Hospital Preparedness a Decade after 9/11:
Progress and Remaining Challenges

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OUTLINE

- Progress in hospital preparedness
- Coalitions
- Challenges in hospital preparedness
  - Programmatic
  - Operational
- Our ongoing projects
ARE HOSPITALS BETTER PREPARED NOW THAN A DECADE AGO?

• If so,
  – In what ways?
  – What has motivated the improvement?
  – What remains to be done?

• We were tasked with answering these questions
  – Resulted in a series of 2 major reports and 3 minor reports
  – And spurred some ongoing projects
Assessment of the progress in healthcare preparedness for mass casualty disasters achieved as a result of the first 5 years (2002-2007) of the HPP
The Next Challenge in Healthcare Preparedness: Catastrophic Health Events

January 2010

- Description of capabilities of a prepared healthcare system
- Analysis of current response strategy and structure
- Recommendations to built on current successes and existing structures to make all-hazards healthcare preparedness and response scalable to include catastrophic health events
- Provisional assessment criteria for ongoing assessment of progress towards these national preparedness and response capability goals
HOSPITAL PREPAREDNESS IN THE OLD DAYS...

- “Disaster preparedness” = food, shelter, and $ for displaced persons; cleaning up and rebuilding----not medical
- Few large-scale disasters in US in 20th century. 1900 Galveston hurricane, 1906 San Francisco earthquake, and 1918 influenza pandemic all preceded era of modern hospitals.
- Before 2001, the JC standards focused on protecting facilities and ensuring continuity of operations during natural disasters (e.g., floods and hurricanes); part of Environment of Care standards
- Hospital planning for multiple casualties generally focused on the response of individual hospital emergency departments.
HAS HOSPITAL PREPAREDNESS IMPROVED?

- How to define hospital preparedness?
  - “You know it when you see it”
  - Social science approach: Look for concurrence in the individual judgments of a large sample knowledgeable people (Consensus of expert opinion)
    - Cross-walk of 5 published comprehensive lists of elements of preparedness from authoritative sources
# Consensus Elements of Hospital Preparedness

## Crosswalk of Elements of Preparedness

<table>
<thead>
<tr>
<th>Element</th>
<th>APIC</th>
<th>CDC</th>
<th>AHRQ</th>
<th>JC</th>
<th>HPP</th>
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<tbody>
<tr>
<td>Planning and Process:</td>
<td></td>
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<td>A written disaster plan</td>
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<td>Leaders and medical staff involved</td>
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<td>A multidisciplinary disaster committee</td>
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<td>All-hazards planning</td>
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<td>CBNE plans</td>
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<td>Includes mitigation activities</td>
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<td>Collaborate with EMA for planning</td>
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<td>Collaborate with suppliers for planning</td>
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<td>Collaborate with RMS for planning</td>
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<td>Collaborate with public health for planning</td>
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<td>MOU with other hospitals/facilities</td>
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<td>Plans for both internal and external events</td>
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<td>A hazard-vulnerability analysis</td>
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<tr>
<td>Coordinated with community</td>
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<tr>
<td>Disaster coordinator</td>
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<td>Annual reviews of plan</td>
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<td>Command and Control:</td>
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<tr>
<td>An incident command system</td>
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<td>Integrated with community</td>
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<td>A command center</td>
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<td>Plan activation—how and who</td>
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<tr>
<td>Regional sharing of assets and resources</td>
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<td>Surges</td>
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<td>Early discharge of patients</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Cancellation of elective surgery</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Open ancillary space</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Use alternative care facilities</td>
<td>x</td>
<td>x</td>
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<td>Consider special populations</td>
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<td>x</td>
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<td>Consider psychosocial needs of patients and families</td>
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<td>x</td>
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<tr>
<td>Bolster medical records capacity</td>
<td>x</td>
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HAS HOSPITAL PREPAREDNESS IMPROVED?

• How to define hospital preparedness?
  – Compared this cross-walk to findings from published AAR of actual disasters
    • Also closely correlated
  • Merged the common elements and added findings from tabletop exercise of a catastrophic disaster
  • This became our working definition of preparedness
HAS HOSPITAL PREPAREDNESS IMPROVED?

