Networking Needs of Health Care Personnel in Disaster: National Library of Medicine Initiatives

Fall 2008 Internet2 Members Meeting
New Orleans, Louisiana
October 15, 2008
Overview

- Overview of NLM’s Work on Disaster Information and Examples of Grant-Funded Projects – Mr. Victor Cid
- Scalable Information Infrastructure Projects – Dr. Michael Ackerman
- Hospital Disaster Preparedness Partnership Projects – Captain Mary Chaffee
- Family Reunification Project – Mr. Michael Gill
- Discussion
Objectives

- To explain NLM’s work on disaster information for health care
- To present examples of network-dependent applications to support health care personnel during disasters
- To stimulate dialogue focused on improving the health care networking infrastructure used during national disasters

How can advanced networking help support the health system during disaster?
Overview of NLM’s work on Disaster Information and Examples of Grant-Funded Projects

Mr. Victor Cid
Staff Scientist, Disaster Information Management Information Center
National Library of Medicine
U.S. National Library of Medicine

Mission
Collect, organize, and disseminate health-related information.

- World’s largest bio-medical library
  - 9 million items in collection
- Services: PubMed, MedlinePlus and many others
  - 900 million searches of PubMed done each year!
  - Articles from 5,200 journals indexed monthly
- Research and Development
  - Biomedical informatics and communications
- “New” focus: Disaster information
Disaster: A non-routine event or an agent that disrupts a complex human social system that has inherent vulnerabilities

- Disasters:
  - Have increased in frequency and intensity in the U.S. since 1970
  - Can cause sudden and massive demand for health services
  - Often result in major disruptions of essential services like power, water, and supply systems
  - Can severely disrupt information services when the health system is struggling to care for disaster victims
NLM Long-Range Plan 2006-2016

- NLM will be a partner in Federal disaster preparedness and recovery
  - Demonstrate how medical libraries can provide critical information services during a disaster
  - Ensure access to health information and effective use of libraries and librarians when disasters occur
  - Establish a Disaster Information Management Research Center
Disaster Efforts Across the NLM

- **LO**: Disasters Gray Literature, DBs, NN/LM, etc.
- **LHCBC**: Grants, R&D
- **SIS**: Toxicology and Environmental Health, Specialized Information Tools
- **OCCS**: IT R&D
- **NCBI**: Bioinformatics Research and DBs
- **EP**: Grants

**Disaster Information Management Research Center**
The Disaster Information Management Research Center

Goals:

- Ensure access to critical information by first responders, public health personnel, clinicians and patients
- Provide education/training
- Develop the concept of the Disaster Information Specialist
- Conduct research and development:
  - Ensure access to health information in disasters
  - Ensure effective use of library assets in disasters
  - Provide information to enhance clinician decision-making
  - Support the development of scalable information infrastructure

Improving access to the nation’s disaster information
Examples of NLM Initiatives

- Extramural Programs (EP) Funded Disaster-related Projects
- High Performance Computing and Communications (HPCC) Funded Scalable Information Infrastructure (SII) Projects
- Hospital Emergency Preparedness Partnership Projects
EP-Funded Disaster Projects

- Informatics for Empirically Supported Influenza Pandemic Control E-strategies (PI: J. Brownstein, Harvard University)

  - Syndromic surveillance
  - Leverage existing automated advanced real-time public-health surveillance system (AEGIS)
  - Measure key determinants of influenza spread
  - Develop models of national and urban influenza spread
EP-Funded Disaster Projects (Cont’d)

AEGIS Architecture

J Am Med Inform Assoc., 2007 Sep-Oct, 14(5), 581-588
EP-Funded Disaster Projects (Cont’d)

J Am Med Inform Assoc., 2007 Sep-Oct, 14(5), 581-588
EP-Funded Disaster Projects (Cont’d)

- Disease Surveillance in Real Time: Geotemporal Methods (PI: K. Mandl, Harvard University)

  - Purpose:
    - Public health surveillance and disease prevention
    - Develop surveillance network at multiple hospital emergency departments (EDs)
    - Detect abnormal disease patterns in ED databases in real-time
EP-Funded Disaster Projects (Cont’d)

- Improving Trauma System Response to Disaster (PI: C. Branas, University of Pennsylvania)

  - Purpose:
    - Develop a model for optimal execution of mutual aid agreements
    - Develop a model of trauma center service coordination
    - Assess capacity of 25 U.S. trauma centers
    - Coordinate 15 geographically dispersed disaster databases (incidents, resources, etc.)
EP-Funded Disaster Projects (Cont’d)

