[8] whereas the 1993 earthquake in Latur, India, measured 6.4 and killed approximately 9,000 people.[9] In 1998, Hurricane Mitch brought havoc to Honduras and Nicaragua, killing over 10,000 people in landslides and floods. Mitch was both a natural and a human disaster, where extreme weather collided with poverty, environmental degradation and social inequality[10] (see sidebar on page 10).

## Canadian Patterns and Trends

Windstorms, floods and forest fires are the predominant disaster types in the Americas.[4] In Canada, as elsewhere, the risk of a disaster occurring varies from place to place. Geographic and geologic features are important risk factors for natural disasters, as evidenced by the storm paths along the Great Lakes–St. Lawrence corridor; the rock, mud and landslides in mountain regions; the droughts in the southern Prairies; and the storm surges in coastal regions and flooding of many river basins.[11]

### Frequency of Canadian disasters on the rise

In Canada, the frequency of both natural and technological disasters has been increasing over the past century (see Figure 4). The increase is largely driven by the increasing frequency of hydrometeorological disasters, particularly floods, which are the most commonly reported disaster. Flood disasters along Canadian rivers are on the rise—almost three quarters (70%) of the river floods of the past century have occurred since 1959.[12]

### Impacts show mixed trends

Table 1 provides a snapshot of deaths, the number of people affected and the direct economic costs associated

A number of factors often drive these patterns and trends, either by increasing the probability of the event occurring or by increasing the severity of the resulting consequences.

with natural disasters in Canada since 1900. While analysis shows an increase in the number of people affected as well as in direct costs, mortality appears to be on the decline.

The impacts of floods have helped shape the overall impact trends. For example, there have been few flood-related deaths in Canada and relatively few injuries, perhaps due to preventive measures and the number of safe evacuations. Since 1900, several large-scale floods (e.g., 1950 Red River flood, 1996 Saguenay flood) have led to the evacuation of more than 200,000 people.[13] Moreover, given the extensive economic costs associated with flooding, the psychological impacts can be substantial as affected families cope with longer term recovery issues.[14]

## What Contributes to the Trends?

To understand these patterns and trends, one must examine the underlying factors that affect the risk profile of the world in which we live. **Risk** is considered to be the product of the likelihood of an event happening and the severity of the associated impacts.[1] Hence, a number of factors often drive these patterns and trends, either by increasing the probability of the event occurring or by increasing the severity of the resulting consequences. Some of the drivers include:

*Climate Change:* A key factor underlying these changing risk patterns is global climate change. The *Intergovernmental Panel on Climate Change*[15] concludes that warming of the climate system is "unequivocal" and that it is "virtually certain" that there will be further temperature increases. The rate of surface water evaporation and precipitation will also increase, contributing to more frequent and unpredictable droughts, heavy precipitation, heat waves and intense hurricane activity.[15]

Climate change can also affect the ecological balance, creating conditions that make a disaster more likely. For example, a warmer climate led to an increasing population of the bark beetle population in British Columbia's

# The Public Health Impacts of Disasters

**Simone Powell**, Division of Aging and Seniors, Centre for Health Promotion, Public Health Agency of Canada

Natural and technological disasters have both short- and long-term public health impacts, which fall into four categories:[16]

**1** **Mortality**—Some deaths are directly related to the disaster and occur within a short time of the event as a result of injuries. Indirect deaths may occur at a later stage due to such factors as the exacerbation of pre-existing health conditions, malnutrition and diseases stemming from contaminated water.

**2** **Morbidity**—Similarly, injuries and illness can result from direct exposure to the hazard or extreme event. They can also occur through more indirect pathways over time—for example, from mould in buildings following a flood, or from hazards created by damaged physical structures. Disruption in water supplies and sewage systems, as well as contaminated food and water, can produce conditions for the spread of communicable diseases.[16,17,18] Disasters also result in both short- and long-term stress responses, behaviour change and mental health problems, such as depression.[19]

**3** **Material Losses**—Disasters produce direct and indirect economic hardship for individuals and communities, with implications for health. Such immediate losses as damaged or destroyed housing can result in psychological stress. Individuals may lose their source of income, along with their ability to provide for themselves and their families if, for example, their place of work is destroyed, resulting in long-term hardship.[20]

**4** **Social Disruption**—Disasters can tear apart communities, supportive relationships and social support networks. They can disrupt or shut down local health and social services. Even if such services are able to continue, they may be overwhelmed by acute injuries and may be unable to provide continuity of care for those with pre-existing health conditions. As a result of injury, displacement and death, individuals can lose the support of others upon whom they depend for day-to-day survival or independence.[19]

**Mortality, Number of People Affected and Damages Associated with Natural Disasters in Canada, 1900–2002**

|  | 1900–1969 | 1970–1979 | 1980–1989 | 1990–1999 | 2000–2002 |
|---|---|---|---|---|---|
| **Estimated number of disasters** | 160 | 92 | 114 | 151 | 29 |
| **Estimated number of deaths[a]** | 3,010 | 114 | 283 | 179 | 18 |
| **Estimated number of people affected[b]** | 162,462 | 25,477 | 50,285 | 712,625 | 154 |
| **Estimated direct damage costs[c] (CAN$ billions)** | $4.882 | $9.712 | $17.617 | $13.710 | $0.203 |

*Source: Canadian Disaster Database, Public Safety and Emergency Preparedness Canada, 2005 data.[21]*

Notes: Data compiled using natural disaster information about meteorological events.

[a] Health data not available/could not be confirmed for some disasters.

[b] Number of people affected reflects the number of people injured and evacuated during a disaster event.

[c] Disaster damages based on 1999 Canadian dollars for those disasters occurring between 1915 and 2002. Total disaster damage is based on cost data for 76 of 160 disasters occurring between 1900 and 1969, and for 324 of 388 disasters occurring between 1970 and 2002. Estimates are conservative and include direct costs only (excluding uninsured and indirect costs, such as hospitalization).

## Figure 4 — Frequency of Disasters in Canada, by Selected Classes and Sub-Classes of Disasters, 1900-1999
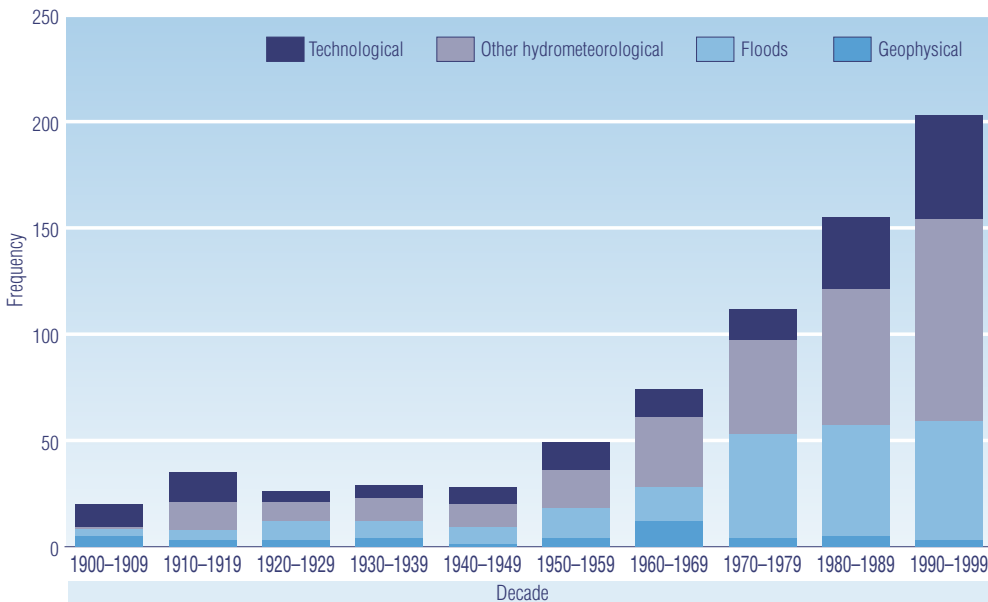


Data source: Canadian Disaster Database.[21]

interior forests, which in turn led to large-scale forest die-offs and an increased risk of forest fires.[22] Abnormally hot, dry weather in 2003 resulted in over 2,500 wildfires, consuming over 250,000 hectares of forest, destroying over 334 homes and many businesses, and forcing the evacuation of over 45,000 people—at an estimated cost of $700 million.[23]

*Large-Scale Urbanization:* As of 2005, half (49%) of the world's population lived in urban centres, up from 13% in 1900. The United Nations projects that this trend will continue.[24] Such concentration of people and assets can magnify the impacts of disasters. The Kobe earthquake of 1995 represented the first time in history that an earthquake took place directly beneath the centre of a densely populated urban area—and the impacts were devastating in human (more than 6,000 deaths) and economic losses (exceeding US$100 billion in 1995 value).[25] Furthermore, the rapid growth of slums in which millions of people reside in areas lacking basic

**A**s of 2005, half (49%) of the world's population lived in urban centres, up from 13% in 1900. The United Nations projects that this trend will continue. Such concentration of people and assets can magnify the impacts of disasters.

sanitation, electricity and potable water, create a fertile setting for the introduction and rapid spread of infectious diseases, increasing both the frequency of infectious disease outbreaks and the number of people infected.

*Globalization:* The Severe Acute Respiratory Syndrome (SARS) epidemic of 2003 demonstrates the important role that increased global trade and travel can play in the rapid spread of infectious diseases. SARS began in the wild animal meat markets of southern China where the virus was harboured by the wild civet cat that was being slaughtered and sold. Within days of the first outbreak, SARS had spread to affect people thousands of miles from its source, including Canada. While the mortality and morbidity associated with SARS did not compare with those of outbreaks such as malaria or tuberculosis, the disruptions to the global economy related to interruptions in trade and travel had an estimated global cost of US$30–$100 billion.[26]

## Conclusion

Disasters have an uneven impact on our communities. While impacts relate to the level of exposure, they also depend upon the vulnerability of populations (see article on page 23). Disasters are on the rise in Canada and many of their impacts are increasing. This snapshot of disaster trends and their underlying factors sets the stage for discussions in the next articles about the increasing importance of emergency management in protecting the health of communities and individual Canadians— and the need for long-term investments to reduce the risk of disasters and to prepare for, respond to and recover from them. ■

*Please note: Full references are available in the electronic version of this issue of the Bulletin: http://www.healthcanada.gc.ca/sr-sr/pubs/index-eng.php*

# Emergency Management:
# From Principles to Action

**David Etkin**, School of Administrative Studies—Emergency Management, York University, and **Dave Hutton, PhD**, formerly of the Centre for Emergency Preparedness and Response, Public Health Agency of Canada, and currently with the United Nations Relief and Works Agency, West Bank

Over the past decade, events such as the 2003 European heat wave, Hurricane Katrina and SARS have focused attention on the need for improved emergency management. In tracing the evolution of the emergency management field, this article examines the challenges faced in developing comprehensive, integrated systems, and examines the four pillars on which current systems are based.

The past decade has given rise to an increasing recognition among decision makers, practitioners and academics alike of the importance of developing an emergency management system that is based on a strong theoretical and evidence-based approach. Within the health care sector, events like the Severe Acute Respiratory Syndrome (SARS) crisis have demonstrated the importance of developing a health emergency management system that is grounded in established and tested principles of emergency management. Although much work is still required to achieve a comprehensive pan-Canadian health emergency management system, one which can ensure effective and timely coordination across all levels of government, the development of common policy and planning frameworks is allowing jurisdictions to plan, train and work together in a far more effective way.

## What is Emergency Management?

For many years emergency management was associated with the Cold War and civil protection. Over the years, however, it has evolved into a far more dynamic and multidisciplinary process based on the notion that communities can choose how they prepare, cope with or adjust to the hazards that they face. Beginning in the 1970s, in large part due to the work of geographer Gilbert White and sociologist Eugene Haas,[1] emergency management became rooted within a theoretical framework based on four pillars that constitute an emergency management cycle:

- *Mitigation/Prevention*—long-term actions that reduce and/or prevent the risk of a disaster, such as constructing dams and land-use planning that prohibits people from building homes or businesses in high-risk areas.

- *Preparedness*—planning for disasters and putting in place the resources needed to cope with them when they happen—for example, stockpiling essential goods and preparing emergency plans to follow in the event of a disaster.

- *Response*—actions taken during and immediately after a disaster has occurred, including the activities of police, firefighters and medical personnel.

- *Recovery*—longer term activities to rebuild and restore the community to its pre-disaster state.

Historically, the emphasis has been on preparedness and response, but increasing disaster-related losses over the past few decades have led to greater emphasis on mitigation/prevention and recovery. Experience has taught us that unless mitigation/prevention efforts are adequate, the impacts of disasters just get worse. As Benjamin Franklin so aptly put it, "An ounce of prevention is worth a pound of cure."

### An all-hazards approach to planning

A key concept that has emerged in emergency management is the **all-hazards approach**. It is no longer sufficient or possible to plan for individual threats. Canadians are now faced with a wide range of risks to their health and

safety, ranging from potential natural and technological disasters to acts of terrorism and infectious disease outbreaks. While it makes good sense to identify specific threats and how to respond to them, it is a daunting if not impossible task to create a specific emergency plan for every possible hazard. Thus, from the perspective of both efficiency and completeness, emergency management has adopted an all-hazards approach to planning.[2] Note that all-hazard planning does not exclude a risk-based approach that considers the probability and consequences of specific threats. The two approaches complement each other and should be used jointly as part of a comprehensive risk management strategy.

The idea behind all-hazards risk management is twofold:

- **Emergencies and disasters have many aspects in common** in terms of the mitigation, preparedness, response and recovery needed by people, communities and organizations. It makes sense, therefore, to plan for generic sets of actions that are required when something negative happens, no matter what the cause. For example, a community might need to evacuate for many possible reasons (e.g., a hurricane or toxic spill) and needs to have an evacuation plan applicable to any hazard.

- **Actions taken to reduce one risk should not adversely affect another.** For example, the levees protecting the Mississippi River and New Orleans from flooding have prevented the replenishment of soils in the coastal wetlands that have provided some protection to the city. The low-lying Mississippi Delta, which buffers the city from the Gulf of Mexico, is rapidly disappearing at the rate of 25 to 30 square miles of delta marsh per year.[3] As shown during Hurricane Katrina, the loss of such protective mechanisms can have devastating human and health consequences.

### Protecting the most vulnerable

Sound emergency management takes into account the capacity and resources that a community has to prepare

> *"An all-hazards emergency management approach looks at all potential risks and impacts, natural and human-induced (intentional and non-intentional) to ensure that decisions made to mitigate against one type of risk do not increase our vulnerability to other risks."[4]*

for emergencies and disasters, as well as its residents' vulnerabilities to hazards. Thus, while it is critical that efforts contribute to an efficient response capacity—including preparation of plans to respond to emergencies of all types, training and organization of emergency workers and stockpiling of critical supplies and equipment—steps must also be taken to protect the most vulnerable persons and groups living in communities. Events like the European heat wave of 2003 and Hurricane Katrina have taught us that disasters almost always have the harshest effects on the frail, the elderly, the disadvantaged and the least able to cope (see article on page 23).

