The Central American Network for Disaster and Health Information

Stacey J. Arnesen, MS; Victor H. Cid, MS; John C. Scott, MS; Ricardo Perez, MS; Dave Zervaas, MS, Drs

See end of article for authors' affiliations.

DOI: 10.3163/1536-5050.95.3.316

Purpose: This paper describes an international outreach program to support rebuilding Central America's health information infrastructure after several natural disasters in the region, including Hurricane Mitch in 1998 and two major earthquakes in 2001.

Setting, Participants, and Description: The National Library of Medicine joined forces with the Pan American Health Organization/World Health Organization, the United Nations International Strategy for Disaster Reduction, and the Regional Center of Disaster Information for Latin America and the Caribbean (CRID) to strengthen libraries and information centers in Central America and improve the availability of and access to health and disaster information in the region by developing the Central American Network for Disaster and Health Information (CANDHI). Through CRID, the program created ten disaster health information centers in medical libraries and disaster-related organizations in six countries.

Results/Outcome: This project served as a catalyst for the modernization of several medical libraries in Central America. The resulting CANDHI provides much needed electronic access to public health ''gray literature'' on disasters, as well as access to numerous health information resources. CANDHI members assist their institutions and countries in a variety of disaster preparedness activities through collecting and disseminating information.

Highlights

- The program led to the creation of an international network of libraries and information centers for disaster information and a digital library including over 10,000 gray literature documents on disaster-related information.
- Collaborative efforts between several organizations and government agencies promoted the development and growth of the Central American Network for Disaster and Health Information (CANDHI) and led to development of a sustainable model for maintaining this program in the region.

Implications

- Improvement in information management and access facilitated by the CANDHI program will contribute to disaster preparedness activities in Central America.
- Improvements in information management and access over the course of the program has contributed to modernization of medical libraries in Central America.
- The CANDHI program provides a useful model for disseminating health information in underserved, disaster-prone environments and for managing nontraditional literature regarding health aspects of disasters.

INTRODUCTION

The countries in Latin America and the Caribbean as a region vie for the unfortunate distinction of having the greatest exposure to disasters of all regions in the world. From 1980 to 2006, an average of 21 disasters occurred per year in Central America, resulting in 47,000 deaths [1]. In 1998, Hurricane Mitch caused severe damage in Central America, leaving more than 18,000 dead and 12,000 injured in the hardest hit countries, Honduras and Nicaragua [1, 2]. In 2001, 2 earthquakes in El Salvador left 1,100 dead and more than 1.5 million affected [1]. Such natural disasters clearly cause enormous suffering, including both human costs in terms of the number of dead and injured, as well as serious deprivation in terms of other health care and related services such as food supply, drinking water, housing, and environmental sanitation.

During many of these disasters, health facilities and communication services were severely damaged [2]. The widespread public health impact of these disasters also highlighted the need for an organized and multisectorial approach to disaster preparedness, response, and mitigation [2]. Coordinating this kind of approach to disaster reduction, including all relevant parties, requires timely availability of reliable information from many and varied sources as well as significant human and technological infrastructure [3, 4].

Recently, the demand for and availability of information on health issues related to disasters have increased in volume, and relevant information has improved in quality [3]. Information produced about disaster health issues in Central America, in particular, has seen important advances in terms of usefulness for preparedness planning, strategic decision making, and

coordinating humanitarian emergency operations [3, 4]. This is largely due to the recent focus on information collection and management by international organizations such as the Pan American Health Organization (PAHO) and the United Nations International Strategy for Disaster Reduction (ISDR) to facilitate the transfer of ''lessons learned'' during disasters [3, 4]. Most of the material consists of unpublished reports and assessments, often with limited circulation, and conference presentations or training courses, often with no formal reports [3, 4].

Despite the recognition that access to information is essential to disaster preparedness, inadequate information technology, lack of training in how to find and manage information, and lack of awareness about what information is available often prevents or delays access to vital information by governments, health professionals, and communities before, during, and after crises [4]. Medical libraries and information centers in Central America, even before the disasters, were poorly developed and had little access to current information on health or disasters. Hurricane Mitch made the situation worse for many libraries, as scarce resources were diverted to other areas [5–7].

In response to these challenges, an international collaboration was developed to address issues of infrastructure and access to disaster-related health information throughout Central America. This paper describes the organization, development, activities, and future of the Central American Network for Disaster and Health Information (CANDHI) as an effort to rebuild the health information infrastructure and increase the provision of health information related to disaster planning and management in Central America.