How to measure improvement?
- Until 2007, HPP reporting was incomplete and inconsistent
- 2 approaches:
  - Semi-quantitative: compared studies of hospital preparedness before and after 2002
  - Qualitative: (social science approach--concurrence in the individual judgment of a large sample)--Nationwide series of semi-structured interviews
STUDIES OF HOSP PREP BEFORE AND AFTER 2002

• 1995-2001: 7 studies of “WMD preparedness”
  – No studies of basic emergency preparedness
  – Prior to 1998, little mention of BT, emphasis on Haz Mat
  – Minority of hospitals had WMD plans, training or exercises (esp bio)
  – Little collaboration with neighboring hospitals or emergency agencies

• 2001-2002: 4 studies
  – A great deal of planning after 9/11
  – Less training
  – Some exercises
  – Very limited purchasing or hiring

• 2001-2006: 7 studies
  – More collaboration
  – More training
  – Purchase of PPE, communications and decon equip
NATIONWIDE SERIES OF INTERVIEWS

• 2008: Over 1 year conducted ~150 hours of interviews with over 130 preparedness professional in all fifty states and major cities and territories
  – Including 14 site visits

• Brought 21 of these people together along with senior federal officials for a day-long discussion of issues
FINDINGS

- The state of preparedness of individual hospitals improved significantly from 2002-2008

- Coalitions, consisting of healthcare institutions and local and state agencies, are emerging across the country
  - Healthcare Coalitions are essential to effective regional responses to commonly occurring mass casualty events that overwhelm an individual hospital
  - Healthcare Coalitions are creating a foundation for both local and national healthcare preparedness

- Planning for catastrophic health events, including crisis standards of care, was mostly lacking
WAYS IN WHICH INDIVIDUAL HOSPITALS WERE BETTER PREPARED

- Appointed emergency managers
- More comprehensive planning
- Better training
- More realistic exercises and use of AAR
- Better information and communication tools
- Adoption of ICS
- Purchase of essential equipment
- Consideration of alternate care sites
- Consideration of changes in standards of care
RHODE ISLAND NIGHTCLUB FIRE

Example of improved hospital preparedness
February 20, 2003  The Station nightclub Warwick RI
THE STATION NIGHTCLUB FIRE

Victims jam the main exit of The Station
RHODE ISLAND HOSPITAL RESPONSE

• 215 patients treated at a dozen hospitals throughout Rhode Island and neighboring Massachusetts.
• 79 of these patients were admitted, many severely burned.
• Rhode Island Hospital received 64 patients over 2 hours, 45 of whom were in critical condition, but none of them died.
• Of the 215 patients treated in hospitals, 4 died.
• Clinicians and administrators at these hospitals attributed this remarkable outcome to the planning and drills that they had conducted since 9/11.
• Yet, after-action reviews indicated many areas for improvement particularly in communications and area-wide coordination.
“HEALTHCARE COALITION”

A formal collaboration among hospitals that includes public health. May include other healthcare entities. Close relationship with EMS and EMA. Should have role in both preparedness and response.
HEALTHCARE COALITIONS (MSCC TIERS 2-4)

- **Federal response (regional and national)**
  - **State A**
  - **State B**
    - **Jurisdiction I (PH/EM/public safety)**
    - **Medical Support**
      - **HCFA**
      - **HCFA**
      - **HCFA**
      - **HCFA**

- **Federal response (support to state and locals)** TIER 6
- **Interstate regional coordination (management coordination and mutual support)** TIER 5
- **State response and coordination of intrastate jurisdictions (management coordination and support to jurisdictions)** TIER 4
- **Jurisdiction incident management** TIER 3
- **Healthcare “coalition” (info sharing; cooperative planning, mutual aid)** TIER 2
- **Healthcare asset management** TIER 1

*HCFA = Healthcare Facility Asset (eg, hospital)  PH = Public Health  EM = Emergency Management*
IMPORTANT CHARACTERISTICS OF HEALTHCARE COALITIONS

- Include at least all hospitals, public health and emergency management agencies, and EMS; formally linked (e.g., by MOUs)
- Conduct joint threat assessment, planning, purchasing, training, and drills
- Serve as an information clearinghouse with systems for tracking patient load and assets
- Have a formal role in local/state incident command system
- Coordinate volunteers in healthcare settings
- Provide forum for decisions regarding allocation of resources
- Coordinate alternate care facilities
PRELIMINARY EVIDENCE OF COALITION VALUE:
EVENTS WHERE COALITIONS IMPROVED RESPONSE*
(*EXAMPLES FROM HPP INTERVIEWS AND HFPP REVIEWS)