### Building community capacity

Although disasters may often have devastating consequences, they have also taught us that people can and do recover from such catastrophes, and that they must be regarded not as victims but as partners in both preparing for and recovering from extreme events. Volunteers of all ages and from all walks of life play an important part in enabling communities to prepare for and recover from emergencies (see article on page 34). For example, volunteers can fill sand bags during floods, work telephone information lines, or deliver food and supplies to persons unable to leave their homes. **Enhancing resilience** is now recognized as a key concept in building the capacity of communities to prepare for emergencies and disasters (see article on page 29).

### Mitigating future risks

Disasters, finally, have taught us to plan for the future in ways that do not increase vulnerabilities. It is important that policies and programs are implemented in a sustainable manner, so that risks are not transferred from one community to another or postponed to future generations. Efforts to manage the effects of climate change are a case in point. Good emergency management builds on and enhances the capacities of communities to mitigate the risks that their members face both today and tomorrow.

## Making Emergency Management Work in Canada

Health emergency management is not new to Canada. Each province and territory has legislation, emergency preparedness plans and coordinated response activities that can be mobilized during emergencies (see article on page 45). However, there may be events of such magnitude that a jurisdiction cannot manage without additional assistance, such as a massive earthquake, an infectious disease outbreak, or a large-scale terrorist attack.

The 2003 SARS crisis in Canada highlighted the importance of having a pan-Canadian health emergency management system that is based on established and evidence-based principles. Indeed, two of the key lessons learned from SARS were: first, the need for common emergency planning and preparedness frameworks and protocols in order that jurisdictions communicate and share resources effectively; and second, clear jurisdictional roles and responsibilities in order to avoid confusion in planning and decision-making processes.

These have, in part, been addressed through the development of the **National Framework for Health Emergency Management**,[5] which sets out guidelines that can be used by jurisdictions across Canada to develop consistent policies and practices to enhance the safety and protection of Canadians during emergencies.

The National Framework (Figure 1) is based on the four pillars of emergency management. At each phase, the emphasis is on particular activities—for example, the pre-event phase emphasizes critical planning and preparedness activities, such as the development of multi-jurisdictional coordination and planning mechanisms, the establishment of communication mechanisms with common terminology and protocols, as well as the training of emergency managers and first responders.

### Ensuring a coordinated approach

Many of the concepts identified within the National Framework are now being operationalized through the **Pan-Canadian Health Incident Management System** (PCHIMS).[6] Among the most critical components is the capacity to link the separate emergency response systems of Canada's ten provinces and three territories. Agreement on common terminology and planning processes is essential to avoid confusion when jurisdictions must work together. This will help ensure that three critical elements of managing a coordinated response are addressed:

- How do we communicate with each other?
- How do we plan together?
- Who is responsible for doing what?

Coordination is also required to implement and maintain strong communication and information management processes. The capacity to prepare for and respond to a range of unpredictable threats, above all, rests on the capacity to share and coordinate information amongst organizations and across sectors. In addition, communication with the public is essential to enabling people to prepare themselves for disasters, alerting them to potential threats to their health and safety, and ultimately maintaining their trust and confidence during times of crisis.

### Access to resources

It is also essential that jurisdictions have adequate equipment and supplies in place to respond to large-scale disasters. **Resource management** is a key emergency management principle, which ensures that both human and material resources can be rapidly mobilized, tracked and accounted for during emergencies. Depending on the type of emergency, resources can range from medical personnel like physicians and nurses to hospital beds, medical supplies and medicines, as well as diagnostic support such as laboratories. In Canada, resource management is supported through several mechanisms, including mutual assistance agreements between jurisdictions, cross-border agreements between provinces and territories, and the **National Emergency Stockpile System** (NESS), which maintains depots of essential health supplies and equipment across Canada (see article on page 37).

### Responding across sectors

Maintaining the health of people during emergencies, however, is not limited to the health sector. Essential non-medical issues like emergency food, clothing, lodging and family reunification for evacuees are also critical to maintaining health and safety. Emotional, spiritual and other forms of psychosocial support are also important to assist people during times of crisis. Emergency social services and non-government and voluntary organizations play a major role in fulfilling these needs (see article on page 34).

It is also essential that broader public health functions are integrated into emergency response structures for a range of public health threats that require planning and preparedness. These include acts of bio-terrorism

**Figure 1** Canada's National Framework for Health Emergency Management
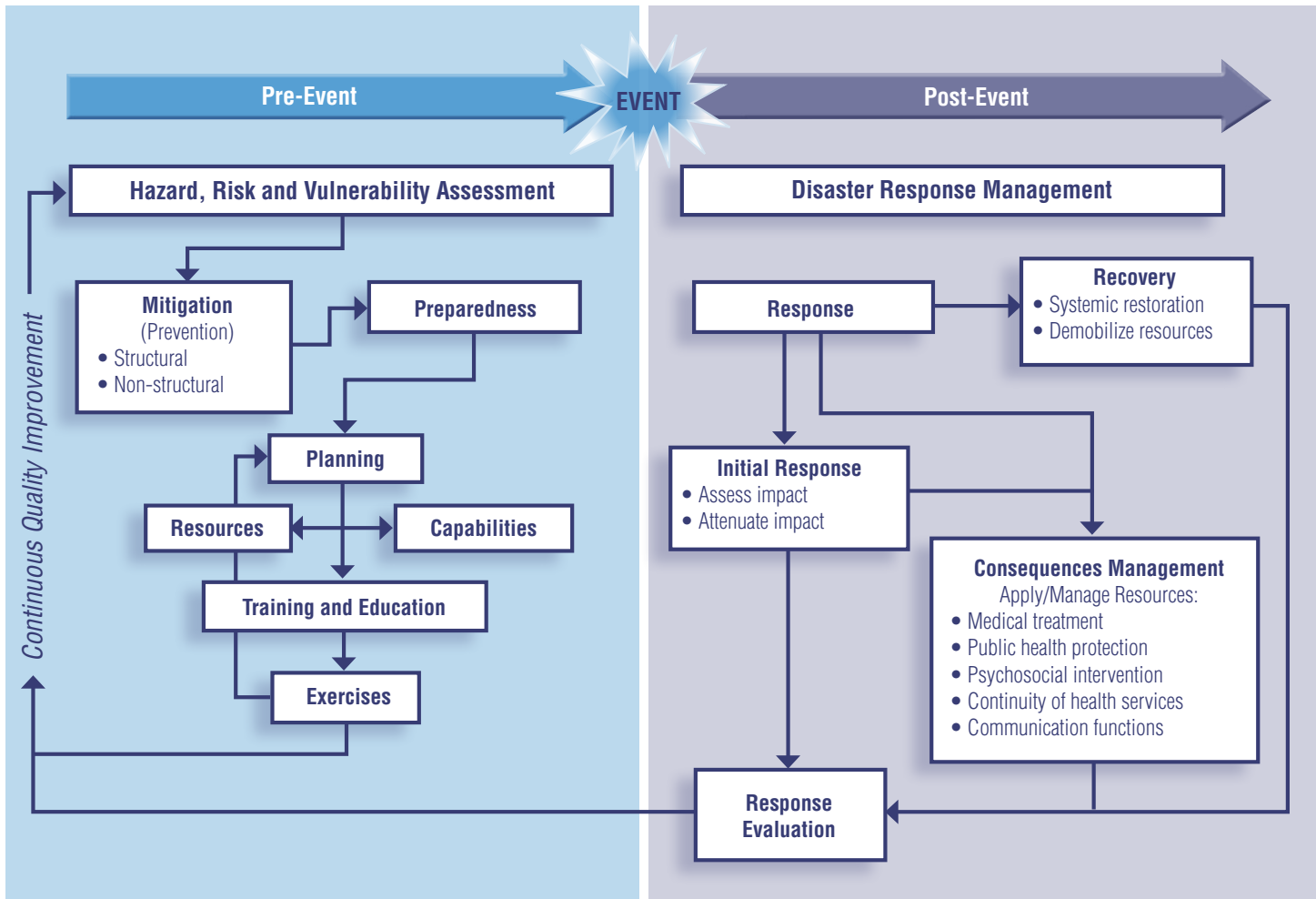


*Source: Federal/Provincial/Territorial Network on Emergency Preparedness and Response, 2004.*[5]

(e.g., release of anthrax or smallpox), radiological and chemical accidents, as well as infectious disease outbreaks like Pandemic Influenza. Emergency management must be able to work both with and across all sectors of health (e.g., pharmacies, acute and long-term care, and public health) to coordinate diverse public health interventions (including but not limited to rapid epidemiological investigation, infection control measures, quarantine guidelines, and specimen collection and transport).

## Conclusion

Since the World Trade Center Attacks of 2001 and the SARS crisis of 2003, significant steps have been taken to strengthen Canada's health emergency management system—but much work lies ahead. While Canada has to date escaped the devastating type of disasters that have struck the United States, this has meant that emergency

preparedness is often overlooked as an essential component in ensuring the continuing health and safety of Canadians.

This not only has obvious funding and resource implications, particularly at the municipal level where emergency management is often only one of an official's multiple responsibilities, but has meant that emergency management as a discipline—grounded in a theoretical framework and based on evidence-based practice—is only just emerging in this country. The capacity to develop and implement a truly integrated and comprehensive health emergency management system in Canada will ultimately depend on decision makers, researchers and practitioners working together to ensure that policies and programs are rooted within evidence-based frameworks and standards of practice. ■

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# Critical Health Infrastructures During Disasters

# Lessons Learned

**C**ase studies illustrate some of the ways that weather-related emergencies can affect human health, the health care system and the critical infrastructure on which it depends. This article highlights some of the lessons learned from case studies of the 1998 ice storm and Hurricane Juan.

**Kaila-Lea Clarke**, Climate Change and Health Office, Healthy Environments and Consumer Safety Branch, Health Canada

It is estimated that the number of extreme weather-related events in Canada increased from approximately three per year in the 1970s and 1980s to twelve per year in the 1990s.[1] As the article on page 8 has pointed out, this trend is projected to increase as the climate continues to change. In the 1990s, natural disasters caused 179 deaths and 1,000 injuries, and affected over 700,000 Canadians. The people affected were evacuated, made homeless or lost critical infrastructure services. Although mortality in Canada attributed to natural disasters has decreased in the past several years, the number of people affected has risen.

During weather-related emergencies, the health care system plays an essential role in reducing mortality and morbidity, but this role can become compromised if the system, or the critical infrastructure upon which it relies, is affected negatively by the event. Hurricane Juan and the 1998 ice storm are two Canadian disasters that illustrate the role of critical infrastructure and public health response in decreasing the risk of injury, illness, stress-related disorders and fatalities associated with extreme weather events. Both provided emergency managers and public health officials with lessons that have contributed to more effective planning for and management of health care services in the face of weather-related disasters.

For this project, the Climate Change and Health Office at Health Canada drew its analysis from peer-reviewed scientific publications, and professional association and government reports from multiple disciplines, including nursing, public health, medicine and emergency preparedness. Standard academic and government databases were also searched via keyword content and title searches. A valuable resource was Public Safety Canada's Canadian Disaster Database[2] (see *Using Canada's Health Data*, page 47).

## Hurricane Juan Hits the Maritimes

In September 2003, Hurricane Juan, a category 2 hurricane, made landfall in Nova Scotia as one of the most powerful and damaging hurricanes ever to affect Canada. Juan was responsible for eight

## What is critical infrastructure?

Critical infrastructure usually includes energy and water supply, communications, transport, health services and food supply.[3]

deaths.[2] More than 300,000 people were without power for up to 10 days, telephone service was disrupted and the water infrastructure was compromised.[4]

Major hospitals were affected by the devastation, including the Victoria General Hospital in Halifax. With part of its roof ripped off, the hospital sustained flooding and water damage to eight floors, including storage rooms that contained sterile medical supplies. More than 200 patients had to be relocated to other facilities. Beds at functioning facilities became scarce, as most patients, even those with minor injuries, could not be sent home since the essential resources needed to manage their own care (power, water and telephone) were compromised.

The impacts of Juan were felt for up to four weeks after the event. For example, owing to flooding and air quality issues related to the presence of possible moulds, the Victoria General did not open its operating theatres until four weeks after the initial event. The resulting cancellation of 78% of scheduled surgeries increased surgical wait lists as the 370 cancelled surgeries were rebooked.[4]

### Lessons learned

Many lessons were learned from the experience and several adaptations have been implemented in order to ensure that health professionals in the Halifax region are better prepared for future emergency situations. There is now greater recognition that the management of relocated patients, staff and medical equipment presents many unanticipated challenges, and that specific personnel need to be allocated to these tasks. This would help to ensure the communication of direct and accurate information about the needs of patients and staff. For example, it has been recommended that a familiar charge nurse or manager be appointed to staff at all times when they are relocated to an unfamiliar work environment.[4]

After Hurricane Juan, a toll-free phone number was established to provide hospital staff with up-to-date information during emergency situations. Adaptations to improve communication are being considered, including access to alternate satellite feed for TV coverage and digital access via the Internet that would allow for communication to the public about scheduling changes at hospitals during an emergency (such as cancelled surgeries and closed emergency rooms). A program is also being developed to train duty officers and administrators to respond to emergency situations. Finally, the District Emergency Response Centre has been moved to a new location equipped with improved systems for emergency power.[4]