ESTABLISHING PARTNERSHIPS TO STRENGTHEN THE CENTRAL AMERICAN HEALTH INFORMATION INFRASTRUCTURE

Following Hurricane Mitch, the National Library of Medicine (NLM) was approached by PAHO to help support developing a disaster information system in Central America to collect, disseminate, and share scientific and technical information related to health and disasters. PAHO and ISDR already supported the Regional Disaster Information Center for Latin America and the Caribbean (Centro Regional de Información sobre Desastres América Latina y el Caribe, or CRID) but were interested in broadening the scope to additional libraries and organizations. However, many of the libraries in Central America did not have the technical capacity or resources needed to create a disaster information center.

To support these efforts, NLM agreed to provide financial and technical assistance for rebuilding and improving the local and national health information infrastructure in Central America by developing local disaster information centers. These centers, joined together, formed CANDHI (Figure 1). Beginning in 2000, NLM funded the Foundation for the Coordination of Information Resources for Disaster Prevention (Spanish acronym, FundaCRID), the nongovernmental organization operating CRID, to serve as the contractor and coordinator for CANDHI.

Figure 1
Central American Network for Disaster and Health Information (CANDHI)

See Table 1 for acronym definitions

CANDHI began in Honduras and Nicaragua in response to Hurricane Mitch. Following two devastating earthquakes, El Salvador was added to the network. In 2003, Guatemala joined the network with funds from the UK Department for International Development, and, in 2005, Panama and Costa Rica were added with supporting funds from the European Commission on Humanitarian Aid (ECHO). In 2006, a second center in Guatemala joined the network, using its own resources. CANDHI centers currently operate in all six Spanish-speaking Central American countries [8, 9] (Table 1).

Centro Regional de Información sobre Desastres América Latina y el Caribe, program coordinator

CRID is a nongovernmental organization based in Costa Rica that began as the PAHO Disaster Documentation Center in 1994 and evolved into a regional center, renamed CRID, in 1998. PAHO and ISDR provide financial support and general management for CRID. CRID, whose mission is ''to promote a culture of disaster prevention in Latin America and the Caribbean,'' develops and supports activities to improve scientific and technical information related to disaster management. CRID's skills in disaster information management and knowledge of the region make the organization uniquely qualified to coordinate the development of disaster health information centers at libraries and information centers throughout Central America.

For the CANDHI project, CRID is responsible for developing and coordinating the disaster information centers at the selected libraries and information centers, providing training, technical assistance, and general guidance to all CANDHI centers. CRID also pro-

Table 1
Central American Network for Disaster and Health Information (CANDHI) Centers

CANDHI Center	Abbreviation	Location
Regional Disaster Information Center for Latin America and the Caribbean (*Centro Regional de Información de Desastres para América Latina y el Caribe*)	CRID	San José, Costa Rica (project coordinator)
National Emergency Commission (*Comisión Nacional de Emergencias*)	CNE	San José, Costa Rica
Disaster Information Center of the National Medical Library of Honduras, National Autonomous University of Honduras (*Centro de Información de Desastres de la Biblioteca Médica Nacional, Universidad Nacional Autónoma de Honduras*)	CIDBIMENA	Tegucigalpa, Honduras
Disaster Information Center of the Northern Region's University Center (*Centro de Información de Desastres del Centro Universitario de la Región del Norte*)	CIDCURN	San Pedro Sula, Honduras
Documentation Center of the Pan American Health Organization and the Ministry of Health of El Salvador (*Centro de Documentación de la Organización Panamericana de la Salud y del Ministerio de Salud de El Salvador*)	CEDOC/OPS	San Salvador, El Salvador
Disasters Protection Center (*Centro para la Protección de Desastres*)	CEPRODE	San Salvador, El Salvador
Medical Library, University of El Salvador (*Biblioteca Médica de la Universidad de El Salvador*)	UES	San Salvador, El Salvador
Health Research and Education Center (*Centro de Investigación y Estudios de la Salud*)	CIES	Managua, Nicaragua
Medical Library, National Autonomous University of Nicaragua at León (*Biblioteca Médica de la Universidad Nacional Autónoma de Nicaragua en León*)	UNAN-León	León, Nicaragua
Medical Library, University of San Carlos (*Biblioteca Médica de la Universidad de San Carlos*)	USAC	Guatemala City, Guatemala
National Coordination for Disaster Reduction (*Coordinadora Nacional para la Reducción de Desastres*)	CONRED	Guatemala City, Guatemala
National Civil Protection System (*Sistema Nacional de Protección Civil*)	SINAPROC	Panama City, Panama

vides electronic information and tools to enhance the capabilities of the CANDHI centers.

