The Growing Importance of Information Technology in Disaster Medical Response

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Welcome to Florida

We are here
Seminar Objectives

- To assess the current emergency disaster response environment.
- To explore how information technology, e-health, and wireless technology can improve the quality and efficiency of Disaster response.
- To discuss Regional Health Information Organizations (RHIO’s) as a mechanism to enhance disaster response.
- To develop a checklist of information technology initiatives that can promote process improvement in Disaster Response.
Occurrence of natural disasters as reported in EMDAT: 1900 - 2003

### Table 5 - Comparing the human impact of natural disasters between the 10 richest and 10 poorest countries

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Luxembourg</td>
<td>44,000</td>
<td>0</td>
<td>Somalia</td>
<td>550</td>
<td>2,701</td>
</tr>
<tr>
<td>United States</td>
<td>37,600</td>
<td>59</td>
<td>Sierra Leone</td>
<td>580</td>
<td>155</td>
</tr>
<tr>
<td>Norway</td>
<td>31,800</td>
<td>5</td>
<td>Burundi</td>
<td>600</td>
<td>674</td>
</tr>
<tr>
<td>Switzerland</td>
<td>31,700</td>
<td>2</td>
<td>Congo, RD</td>
<td>610</td>
<td>114</td>
</tr>
<tr>
<td>Ireland</td>
<td>30,500</td>
<td>4</td>
<td>Tanzania</td>
<td>630</td>
<td>1,531</td>
</tr>
<tr>
<td>Canada</td>
<td>29,400</td>
<td>72</td>
<td>Malawi</td>
<td>670</td>
<td>8,748</td>
</tr>
<tr>
<td>Belgium</td>
<td>29,000</td>
<td>2</td>
<td>Afghanistan</td>
<td>700</td>
<td>1,120</td>
</tr>
<tr>
<td>Denmark</td>
<td>29,000</td>
<td>0</td>
<td>Eritrea</td>
<td>740</td>
<td>6,402</td>
</tr>
<tr>
<td>Japan</td>
<td>28,000</td>
<td>182</td>
<td>Ethiopia</td>
<td>750</td>
<td>5,259</td>
</tr>
<tr>
<td>Austria</td>
<td>27,700</td>
<td>29</td>
<td>Madagascar</td>
<td>760</td>
<td>2,090</td>
</tr>
</tbody>
</table>

Table 8 - Top 10 disasters costs as a proportion of GDP

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Disaster Type</th>
<th>Cost US$ (Million)</th>
<th>Cost 2003 US$ (million)</th>
<th>% of Previous Year GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>St. Lucia</td>
<td>1988</td>
<td>Hurricane</td>
<td>1,000</td>
<td>1,558</td>
<td>413%</td>
</tr>
<tr>
<td>Mongolia</td>
<td>1996</td>
<td>Forest Fire</td>
<td>1,713</td>
<td>2,013</td>
<td>192%</td>
</tr>
<tr>
<td>Vanuatu</td>
<td>1985</td>
<td>Cyclone</td>
<td>173</td>
<td>296</td>
<td>139%</td>
</tr>
<tr>
<td>Samoa</td>
<td>1991</td>
<td>Cyclone</td>
<td>278</td>
<td>376</td>
<td>138%</td>
</tr>
<tr>
<td>Dominica</td>
<td>1979</td>
<td>Hurricane</td>
<td>44</td>
<td>113</td>
<td>99%</td>
</tr>
<tr>
<td>Mongolia</td>
<td>2000</td>
<td>Winter Storm</td>
<td>875</td>
<td>937</td>
<td>97%</td>
</tr>
<tr>
<td>St. Kitts &amp; Nevis</td>
<td>1995</td>
<td>Hurricane</td>
<td>197</td>
<td>238</td>
<td>89%</td>
</tr>
<tr>
<td>Samoa</td>
<td>1990</td>
<td>Cyclone</td>
<td>119</td>
<td>119</td>
<td>62%</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>1998</td>
<td>Hurricane</td>
<td>1,000</td>
<td>1,131</td>
<td>51%</td>
</tr>
<tr>
<td>Honduras</td>
<td>1998</td>
<td>Hurricane</td>
<td>2,000</td>
<td>2,262</td>
<td>42%</td>
</tr>
</tbody>
</table>