- DIORAMA: Dynamic Information Collection and Resource Tracking Architecture (PI: A. Ganz, University of Massachusetts at Amherst)

- Purpose:
  - Identify response assets in disaster
  - Use RFID technology to identify location and status of patients, responders and emergency transport vehicles in mass casualty incidents
  - Transfer data to Incident Commander, primarily via satellite links
  - Use mobile units designed for rapid deployment
EP-Funded Disaster Projects (Cont’d)

- Crisis Nursing Resource (CNR) Information System (PI: D. Troy, Miami University)

  - Purpose:
    - Develop emergency response tool for nurses (Red Cross)
    - Create database of local health services and products (e.g., medication or medical equipment replacement)
    - Develop infrastructure for accessing database across country when normal data communications are not available in affected community
    - Create Resource Data Center for Community Disaster Intervention at Miami University (Oxford, Ohio)
Scalable Information Infrastructure (SII) for Health and Disaster Management

Michael J. Ackerman, Ph.D.
Assistant Director
High Performance Computing and Communications
National Library of Medicine
Applications of Advanced Network Infrastructure Technology in Health and Disaster Management

- Applications demonstrating **self-scaling** technology
- Applications utilizing **self-optimizing end-to-end network aware** real-time technology and/or **middleware**
- Applications dependent on **wireless** technology
- Applications which involve **advanced authentication** methodologies, e.g., biometrics or smartcards
- Nomadic technology applications and/or applications using **geographic information systems** (GIS) techniques

www.nlm.nih.gov/oam/02103VMS.pdf
Traditional Emergency Patient Flow

9-1-1 Dispatcher → Ambulance dispatched → EMT stabilizes Patient

Treatment → Patient Triage & Transport → Hospital ED
Disaster Management Triage Tag

Front

Back
Wireless Internet Information System for Medical Response in Disasters (WIISARD)

- The development of an integrated software-hardware system designed to enhance the delivery of medical care at the sites of terrorist attacks and other disasters.

- Technologies include self-optimizing wireless end-to-end networks, GPS, RF tags, GIS, and handheld and wearable computers.

California Institute for Telecommunications and Information Technology
Cal-(IT)2; University of California at San Diego, San Diego, CA
www.wiisard.org
WIISARD Intelligent Triage Tag (iTAG)

- Large easy to operate buttons
- 802.11 Networking
  - Integrated web server
  - WAP and WEP security
- IPF 65 case
  - Resistant to pressured streams of water
- Daylight visible LED’s flash
  - Help providers locate victims
- Speaker/sound
  - Alerts and feedback
- Sensors
  - 3 axis acceleration, temperature, light
- LCD display for
  - Alerts-information
  - Display medical data
- AA NIMH batteries
Calmesh geoware networking platform

- Sockris NET 4521 133 Mhz 486
  - Linux microcomputer
  - Two 10/100 Mbit ethernet ports,
  - up to 64 Mbyte SDRAM memory
  - Compact Flash module
  - MiniPCI type III board
  - two PC-Card/Cardbus adapters
- Water resistant case,
- External antennae,
- 12V battery source provider 8-12 hours of continuous operation
- Single switch on
- External GPS
Remote Field Assessment
Advanced Network Infrastructure for Health and Disaster Management

- Next generation emergency medical dispatch
- Supporting emergency medical teams away from the hospital
- Mobile video conferencing
- Evaluating effects on clinical care
- IP-based 3G infrastructure

University of Alabama at Birmingham
Birmingham, AL
www.hires.uab.edu
EMS Communications

- WiFi Hotspot around ambulances
  - Tested range with 802.11 a,b,g, pre-n
  - Used “Smart Packets” and “Turbo Codes” to extend communication at the “fringe”

- Experiment with WiMax
  - Static Communication – excellent
  - Mobile communication – ????
GIS – Ambulance Locations
Scalable Medical Alert Response Technology

- Patient tracking and monitoring:
  - Begins at the emergency site
  - Continues through transport, triage, stabilization, and transfer
  - Within a health care facility

- Based on a scalable location-aware monitoring architecture
  - Remote transmission from medical sensors
  - Display of information on personal digital assistants
  - Detection logic for recognizing events requiring action
  - Logistic support for optimal response

Brigham and Women's Hospital  Harvard Medical School  Massachusetts Institute of Technology  smart.csail.mit.edu
Why Not Use Active Tags?