Central American Network for Disaster and Health Information (CANDHI) centers

CANDHI currently consists of ten disaster health information centers, plus CRID, in six Central American countries (Table 1). Prior to the development of CANDHI, the modern concept of an information center was almost nonexistent in the participating centers. The libraries selected for this project typically had old medical books and a small number of subscriptions to medical journals. There was little or no electronic access to health or disaster information.

CANDHI PROGRAM COMPONENTS

In line with the program's goal to help rebuild the health information infrastructure of Central America, CANDHI's major objectives include information technology infrastructure development, information management training, and information product development.

Information technology development

The institutions invited to join the project were selected based on assets that they were expected to contribute to the project, including institutional reputation and ongoing roles in the health and/or disaster areas in their countries. However, many centers had very limited information technology (IT) resources and skills at the onset of the project. Thus, strengthening the technological infrastructure of the participating institutions was essential for strengthening the health information systems and in establishing the CANDHI network. The project's IT development process, customized to the capabilities and logistical resources at each site, was planned primarily by CRID with technical assistance from NLM.

Hardware and software. Initially, the project provided the participating centers with one server-class computer and two personal workstations, with additional computing equipment purchased as the project evolved and new funding sources became available. The centers received general guidance from CRID about server platform configuration, with the freedom to decide which configuration best fit their local environment.

The project also supplied supplementary equipment such as uninterruptible power supplies, printers, and document scanners. All the computer equipment and peripherals were interconnected via a local area network, also commonly connected to other existing networks in their institutions for greater functionality. PAHO also contributed database management systems and other information products and tools developed or adapted by the Health Sciences Library for Latin America (BIREME).

Internet connectivity. At the time of the project's inception, Internet access was unreliable or nonexistent at the CANDHI sites. A key step in the project's development was the initial provision of permanent Internet access to all participant sites. As the project has progressed, the sites have improved the quality and speed of their Internet connections from their original 128 Kbps up to 256 Kbps, 1 Mbps, and higher bandwidths. Currently, most of the institutions hosting the CANDHI centers are now independently funding Internet connectivity for the centers as well as the libraries and other facilities.

Technical skills. Each CANDHI center has one trained IT specialist who dedicates time to this project. CRID held several training sessions to help IT personnel acquire additional skills and to facilitate dialog among the IT specialists. The IT training has included Linux management; search engine development; Website de-

Table 2
Information management training courses

Course	Subject	Location	Date
1	Disaster management, online health resources, online disaster resources	San Jose, Costa Rica	April 2001
2	National Library of Medicine health information	Bethesda, MD	September 2001
3	Website design and development, Health Sciences Library for Latin America (BIREME) database management tools	Managua, Nicaragua	August 2002
4	Digital library development, Website maintenance	Guatemala City, Guatemala	February 2004
5	Information management theory, toolkit development, outreach, and marketing	Panama City, Panama	May 2005
6	Content management systems, promotion, database management refresher	San Salvador, El Salvador	October 2005
7	Facilitation, communication, training	San Jose, Costa Rica	April 2006

velopment, maintenance, and metrics; IT security; and content management systems.

CANDHI metasearch tool. Every center has its own valuable collection of resources, experience, and skills to offer to its user community. Work is ongoing in two areas to make the information from each center's Website more accessible: (1) improving metadata for the full-text documents to enhance retrieval of the documents by any source including popular search engines (such as Google or Yahoo!) and (2) implementing a CANDHI-wide information search capability. The CANDHI-wide search engine allows users of any CANDHI center Website to search information from any or all the centers simultaneously. This tool will provide a virtual, region-wide disaster health information resource, enabled and maintained by the synergistic contributions of the participating centers.

Information management

Another of CANDHI's objectives is to train health sciences librarians to develop and manage collections of health-related disaster information and to promote and provide access to this information. Since 2001, a number of training courses have been developed by CRID and conducted by staff from CRID, NLM, PAHO, and BIREME (Table 2). Attendees at each session often included twenty-five to thirty librarians and IT specialists from each of the CANDHI centers, as well as several librarians from local institutions (universities, PAHO, government agencies). Each training course was four to five days long.