## The 1998 Ice Storm in Eastern Canada

A massive ice storm befell eastern Canada in January 1998. It was unprecedented in terms of the number of individuals affected, the intensity of the freezing rain and the duration of the event. The storm resulted in the disruption of power and water supplies, public and health services, and emergency services were hindered by the lack of communication. The storm lasted for several days; its effects were felt for weeks afterwards. Collectively within Ontario and Québec, approximately 260 communities declared
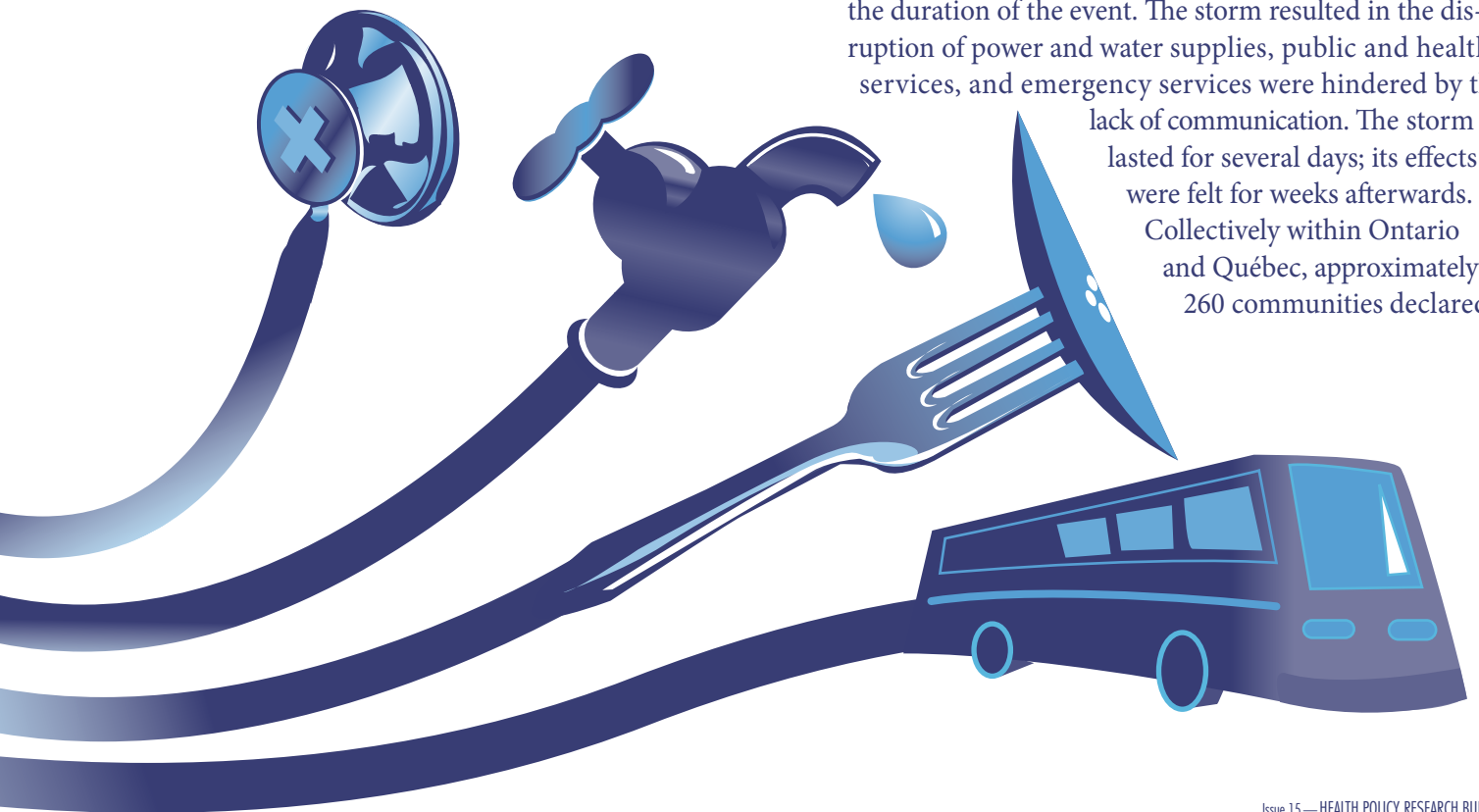
a disaster. The following data illustrate the magnitude of the disaster:

- Property damage was extensive and the economic losses amounted to nearly $5.41 billion making it one of the most expensive disasters in Canadian history.[2]

- 945 people were injured and 28 lives were lost.[2]

- Over 120,000 km of power lines and telephone cables were destroyed.[5]

- More than 3.5 million people lost electricity; for some, it was not restored until more than three weeks later.[1]

- The storm resulted in mass evacuations, forcing some people to take up residence in temporary shelters.

Interestingly, most deaths were not due to direct exposure during the storm. Rather, they were attributed to the use of indoor open flames or heaters used in the absence of functioning power infrastructure.[6] For example, 700 cases of carbon monoxide poisoning were reported in one health region alone.[7] Common injuries included frostbite and fractures from falls on slippery sidewalks or while clearing ice from roofs. Insomnia, anxiety, irritability and some longer term mental illnesses were also reported.[7]

The conditions created by the storm put hospitals and emergency services to the test. Hospitals experienced an increase in the number of individuals seeking medical attention for injuries, carbon monoxide poisoning, respiratory infections and heart problems.[8] Hospitals had to accommodate individuals who were being transferred from smaller hospitals, home-care programs and nursing homes that could no longer provide essential services—such as power for respirators.[8] Some hospitals operated on generators for up to three weeks. Larger hospitals that had emergency generators were able to provide only the most essential hospital services, while smaller hospitals had generators that supplied only lights and telephones.[7] Ambulances and emergency medical technicians were heavily relied upon for medical emergencies and to transport people to shelters and hospitals, as well as to transport medicines and medical equipment. Hazardous road conditions and lack of a reliable communication system challenged the transport of people and goods.

> **R**apid surveillance of health impacts following events such as these is important, as it can provide accurate and timely information that can be used to inform health professionals when planning for future events.

### Learning on the spot

Health professionals in affected communities resorted to a number of ad hoc adaptations, and learned how well they sufficed as they were implemented. For example:

- To prevent the spread of illnesses in shelters, those that became sick were isolated from the other residents, and health care workers were vaccinated.[7]

- Many hospitals provided shelter to the families of their employees and medical staff, in order to maintain staff levels and availability.[8]

- The Ordre des psychologues du Québec set up a hotline to help the public cope with stress-related disorders.[7]

- The Ordre des pharmaciens du Québec refilled medications without requiring a prescription or bottle.[7]

After the ice storm, the Québec government mandated the Nicolet Commission to review the event and the manner in which communities responded.[9] Since then, the province has taken important steps to strengthen emergency preparedness and response capacity at both the community and individual level. As a result, the province is now in a position to better cope with future extreme events (see article on page 21).

## Future Research Needs

Much can be learned from events like Hurricane Juan and the 1998 ice storm. Other recent examples are not difficult to find: the recent hurricane-like severe wind storm in British Columbia in the autumn of 2006 resulted in a boil water advisory affecting two million people;[10] and, in August 2005, the Greater Toronto area was hit with heavy rain that washed away infrastructure and flooded basements.[11]

Rapid surveillance of health impacts following events such as these is important, as it can provide accurate and timely information that can be used to inform health professionals when planning for future events.[12] Information is also needed regarding long-term health impacts and the role of health services in the recovery process during and after an event. Few Canadian studies have reported on factors that lead to successful recoveries. Such information would help to increase the resilience of public health systems to future events, thereby limiting or minimizing the long-term threats to human health and well-being. ■

**Claude Martel**, Service des activités de sécurité civile, ministère de la Santé et des Services sociaux du Québec

# Case Study in Emergency Preparedness and Response:

# The Québec Model

**T**he 1996 Saguenay floods and the 1998 eastern Canadian ice storm were instrumental in the development, by the Government of Québec, of a comprehensive program of research and policy action that has resulted in improved emergency preparedness at all levels, including local and regional municipalities.

Although the ice storm of 1998 lasted only a few days, it debilitated much of Québec, eastern Ontario, New Brunswick and Nova Scotia for weeks following the event. In the aftermath of this disaster, the Government of Québec recognized the need to address the weaknesses that the storm had exposed—in particular, the deficits in surge capacity across the province.

**Surge capacity** is the capacity needed to react to a sudden, constant or complex need for goods and services that are essential to individuals or groups affected by a real or threatened disaster. Achieving surge capacity calls for a combination of measures aimed at action, coordination and communication to support emergency management policies, approaches, processes and organizations (see sidebar). It also calls for the mobilization of many players and resources and requires coherence and complementarity among players and jurisdictions.

## Taking Comprehensive Action

Following the ice storm, the Government of Québec, along with its partners, took action on a number of fronts to strengthen its emergency preparedness and response capacity—including the surge capacity that

## Some Key Ingredients

Surge capacity relies on a systematic and structured approach common to all players. Planning for surge capacity involves numerous activities and components, including: mobilizing and optimizing resources; defining roles and responsibilities; making players accountable; facilitating movement between jurisdictions; establishing coordinated approaches and good communication; defining decision-making processes; prioritizing; taking action; and aiming for continuous improvement and evaluation.

would be required to respond to a sudden, sustained and/or complex demand for goods and vital services during a disaster. The action taken demonstrated that, since prevention alone cannot eliminate all the risks, the concept of surge capacity must apply as much to preparedness as to response and recovery.

### New public safety legislation

At the centre of the efforts was Québec's *Civil Protection Act* (2001),[1] which put in place a model of civil safety that included essential structural elements at the local, regional and provincial levels. The Act revised and extended public safety legislation to improve the emergency preparedness of various organizations and agencies within local and regional municipalities. It also ensured that, at every level, all necessary sectors were engaged.

## An integrated, all-hazards approach

The health sector was identified as having a key role. Under the *Civil Protection Act,* Québec's **National Civil Protection Plan** (NCPP)[2] was developed to provide the general planning framework for the health sector in the event of a disaster. The plan ensures an integrated government approach, by clearly defining the linkages and responsibilities of every department and governmental organization. This coherent, all-hazards framework regulates the operation of 15 sectors, including health, services to disaster victims, food supply, housing, safety, communication, environment, energy, municipality, transport, economy, finance, logistics and others. It also serves as a frame of reference for Québec's 18 socio-health regions.

The activities of participating sectors rely on a rich source of human, material, informational and financial resources. Figure 1 provides a snapshot of just three of these sectors.

## Building Surge Capacity in the Health System

The aim of the NCPP's **Health Mission** is to preserve the life and well-being of people during disasters. It establishes a framework for planning for and responding to disasters that will provide the required surge capacity, by:

- supporting the promotion, prevention, protection and maintenance of essential services

- regulating pre-hospital, diagnostic and medical services

- ensuring the availability of hospital nurses, temporary living arrangements and first-level psychosocial and telephone support

**Figure 1**  Allocation of Resources to Selected Sectors under Québec's National Civil Protection Plan

| Sector | Resources Allocated |
|---|---|
| Health | 292 establishments: 1,745 installations and 79,000 beds |
| | 200,000 employees, including 43,500 nurses and 19,000 physicians |
| | 625 ambulances and 3,700 attendants |
| Transport | 540,000 commercial vehicles and 120,000 heavy vehicles |
| | 4,000 public transit vehicles (plus trains, planes and boats) |
| Security | 13,400 police officers |

- regulating the human, material, informational and financial resources of the provincial health network to provide additional surge capacity, as needed

Most importantly, the Health Mission clearly defines the responsibilities of each partner and sector, offers a communication strategy, and provides an operational framework for surveillance, alerts and resources.

## Coordinated action at the local level

The province's **Disaster Site Coordination Framework**[3] was developed to guide municipalities and local organizations, including health organizations, in implementing coordinated intervention during disasters. It also facilitates the communication of critical information and relevant explanations between responders.

To enhance the protection of people, goods and the environment, Québec's Ministry of Public Security applies a risk management approach to help analyze and manage a number of natural and human-induced risks (see Figure 2).  ■

**Figure 2**  Risk Management Cycle



Establishing the context

Understanding the risks
- Identifying the risks
- Analyzing the risks
- Evaluating the risks

Addressing the risks
- Identifying possible measures
- Evaluating and selecting measures
- Planning and implementation

Leadership — Communication and consultation

Follow-up and making adjustments
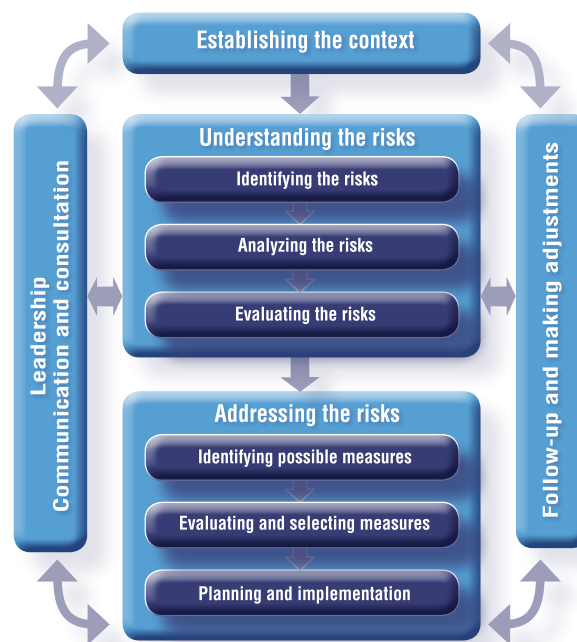
*Source: Québec Ministry of Public Security, 2008.[4]*

# The Health Impacts of Disasters:

# Who Is Most at Risk?

**Simone Powell**, Division of Aging and Seniors, Centre for Health Promotion, Public Health Agency of Canada

Research shows that the health impacts of disasters are not distributed uniformly across the population. This article explores the concept of vulnerability and its underlying determinants. It also presents an overview of who is most at risk, with a closer look at seniors—their vulnerabilities, the nature of their needs and their potential contributions. The research provides findings relevant to future disaster planning for seniors and others in Canada.

## Vulnerability and Disasters

All populations exposed to a disaster event are at risk of suffering serious health impacts. However, research has shown that some groups are more at risk than others to the immediate and long-term consequences.[1]

Vulnerability to disasters can be understood as "the relationship between common social and economic characteristics of the populations, individually and collectively, and their ability to cope with hazards that they face."[2] Canada's **National Framework for Health Emergency Management** notes that identifying the characteristics of vulnerable populations is as important as understanding the characteristics of a hazard.[2] Further, the emergency management profession is recognizing that the only way to make a significant change to a community's catastrophic risk profile is to influence the social, economic and physical factors that determine the community's exposure to those risks and its ability to cope with an actual impact.[3]

### Determinants of health and vulnerability

The factors that increase an individual's vulnerability to harm in a disaster situation are similar to those factors which determine the general health of individuals: physical determinants; social networks and environments; education and literacy; economic determinants; personal health practices/coping skills; health services; biology and genetic endowment; healthy child development; gender; and culture.[4,5]

Research shows that the health impacts of disasters are not distributed uniformly across the population.

Photos by: Win Henderson, Andrea Booher and Jocelyn Augustino.

Understanding these determinants and how they relate to vulnerability is critical. It can help explain why some groups are more vulnerable or "at risk" than others and, hence, provide guidance for understanding the impacts of disasters and for taking action throughout the emergency management cycle. For example, persons with limited social networks or who are socially isolated may lack access to assistance during an emergency. Others with low income may not have the financial resources needed to prepare for, respond to (e.g., evacuate quickly) or recover from an emergency. They also may be forced, because of their economic circumstances, to live in poor quality housing that may not withstand the impacts of a disaster.[1]

Just as is the case with the determinants of health, the factors that

## Gender Differences

Research has suggested that there are gender differences in many aspects of disaster situations, including in the perception of hazard risk. A review of Canadian and international disaster case studies found that women had a lower tolerance to risk, were relatively more attentive to disaster risk communications and were more likely to undertake family emergency preparedness than men, especially if their family members were threatened. However, this is an area in which more research is needed.[6]

influence vulnerability do not act in isolation. Rather, they can interact in a way that exacerbates the impacts of emergencies. Moreover, these factors can change with age, life circumstances and gender roles.[3]

## Who is Most at Risk?

Drawing on expert consultations, existing literature and the application of the social determinants of health, the Canadian Red Cross identified 10 high-risk population groups in Canada who are least likely to anticipate, prepare for, cope with and recover from the effects of a disaster, and whose needs should be taken into consideration in emergency planning (Figure 1).[2]

Identification of these groups does not suggest that their members are homogeneous or that they are mutually

## Figure 1  Ten High-Risk Population Groups in Canada[3]... and Why They are at Risk

**Seniors** experience greater disaster-related loss, injury and death than younger populations.[7] (Seniors' vulnerabilities are discussed in more detail later in this article.)