- Dynamic monitoring
- Identification
- Location
- Communication
Patient Monitoring System

One lead EKG
Oximeter
National Multi-Protocol Ensemble for Self-Scaling Systems for Health (NMESH)

- Model for large-scale implementation of a self-scaling national networked health system
  - Can be realistically deployed in short order with existing resources and only conservative expectations

- Address problems of scalability and preparedness at multiple levels
  - Leverages prior work on multi-institutional "on-the-fly" data integration, regional patient-controlled medical records, self-describing peer-to-peer networks, cryptographic health identification systems, and a GIS-based biosurveillance toolset

Children’s Hospital, Boston, MA
nmesh.chip.org
Design Issues and Computer Science Challenges

- Advanced test bed to explore Distributed File System architectures
  - Control issues – no introspection, wrong granularity – data schema problem
  - Parts of record important, parts are not – breaking up opaque file system

- High levels redundancy
  - Network scale constraints of not being able fully replicate vs. fully distributed
  - Different trade-off for public health vs. medical individual queries
  - Data update problems – age of update
Hurricane Katrina – Ultra Low Bandwidth Communications

- Only text messaging worked consistently
- Situation awareness and disaster relief information in 160 characters or less
Search carpal tunnel syndrome surgery vs. steroid randomized control trial

Surgical decompression vs. local steroid injection in carpal tunnel syndrome: A one year prospective randomized open controlled clinical trial

Lypen, D. Arthritis and Rheumatology, February 2005. “The bottom line”: Over the short term local steroid injection is better than surgical decompression for the symptomatic relief of carpal tunnel syndrome. At one year local steroid injection is as effective as surgical decompression for symptomatic relief.
Overview of Hospital Emergency Preparedness Partnership Initiatives

Mary Chaffee, PhD, RN, FAAN
Captain, Nurse Corps, U.S. Navy
Disaster Research Coordinator,
Disaster Information Management Information Center,
National Library of Medicine
The Motivation for the Partnership
The Bethesda Hospitals’ Emergency Preparedness Partnership (BHEPP)

- In 2004 three hospital leaders recognized great vulnerability of Bethesda area to extreme patient surge in event of major disaster in National Capital Area.

- Goals:
  - Leverage combined resources in disaster response
  - Develop a model of multi-agency collaboration

- First military-federal-civilian hospital preparedness partnership in the U.S.
Why NLM Joined the Bethesda Hospitals’ Emergency Preparedness Partnership

- Research a critical part of the BHEPP strategic plan
- Congressional funding received for disaster research
- NLM joined the partnership to conduct research and development to:
  - Strengthen communications interoperability
  - Maintain information access during disaster
  - Support responder education
Improving Access to Patient Medication Records in Disaster: The RxHub Project

**Purpose:**
To evaluate use of automated access to multiple sources of prescription data to reconcile patients’ medication records

Disaster victim presents to hospital for care; may be unable to provide medication information

Hospital queries RxHub to obtain automated transmission of patient prescription data

Clinicians have more complete patient medication data for decision-making

RxHub is a consortium of major Pharmacy Benefit Managers with data on about 250 million patients nationwide
Building Network Back-up

Two systems are being installed to provide back-up communications when all standard systems fail in disaster.

**Laser Communications Back-up**
- Laser towers are being installed at each partner hospital
- Laser communications will be evaluated as a back-up system during disaster

**Dark Fiber Communications Back-up**
- A ‘dark fiber’ (commercial unused fiber-optic cable) system is being installed to evaluate its use as a back-up system during disaster
RFID Patient and Equipment Tracking

Problem:
In mass casualty events, it is difficult to track location of patients and critical assets.

Solution to be Evaluated:
An RFID tag will be attached to mass casualty patients and major equipment to track their location in a disaster.

- RFID Tag on Patient:
  - The chip holds data about the patient or object to which it’s attached.
  - The antenna transmits information using radio waves.

- Location can be monitored by computer.
Patient Data: Digital Triage Data Capture

Mass Casualties are Generated in a Disaster

Patient Data are Recorded with Digital Pen on Triage Form

Digital Pen Transmits Written Data to Computer Network

Triage Data is Available for Transfer to Another Partner Hospital

Total Patients Triaged: 186
Burn .... 17
ICU.....36
Pediatric...13
Surgical.....24

Data Reports are Available for Administrators and Emergency Personnel
Army MARS Radio as Communications Back-up

- MARS is a DoD-sponsored program, consisting of licensed amateur radio operators who use ham radio to support military communications.

- Research question: Can the Army-MARS Amateur Radio System provide BHEPP with backup digital communications for critical information exchange during disasters?