Five national training courses have been taught by CANDHI members to disaster management organizations in each of the participating countries. The CANDHI centers have also conducted numerous smaller training and demonstration sessions for local organizations, government agencies, and educational institutions. Access to health-related disaster information is also included as part of the public health curriculum for students at several universities including the National Autonomous University of Honduras and the Health Research and Education Center in Nicaragua.

Since 2001, several thousand people throughout Central America—including approximately 1,200 national disaster management authorities, 300 librarians and information specialists, and numerous health professionals, students, government employees, and personnel from community organizations—have been trained to use CANDHI resources.

Information product development

Digital libraries. In addition to assisting in the development of local disaster information centers and the CANDHI network, CRID has also been responsible for developing procedures for creating a digital library of key documents related to health and disasters. CRID's collection of materials comprises primarily gray (unpublished, non-peer reviewed) literature resulting from expert meetings; case studies and evaluations; university research; public health and civil engineering assessments; guidelines and technical reports issued by governmental authorities; and publications, resolutions, journals or bulletins, and technical proceedings [10]. Many of these materials were prepared by the United Nations and other specialized organizations (e.g., PAHO, the World Meteorological Organization, the Economic Commission for Latin America and the Caribbean). The majority of materials are in Spanish, with some documents in English, French, and other languages. Before CANDHI, the documents were indexed in a bibliographic database but only available in print and shared with users by fax or regular mail.

CANDHI provided the opportunity for CRID to develop a digital library of its collection to share this key source of disaster-related health information more broadly in the region. Currently, over 10,000 documents (approximately 65% of the CRID collection) are freely available online, and more documents are added daily. These documents are searchable via the CRID Website <www.crid.or.cr> and from the Websites of each participating center, described further below. The individual CANDHI centers also collect and scan local documents about disasters.

The CRID database includes a description of every document made available in hypertext markup language (HTML) format to enable searching the documents by keywords, title, author, and other parameters. Electronic copies of printed documents are mainly in portable document format (PDF). Around 10% of the PDF documents have also been processed with an optical character recognition (OCR) system and therefore are available for full-text searching, and more documents are expected to be processed this way over time. Multimedia files are also indexed and available

online, including image and media files (e.g., JPEG, WAV, or AVI files). Many documents are also linked from topical lists on the Websites, enabling users to browse documents by specific subjects.

In addition, CRID has created searchable CD-ROMs of electronic documents in specific subject areas such as volcanoes, water resources, and human settlements. CANDHI centers have also created specialized CD-ROMs, including *Disasters in Honduras* and *Lessons Learned in the 5 Years following Hurricane Mitch.* These CDs have been distributed to hundreds of health professionals and disaster managers across Central America and provide an easy mechanism to generate interest and use of vital information for disaster planning. The CD-ROMs incorporate a custom search engine that enables searching for documents using the same information fields available via the search engines in the CANDHI Websites. The information from these CDs is also available on the CRID and CANDHI center Websites as ''Information Packets.''

Websites. The CANDHI centers in Honduras, Nicaragua, El Salvador, Panama, and Guatemala have all developed local CANDHI Websites [11]. Although each Website has its unique features, all provide access to the CRID bibliographic database on disasters, the CRID digital library, their own digital library of local documents, and local resources and contacts. Over the next few months, Costa Rica will also make its Website publicly available.

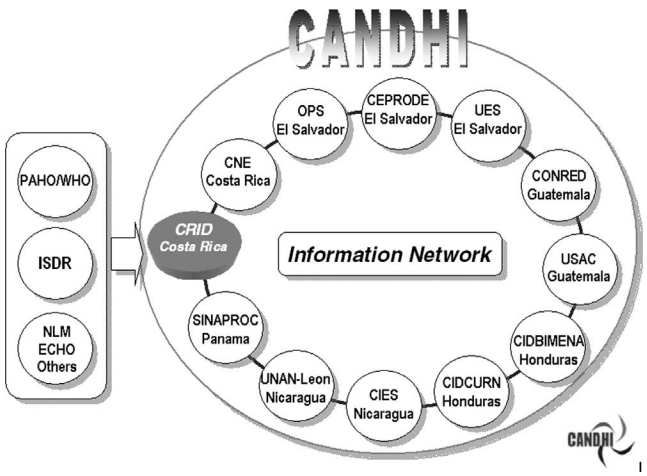
Although Website statistics are not yet available from all CANDHI centers, in 2005, over 25,000 unique visitors accessed 5 of the CANDHI Websites, and over 170,000 unique visitors accessed the CRID Website. In addition, over 9,500 people visited the CANDHI centers in person to obtain information.