- **Virginia Tech shooting (2007):** Southwest Virginia Healthcare Coalition
- **Minnesota bridge collapse (2007):** Regional Hospital Resource Center
- **Tulsa tornados & ice storm:** Medical Emergency Response Center
- **Seattle snow storm (2008):** Seattle-King County Healthcare Coalition
- **Hurricanes Gustav & Ike (2008):** Galveston, Texas
- **Alaska RSV outbreak (2008):** All Alaska Pediatric Partnership
- **Southern California wildfires (2005):** Disaster Resource Centers
- **Florida hurricanes, wild fires, & race horse poisoning:** Palm Beach, FL, Healthcare Emergency Response Coalition
PRELIMINARY EVIDENCE OF COALITION VALUE: H1N1 (2009)

- **Seattle, Northern Virginia, NYC, Los Angeles, and Connecticut** activated medical coordination centers
  - Collected healthcare situational awareness data
  - Coordinated plans to distribute/use stockpiled antivirals
  - Translated, coordinated, and distributed clinical guidance
  - Coordinated messages to media

- **UC Davis Emergency Care Coalition**
  - Initiated rural telemedicine connection to coalition hospitals to support care of critically ill H1N1 patients
WHAT OTHERS HAVE FOUND SINCE 2008

• CDC, National Health Statistics Report, 2011
  – Nearly all hospitals had response plans for natural disasters, epidemics and chemical, and biological incidents
  – most hospitals had plans for cancellation of elective procedures and admissions,
  – most hospitals had MOUs with other hospitals to transfer adults during an epidemic,
  – 2/3 had plans for alternate care areas with beds, staffing, and equipment.
  – 1/2 of hospitals planned for alternate care areas in inpatient hallways or decommissioned ward space, or for conversion of inpatient units to augment intensive care.
  – 1/2 of hospitals had adjusted standards of care for allocation of mechanical ventilators for mass casualties.
  – 1/2 of hospitals had staged epidemic drills,
  – 1/2 of hospitals planned for advance registration of health care professionals
UNKNOWN NUMBER OF COALITIONS

• How many are there and what do they look like?
• Our survey
  – Statistically valid national survey of ~4000 hospitals
  – In cooperation with AHA and HPP
  – Whether they are part of a coalition
  – Describe the degree of collaboration with other hospitals and agencies
Challenges Going Forward
PROGRAMMATIC CHALLENGES FOR HOSPITAL PREPAREDNESS

• Shrinking federal funding
  – Tension between funding for individual hospitals vs coalitions or state or regional activities
  – Competing priorities
    • Hospital: preparedness vs new CT scanner
    • PH: preparedness vs childhood immunization

• Diminished perception of threat

• To justify ongoing funding, must demonstrate effectiveness
  – Does preparedness save lives or cut losses?
    • Can you prove it?
  – What is the best way to measure progress in preparedness?
    • Process measures vs outcome measures
CLINICAL/OPERATIONAL CHALLENGES FOR HOSPITAL PREPAREDNESS

• Contagious infectious diseases e.g., SARS
  – The threat to hospitals and HCWs
  – Hospitals as disease amplifiers

• Catastrophic health events (e.g., nuclear detonation, or large scale anthrax attack)
  – How do we harness the huge capacity of our healthcare system to save the most lives
SARS

- 8098 cases
- 774 deaths
- ~10% case fatality rate
- 1,707 (21%) were healthcare workers (HCW)
HONG KONG

- 1755 cases
- 302 deaths
- 405 HCW
  - Prince of Wales 85 HCW
  - Princess Margaret 62 HCW
    - >600 SARS patients
  - Alice Ho Min Ling 40 HCW
BEIJING

>2,500 cases
3 superspreading chains
77 cases from one 62yo woman admitted for DM control (hospital acquired)