- Goal: Leverage ham radio resources for last-resort data communications.
Virtual World Disaster Training

- Will evaluate use of a virtual world platform to enhance BHEPP emergency training
- Will use 3-D mapping to enhance emergency training and planning
The Lost Person Finder Project

Mr. Michael Gill
Electronics Engineer, Communications Engineering Branch,
Lister Hill Center for Biomedical Communications,
National Library of Medicine
The Problem: Family Reunification During Disaster

- Local or wide-area displacements of people
- Hospitals often a focal point
- Face flood of inquiries about the missing and injured
- Staff are busy with patient surge
Attributes of the Lost Person Finder Solution

- A system to register, search, and notify
- Low-impact on staff, direct access by public
  - Operated by self, family member, volunteer, family reception staff
  - Automatically gets data from hospital IT systems
  - Passive notification + active search
  - Registration: “lost”, “found”, “last seen”, who to notify
  - Photos vital, may be only info available
    - Previously captured: lost persons
    - Newly captured: disaster victims
- Web and personal devices offer alternative sources of obtaining information and ways to contact
Web and Personal Device Alternatives

- Sources of photos, IDs, and other info
  - Cell phone as input
    - Text messaging, photo upload
  - Existing web sites
    - Employer, Hobbies, Volunteer agencies
    - Social networking (LinkedIn, MySpace, FaceBook, etc.)
    - Blogs
    - Personal photo-sharing albums (e.g., Flickr, SnapFish)
  - Photo scanners upload to web site

- Notification
  - Email, text messaging, RSS feed
Lost Person Finder Assumptions

- Sources of data will be mainly public domain
- Primary focus on partnership hospitals
  - Interface via “Disaster Patient Data Exchange” to 3 hospital IT systems
  - Possible extensions to broader region
- Public web-based solution
  - NLM/CEB hosts system initially
- Initial Connectivity by public and assistants
  - Laptops with Wi-Fi or cellular Internet access inside/outside BHEPP sites
- Suburban Hospital initial BHEPP test site
Lost Person Finder
Concept Architecture

Field Admissions / Routing / Decontamination

- Pedestrians and Self-referrals
- Emergency Vehicles
- Suburban Hospital
- Navy Medical
- NIH Clinical Center

Admissions / IT
Admissions / IT
Admissions / IT
Lost Person Finder
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- Admissions / IT

- Disaster Patient Data Exchange

- RFID Patient Tracking
- RxHub
- Other RHIOs

Other RHIOs

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Lost Person Finder
Concept Architecture

Field Admissions / Routing / Decontamination

Pedestrians and
Self-referrals

Emergency
Vehicles

Suburban
Hospital

Navy Medical

NIH Clinical
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Admissions / IT

Admissions / IT

Admissions / IT

Disaster Patient Data Exchange

Lost Person Finder Database/Web Site

On-site Family and Friends

Notification
Walls

Stations to
Search, Upload
Photos, Say “We’re
Here”

Off-site Family and
Friends (by PC, PDA,
Cell Phone)

Query by Name,
Address, Description, Face,…

Upload Photos,
Information, Say “We’re Here”

Search Results:
Name, Photo, Location, …
One Starting Point: Sahana

- Built as a response to 2004 Asian tsunami
- Used in subsequent major disasters
- Free and open source software
- Customizable and extensible

www.sahana.lk
Sahana Elements to be Investigated

- Missing Person Registry
- Organization Registry
- Camp Registry
- Administration / Data Exchange
- Other Elements
  - Request Management System
  - Inventory Management System
  - Catalog System
  - Volunteer Management System
  - Situational Awareness
Notification Wall Concepts: Exterior Temporary Installation

- Weather-proof monitors
- Carried, wheeled, or trucked out
- Sits on pavement, storage box, cart, or table; hung from fence
Notification Wall Concepts: Exterior Mobile Installation

- Permanent vehicle or trailer mounting
- Could be vehicle-powered
Notification Wall Concepts: Exterior Permanent Installation

- Weather-proof displays
  - Mounted on separate pedestal
  - Mounted on or recessed into building or perimeter wall

- Inside, outward-facing through-glass displays
- Can be paired with room-facing monitors
Notification Wall Concepts: Interior Permanent Installation

- Dual-use (emergency and routine)
- Over entries, along walls, or on pedestals
Notification Wall Concepts:
‘Fish-Eye’ View for Large Numbers of Photos

- Small photos enlarge as screen scrolls
- Allows many photos to be displayed
Multiple Fish-Eye Photos

- Moving expansions shows photos compactly

Men

Women

Children
Discussion