A CANDHI portal Website, currently under development, is intended to provide a framework for identifying and retrieving local and regional information on disasters. This Website will describe the program, the participating centers, and CRID and employ the CANDHI meta-search engine for enhanced retrieval of disaster information across Central America. CRID is responsible for the initial development of the portal, and it is anticipated that several CANDHI centers will rotate responsibility for site maintenance.

FUTURE ACTIVITIES AND SUSTAINABILITY

A major strategy for ensuring CANDHI's sustainability has been and will continue to be selecting the centers. The principal criteria for selection have been (1) the prospective center's standing within the national or subnational health and/or disaster network, (2) organizational experience pertaining to project development activities, and (3) enthusiasm and motivation to develop and maintain the information services that the project is designed to enhance. Continuing to use these criteria to select CANDHI centers will ensure that the initiative fits into the core mission of each partner organization and, therefore, is likely to be incorporated into ongoing strategic plans.

Figure 2
CANDHI collaborators and sponsors



See Table 1 for acronym definitions

Over time, resources to sustain the project are expected to be supported from regular and ongoing budgets of the partners. Currently, seven of the centers no longer rely on outside support for Internet access but have incorporated these charges into their own budgets. Several of these centers have also upgraded their Internet connections to higher speeds and have purchased additional computers for their libraries. To support CANDHI partners and the network as a whole, PAHO country offices and other credible sources of information on health and disasters will continue to provide ongoing information content and technical assistance to the project.

Although IT services have grown tremendously since the project began, several issues still need to be resolved. Information technology evolves rapidly, and therefore it has become difficult for IT professionals in any setting to keep current with all relevant developments. To help the participating sites keep abreast of current technologies, NLM and CRID will offer training via videoconferences and in person, when possible. Efforts also are being made to improve the routine technical management of the server platforms. NLM periodically monitors the availability of the CANDHI center Websites, to evaluate the impact of any periods of ''down-time'' and to help the centers monitor the status of their own information services.

As additional partners joined CANDHI and other organizations inquired about becoming partners, it became apparent that resources were needed to assist these new partners. This led to the idea of a Disaster Information Center (DIC) Toolkit that is intended to provide the resources needed for establishing, developing, and managing disaster information centers throughout the region (Figure 3). The DIC Toolkit is being implemented as a multimedia, interactive Web application. Other versions are under consideration, such as a CD-ROM version and a print edition, for special needs. The DIC Toolkit is still in development

Figure 3
Disaster Information Center Toolkit components

- **Presentation:** general overview of the toolkit and its objectives
- **Reference Framework:** background information on information science, disaster information, role of information technology in disaster information services, and ways information is used in disaster management
- **Planning:** suggested information resources and tools for planning the development of a disaster information center, including methodologies and tools for the strategic planning and management of information centers
- **Management:** information tools for operational management of a disaster information center, includes information about identifying and serving information users, collection and content management, and information retrieval
- **Technology:** conceptual and background information about computer and network technologies, methodologies for information technology and information project management, and descriptions of software tools available for implementing information services
- **Services:** methodologies for planning, design, implementation, and management of information services on a Web platform
- **Training:** methodologies for developing training activities for information users and creating continuing education programs
- **Case Study:** hypothetical example of how the Disaster Information Toolkit can be used in the development of a disaster information center
- **Additional tools:** glossary of terms used in the toolkit, interactive quizzes, links to related Websites and documents, bibliography, list of frequently asked questions

and not yet publicly available. Once it is complete, it will be available from the CANDHI, CRID, and participating centers' Websites.

The project will also likely serve as a key information resource during future natural disasters in the region. During the past two years, the participating centers had several opportunities to assist with preparations for and response to hurricanes, including Hurricanes Adrian and Stan. CANDHI centers quickly added up-to-date information on storms to their Websites, highlighted useful resources on hurricanes, identified potential target areas, and met with local public health and government officials and provided them with documents and other resources to assist with preparedness, response, and recovery activities. As Hurricane Adrian approached Central America in May 2005, the disaster information center in Guatemala was asked to be ''on call'' by university and government officials.