**Aboriginal populations**, on average, have lower economic and health status than the general Canadian population[8] and many Aboriginal communities are geographically isolated,[9] two factors that increase their vulnerability during a disaster.

**Women** may be more vulnerable to some health impacts—for example, women's roles as primary family caregivers may expose them to harm as they work to protect others.[6]

**New immigrants and cultural minorities** may face language barriers that reduce their awareness of assistance programs. Language barriers may also prevent them from understanding pre-emergency education efforts and emergency procedures.[10]

**Persons with low income** suffer the greatest disaster losses and have the most limited access to public and private recovery assets.[11]

**Children and youth** are particularly vulnerable to separation from family and disruption of normal routines, resulting in emotional distress and changes in behaviour.[12]

**Persons with disabilities** may be at greater risk for injuries or exclusion during disasters, in part because response systems are typically designed for people without disabilities.[12]

**Transient populations** tend to have loose social and economic networks and can become socially marginalized, leading to a lack of resources and increased vulnerability.[13]

**Persons with low literacy levels** may face challenges in reading and understanding emergency preparedness and response messages.[14]

**Medically dependent persons** require ongoing medical supervision or care at shelter sites, which are generally equipped to provide only very basic first aid.

*Note: Other populations that may not be captured in these groups—but who may be at particular risk in the face of a disaster—include individuals with morbid obesity, pregnant women and people living in zero-vehicle households.[15]*

exclusive categories. On the contrary, throughout the disaster cycle for each hazard, vulnerability should not be assumed but investigated.[3] As noted by the Organisation for Economic Co-operation and Development, it is "necessary to identify vulnerabilities and vulnerable population groups and find ways to monitor and reach these groups and integrate that data into risk and vulnerability assessments."[1]

## Meeting the Needs

Having a sense of who is most at risk during an emergency can help communities and emergency management organizations to reduce risk and prioritize responses. However, confronting a long list of at-risk groups can prove to be overwhelming, particularly if one considers that over half of a community's population may be at risk during an emergency.[15]

In response to this challenge, a functional needs approach has been gaining acceptance among emergency management planners as a way to identify, plan for and meet the needs of high-risk or vulnerable groups (see sidebar). Rather than grouping needs based on population characteristics of age, gender, disability, etc., this approach identifies cross-cutting areas of functional needs that may be faced by one or more at-risk populations. By so doing, it also accommodates people who may not fit into a single or specific population group (e.g., children with a disability), who may not identify themselves as part of a group, or whose needs are temporary.[16]

While such an approach can help ensure that a full range of functional needs is identified and addressed, it is important not to lose sight of the particular historic, social and personal contexts that shape the lives of "at-risk" groups. A lifetime of discrimination and marginalization, or exposure to previous emergencies, losses and diseases, also influences how people respond to and cope with disasters and must be taken into consideration in emergency planning.

In this context, the Public Health Agency of Canada (PHAC), in conjunction with the World Health Organization (WHO) and others, has examined the real-life experiences of seniors in disasters, providing useful information that can be applied to planning for seniors and for groups that—particularly in an emergency situation—may share some of the functional needs and challenges faced by seniors.



A **Functional Needs Framework** grew out of the *International Classification of Functioning, Disability and Health* developed by the WHO, and is defined along eight functional limitation areas: hearing, seeing, breathing, walking/mobility, manipulation, communication, learning and understanding.[17] The Framework identifies five essential function-based needs:

1. **Medical**—those who are unable to care for themselves or who require medical assistance.

2. **Communication**—includes those with communication limitations (e.g., a minority language, learning disabilities or sensory loss).

3. **Supervision**—those without family or friends who require supervision, such as children, the cognitively impaired, etc.

4. **Maintaining functional independence**—those who require early interventions, medical stabilization, etc., to avoid deteriorating health.

5. **Transportation**—includes individuals who are transportation dependent, whether or not they are otherwise functionally independent.[15]

## International Research on Seniors and Disasters

Evidence from past disasters has demonstrated that older adults are disproportionately represented among the dead and injured. For example, the greatest age-specific death rates resulting from the 2004 tsunami in Aceh, Indonesia, were among adults aged 60 to 69 (23%) and those aged 70 and over (28%). Likewise, 70% of persons who died during the 2003 heat wave in France were over the age of 70, and during Hurricane Katrina 71% of the dead in Louisiana were over the age of 60.[7]

Between 2006 and 2050, the proportion of people aged 60 and over will double from 11% to 22% of the global population.[18] The oldest segment of the population (over age 80) is growing at an even faster rate. This same trend is found in Canada, where the proportion of older Canadians is projected to double in almost 50 years.[19]

### Sixteen International Case Studies

**War**—Lebanon (2006)

**Drought**—Bophirima, South Africa (2003)

**Heat Waves**—France (2003)

**Floods**—Mozambique (2000); Manitoba (1997); Saguenay, Québec (1996)

**Hurricanes**—Jamaica (2004–2005); New Orleans (2005); Cuba (1985–2005)

**Earthquakes**—Turkey (1992–1999); Kashmir (2005); Kobe, Japan (1995)

**Tsunami**—Aceh, Indonesia (2004)

**Ice Storm**—Québec (1998)

**Wildfires**—British Columbia (2003)

**Nuclear Power Plant Explosion**—Chernobyl, Ukraine (1986)

## Building the Evidence

Despite the fact that seniors are disproportionately affected during disasters, they have often been overlooked or given low priority in emergency situations.[20] To examine this situation more closely, PHAC, in collaboration with the WHO and other partners, undertook 16 international case studies (see sidebar) to examine how older people were affected in a range of disasters. Case study authors used available data sources (including age-disaggregated data when available) on the impact of these disasters to assess the strengths, gaps and best practices regarding emergency planning and response, including contributions made by seniors. They also offered policy recommendations for better meeting the needs of seniors.[7]

### *What contributes to seniors' vulnerability?*

It is not age per se that makes seniors vulnerable to disasters. Rather, it is the combination of factors that are often associated with older age that increases vulnerability and capacity to cope. Moreover, limitations that are manageable under normal circumstances may quickly become overwhelming in a crisis.

By looking at the determinants of vulnerability, the case studies provide information that helps us understand why seniors are more vulnerable, and how to mitigate the risks they face.

**Social Networks/Environments:** Seniors, particularly those with chronic conditions, are often able to cope on a daily basis and maintain a sense of independence because of the assistance they receive from others. Emergency situations disrupt these relationships leaving older people, especially those with small social networks, at risk for isolation, neglect, exploitation and violence. *In the Kashmir, Jamaica and Lebanon cases, the loss of these relationships resulted in social isolation, marginalization and even abandonment when family members were overwhelmed by their own needs or were unable to evacuate their older family members.*

**Gender:** Older women are more likely to live in poverty and in inadequate housing. Because of their longer life expectancy

they frequently live alone, often with chronic disabling conditions. *In the Lebanon, Aceh and British Columbia case studies, older women were significantly more dependent on others for information, support, access to health care and other services. Women living in poverty were particularly vulnerable in Jamaica. Men also faced difficulties when they took on roles normally ascribed to women, such as child care in the case of Aceh.*

**Economic Determinants:** Seniors living on limited incomes often live in poor housing, in high-risk areas and lack access to transportation. Further, they are often less likely or able to prepare for an emergency. *The effects of low income were particularly evident in the disasters in Kobe, Jamaica, Bophirima and British Columbia, where, during the recovery phase, seniors were less likely to receive financial aid or be considered candidates for post-disaster loan programs.*

**Health and Social Service Systems:** Aging-related physical changes and chronic illnesses create more dependency on health and social services. When emergencies disrupt or shut down these services, seniors are at greater risk for injury, exacerbated health conditions and death. *Disruption of health services prevented access to care by seniors in a number of case studies including Jamaica, Kashmir and Lebanon. In France, poor coordination between emergency, health and social services had deadly outcomes for seniors.*

## *How to mitigate negative impacts*

Case study findings confirm previous disaster research, and go further to offer insights into practices that exacerbate vulnerability as well as those that have been shown to mitigate negative outcomes in each phase of a disaster.

**Preparation Phase**—Neglecting to include seniors' needs and contributions in emergency plans and policies contributed to negative outcomes. On the other hand, when seniors were specifically identified in plans, effective communication strategies were used and seniors were provided with appropriately designed shelters and a continuity of health services. In Cuba, where the emergency plans were the most comprehensive of the jurisdictions studied:

> *Seniors living on limited incomes often live in poor housing, in high-risk areas and lack access to transportation. Further, they are often less likely or able to prepare for an emergency.*

- Both the mortality rate for seniors (4 out of 17 deaths) and the overall mortality rate were lower in Cuba during hurricanes from 1985 to 2001 than in neighbouring islands.
- Great efforts were made to ensure that seniors were active members of local emergency committees and that they played a role in public information and education.

**Response Phase**—Failure to take seniors and their functional needs into account resulted in delays in evacuating long-term care facilities, poorly designed shelters, separation from family, health services that were unable to cope with excessive demands for medical attention and inadequate consideration of seniors' food and nutrition requirements. When response plans considered the needs of seniors, the process worked well:

- In British Columbia and Québec, home care staff prepared older clients for relocation.
- In Kashmir, a no-queue system was established for older adults at food distribution points, while in Kashmir and Cuba, food was delivered to those who could not evacuate.
- In British Columbia, Cuba, Jamaica, Kobe, Lebanon and Québec, emphasis was placed on relocating at-risk seniors to safe shelters.
- In Turkey and Kobe, specialized housing was created.
- In Kobe, substantial efforts were made to address psychosocial needs through community support and interaction.

**Recovery Phase**—Seniors were disadvantaged by a number of faulty practices, such as exclusion from livelihood recovery programs and retraining, inaccessible or incomprehensible benefit application forms and processes, premature withdrawal of support services, housing that was socially and structurally unsuitable, and exclusion from the rebuilding process. Good practices included:

- In Turkey, Jamaica, Aceh and Kobe, restoration of older persons' homes was a priority in some locations.

- In Turkey, an NGO ran a rehabilitation centre with recreational facilities for seniors.

- In Kobe, housing for older persons was built with on-site services and support, as well as opportunities for social interaction.

- In Aceh, Cuba, Kashmir and Mozambique, seniors were included in recovery planning and reconstruction projects.

## Seniors as Contributors

Almost all of the case studies uncovered ways in which older people made significant contributions, demonstrating that being in need and being able to contribute are not mutually exclusive (see sidebar). For example, seniors served as volunteers to provide outreach, information, material, practical assistance and emotional support—in addition to supporting their families by taking on caregiving responsibilities and sharing their resources. By offering their strength and experience, older people also served as models of resilience and resourcefulness to other community members.

## Policy Action in Support of Seniors

Since 2006, PHAC's Division of Aging and Seniors and the Centre for Emergency Preparedness and Response have collaborated to bring together the fields of emergency management and gerontology to exchange knowledge, create new partnerships and build a foundation for action. By working with Canadian and international experts, research has been moved into action, priorities have been identified, and new networks designed to move these priorities into concrete outcomes and to share tools and resources have been created. Examples include:

- A framework for action—*Building a Global Framework to Address the Needs and Contributions of Older People in Emergencies*[21]—was prepared by PHAC

### All About Seniors

*For Seniors, By Seniors,* is a peer-support group in Winnipeg that is operated by eight to twelve senior volunteers who make up a "Leaders Team." Members of the Leaders Team travel around the community to host workshops and do presentations for seniors on emergency preparedness. *For Seniors, By Seniors* uses a peer-based, adult education approach, and encourages seniors to use their skills to prepare for and cope with emergency situations. The strengths that seniors bring to emergency situations are a key component of their teachings.

—Bill Hickerson, Good Neighbours Senior Centre, Manitoba

drawing on the case studies and guidance from experts at the 2007 Winnipeg International Workshop on Seniors and Emergency Preparedness. The framework was presented to the United Nations Commission for Social Development in February 2008.

- An advocacy brief was prepared by the WHO, HelpAge International and PHAC for the United Nations humanitarian community. This brief outlines key issues and provides some practical guidance for humanitarian workers.[22]

## Conclusion

Research on the determinants of disaster vulnerability—much of which has roots in the population health field—provides practical information that is increasingly being used in emergency management. Knowing who is vulnerable and the nature of their functional needs provides a foundation on which to identify and plan for individual and community needs, and offers direction on how resources can best be targeted. Many of the lessons learned from examining the nature of seniors' vulnerabilities and needs in real-life disasters can be applied to future disaster planning for seniors and other populations in Canada.

Whether considering the needs of high-risk groups, or looking across groups to determine the functional needs of a community's population, it is important that emergency organizations recognize the contributions that these groups can make and engage them as active participants in the emergency management process. ◾

# Resilient *Canadians,* Resilient *Communities*

**Peter Berry, PhD**, Climate Change and Health Office, Healthy Environments and Consumer Safety Branch, Health Canada, and **Dave Hutton, PhD**, formerly with the Centre for Emergency Preparedness and Response, Public Health Agency of Canada, and currently with the United Nations Relief and Works Agency, West Bank

Experiences with emergencies in a number of communities in Canada over the past century have tested their resilience. Many lessons have been learned and, together with findings from a growing body of research, these experiences have shed light on how community resilience can be strengthened. This article discusses the value and role of resilience in withstanding, recovering and learning from disasters—particularly important in light of emerging issues and trends which could portend even greater impacts on human health.

## The Importance of Resilience

The principle of resilience is emerging as an integral component of emergency management practice in Canada. Resilience can generally be defined as the "capability of individuals and systems [families, groups and communities] to cope with significant adversity or stress in ways that are not only effective, but tend to result in an increased ability to constructively respond to future adversity."[1]

Resilient people and resilient communities suffer less in the face of disasters that threaten health and well-being. Three properties of resilience lessen human suffering during and after an event:[2]

- the ability of a community to withstand a disaster and its consequences (**resistance**)
- the ability of a community to "bounce back" to its pre-disaster level of functioning (**recovery**)
- the extent to which a community learns from the disaster experience and transforms this knowledge into more advanced emergency management functioning (**creativity**)

## Levels of Resilience Vary

Overall, Canadians enjoy high levels of health and well-being and access to health and social services, providing a strong foundation of resilience to a wide range of hazards. However, this foundation is not shared by everyone; some individuals and population groups, such as the poor and socially marginalized, are more vulnerable to disasters and less resilient than others (see article on page 23).