20% fatality rate
SINGAPORE

238 cases, 33 deaths, 97 HCW, 88% nosocomial

5 super spreaders
Toronto

Sui-Chu Kwan
76 yo F

Tse Chu Kwan
43 yo son

Scarborough Grace Hospital

Obviously sick
Dx. CAP
No beds
Stays in ED 18 hours
Toronto

76 yo F

44 yo son

Scarborough Grace Hospital

Patient B
- 12 HCW
- 2 patients
- wife

Patient C
- 7 HCW
- wife

4 family members

Other hosp

Other hosp

4 HCW
- 8 HH
- 1 visitor

4 HCW
- 7 visitors
- 5 HH
- 1 patient

2 HCW
Scarborough Grace Emergency Department
March 16
Aerosol-generating Medical Procedures

- Toronto family physician examined 3 members of a family with symptoms of a respiratory virus
  - April 4: Onset of symptoms
  - April 13: ICU
    - Non-invasive positive pressure ventilation (BiPAP)
    - Intubation (assist-control ventilation)
    - Frothy secretions that obstructed ventilator tubing, requiring disconnection and drainage
    - Switched to high-frequency oscillatory ventilation for 7 days
    - All staff wore N-95 masks, gowns, gloves, goggles
TABLE. Characteristics of 11 health-care workers who developed symptoms of Severe Acute Respiratory Syndrome (SARS) following exposure to the index patient during the time of his intubation — Toronto, April 15–18, 2003

<table>
<thead>
<tr>
<th>Health-care worker</th>
<th>Symptom onset date</th>
<th>Suspect or probable SARS case</th>
<th>Occupation</th>
<th>Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>April 15</td>
<td>Suspect</td>
<td>Respiratory therapist</td>
<td>Provided care before, during, and after intubation in ICU*</td>
</tr>
<tr>
<td>2</td>
<td>April 16</td>
<td>Suspect</td>
<td>ICU nurse assigned primarily to another patient</td>
<td>Provided care before, during, and after intubation in ICU</td>
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<td>3</td>
<td>April 16</td>
<td>Suspect</td>
<td>ICU primary nurse</td>
<td>Provided care before, during, and after intubation in ICU</td>
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<td>4</td>
<td>April 16</td>
<td>Suspect</td>
<td>Respiratory therapist</td>
<td>Provided care before, during, and after intubation in ICU</td>
</tr>
<tr>
<td>5</td>
<td>April 16</td>
<td>Probable</td>
<td>Ward physician</td>
<td>Examined patient on ward during morning of April 13</td>
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<tr>
<td>6</td>
<td>April 17</td>
<td>Probable</td>
<td>ICU physician</td>
<td>Provided care before, during, and after intubation in ICU</td>
</tr>
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<td>7</td>
<td>April 17</td>
<td>Suspect</td>
<td>ICU charge nurse</td>
<td>Provided care before, during, and after intubation in ICU</td>
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<td>8</td>
<td>April 18</td>
<td>Suspect</td>
<td>ICU physician</td>
<td>Examined patient on ward during early morning of April 13</td>
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<tr>
<td>9</td>
<td>April 18</td>
<td>Suspect</td>
<td>Radiology technician</td>
<td>Provided care after intubation in ICU</td>
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<td>10</td>
<td>April 18</td>
<td>Not a case†</td>
<td>ICU nurse assigned primarily to another patient</td>
<td>Provided care before intubation in ICU</td>
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<tr>
<td>11</td>
<td>April 21</td>
<td>Not a case§</td>
<td>ICU physician</td>
<td>Provided care before intubation in ICU</td>
</tr>
</tbody>
</table>

* Intensive care unit.
† Illness marked by headache, cough, and diarrhea but without fever.
§ Illness marked by cough and infiltrate on chest radiograph but without fever.
Toronto SARS II

- 5 cases pneumonia in Rehab hospital
- 8 cases unsuspected SARS
- 30 HCW
- 96 yo M Pelvic fracture
- Nurse working with a “cold”
- Mother infected at another hospital
- North York General
- 5 cases pneumonia in Rehab hospital
• 258 cases
• 44 deaths
• 50% HCW
• 77% nosocomial
• 25,000 quarantined
• 200 hospitals cancelled all elective procedures for 4 days
• Offices closed to unnecessary visits
• 3 hospital closed to all but SARS patients for average of 3 weeks
HOSPITAL AMPLIFICATION

Modern medical care may worsen contagious disease outbreaks (hospital as a disease amplifier)

• Precedents:
  – Smallpox (Meschede, Germany 1970)
  – Ebola (Kikwic, Congo 1995)

• Implications for other diseases
  – Influenza
  – Plague
CATASTROPHIC HEALTH EVENTS