## Top 10

Natural disasters by number of deaths - 2005

<table>
<thead>
<tr>
<th>Event</th>
<th>Location</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earthquake, October</td>
<td>Pakistan</td>
<td>73,338</td>
</tr>
<tr>
<td>Hurricane Stan, October</td>
<td>Guatemala</td>
<td>1,513</td>
</tr>
<tr>
<td>Hurricane Katrina, August</td>
<td>United States</td>
<td>1,322</td>
</tr>
<tr>
<td>Earthquake, October</td>
<td>India</td>
<td>1,309</td>
</tr>
<tr>
<td>Flood, July</td>
<td>India</td>
<td>1,200</td>
</tr>
<tr>
<td>Earthquake, March</td>
<td>Indonesia</td>
<td>915</td>
</tr>
<tr>
<td>Flood, June</td>
<td>China, P Rep</td>
<td>771</td>
</tr>
<tr>
<td>Earthquake, February</td>
<td>Iran, Islam Rep</td>
<td>612</td>
</tr>
<tr>
<td>Measles Epidemic</td>
<td>Nigeria</td>
<td>561</td>
</tr>
<tr>
<td>Flood, February</td>
<td>Pakistan</td>
<td>520</td>
</tr>
<tr>
<td>Rank</td>
<td>Date</td>
<td>Country</td>
</tr>
<tr>
<td>------</td>
<td>-------</td>
<td>---------------</td>
</tr>
<tr>
<td>1</td>
<td>1991</td>
<td>Peru</td>
</tr>
<tr>
<td>2</td>
<td>1988</td>
<td>Ethiopia</td>
</tr>
<tr>
<td>3</td>
<td>1991</td>
<td>Nigeria</td>
</tr>
<tr>
<td>4</td>
<td>1996</td>
<td>Burkina Faso</td>
</tr>
<tr>
<td>5</td>
<td>1996</td>
<td>Nigeria</td>
</tr>
<tr>
<td>6</td>
<td>1984</td>
<td>India</td>
</tr>
<tr>
<td>7</td>
<td>1995</td>
<td>Niger</td>
</tr>
<tr>
<td>8</td>
<td>1988</td>
<td>India</td>
</tr>
<tr>
<td>9</td>
<td>1982</td>
<td>Bangladesh</td>
</tr>
<tr>
<td>10</td>
<td>1991</td>
<td>Niger</td>
</tr>
</tbody>
</table>

Annual reported economic damages from natural disasters: 1975-2005

2005 Disasters in Numbers. cred@epid.ucl.ac.be. www.cred.be.
Factors Contributing to Disaster Severity

- Human vulnerability due to poverty & social inequality
- Environmental degradation
- Rapid population growth especially among the poor
- Urban Growth

Sources: CDC & EK Noji, *The Public Health Consequences of Disaster*
Influence of Urban Growth

Urban population: 1920: 100 million
1980: 1 billion
2004: 2 billion

Source: CDC & EK Noji, The Public Health Consequences of Disaster

1. Tokyo-Yokohama, Japan - 33,200,000
2. New York, United States - 17,800,000
3. Sao Paulo, Brazil - 17,700,000
4. Seoul-Incheon, South Korea - 17,500,000
5. Mexico City, Mexico - 17,400,000
6. Osaka-Kobe-Kyoto, Japan - 16,425,000
7. Manila, Philippines - 14,750,000
8. Mumbai, India (formerly Bombay) - 14,350,000
9. Jakarta, Indonesia - 14,250,000
10. Lagos, Nigeria - 13,400,000
11. Kolkata, India (formerly Calcutta) - 12,700,000
12. Delhi, India - 12,300,000
13. Cairo, Egypt - 12,200,000
14. Los Angeles, United States - 11,789,000
15. Buenos Aires, Argentina - 11,200,000

www.demographia.com accessed December 27, 2006
Emergency Management

- Emergency management is the application of science, technology, planning and management to deal with extreme events that can injure or kill large numbers of people or create extensive property damage (1).
- The challenge in emergency medical response is to insure that adequate personnel, supplies, equipment and protocols are in place to deal with potential threats.
- Emergency medical response requires a plan that is scalable to the threat and coordinates the use of local, regional, and national resources.
Components of Medical Disaster Response

