Challenges and Guidance Associated with Hospitals/Mass Medical Care Sites in Neighboring Jurisdictions

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Institute of Medicine: Nationwide Response Issues after an Improvised Nuclear Device Attack: Medical and Public Health Considerations for Neighboring Jurisdictions
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This presentation is the opinion of the presenter and does not represent ASPR, HHS or the Federal Government.
Outline of presentation

• Systems-based approach
• Response organization & situational awareness resources
  – Spatial- RTR system and MedMap
  – Tools for preparedness & “just-in-time” use- REMM, Playbooks
• Enhancing the federal response
  – Radiation Injury Treatment Network -RITN
  – Bulking up local inventories- User-managed Inventory (UMI)
• Scarce resources setting
  – Triage guidance
  – Diagnostics and Integrated Laboratory Network
• Challenges and opportunities

Many acknowledgments
Expertise required for comprehensive medical response to radiation incident

Complex system with many interrelated parts

Science and research based, peer review publication

Molecular & cellular biology → Tissue & organ biology → Damage repair & inflammation

Basic science

Applied science & medical experience

- Medical countermeasure
- NIAID, BARDA, DOD
- Medical management
- REMM (NLM/HHS)
- Rad Lab N

Triage → Transportation

Fatality management

- Local, regional and national through Regional Emergency Coordinators
- Radiation Injury Treatment Network (RITN); & NDMS
- REMM

Medical expert care

Long term management

International partners

Response system

MEDMAP

RTR

MC

AC

Rad Lab N

REMM

Annal Emerg Med 53:213, 2009
Acute Radiation Syndrome (ARS) and Delayed Effect of Acute Radiation Exposure (DEARE)

- Continuum of injuries - Multi-organ injury
- Time to clinical manifestation depends on organ system and dose

**Phases: Prodrome → Latent → Manifest**

Organ syndromes

- Hematological (>2 *Gy)  few days to 2 months
- Gastrointestinal (>6 Gy)  few days to a week
- CNS/Cardiovascular (>10 Gy)  immediate
- Cutaneous (>6 Gy)  few days to weeks
- Combined injury  immediate
### Distribution of casualties from Nuclear Detonation modeling (from a series of models)

<table>
<thead>
<tr>
<th>Injury Type</th>
<th>Category</th>
<th>Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>50%ile</td>
</tr>
<tr>
<td><strong>Trauma (ISS Score)</strong></td>
<td>Mild (1-9)</td>
<td>20,000</td>
</tr>
<tr>
<td></td>
<td>Moderate (10-14)</td>
<td>34,000</td>
</tr>
<tr>
<td></td>
<td>Severe (&gt;15)</td>
<td>14,000</td>
</tr>
<tr>
<td><strong>Radiation (Dose in cGy)</strong></td>
<td>Mild 75-150 cGy</td>
<td>4,000</td>
</tr>
<tr>
<td></td>
<td>Moderate 150-530 cGy</td>
<td>6,000</td>
</tr>
<tr>
<td></td>
<td>Severe 530-830 cGy</td>
<td>3,000</td>
</tr>
<tr>
<td></td>
<td>Expectant &gt;830 cGy</td>
<td>5,000</td>
</tr>
<tr>
<td><strong>Combined Injury (Rad Dose &gt; 150 cGy)</strong></td>
<td>Trauma and/or Burn (Mild – Severe)</td>
<td>2,000</td>
</tr>
</tbody>
</table>
Structural, radiation and medical response zones (based on situational awareness)

<table>
<thead>
<tr>
<th>Site</th>
<th>Radiation</th>
<th>Physical damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTR 1</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>RTR 2</td>
<td>√</td>
<td>0</td>
</tr>
<tr>
<td>RTR 3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Site | Predetermined site  
--- | -------------------  
MC | Medical care  
AC | Assembly center  
EC | Evacuation center

MedMap system

ASPR: Resilient People. Healthy Communities. A Nation Prep

Hrdina, Coleman, Knebel
MedMap - Multiple Layers and Tools
Rapid Situational Awareness

Olsen, Shankman
I – X: FEMA Regions
■ Primary Transplant Centers
► Primary Donor Centers
△ Cord Blood Banks
● Secondary Transplant Centers

NMDP - Radiation Injury Treatment Network RITN

RITN includes NCI Cancer Centers and is growing

Chao, Weinstock, Case

UMI- User Managed Inventory
Would supplement current supply modalities

USG oversight/coordination

Other agreements Internat’l partners

RITN, NDMS Non-gov’t system or network

DMI- Distributor Managed inventory

Manufacturer surge

Hatchett, Wallace, Casagrande, Cliffer
"What do I do?"