Levels of resilience can also vary across communities and regions. The risk factors associated with the frequency of emergencies and the severity of their consequences include dense populations in urban areas, human settlement in hazard-prone areas, and complex and deteriorating infrastructures (see article on page 8). These risk factors may reduce levels of community or regional resilience.

It is not possible—nor is it the role of emergency management—to eliminate all of the many factors that make people less resilient to hazards. However, it is important that emergency managers and public health decision makers work with communities to identify risks and vulnerabilities, and to develop the resources and capacities that enable people to effectively prepare for, respond to and recover from all types of threats.

# How Emergency Management Plays a Role

A key purpose of emergency management is to assist communities to prepare for unexpected and sometimes overwhelming events that threaten people's physical, economic, social and/or emotional well-being. Good emergency management recognizes that this is most effectively achieved by working closely with communities to identify risks and hazards and to mobilize and strengthen existing resources and capacities. In this sense, emergency management is only as strong as the communities it supports.

## *Focusing on mitigation and prevention*

A fundamental step in preparing communities for disasters is to reduce the potential impacts of threats from hazards. Mitigation activities can be either non-structural or structural in nature. Health promotion is an example of non-structural mitigation. In emergencies, hospitals are inundated, leaving those but the most seriously ill at risk of not being able to access medical care. A focus on disease prevention and control among other actions may reduce demand on hospitals and render the population healthier and more resilient to the effects of emergencies and disasters.

An example of structural mitigation is ensuring that health care facilities are not built on flood plains, or are protected by dikes. The city of Winnipeg demonstrated the resilience concept of "creativity" when it responded to its experience with the 1950 Red River flood by building a floodway around the city, thereby substantially improving its resistance to future floods (see sidebar). This resistance was amply demonstrated during the 1997 flood which resulted in fewer community impacts.

Although historically there has been less focus on prevention and mitigation efforts in Canada, the *National Disaster Mitigation Strategy*[4] is now focusing attention on Canada's need to strengthen its mitigation/prevention activities. There is also growing consensus within the international community that more emphasis must be placed on mitigation/prevention. At the 2005 United Nations World Conference on Disaster Reduction, the delegates stated that: "We recognize that a culture of disaster prevention and resilience, and pre-disaster strategies, which are sound investments, must be fostered at all levels."[5]

## Mitigating the Damage Caused by Flooding: The Case of Manitoba's Red River[3]

The city of Winnipeg, Manitoba, is situated at the confluence of the Red and Assiniboine rivers, in one of the world's most flood-prone regions. In 1950, Winnipeg was deluged by a flood that forced the evacuation of half of its citizens, many of whom lost their homes and livelihoods. During the decade that followed, various flood protection options were debated and, despite concerns about costs, the green light was given for the construction of a US$63 million diversionary channel around the city.

The floodway was completed in 1967, but remained untested until 1979, when another flood with waters equivalent to those of 1950 were diverted around Winnipeg. The next Red River flood to test the floodway occurred in 1997 and was considerably larger than both previous floods. The Red River valley was flooded from southern North Dakota to Lake Winnipeg, causing large-scale evacuations; however, the city of Winnipeg was largely unaffected, save for some low-lying riverside properties. Without the floodway, at least half of the city would have been submerged under a metre and a half of water, and the ensuing damage would have cost several billions of dollars to repair.

Winnipeg's floodway is a clear example of why disaster mitigation needs to be seen as a long-term intervention, where costs are recovered over several generations and where benefits may not be felt for many years to come.

## Assessing hazards to improve resilience

Identifying and understanding the hazards and risks that may threaten a community is a key step in building resilience. Although a community may have many resources, it is important that they are employed in an effective and equitable way to respond to particular events. To be most informative, hazard, risk and vulnerability assessments require information on the location of critical infrastructures, the expected location, frequency and magnitude of hazards, and where "at-risk" populations reside.[6]

The recently released report *Human Health in a Changing Climate: A Canadian Assessment of Vulnerabilities and Adaptive Capacity* provides information to aid community and regional public health and emergency management officials gauge future risks to health from climate change and identify needed adaptations.[7] A key finding is that climate change is expected to increase extreme weather and other climate-related events in Canada such as floods, droughts, forest fires and heat waves—all of which increase health risks to Canadians. Resilience to these natural hazards can be increased through efforts to renew and strengthen critical infrastructure, improve the emergency preparedness of individuals and enhance disaster mitigation activities across Canada.[8]

## Developing early warning systems

Early warning systems maximize the probability that people can take the appropriate actions to protect themselves from a natural hazard event. These systems are designed to detect or forecast a potential danger and issue an appropriate alert. Canada relies on several systems that issue warnings for specific hazards (e.g., heat waves, storms). A common problem is the weak link between the technical capacity to issue the warning and the capacity of the warning to trigger the appropriate response among the public.[9] Despite this, early warning

**Identifying and understanding the hazards and risks that may threaten a community is a key step in building resilience. Although a community may have many resources, it is important that they are employed in an effective and equitable way to respond to particular events.**

systems have been shown to reduce the loss of life associated with natural hazards.[10,11,12,13]

## Maintaining community infrastructure

Many communities in Canada face pressures from aging infrastructure, increasing the risk of destruction and service disruption during a disaster.[14] Because modern infrastructures serve a complex range of functions—such as transportation, communication, energy, utilities, water and waste systems—their interconnectedness exacerbates a community's vulnerability to disasters.[15] Building and maintaining infrastructure to withstand the impacts of an increasing number of extreme events is an investment that can improve a community's resilience during and after a disaster.

Health-related infrastructure such as hospitals, emergency medical services, walk-in clinics and pharmacies, as well as related psychosocial services such as telephone help-lines and grief counselling, are not only important in maintaining the health of people in everyday life, but also serve as the foundation to respond to any emergency or disaster.

## Supporting community groups and networks

Perhaps the greatest resource of any community is its people. People and communities struck by disasters should not be regarded as either helpless or as passive recipients of assistance. Rather, they should be seen as active partners in emergency preparedness and planning.

Engaging community groups in emergency management activities is critical to enhancing resilience. Working with community groups and networks can enhance outreach and raise awareness among the public, particularly hard to reach or socially invisible groups (e.g., frail and isolated seniors, non-English speaking newcomers, the poor and homeless). Community partners are also often the most knowledgeable about the distinct needs of their members. Although community organizations

are increasingly recognized as partners in emergency management, a recent study found that many emergency management and voluntary organizations in Canada do not have the networks and resources needed to maximize their collective potential.[16]

Public and private sector organizations are also critical partners. Those with well-planned and tested business continuity plans will be better prepared to provide their services during a disaster and, by continuing to function, will enhance their community's capacity to "bounce back." Businesses play a key role in assisting communities to recover after disasters, often contributing financial resources and much needed supplies and materials to affected communities.

### Enhancing individual preparedness

Individual action to plan and prepare for disasters is the cornerstone of stronger and more resilient communities in Canada. The ability of an individual or family to be self-sufficient for at least the first 72 hours after a disaster lessens personal suffering and hardship and reduces the demands on overstretched response systems.

Raising awareness and understanding of the risks that people face is an ongoing priority for emergency managers. A recent study conducted by the Public Health Agency of Canada and the University of Manitoba found that only 16% of surveyed Manitobans believed that a disaster would *definitely* occur in the area where they live, while 53% thought a disaster *might* occur, but was not likely.[17] Participants' worries tended to focus on more immediate issues such as personal and family health. Similarly, a Health Canada study found that although many Canadians are concerned about climate-related health risks,[18] they often fail to heed the advice of public health authorities to prepare for emergencies and reduce health risks from events such as heat waves.[19]

Working closely with communities can help ensure that people's different beliefs, attitudes and perceptions are taken into account when preparing messages and public information. This, in turn, can increase the likelihood that provided information will be listened to and acted upon.[20]

## Building an All-Inclusive Approach

In 2007, the World Health Organization (WHO) oversaw the development of a six-year health sector strategy for community capacity development to protect health

In its **Strategy for the Health Sector and Community Capacity Development**, the WHO outlined key priorities for the health sector to maintain and protect the health of people in emergencies:[21]

- assessing and monitoring baseline information on risk reduction and emergency preparedness at regional and country levels

- institutionalizing risk reduction and emergency preparedness programs in ministries of health and establishing an effective all-hazard/whole-health program

- encouraging and supporting community-based risk reduction and emergency preparedness programs

- improving knowledge and skills in risk reduction and emergency preparedness and response

in emergencies.[21] This risk-reduction strategy recognizes that although many emergencies are unpredictable, much can be done to prevent and mitigate their effects as well as to strengthen the response capacity of communities at risk (see sidebar).

Canada's future capacity to reduce health risks from disasters will ultimately depend on the ability of public health and emergency management officials and their partners to assess community risk and to plan, prepare and respond effectively. Successful collaboration with all community groups, including those representing the community's most vulnerable residents, is paramount. Community and individual resilience can be actively strengthened. Enhancing resilience through all phases of emergency management—prevention, preparation, response and recovery—requires coordinated effort. The steps that Canadians, communities and their leaders take today to build resilience to emergencies will have a profound impact on public health tomorrow. ■

*Please note: Full references are available in the electronic version of this issue of the Bulletin: http://www.healthcanada.gc.ca/sr-sr/pubs/index-eng.php*

# The Rural Reality

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**W**hen disaster strikes, the type of help provided to individuals and their communities depends on a variety of factors, such as the severity of the disaster and the characteristics of the population affected. Both sociodemographic and psychological factors figure into the equation.

## Sociodemographic Factors

Understanding and respecting a community's resources, traditions and values is critical to enabling individuals to accept psychosocial help in a disaster situation. Rural communities have particular characteristics that can either support or hinder both recovery efforts and the adoption of community-based strategies to minimize the negative consequences of a disaster. On the socioeconomic front, rural communities appear to be disadvantaged compared to their urban counterparts, due to higher rates of poverty, unemployment and underemployment. Moreover, rural communities have a larger population of seniors, who have unique needs in times of disaster (see article on page 23).

Research also shows that the physical health of rural dwellers is generally lower and more fragile than that of city dwellers. People who live in rural areas have higher rates of chronic disease, cardiovascular disease, hypertension and diabetes.[1] They also have poorer access to a variety of health care services—social and medical services are frequently not available in rural and remote areas, or are not up to par with urban centres. Similarly, access in rural communities to education and training, as well as to infrastructure, funding and government services, is more limited. Other issues, such as the exodus of youth, economic restructuring and globalization also diminish the capacity of rural communities to respond to a disaster.

## Psychosocial Impacts

Canadian research confirms the fragile state of rural dwellers exposed to a disaster. Studies of two small (less than 1,500 people) rural communities clearly revealed that, in the aftermath of severe flooding, the physical health and psychosocial functions of these residents were strongly affected for weeks, months and even years.[1,2] Among other things, the researchers observed the emergence of feelings of insecurity, the onset or aggravation of health problems, signs of depression, anxiety and post-traumatic stress, marital conflicts, prolonged disruption of social or leisure activities, and job loss.

In a study of families affected by the ice storm of 1998, researchers observed that the reactions and feelings of families with young children in rural areas and farmers dealing with power shortages were more negative, and that they had more problems and more sources of stress to deal with than did urban dwellers.[3]

On a more positive note, certain social factors and attributes specific to people living in rural communities indicate that rural dwellers generally demonstrate resilience in the face of disaster and manage to make decisions that help the community "get back on its feet." These include having a strong network of friends and neighbours willing to help, greater self-reliance, resourcefulness and independence, the desire to preserve one's quality of life, as well as the community's level of energy. ◼

# Tapping the Potential of
# Voluntary Sector
## Organizations

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**T**he voluntary sector constitutes an important part of any community and consequently plays important roles during times of emergency. This article explores those roles and draws on the results of collaborative research initiatives[1] among federal government authorities, academics and voluntary organizations regarding the potential for increasing engagement with the voluntary sector to prepare for and respond to health emergencies, including supporting high-risk populations.

The voluntary sector includes a variety of non-profit organizations and community groups, such as religious groups, social services and community associations, as well as the volunteers themselves. While some key voluntary organizations have a mandate to participate in emergency response, the vast majority of the over 161,000[2] registered Canadian non-profit organizations do not. Nevertheless, many play an indirect role, and research indicates that the sector offers untapped potential to further contribute to a community's capacity to cope with and respond to health emergencies.

## The Voluntary Sector in Emergency Response

When a disaster strikes, a wide range of emergency health and social services are called into action. Many of these services—reception centre management, registration and inquiry, emergency lodging, feeding, clothing, first aid and personal services—are often mandated to specific voluntary sector organizations, such as the Red Cross, St. John Ambulance and the Salvation Army, by the applicable municipal, provincial or territorial authority. Other organizations make

important contributions by providing key support services and addressing surge capacity. As well, there are some emerging roles that hold great potential:

### Ensuring continuity of key support services

Many voluntary organizations act as a "safety net" supporting those who are socially vulnerable, through community-based services such as "Meals on Wheels." (Of Canadian voluntary organizations, 23% serve children and youth, 11% serve the elderly and 8% serve people with disabilities.[2]) Through service continuity planning, such organizations are able to continue their service delivery during an emergency, thereby mitigating the effects on their clients and minimizing the demands on emergency health and social services.

### Mobilizing human resources: surge capacity

During the Severe Acute Respiratory Syndrome (SARS) crisis, the Canadian Red Cross, St. John Ambulance and the Salvation Army supported local authorities by mobilizing over 700 volunteers and staff to deliver 13,500 health kits and food parcels to over 10,000 people quarantined in their homes; as well, they supported health

### Ready or Not . . . the Voluntary Sector Responds

Gander, Newfoundland, accommodated the sudden influx of 6,600 passengers (a 63% increase in its population) from 38 flights diverted there on September 11, 2001.[3] Across Canada, voluntary sector organizations served over 33,000 stranded passengers that day.[4]

professionals to provide screenings in airports and Emergency Operations Centres.[5]

### Emerging roles

In addition to emergency health and social services, public authorities are increasingly turning to voluntary organizations to play a greater role in other areas, given their knowledge and position in the community. These roles can be provided through organizations and community groups, or more informally through neighbour-helping-neighbour initiatives, and include:

**Addressing Special Needs**—Emergency managers identify "reaching high-risk populations with targeted preparedness information and warnings" as a key risk-communication challenge.[6] Voluntary organizations could be natural partners in planning public health warnings for particular populations. For example, ethnocultural organizations could help overcome language and cultural barriers faced by new Canadians.