- While no two disasters are identical, the medical, physical, psychological and public health impacts are similar.
- Disaster medical response consists of mass casualty response, incident control, decontamination, comprehensive medical treatment, and public health initiatives (1).
- A key factor is the development of a unified command and control structure linked by a robust informatics network that allows for a clear assessment of the event and the efficient utilization of health care resources.

Importance of Disaster Information

- This requirement starts at the location of the incident, progresses through the first responder, into the hospital trauma center and continues through the continuum of care.

- Satellite technology has allowed rapid advances in telecommunications to assist when a disaster occurs
  - Low Earth Orbit Satellites
  - Wireless Technologies
  - Internet
  - Computer Miniaturization “smart devices”
Disaster Informatics

- In the U.S., disaster medical response requires the coordinated efforts of local, state and federal resources.
- International disasters require the involvement of organizations such as the United Nations and the International Committee of the Red Cross along with the host nation in the planning process.
- The application of new communication systems can assist in planning within the chaotic environment of disaster response. Such disaster informatics will enhance mass casualty triage, improve the safety of first responders, facilitate command and control as well as improve overall resource utilization.
Stafford Act
Authorizes President to …

- Declare national emergency at the request of governor
- Assist State and local governments to …
  - Lessen or avert threats
  - Save lives, protect property, protect public health & safety
  - Alleviate damage, loss, hardship, or suffering
- Appoint Federal Coordinating Officer to …
  - Assess needs, define priorities
  - Establish interagency teams and field offices
  - Help citizens and public officials obtain assistance
Problems in Disaster Response

- Limited Resources
- Inadequate Communication
- Inadequate Data
- Misinformation
- Damaged Infrastructure
- Great Personal Risk
Typical Applications

Source: Gerald Merckel, PhD GeoAge, Inc. Jacksonville, FL  www.geoage.com

Applications

- Facilities Management
- Field Appraisal and Survey
- Environmental Monitoring
- Emergency Management
- Remote Instrumentation
- Fleet and Crew Management
- Others........

Technology

- Global Positioning Systems
- Intelligent Field Instrumentation
- Wireless Communications
- Internet Based Geographic Info Systems

Diagram:

- Global Positioning System
- Wireless Communications
- Mobile Users
- Field Instrumentation
- Internet
- Real Time Field Data
- GIS Database
- Server
- Users accessing Data
- Antenna
- PDA
- Satellite
- Global Positioning System
- Wireless Communications
- Person 1
- Real Time Field Data
- GIS Database
Web Interface to Internet Map Server
Mass Casualty Incidents

Mass Casualty Incidents (MCI) represent one of the greatest challenges to a community’s emergency response system due to their magnitude and intensity.

International disasters have claimed 3 million lives and have adversely affected 800 million over the past 20 years (1).

These are in response to such events as:
- September 11th, 2001, New York City
- Madrid Train Station Bombings
- Tokyo Subway Sarin release
- Indian Ocean Tsunami 2004
- Hurricane Katrina 2005, New Orleans

During the Tokyo Sarin release, 10 percent of all emergency technicians were injured and 25 percent of all emergency room staff became symptomatic due to Sarin contamination. The use of CBN sensors combined with real time atmospheric data would identify potential danger areas.

DoD sent Navy hospital ship USNS Comfort to New York City, as well as providing supplies, equipment and transportation support.

USNS Comfort: 1,000 beds, 12 OR’s, MRI, CAT scan, blood bank.
Critical problems identified in Hurricane Katrina involved public sanitation, water safety, infection control, environmental health and access to care (1).

Recent analysis show 229,866 people lost including 186,983 dead and 42,883 missing (1).