• A disaster in which overwhelms the medical capacity of an entire region
• Thousands of patients
• Examples:
  – Large scale bioterrorism
  – Nuclear detonation
  – Large earthquake
  – Severe pandemic
CATASTROPHIC HEALTH EVENTS:

• Anthrax
• Nuclear detonation

• Issues:
  – How to scale up
  – Triage, transport, treatment
  – Crisis standards of care
  – NDMS role
  – International aid
ANTHRAX
NATIONAL PLANNING SCENARIO

330,000 individuals “exposed” in covert aerosol release in large city (let’s say DC)

Scenario projects 13,000 cases of inhalational anthrax, most requiring critical care

Center for Biosecurity
NATIONAL CAPITOL REGION: EXISTING HOSPITAL SURGE CAPACITY

• Expected need
  – ~13,000 hospital beds—mostly ICU

• ~40 hospitals within 20 miles
  – Assume 30% surge available within 24 hours
    • 3000 beds
    • 400 critical care beds

• Big triage problem
  – A large proportion of the population will seek medical care
  – No system or rapid diagnostic testing for triage

• Big treatment problem
  – To get to 13000 beds, would need all the surge capacity from Philadelphia to Norfolk
NUCLEAR NATIONAL PLANNING SCENARIO: 10-KILOTON IMPROVISED NUCLEAR DEVICE
THE ACUTELY INJURED WOULD OVERWHELM AREA HOSPITALS

Victims:
- 9,000 instantaneous deaths
- 19,000 injured from the blast, burns, trauma, and radiation
  - 6,000 die in <24 hours
  - 13,000 acutely injured people survive
- Many thousands more with glass injuries, car accidents, etc.
- An additional 120,000 people exposed to significant fallout will start to become sick over 1-14 days (most will need hospital care)

Hospital Capacity:
- 4 hospitals are destroyed or nonfunctional (65% of DC capacity)
- Estimated surge capacity of the remaining 36 NCR hospitals: 2,400
PROBLEMS DERIVED FROM CHE SCENARIOS

- Local hospitals are at risk of becoming quickly dysfunctional and may be unable to care for the sick and injured
- The need for critical care services will far exceed the local and geographically contiguous regional capacity
- Triage/first aid centers will be needed immediately and in large numbers
- Screening will be needed for patients who might have had significant exposures (radiation, combined injury, incubating anthrax), but no rapid diagnostics exist
- Deployable medical resources are too few and too slow
- Local, state and federal governments do not have sufficient situational awareness capabilities or transportation capacity to move patients to where they can get care and track them
  - ~13,000 in both scenarios will need to be moved within 100 miles
  - In the nuclear scenario, an additional 100,000 patients with ARS will need to be transported to hospitals beyond 100 miles before they become critically ill
STRATEGIC CHALLENGES IN HEALTHCARE RESPONSE TO CATASTROPHIC HEALTH EVENTS

1. No national plan or infrastructure exists for coordinated action by multiple public and private parties across jurisdictions for immediate response to save lives.

2. There is no mechanism to achieve situational awareness needed to coordinate all public and private healthcare resources and to manage and track distribution of patients.

3. Current transport plans and resources are grossly inadequate to move the expected number of patients in time to save lives and maintain essential healthcare services.

4. Incident management structures may be inefficient early on in a very large scale event due to inadequate situational awareness, long chains of authority, overwhelmed decision makers, and “analysis paralysis”.

5. Large parts of the healthcare sector (e.g., urgent care and surgical centers, long term care facilities) are not well integrated into disaster preparedness systems; they may provide additional surge capacity and maintain essential medical services.
POSSIBLE SOLUTIONS

1. Promote fully functional healthcare coalitions in every community

2. Ensure close operational relationships between neighboring healthcare coalitions (even across state lines) for mutual aid to supplement state and federal incident command systems

3. Incentivize all healthcare entities to participate in healthcare coalitions for disaster response

4. Create a patient transportation system that harnesses private sector resources

5. Create a *National* (not federal) concept of operations plan for healthcare response to a catastrophic health event down to the local level
IN CONCLUSION

• We have made much progress over a decade, but much left to do
• Ongoing projects:
  – National survey of coalitions
  – Harnessing commercial clinical labs for mass assessment of radiation dose
  – Crisis standards of care
  – International “medical mutual aid” for catastrophic health events
  – Systematic review of disasters
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Center for Biosecurity