**Leveraging Community Resources**—The voluntary sector has access to skills, assets and resources that could supplement the public authorities' response to a disaster or health emergency. For example, during the 2003 Northeastern Blackout, the Ottawa Kids Hotline handled hundreds of calls from distressed adults, stretching far beyond its usual mandate.

**Fostering Civic Engagement**—By bridging a diversity of community actors, voluntary organizations[7] nurture an environment where citizens not only have resources but feel empowered and responsible to use them,[8] thereby contributing to a community's resilience. Evidence indicates that a vital voluntary sector and engaged citizenry provide a strong foundation for collaboration in emergency situations,[9] with engaged citizens being more likely to take responsibility for themselves and for others in both hazard mitigation and disaster response.

## Tapping the Voluntary Sector's Potential

While the voluntary sector's response to SARS was successful, the organizations that had responded to the event recognized that they would not have the capacity to provide a similar scope of response if a more widespread event were to occur. In strategizing how best to develop the required surge capacity, they identified a couple of challenges:

- how to strengthen their own capacity and expand the cadre of voluntary organizations that public authorities normally turn to in times of emergency
- how to plan and target limited resources to address the needs of those with the least capacity to help themselves

Recognizing the voluntary sector's untapped potential, a voluntary sector-led initiative looked at how governments and the voluntary sector could collaborate to build and sustain the surge capacity required for a large-scale emergency. The initiative resulted in a Voluntary Sector Framework for Health Emergencies[10] that encouraged all organizations to consider mobilizing their resources to supplement the services delivered by the authorities in health emergencies.

Building on this initiative, in 2007 the Canadian Red Cross teamed up with Brandon University, the Public Health Agency of Canada and Public Safety Canada to assess the gaps in meeting the needs of high-risk populations and to identify the types of resources and networks that would promote disaster planning to reduce vulnerability.[6] As part of this project, two online surveys were administered to collect baseline data about existing relationships between governments' emergency management organizations and voluntary organizations in order to assess their readiness to serve high-risk populations.

### Identifying gaps

Emergency management organizations were asked "Which of the following high-risk populations has your organization considered in its emergency management activities?" Two thirds reported taking seniors and persons with disabilities into account (see Table 1), suggesting that the recent focus on age and disability concerns may be having a positive effect. However, only a third addressed the needs of cultural minorities and women. These disparities may reflect the language barriers that sometimes limit outreach to new immigrants, as well as a lack of understanding and training on the gender dimensions of disasters. Learning more about the needs of high-risk populations, of which the public authorities may neither be aware of nor equipped to address, could highlight gaps that the voluntary sector might be called upon to fill.

### Addressing voluntary sector constraints

When voluntary organizations were asked about the constraints limiting their capacity to provide emergency management services to the high-risk populations

they serve, some identified a lack of awareness about emergency management systems, as well as a lack of mandate coupled with concerns over risks and liabilities (see Table 2). However, 70% of respondents cited resource constraints. As most voluntary organizations function on tight budgets without paid staff,[11] formal umbrella organizations or communication systems, an opportunity exists for emergency management organizations to strengthen the capacity of those working with high-risk groups.

## Broadening relationships

The survey results revealed a need for increased outreach between the emergency management and voluntary sector communities. While 70% of emergency management organizations reported collaboration with voluntary organizations serving high-risk groups, for the most part this involved ongoing relationships with those already involved in emergency response, such as the Red Cross, the Salvation Army and St. John Ambulance. Other organizations that would have valuable knowledge of particular high-risk groups were rarely cited as collaborative partners. For instance, of 48 respondents asked about partnerships with voluntary organizations serving high-risk groups, the Canadian National Institute for the Blind was cited three times, food banks (which have insight into survival strategies of low-income populations) once, and women's shelters not at all.[6]

### Table 1  Outreach to High-Risk Populations: Populations Considered in Emergency Management Activities

| Canadian High-Risk Populations | % of Responding Emergency Management Organizations |
| --- | --- |
| Seniors | 67 |
| Persons with disabilities | 61 |
| Aboriginals | 61 |
| Medically dependent | 54 |
| Low income | 51 |
| Children and youth | 49 |
| Low literacy | 44 |
| Transient populations | 40 |
| New immigrants/cultural minorities | 35 |
| Women | 26 |
| Other (e.g., students, mental health) | 19 |
| None | 9 |

Source: Canadian Red Cross, 2007.[6]

### Table 2  Constraints Facing Voluntary Organizations

| Voluntary Sector Organizational Constraints | % of Responding Voluntary Organizations |
| --- | --- |
| Resource constraints | 70 |
| Limited awareness of emergency management systems | 36 |
| Not in organizational mandate | 31 |
| Other (e.g., lack of trained staff, emergency preparedness not a top priority) | 26 |
| Lack of organizational initiative/leadership | 20 |
| Limited awareness of hazards and disasters | 18 |
| No constraints | 7 |

Source: Canadian Red Cross, 2007.[6]

Similarly, less than half of the voluntary sector respondents surveyed had existing relationships with any one category of emergency response official.[6] Voluntary organizations feel the impact of these gaps, as illustrated by voluntary sector findings that cited emergency managers' need for greater sensitivity to misinformation about high-risk populations, stronger lines of communication with high-risk groups and greater collaboration with the voluntary sector. Although some progress is being made in bridging these gaps,[12] the voluntary sector still struggles for recognition of its contribution to emergency relief efforts.

## In Summary

Increased collaboration between emergency management and voluntary sector organizations during pre-emergency planning stages could result in more robust response plans that would address the diverse needs of the Canadian population. A shared understanding and improved integration of the potential contribution of the voluntary sector in emergency response activities could optimize the use of human and other resources, leading to a cost-effective, integrated approach. While a full study of the economic contribution of voluntary organizations and volunteers to emergency response activities has not been conducted in this country, the significance of its contribution warrants further research. ■

*Please note: Full references are available in the electronic version of this issue of the Bulletin: http://www.healthcanada.gc.ca/sr-sr/pubs/index-eng.php*

# Post-Disaster Surge:

## *How Does Canada's Health System Cope?*

**Wayne Dauphinee**,
Former Co-Chair,
Canadian Public Health
Network, Emergency
Preparedness and
Response Expert

**A**fter a mass casualty event, victims place great additional demands on the health system. This "medical surge" can have enormous implications for caring not only for those affected by the event, but for others who are unaffected but who also require medical care. This article explores how medical surge can be managed, and the importance of planning for increased surge capacity well in advance of a crisis in order to reduce post-disaster morbidity and mortality.

One of the greatest challenges facing Canada's health care system is having the capacity to meet the demands placed upon it in the wake of a disaster. During this period, the goal is to maintain operational integrity while dealing with the medical surge created by the event. How well the system is able to perform both of these functions will have an influence on the health outcomes of those already in the system as well as on the morbidity and mortality rates of disaster victims.

## Catastrophic Health Events Lead to Medical Surge

A catastrophic health event is a natural or human-caused incident that overwhelms the capabilities of immediate local and regional emergency response and health care systems.[1] Whether it is a pandemic or a mass casualty event such as a terrorist attack or a natural disaster, this type of event can result in an untold number of ill and injured. Not only must the health system maintain a high level of preparedness to respond to a range of such disasters, it must also be able to deal efficiently and effectively with the associated medical surge.

Medical surge has impacts on virtually all aspects of health care, from pre-hospital care at the incident site through to hospital emergency and acute care services, to rehabilitation and full recovery. As a result, **surge capacity**, the ability to expand existing capacities in response to medical surge, is one of the most fundamental challenges facing a health emergency preparedness program.

### *Mobilizing resources to meet surge*

**Capability mobilization** refers to the rapid expansion of existing capacity to meet specific care requirements. This may include increased personnel (clinical and non-clinical), support functions (laboratories and radiology), physical space (beds, alternative care facilities) and logistical support (clinical and non-clinical equipment and supplies). This expansion provides for the event-related ill and injured to be rapidly and appropriately cared for, while the continuity of routine care is maintained for non-event-related illness or injury.

## Different disasters, different requirements

The requirements to meet medical surge vary, depending on the type of disaster. In the case of a **mass casualty event**, the health system is confronted by any or all of the following: a sudden influx of a large number of patients requiring interventions beyond the capacity of available resources; the presentation of patients with special care requirements demanding enhanced skill sets (e.g., care for chemical burns); and event-related impacts that compromise a hospital's ability to provide patient care (e.g., loss of electrical power or water).

The requirements resulting from an **infectious disease outbreak** create a different set of demands. For example, during a pandemic event, there would be an increased demand for ventilators and antiviral and antibiotic drugs. The surge resulting from a **natural disaster**, where infrastructure has been affected (as was the case following Hurricane Katrina), could result in the need to relocate entire health care facilities and rapidly establish alternative care sites.

## Intensity and timing of surge also varies

Surge events that impact routine operations may be either brief in duration or prolonged over a period of days or weeks. **Natural disasters** have immediate or sudden impacts that are characterized by large numbers of casualties at the outset, which then generally taper off. **Infectious disease outbreaks** have protracted impacts in which there is a gradual increase in the number of people affected, rising to potentially catastrophic proportions over time. This type of event requires a more sustained response, as the impact is felt over a much longer period than it would be following an immediate impact mass casualty event.[2]

## Planning for and Managing Surge is Complex

Emergency preparedness in the health sector has reached a degree of complexity such that innovative planning is needed to address the full spectrum of threats and risks. This all-hazards approach to planning is very different from planning routine health care. On a regular basis, most Canadian hospitals operate at very high average occupancy rates and emergency departments experience overcrowding.[3] For this reason, traditional practices, such as adding additional staff or parking beds in hallways, are ineffective in a post-disaster surge situation. Furthermore, relatively few health care

### Current Federal/Provincial/Territorial Emergency Management Initiatives

The Public Health Agency of Canada has established three initiatives to support provinces and territories when requested, or to respond to complex emergencies on a national scale:

- The **National Emergency Stockpile System** is an inventory of disaster-oriented medical supplies that are packed for long-term storage, based on specific response functions, to supplement the health sector's response to large emergencies and disasters (e.g., a stockpile of antivirals and central inventory of critical supplies).

- The **National Office of Health Emergency Response Teams** is charged with the creation,

training and certification of multidisciplinary Health Emergency Response Teams ready to be deployed within 24 hours to assist provincial, territorial or other local authorities in providing emergency medical care during a major disaster.

- The **Federal/Provincial/Territorial Memorandum of Understanding on the Provision of Mutual Aid in Relation to Health Resources During an Emergency Affecting the Health of the Public** provides a framework for the exchange of human resources, supplies and equipment between federal, provincial and territorial jurisdictions during an emergency.

professionals have the opportunity to develop expertise in dealing with mass casualty events. Adding to the challenge is the difficulty in developing reliable casualty estimates.

Meeting the challenges requires a response capability that is both flexible and scalable, in that successively higher levels of government may be called upon as necessary.[4] In recent years, federal, provincial and territorial governments have developed or updated a number of key resources that can help build surge capacity (see sidebar, page 38).

In less serious, sudden impact situations, consequences are generally short term and coping is within the realm of possibility, depending on the casualty load. Most health care facilities have and frequently activate "Code Orange" plans to mobilize and manage integral on-site resources to deal with the surge resulting from a mass casualty event. However, many jurisdictions would be overwhelmed by a catastrophic health event, meaning that health planners must prepare for the possibility that outside assistance may be delayed or may not arrive at all within the critical post-event hours (see Figure 1).[4]

Pandemic planning recognizes the fact that the health care system would be rapidly overwhelmed without a well-conceived plan. Although statistically only a tiny proportion of those infected by pandemic influenza are likely to require hospitalization, the number of people requiring some form of medical intervention will likely create a surge situation in primary- and urgent-care settings. Exacerbating the situation is the fact that many health care providers themselves could be unavailable for work due to personal illness or family demands.

## Meeting patient management challenges

There are fundamental differences in patient management during a mass casualty situation as compared with routine practice. When caring for a patient following a disaster, it may be necessary to alter the usual standards of care to achieve a balance between many conflicting factors, including treatment requirements, evacuation requirements, resource availability, as well as environmental and operational conditions. Since time is a critical factor in reducing post-disaster morbidity and mortality, efforts must focus on doing the greatest good for the greatest number of people.



## Emergency Management Within Canada's Public Health Laboratories

**Theodore Kuschak**, Canadian Public Health Laboratory Network, Public Health Agency of Canada

Public health laboratories are expected to maintain day-to-day routine clinical and infectious disease testing while processing an influx of samples during a public health emergency such as an influenza pandemic. In 2003, 375 suspected and probable cases of SARS were diagnosed in Canada. During this period, the National Microbiology Laboratory processed and tested approximately 15,000 specimens while maintaining day-to-day business.

To address issues of surge capacity, public health laboratories focus on six major areas:

- **stockpiling** testing reagents and personal protective equipment to enable rapid and safe testing during an influx of samples

- **cross-training of staff** to ensure that sufficient staff are available to process and test specimens during an emergency

- **optimizing sample processing techniques** to ensure that all sample-related information is maintained

- **optimizing sample testing platforms** to ensure that a high volume of samples can be processed and tested efficiently

- **establishing effective communication and sharing best practices** across laboratories through networks like the Canadian Public Health Laboratory Network

- **business continuity planning** across the laboratory sector ensuring coordinated readiness during crises

**Figure 1** Health Sector Emergency/Disaster Response Capacity in Canada
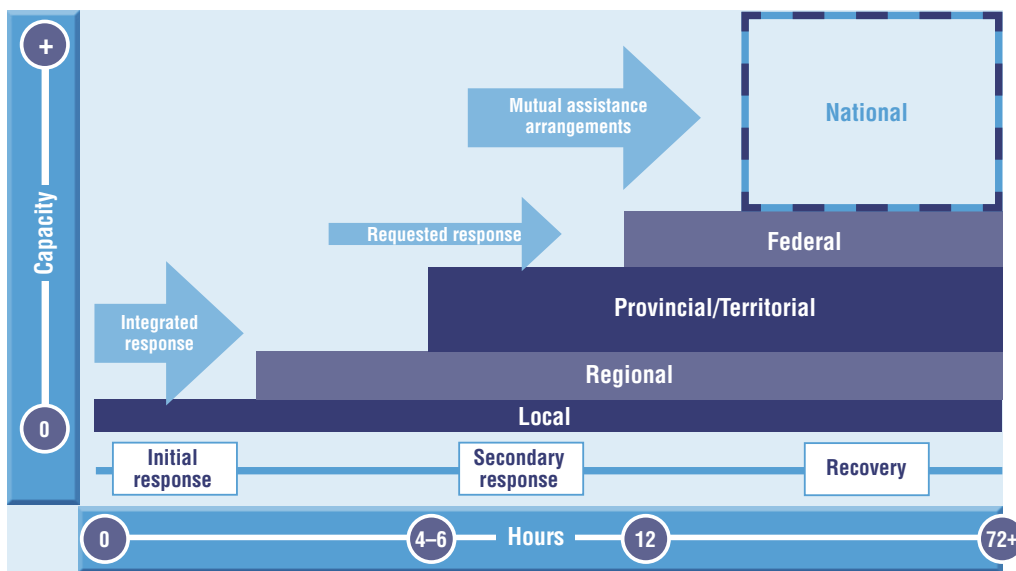


Source: Dauphinee, 2008.[4]

## Public Health: An Important Component of Surge Capacity

The need for increased health system capacity in the wake of a complex emergency or disaster is not restricted to the health *care* sector, but is equally applicable to the public health system. A number of post-Severe Acute Respiratory Syndrome (SARS) studies,[5,6,7] the Naylor report in particular, stressed that surge capacity in public health is vitally important in order to be able to respond appropriately to health emergencies. The public health sector must have contingency plans that cover:

- rapid enhancement of surveillance systems
- information system support for contact tracing
- training and redeployment of staff with field epidemiology, contact tracing and outbreak control expertise
- extended laboratory capacity (see sidebar, page 39) in collaboration with universities and local, national and international organizations
- availability of designated quarantine and isolation centres

### *Community-based surge capacity: reducing demand on hospitals*

To maximize the potential that is incumbent within a community, community health care resources such as walk-in clinics, urgent care centres and social service

agencies should be an integral part of a local emergency response plan. The objective of such an approach would be to increase the front-line (pre-hospital) capacity to deal with minor injuries and illnesses. In a typical mass casualty event, severe injuries are sustained by only about 10% to 15% of survivors.[8,9,10] Many of the remaining survivors may have minor injuries that can be treated out of hospital.