Clearly, a disaster of the magnitude of the Tsunami surpasses the capability of any single nation to meet the short-term disaster response and requires the active support of the international community.

Importance of Public Health Initiatives

- Communication and Monitoring
- Water and Sanitation
- Communicable Disease Control
- Immunization
- Nutrition
- Mental Health
Strategic National Stockpile

- Purpose is to ensure the availability of life-saving pharmaceuticals, antidotes, medical supplies and equipment necessary to counter effects of nerve agents, biological pathogens, and chemical agents.
- Consists of pre-packaged materials in aircraft cargo containers located strategically in 12 locations in US. Each container can be delivered within 12 hours and contains pharmaceuticals, intravenous supplies, airway supplies, bandages, and dressings to support prophylaxis and therapeutic treatment for a population affected by chemical or biological terrorism incident.
- Centers for Disease Control (CDC) has contracts with manufacturers to restock materials within 24-36 hours after utilization.
- Access to Strategic National Stockpile can requested through the Federal Coordinating Officer.
Patient Tracking in a Disaster

- Primary means of information and documentation utilize paper tags to identify patients moving from the field to the hospital.
- These tags have many limitations:
  - Limited space to record medical data
  - Non-weather resistant
  - Difficult to track patient via disaster IT systems
- Scanning patient wristbands at the disaster site and uploading this data via a wireless LAN, disaster planners can identify the number and location of casualties in order to determine transport to trauma centers and other medical facilities.
- Bar coding will enhance patient tracking, improve patient care and coordinate the efforts of first responders, trauma centers and hospital. More importantly, electronic data then becomes the information necessary for disaster planning, casualty estimation, family notification, etc.
Global Positioning Systems

GPS technology and patient tracking can assist in planning for coordinated patient movement throughout the disaster area. While still under development, miniature CBN threat sensors can document those areas affected by contamination and facilitate the safe movement of patients along the continuum of care.

Potential drawbacks that are being investigated:
- Level of resolution and accuracy
- Ability to work within structures
- Signal response delays
- Signal strength and range
Department of Defense (DOD) Initiatives

- DOD is active in the development of satellite uplinks and transfer of information via wireless technology within the disaster area. The information architecture includes a rolling disaster satellite uplink or portable satellite dish. The uplink is augmented with line of sight WiMax wireless links to fire, police, hospitals, EOC and internet.

- PDA’s with preloaded medical information allow the development of an electronic medical record at the disaster site. Patient data could be recorded on real time electronic status boards providing up to date information on patients, personnel and available resources.

- Many of the logistical problems faced in disasters are not caused by shortages of medical resources, but rather from failures to coordinate their distribution.
Command and Control

- Accurate information allows the command and control structure to more efficiently coordinate regional disaster response and most importantly identify when local resources reach peak capacity (1).

- **Electronic Command Boards**
  - Record real time information on the status of patients, personnel, and resources
  - Can receive such information on available resources including ambulance, trauma centers, and hospital availability
  - Can be implemented via the Internet to make the information accessible to many users

**Regional Health Information Organization (RHIO)**

**Definition** – A Regional Health Information Organization (RHIO) is a multi-stakeholder organization that enables the exchange and use of health information, in a secure manner, for the purpose of promoting the improvement of health quality, safety, efficiency and disaster response. (1)

Experts maintain that RHIOs will help eliminate paper-based patient records, provide quick access to automated test results and offer a consolidated view of a patient’s history. (1)

RHIO’s can provide the legal and technological framework to share patient data within local communities and across wide geographic areas.

  - (1) Source: HIMSS RHIO Definition, 2005
RHIO: Key Concepts for Success

- Decentralized architecture built using Internet as communication link.
- Joint governance composed of public and private stakeholders.
- Patient-centric focus with safeguards to protect the privacy of health information.
- Leverage existing technology, expansion of EHRs and federal initiatives as critical enablers.