In addition to assisting several countries in rebuilding their health information infrastructure, this project can be used as a model for collecting and exchanging public health information in geographically isolated and disaster-prone environments and for handling nontraditional or unpublished literature, in this case mainly on the health aspects of disasters. CANDHI coordinators were recently asked to conduct an assessment of information centers and resources in regions of Southeast Asia devastated by the tsunami in December 2004 [12]. The World Health Organization is now planning to create a disaster health information network in that region. Elsewhere in Latin America, PAHO, with funding from ECHO and support of the Programa de Prevencion en Desastres de la Comunidad Andina, Disaster Prevention Program for the Andean Community (PREDECAN), is developing a network of disaster information centers in the Andean region [13]. The PREDECAN program is using the expertise of the CANDHI centers and collaborators to assist in training in and implementation of information products and services to extend and expand the network of disaster information centers in Latin America.

CONCLUSIONS

Through CANDHI, the health information infrastructure in Central America has been strengthened and the project's guiding vision of convenient access to health-related disaster information has become a reality. The CANDHI participants are operating successful and useful local disaster information centers as well as participating in an international network designed to link and support disaster prevention efforts throughout Central America.

Prior to CANDHI, most of the librarians and IT specialists had very little or no Internet experience, had not launched a Website, or developed an online collection of resources and only a few had the facilities to search for health information online [5, 6]. CANDHI prepared librarians and IT specialists to develop and manage collections of health-related disaster information, access various online resources, create and maintain Websites and databases, and create and provide access to electronic documents via the Web and on CD-ROM. With the wealth of information now available, the participating sites have educated several thousand public health professionals, disaster managers, and government leaders about these new resources.

Most of the participating libraries and information centers have shown tremendous growth, not only in the development of local disaster information centers, but more broadly in medical library modernization. They are leaders in the conversion of antiquated university libraries into modern centers of knowledge and information management for their communities [14], such as the modernization of the Northern Region's University Center Library and the National Autonomous University of Honduras Medical School Library in Honduras [15]. Though these two libraries had little to no Internet access and very limited computing resources at the beginning of the project, health professionals and students at these institutions can now access current health information from PubMed, MedlinePlus, BIREME, and many other sources due to CANDHI's assistance and the tremendous efforts of their library directors. All of the participating libraries have expanded not only their services, but also their credibility and level of responsibility in their institutions, leading to enhanced morale, increased involvement in other activities at the institution, and prospects for future recruitment into the profession [14].

This outreach program achieved its goal of improving the health information infrastructure in several medical libraries and other information centers in three Central American countries. With financial assistance from the United Kingdom and the European community, this goal was expanded to information centers in three additional countries. These libraries and information centers now have acquired the knowledge and technological resources that promote delivery of reliable information on health and disasters to a wide range of users. In addition, CANDHI serves as a model for international cooperation and as an information sharing network and should facilitate long-

term improvement of disaster preparedness activities. The NLM/PAHO/ISDR/CRID collaboration also provides a useful model for disseminating health information in underserved, disaster-prone environments and for managing nontraditional literature regarding health aspects of disasters.

ACKNOWLEDGMENTS

The authors thank the staff at CRID and at all of the CANDHI centers for their participation in and dedication to the network. The authors also acknowledge the assistance and forethought of Melvin Spann and Steven Phillips in the initial development of CANDHI.

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AUTHORS' AFFILIATIONS

Stacey J. Arnesen, MS, stacey_arnesen@nlm.nih.gov, Advisor for Special Projects; **Victor H. Cid, MS,** victor_cid@nlm.nih.gov, Senior Computer Scientist, National Library of Medicine, 6707 Democracy Boulevard, Suite 510, Bethesda, MD 20892; **John C. Scott, MS,** jcscott@cpsc.com, President, Center for Public Service Communications, 3221 North George Mason Drive, Arlington, VA 22207; **Ricardo Perez, MS,** perez.tato@gmail.com, Regional Advisor for Disaster Information Management, Pan American Health Organization, Casa 843 A y B Avenida Arnoldo Cano Arosemena, Ciudad del Saber, Corregimiento de Ancón, Panama City, Panama; **Dave Zervaas, MS, Drs,** dzervaas@eird.org, Regional Coordinator for the Americas, United Nations International Strategy for Disaster Reduction, Casa 843 A y B Avenida Arnoldo Cano Arosemena, Ciudad del Saber, Corregimiento de Ancón, Panama City, Panama, and former General Coordinator, Centro Regional de Información sobre Desastres para América Latina y el Caribe (CRID), Pavas, San José, Costa Rica.

Received December 2006; accepted February 2007