Initial pre-hospital care (e.g., first aid, initial medical and psychosocial intervention, and sustaining care) will depend on the integration of all available community health care providers, including physicians, nurses, mental health counsellors, medical first responders, paramedics and first aiders. Early and continuing assessment of the condition of casualties will ensure that each person is referred to the level of care that is appropriate to their medical condition and to the operational situation. When fully implemented, this approach has the potential to significantly reduce the surge impact on hospital emergency departments.

## Conclusion

One of the greatest challenges confronting the Canadian health system is mustering the capability to respond to the demands placed on it following a disaster. One measure of the system's effectiveness is its ability to maintain its operational integrity while minimizing the morbidity and mortality of disaster victims. Therefore, it must develop plans that integrate its capacities into a single, organized response.

Preparing for and dealing with these situations at the local level requires comprehensive planning involving community, primary care, public health and hospital resources. Successively higher levels of government may be called upon as capacity is exceeded. Inter-jurisdictional collaboration ensures the necessary exchange of human and material resources to manage post-disaster surge. ■

*Please note: Full references are available in the electronic version of this issue of the Bulletin: http://www.healthcanada.gc.ca/sr-sr/pubs/index-eng.php*

# The Caring About Health Care Workers Project

**Tracey O'Sullivan, PhD**, Faculty of Health Sciences, University of Ottawa

**H**ealth care providers represent a critical aspect of any country's response capacity in a public health emergency. This Spotlight on Research highlights findings from a multi-partner research program focused on the experiences of Canadian nurses during the 2003 SARS epidemic.

The world became acutely aware of the role of health care workers in a bio-event during the outbreak of Severe Acute Respiratory Syndrome (SARS) in 2003, when 8,000 people worldwide were infected and 774 people died.[1] The outbreak was contained by the dedication of health professionals who worked tirelessly to ensure the safety of the public.[2,3] In Canada, of the 251 confirmed SARS cases, 43% were health care workers. Three of those health care workers died from SARS, and many more have suffered physical and psychosocial ailments, including respiratory difficulties and post-traumatic stress disorder.[2]

A research project entitled *Caring About Healthcare Workers as First Responders: Enhancing Capacity for Gender-Based Support Mechanisms in Emergency Preparedness Planning* (2004–2008) studied the experiences of Canadian nurses during the SARS epidemic.[4] This multi-partner research initiative, funded by the Chemical, Biological, Radiological-Nuclear, and Explosives Research and Technology Initiative, and led by Defence Research and Development Canada, brought together a team of researchers from the University of Ottawa with the Canadian Women's Health Network, the Canadian Federation of Nurses' Unions, as well as several federal government partners including the Public Health Agency of Canada, with Health Canada's Bureau for Women's Health and Gender Analysis serving as the lead federal partner.

The project included four components:

1. Gap analyses of emergency plans from multiple jurisdictional levels

2. Focus groups with 100 nurses in four Canadian cities

3. An online survey with 1,543 critical care and emergency department nurses

4. A policy workshop with multidisciplinary experts in disaster management, health care and policy development

## Key Findings and Policy Implications

### Nurses do not feel prepared

The findings indicate there are important gaps in organizational and social supports for health care workers as critical responders during bio-events. For example, the nurses interviewed stated that they did not feel prepared for large-scale disasters and lacked confidence in Canada's response capacity.
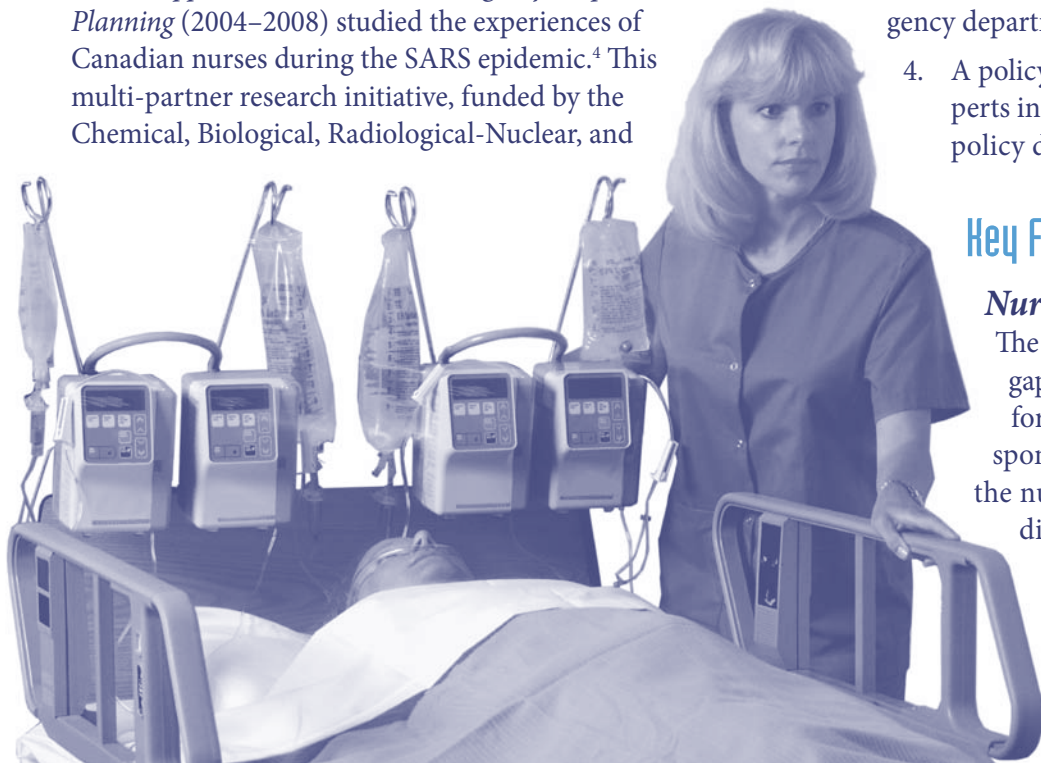
Disaster training, in particular awareness of hospital emergency plans, is a critical gap in preparedness of nursing staff across Canada. In fact, 92.9% of the nurses who participated in the *Caring About Healthcare Workers* survey stated they were "somewhat," "a little' or "not at all" prepared for another large-scale infectious disease outbreak (see Figure 1). Training and communication, repeated at regular intervals, is needed to enhance response capacity for the next bio-event. An article presenting the results of this particular component of the study has recently been published.[5]

## Reliance on part-time staff affects capacity

Availability of adequately trained staff to address surge capacity is essential. Many part-time and casual status nurses patch together the equivalent of full-time work through employment with multiple facilities; financial disparities and inequitable benefits were identified as a barrier to surge capacity and infection control. Part-time nurses with no benefits are more reluctant to stay home when they are sick. They are also relied on for surge capacity in multiple facilities, with the risk of burnout or role conflict as they try to meet the competing demands of different employers. To protect human resources, new and revised policies should include gender-sensitive supports, such as equitable compensation and benefits for all nursing staff.

## Nurses face role conflict

Role conflict emerged as a dominant theme in this project. Heartfelt emotion was expressed as the nurses discussed their concerns about putting their families at risk, and the possibility of not having access to vaccines to protect themselves and their families. Supportive policies, such as priority grouping for the families of health care workers, would alleviate stress from role conflict for health care professionals.

## Reliable information and leadership are essential

Finally, the nurses who participated in the research expressed deep concern about the lack of trustworthy information during SARS. They emphasized the need for credible and coordinated leadership during outbreaks to demonstrate organizational support for front-line responders who put their lives at risk to provide care. Best practices in risk communication need to be engaged before, during and after a bio-event to foster trust and confidence among employees and the public.

## In Summary

Several aspects of our current system of delivering health services in Canada influence our ability to plan for, respond to and recover from large-scale disasters. In general, nurses do not feel prepared and lack knowledge of hospital preparedness plans. Human resources strategies which necessitate reliance on part-time nurses for surge capacity need to be reconsidered, as they could limit emergency services response, particularly in bio-events. Health organizations and decision makers need to recognize the tremendous role conflict experienced by nurses and other health care professionals. Support mechanisms, such as provisions for the families of health care workers and access to reliable information, are needed to alleviate this source of psychosocial stress. Finally, visionary leadership is needed to attend to psychosocial aspects of disasters and maximize support for health professionals, so they can perform to the best of their ability when asked to assist with disaster response. ■

**Figure 1** Canadian Nurses' Sense of Preparedness for an Infectious Disease Outbreak, 2008
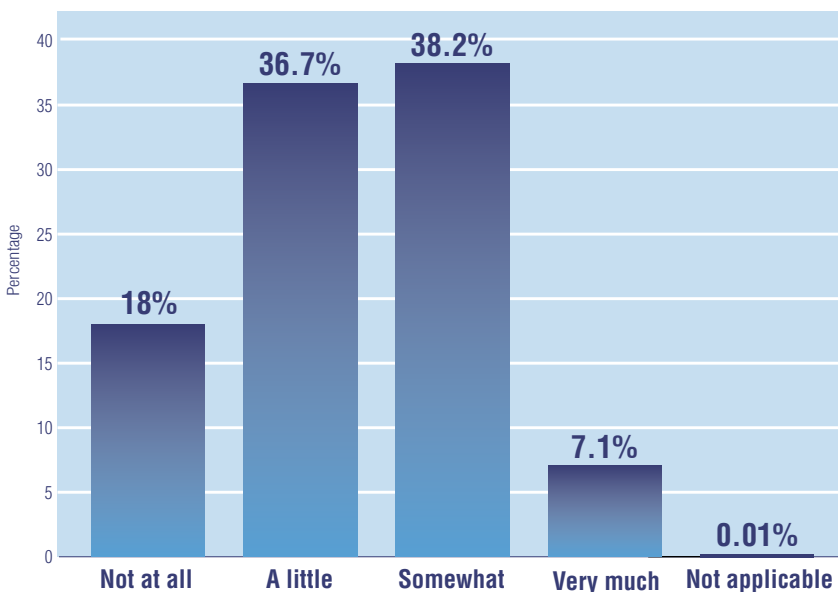


Source: Amaratunga et al., 2008.[6]
Note: n=1,536 (due to missing values)

Please note: Full references are available in the electronic version of this issue of the Bulletin:
http://www.healthcanada.gc.ca/sr-sr/pubs/index-eng.php

# Strengthening the Evidence Base:
# Capitalizing on Synergies

**John Lindsay**, Department of Applied Disaster and Emergency Studies, Brandon University

**E**mergency management is a fledgling profession that is developing a substantial body of research. To date there has been a lack of "cross-fertilization" between emergency management and social science research (including health), although recent events have drawn the two fields of research closer together.

Twelve research areas that provide opportunities to improve the connection between emergency management and health sector research have been identified.[1] The following highlights how research can be focused in each area.

*Vulnerability and Resilience:* Understanding the determinants of vulnerability[2] is crucial to improving emergency management practice. The potential for reducing harm from hazard impacts by improving community resilience is far greater than by incrementally improving disaster response techniques. Exploring ways to promote resilience, especially in conjunction with improving overall community health, is an important area for research.

*Technological Hazards:* Our society is facing a critical infrastructure crisis. Aging infrastructure is leading to more frequent and more severe failures, such as the fatal bridge collapses in Montréal in 2006 and in Minneapolis in 2007. Moreover, the shortfall in infrastructure maintenance and expansion is occurring at a time when society is becoming more dependent on the services provided by infrastructure. This has a clear impact on the health sector, as people are dependent on power and water systems and access to out-patient services to maintain their health. The risk of a prolonged infrastructure failure that would send the injured to health care facilities while simultaneously reducing that facility's capacity to deliver service is a risk worthy of greater consideration.

*Ethnic Minorities:* Within the broader set of determinants of vulnerability (see article on page 23), it is worth considering the unique challenges that some ethnic minority groups face, especially in connection to recent immigrants to Canada who have language, financial and social disadvantages within the context of their communities. Often the factors that make people in these groups vulnerable in a disaster also shape their perception of risk.[3]

*Disaster Impact Field Investigations:* Health-related events, such as Severe Acute Respiratory Syndrome (SARS) or the Walkerton *E. coli* outbreak, may provide opportunities for joint research that can lead to better emergency management practice for related hazards, including conflict-driven events such as terrorism or secondary impacts such as water contamination after an earthquake. Even events that do not exceed a community's ability to cope, like the spread of West Nile Virus across Canada, can serve as "near misses" that may expose systemic weaknesses to be addressed.

*Longitudinal Studies:* The need for longitudinal studies relating to the health impacts following a disaster, such as mental health impacts or the effects of mould after flooding, calls for greater cooperation between health and emergency management researchers. A related long-term issue requiring attention is the success (or lack of success) in mitigating risk and building community capacity to reduce disaster losses. Just as in public health, the positive outcomes of changing public attitudes or improving education and awareness may not manifest themselves immediately. Emergency management research will benefit from applying the time horizons more common to population health studies.

*Theoretical Research:* Theoretical research into root causes and systemic improvements often leads, in the long

term, to better outcomes than do short-term gains in response methods.[4] This, in turn, can lead to research to support a wide range of issues, such as what constitutes a health emergency or the ethics of applying austere triage measures. Exploring these fundamental topics sets the context for more specific research questions.