  - Source: Sutherland, J (2005). Regional Health Information Organization (RHIO): Opportunities and Risks, White paper CTO PatientKeeper, Inc
INSTITUTIONS supporting disaster response:

- Federal Government
- State Governments
- Local Governments
- Department of Defense
- Hospitals
- Healthcare Providers
- Associations & Foundations

Are pushing for the implementation of various ELECTRONIC HEALTH INFORMATION SYSTEMS including: EHR’s, RHIO’s, and CONSOLIDATED DISASTER RESPONSE SYSTEM ARCHITECTURE, etc.
Disaster Myths

- Victims of natural disasters usually die from trauma and are unlikely to have epidemic causing infections.
- When working with the dead protective barriers, i.e., gloves, gowns, boots as well as handwashing with soap and water is recommended (1).
- Most survivors of disasters are saved by local authorities not foreign medical teams.
- The impact of disasters on a country extend beyond the initial phase due to the ongoing need for financial and material resources (2).


Post Traumatic Stress Disorder (PTSD)

- PTSD is a mental illness caused in part by exposure to a traumatic event and can result in reliving the event, difficulty in sleeping and social impairment (1).

- PTSD can be minimized by reliable support systems, providing disaster education, providing specific information about disaster recovery and by providing sympathetic medical treatment (1).

- Research suggests 30% to 60% of disaster victims may experience PTSD as well as 5% to 40% of rescue workers (2).

Challenges in Disaster Response

- The challenge for disaster planners is to identify those programs with the greatest potential benefit and prioritize future expenditures in a manner that will best meet the emerging threat.
- Rural communities lack the staff, equipment and training to respond to NBC threats, it is essential that specialized teams be developed and funded to provide disaster response.
- Such teams could be maintained as national assets and be made available to other nations as a deployable disaster response unit. By equipping these deployable units with the best technology and disaster informatics available, a high standard of international disaster medical response could be maintained in a fiscally responsible manner.
Disaster Response IT Dashboard

- Shared Vision of IT in Disaster Response
- Application Architecture for Disaster Response
- Integration of Disaster Response IT systems
- Use of Pre-positioned/remote Bio Medical Sensors
- Use of Wireless Technology
- Mobile Users and Electronic Linkage to Disaster data
- Integration of Global Positioning System (GPS)
- Disaster Data Warehouse with Real Time Access
- Link with Internet for wide area coverage
- Use of IT Systems in Disaster Exercise
- Capital investment in Disaster IT
- Deployable Disaster Response IT Teams
- Ongoing Research & Investment in Disaster IT
Management Implications

- Increased threat leads to investment in Disaster IT and provides opportunities for collaboration across wide geographic areas.
- Continued access to capital is necessary to improve Disaster Response systems.
- Analysis of historic data allows for focused investments in IT to improve the efficiency and quality of Disaster Response.
- Disaster Planners are challenged to expand the use of IT in order to improve disaster preparedness, mitigation and prevention.
- Rural communities have minimal resources and require the support of mobile disaster response teams.
As was documented during the Tsunami of December 26, 2004, the ability of communities to respond to cataclysmic events is limited by the availability of local resources. The only realistic approach is to develop a coordinated plan to meet local needs through the timely integration of local, state, federal and in some cases multinational resources.

Recent events clearly support the development of specialized disaster response teams within the international community. These disaster response teams should be funded sufficiently to operate with state of the art technology and be trained for rapid deployment.

Additional research in the development of new technology and improved medical treatments combined with strategic stockpiles of antibiotics and vaccines are appropriate.

Disaster-affected countries experience long-term financial cost and material shortages. To minimize these long-term effects, the World Bank established a policy in 2000 to allocate 15 percent of their disaster relief to minimizing future disaster vulnerability (1).

The future of disaster medical response

- Effective use of multiple data sources
- New informatics technologies including remote sensors, wireless LANs, GPS technology, patient tracking systems and online medical resource databases will improve disaster medical response
- Informatics technologies will improve patient care, enhance provider safety and provide better command and control in a Disaster situation
A Comprehensive Strategy for Disaster Response

- Embrace information technology in Disaster Response?
- Cost versus Benefit
- Local, State, National and International Focus?
- Advance or retreat?
Questions

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