*Physical and Psychological Health:* The study of hazard-specific trauma and other aspects of response-phase disaster medicine has been a staple of health-based research. This needs to be extended to include long-term implications of disaster-induced injuries and psychological health issues. Furthermore, the question of health facility protection, both from physical damage during an event and for infection control, needs to be considered in relation to the well-being of health care workers.

*Environmental Health:* The dangers present in the immediate aftermath of a disaster have been brought to the forefront by recent events, including the ongoing studies of the health impacts on rescue workers at the World Trade Center site. Research into these environmental health issues for responders and affected residents may be an initial step to engage epidemiologists and other health researchers in disaster-related studies.

*Voluntary Sector:* Planning for pandemic influenza has proven to be the impetus for bringing together traditional health care providers and voluntary organizations. New ideas about how these organizations can supplement the health sector's efforts to increase surge capacity also raise new questions about credentialing, training and retention, and scope of practice. Practical solutions can be proposed and studied to determine their effectiveness, with the aim of identifying best practices.

*Community Preparedness:* Canada's strong influence on the development of a population health approach demonstrates the leadership its researchers could have on emergency management practice. Community preparedness for disasters, focused on reducing vulnerabilities and enhancing resilience, can benefit from the experiences and research into health promotion.

"The EM [emergency management] community must promote a sense of individual responsibility for community safety and collective responsibility for vulnerability."[5]

*Changing Attitudes:* New approaches to how our communities plan for emergencies are needed. The health sector can contribute to this, as it has embraced partnerships with both geographically- and issue-defined communities, such as patient advocacy groups. Emergency managers must also start to plan *with* communities instead of planning *for* communities. This is especially true when considering the challenges faced by the most vulnerable in our communities. Addressing their needs is not a purely altruistic activity, as it makes an overall contribution to a community's resilience.

*Integrating Disciplines:* The connection between the health literature and disaster studies is just one of a multitude of linkages in a truly multidisciplinary field. Maureen Fordham, an award-winning British emergency management researcher, presents the case for respecting the differences between the fields of study while embracing a "co-evolution with fruitful interchange" on the issues of common interest.[6] The prospect of health and disaster research engaging in such an interchange holds greater potential for improving emergency management practice than does pursuing research along the separate paths.

## Conclusion

The future research agenda must be one that encompasses all facets of emergency management and embraces a multidisciplinary approach. Researchers must forage in unfamiliar fields to find the seeds of collaborative research, and must value a diversity of contributions. Emergency management is a young profession dependent on a growing body of knowledge. Its application to the established realm of health research and practice must be welcomed and respected for both fields to benefit fully from the interaction. The shared goal of building safer, healthier and more resilient communities makes this both possible and imperative. ■

# Who's Doing What?

**Who's Doing What?** is a regular column of the *Health Policy Research Bulletin* that looks at the key players involved in the current theme area. In this issue, we present an overview of Canada's health emergency management system, otherwise referred to as the Pan-Canadian Health Emergency Management System.[1]

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The author acknowledges the assistance of Nancy Scott, Applied Research and Analysis Directorate, Strategic Policy Branch, Health Canada, in the preparation of this article.

## Canadian Jurisdictional Roles and Responsibilities

Emergency management in Canada is a shared responsibility. A coordinated response to large-scale emergencies requires complementary federal/provincial/territorial (F/P/T) response capacities that together provide for concerted and coherent action across different jurisdictions and systems. This type of collaborative effort across levels of government requires first and foremost a shared expectation and understanding of the roles and responsibilities of all partners.

Each level of government has legislation that sets out roles and responsibilities for preparing for and responding to emergencies, including the designated authority to declare and manage emergencies. Regardless of the level of response and support, responsibility for the management of emergency operations almost always rests with the affected local authority. A local authority may, however, be advised and assisted by representatives of provincial departments and agencies in order to provide a coordinated municipal/provincial response. Similarly, the federal government may support a province or territory—usually through coordination and resources belonging to the National Emergency Stockpile System—should the event exceed that jurisdiction's capacity to respond and recover.

Within this structure, Canada also recognizes its responsibilities and obligations to the international community. Canada is a member of the World Health Organization and a signatory to the International Health Regulations. When a public health event has the potential to be international in scope, whether of domestic or foreign origin, Canada's governments must have the capacity to ensure coordinated emergency plans and communications with international partners.

> **E**ach level of government has legislation that sets out roles and responsibilities for preparing for and responding to emergencies, including the designated authority to declare and manage emergencies.

### Local/regional health sectors

Because emergencies almost always occur and are managed at the local level, it is important that local and regional authorities are recognized as part of Canada's health emergency management system. It is also important that emergency preparedness activities be appropriately focused on the "front lines." Community health programs need to be prepared for emergencies and have plans to continue delivering health services while protecting the health and safety of their staff. These plans must also be integrated with local and regional emergency management programs and agencies, as well as within the larger provincial/territorial health emergency management system.

### Provincial/territorial health

Provincial and territorial Ministries of Health play a central role in ensuring that emergency management structures and programs are in place to respond to threats and risks, while also ensuring that preparedness and response activities are built on common F/P/T emergency management principles and guidelines.

Ministries of Health retain a central planning, coordination and communications role in preparing the health systems and social services of their jurisdictions. This typically includes the development of legislation and regulations, establishing standards and guidelines for emergency management programs, and ensuring the implementation of policies and plans which are required for a coordinated provincial/territorial emergency management program. Ministries of Health may also coordinate emergency resource needs created by emergencies, sometimes through bilateral mutual aid agreements with neighbouring provinces, territories or states.

### The federal role

The federal government, through Public Safety Canada, has a key role in developing pan-Canadian policy, emergency response plans

and standards, as well as supporting emergency management stakeholders through training and funding.

Within the health sector, the Health Portfolio, including the Public Health Agency of Canada (PHAC) and Health Canda, is responsible for coordinating emergency response activities. Within the Agency, the Centre for Emergency Preparedness and Response (CEPR) works with Health Canada's Office of Emergency Preparedness in preparing for and responding to emergencies.

During emergencies, the Health Portfolio Emergency Operations Centre is responsible for coordinating planning, communication and decision making across jurisdictions. This is achieved through F/P/T operational protocols delineated within the Pan-Canadian Health Incident Management System.[1]

Health Canada provides emergency health care to First Nations and Inuit communities. It participates

## Coming Soon

Health Canada, in collaboration with Statistics Canada and the Canadian Institute for Health Information, will soon release *Healthy Canadians—A Federal Report on Comparable Health Indicators 2008*. The report includes data on the Canadian population for 37 indicators that were agreed to by Ministers of Health in 2003. It covers such areas as the performance of our health care system and the health status of Canadians. It also provides information on First Nations and Inuit. While there are some international comparisons, no data are presented at provincial/territorial levels. Extensive consultation was undertaken and input incorporated from the First Nations and Inuit Health Branch, other areas of Health Canada, and the Public Health Agency of Canada. *Healthy Canadians* will be available at: http://www.hc-sc.gc.ca/hcs-sss/indicat/index-eng.php

with PHAC in pandemic influenza preparedness planning, and approves new drugs and vaccines to treat Canadians and minimize the spread of disease in the event of an outbreak. The Department leads the Government of Canada's preparedness activities for radiological and nuclear emergencies under the Federal Nuclear Emergency Plan, and provides support and scientific expertise for chemical emergencies. In addition, Health Canada also leads the Global Health Security Initiative and implements the Food-borne Illness Outbreak Response Protocol.

### *Non-government and voluntary sector*

Governments rely on the non-government and voluntary sector for emergency response expertise, specialized skills and resources, and an ability to quickly adapt and respond to emerging situations. Many jurisdictions have contracts with non-government organizations, such as the Canadian Red Cross and the Salvation Army, to provide essential services during emergencies. These include but are not limited to emergency shelter and food, registration and inquiry, personal services and basic psychosocial support. The voluntary sector also retains important capacities that the public authorities may require in the event of a health emergency, including the ability to mobilize volunteers, access local contacts and networks, and utilize acquired knowledge about the community. Professional health organizations play a key role in supporting health professionals, undertaking research and promoting better practice, and disseminating information to the public.

## Canada's Emergency Management System— A Complementary Structure

Emergency management is not "owned" by any one jurisdiction but requires close collaboration between both government and non-government partners. This complementary structure, which constitutes the Pan-Canadian Health Emergency Management System, ensures an integrated and coordinated approach to managing emergencies throughout Canada. It also provides a cornerstone on which jurisdictions may continue to build and strengthen Canada's capacity to prepare for and respond to emergencies of all types and magnitude. ■

*Please note: Full references are available in the electronic version of this issue of the Bulletin: http://www.healthcanada.gc.ca/sr-sr/pubs/index-eng.php*

# Using Canada's Health Data

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## Disaster Data and Their Limitations

Although vastly improved in the past few decades, data on the occurrence of disasters and their impacts remain somewhat problematic. One of the key problems is the lack of standard, accepted definitions. Problems exist over such loose categories as "internally displaced" people or even people "affected" by disaster.

### An array of sources

Often, data are culled from a variety of public sources— newspapers, insurance reports, aid agencies, etc. The original information is not specifically gathered for statistical purposes so, inevitably, even where the compiling organization applies strict definitions for disaster events and parameters, the original supplier of the information may not have done so.

### Counting disasters

The Centre for Research on the Epidemiology of Disasters (CRED) is the main source of international disaster data for many reports, including the annual *World Disasters Report*.[1] For a disaster to be included into CRED's database (EM-DAT), at least one of the following criteria must be fulfilled:

- 10 or more people have been reported killed
- 100 or more people or have been reported affected
- a state of emergency has been declared
- there has been a request for international assistance
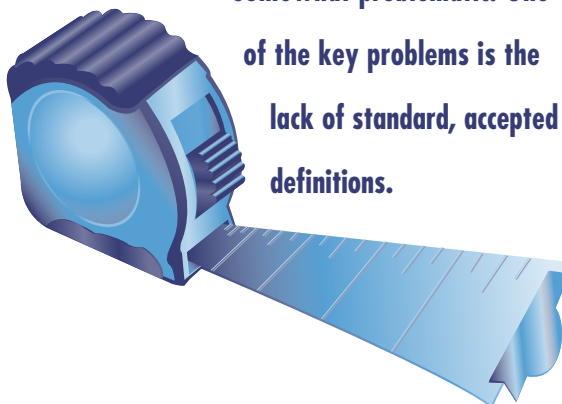
Although vastly improved in the past few decades, data on the occurrence of disasters and their impacts remain somewhat problematic. One of the key problems is the lack of standard, accepted definitions.

### Counting the dead

*The number of people killed includes people confirmed as dead, as well as those missing and presumed dead.*

Data on deaths are usually available because they are an immediate proxy for the severity of the disaster. However, the numbers put forward immediately after a disaster may be revised at a later time, occasionally even several months later.[1]

### Counting the affected

*The number of people affected by a disaster includes the injured, the homeless and those requiring immediate assistance (i.e., people in need of water, food, shelter, etc.) during a period of emergency; it can also include displaced or evacuated people.*

Data on the number of people affected can provide some of the most potentially useful figures, but they are sometimes poorly reported. In conflict situations, for example, each group will wish to maximize sympathy for its own cause and thus maximize the number of people under its control who are said to be suffering.[1] Even in the absence of political manipulation, data are often derived from old census data, with assumptions being made about what percentage of an area's population is affected. Extrapolating estimates to present day figures and then estimating the percentage of the population thought to be affected compounds errors in the original census, and can sometimes render the final figure almost meaningless.[2]

### Counting the economic damages

*The economic impact of a disaster usually consists of the direct consequences on the local economy (e.g., damage to infrastructure, crops, housing) and indirect consequences (e.g., loss of revenues, unemployment, market destabilization).*[1]

Estimates of damages need to be treated with caution because:

- Inflation and market fluctuations are not taken into account when calculating disaster-related damages.

- It is not always clear whether estimates are based on the cost of replacement or the original value.

- Insurance figures include only insured assets and only in areas of the world where disaster insurance is common; therefore whole regions of the world, including those with the poorest countries, are missed.

- The financial value attached to infrastructure is much higher in the more developed nations than equivalent structures in developing countries.

### Data gaps

For natural disasters over the past decade, data on deaths are missing for about one tenth of reported disasters; data on people affected are missing for about one fifth of disasters; and data on economic damage are missing for 85% of disasters.[1] The figures should, therefore, be regarded as indicative only; hence, relative change and trends are more useful to look at than absolute figures.

Nevertheless, information systems have improved over the last 25 years and, as a result, statistical data are much more easily available. An increase in the number of disaster victims, for example, does not necessarily mean that disasters or their impacts are increasing, but may simply be a reflection of better reporting. However, there are still discrepancies: an analysis of the quality and accuracy of disaster data performed by CRED in 2002 showed that, occasionally, for the same disaster, differences of more than 20% exist between the quantitative data of the major databases.[1]

## Available Disaster Databases

The most important publicly available Canadian and international English language disaster databases are listed below.

## Canadian Disaster Database

The most comprehensive database on Canadian disasters includes data on all types of disasters (excluding war). It describes where and when a disaster occurred, how many people died or were affected, and provides a rough estimate of the direct costs (when available). For more information, visit: http://www.publicsafety.gc.ca/res/em/cdd/index-eng.aspx

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## International Databases

### EM-DAT: Emergency events database

The EM-DAT database is maintained by CRED, a World Health Organization collaborating centre based at the School of Public Health, Catholic University of Louvain, Belgium. Although its main focus is on public health, CRED also studies the socioeconomic and long-term effects of large-scale disasters. The database is compiled from various sources, including United Nations agencies, NGOs, insurance companies, research institutes and press agencies. It contains data on the occurrence and effects of over 16,000 mass disasters worldwide, from 1900 to the present. The main objective of the database is to serve the activities of humanitarian agencies. For more information, visit: http://www.emdat.be/

### DISDAT—Disaster Data Portal

The result of a joint collaboration between the Global Risk Identification Program and CRED, DISDAT provides a central access point to existing worldwide disaster data collection initiatives. DISDAT contains 47 registered databases. For more information, visit: http://www.disdat.be/database/search/advsearch.php

### NatCatSERVICE®

Managed by Munich RE, one of the world's largest reinsurance companies, NatCatSERVICE® contains information on natural hazard events that have occurred anywhere in the world over the past 30 years. It provides limited information on countries with low insurance density (Africa, Asia and Latin America—particularly in rural areas). The database is not fully accessible to the public. For more information, visit: http://www.munichre.com/en/ts/geo_risks/natcatservice/default.aspx

### DesInventar

DesInventar covers 16 countries in Latin America and the Caribbean. It presents data on national disasters through local data on human and economic losses. Sub-national DesInventar databases exist for individual states in the U.S., Brazil, Colombia, South Africa and India. The database is not fully accessible to the public. For more information, visit: http://online.desinventar.org/?lang=en

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