Koerner, Murrain-Hill
Action Steps

- Sequential guidance to coordinate the medical response to a nuclear detonation

- Detailed **time-phased, sector-oriented** approaches to response activities with linked **references**.
  - General Readiness Planning and Emergency Management
  - Emergency Medical Services (EMS)
  - Health and Facility Response, Public Health
  - Medical System Response
  - Evacuee Medical Care and Fallout-related Illness
  - Recovery
Serial re-assessment is key as resources change and clinical presentation evolves

- Sort
- Assess
- Life-saving intervention
- Treat, transport, triage

**Immediate**

**Delayed**

**Minimal**

**Expectant**

**FOR Nuc Det**: There will be *Serial Assessments*; triage category may change for an individual- either better or worse.

Radiation-only injuries may require multiple blood samples as well as assessing clinical course.
Standards of Care (IOM report)

Incident demand / resource imbalance increases  
Risk of morbidity / mortality to patient increases

<table>
<thead>
<tr>
<th>Space</th>
<th>Conventional</th>
<th>Contingency</th>
<th>Crisis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space</td>
<td>Usual patient care space fully utilized</td>
<td>Patient care areas re-purposed (PACU, monitored units for ICU-level care)</td>
<td>Facility damaged / unsafe or non-patient care areas (classrooms, etc) used for patient care</td>
</tr>
</tbody>
</table>

| Staff | Usual staff called in and utilized | Staff extension (brief deferrals of non-emergent service, supervision of broader group of patients, change in responsibilities, documentation, etc.) | Trained staff unavailable or unable to adequately care for volume of patients even with extension techniques |

| Supplies | Cached and usual supplies used | Conservation, adaptation, and substitution of supplies with occasional re-use of select supplies | Critical supplies lacking, possible re-allocation of life-sustaining resources |

| Standard of care | Usual care | Functionally equivalent care | Crisis standards of care |

Indicators: potential for crisis standards

Triggers: crisis standards of care

1) Unless temporary, requires state empowerment, clinical guidance, and protection for triage decisions and authorization for alternate care sites / techniques. Once situational awareness achieved, triage decisions should be as systematic and integrated into institutional process, review, and documentation as possible.

2) Institutions consider impact on the community of resource utilization (consider ‘greatest good’ vs. individual patient needs – for example, conserve resources when possible) but patient-centered decision-making is still the focus

3) Institutions (and providers) must make triage decisions balancing the availability of resources to others and the individual patient’s needs – shift to community-centered decision-making

IOM Letter Report, September 2009
The graph illustrates the relative number of victims saved per victim loading, showing the impact of triage strategies on outcomes.

**Model of Resource and Time-Based Triage (MORTT)**

- **Sev Mod Mild**
- **Mild Mod Sev**
- **Mod Sev Mild**
- **No Triage**

The graph indicates that taking moderate cases first (Moderate first) can lead to a higher number of victims being saved compared to other triage strategies, especially under high victim loading (10x over baseline).

Cassagrande, Scarce
Resources for Nuc Det project
Standards of care will vary by location and time after incident.

Operative standard of care:
- Conventional
- Contingency
- Crisis

Relative availability of resources:
- Normal
- Excellent
- Good
- Fair
- Poor

Days after detonation:
- Distant referral center
- MC 100 miles away
- MC 20 miles away
- MC 2 miles away
- RTR1

Overarching ethical principal - Fairness

Optimizing fairness for triage and treatment decisions

Optimizing Fairness for Triage and Treatment Decisions
Triage Considerations

Need (Patient-based issues)
- Medical condition, possibly modified by comorbidity or other factors that affect survival (but not judgments about quality of life)
- Special population
- Urgency for response—likely to die

Effectiveness (Condition-based issues)
- Efficacy of intervention under ideal conditions
- Resource requirement vs. available resources:
  - Staff—Personnel
  - Stuff—Meds, equipment
  - Space—facilities
  - Existing patients already under care

and

Standards of care in effect:
Conventional → Contingency → Crisis

Triage Category and Treatment
Immediate: red
Delayed: yellow
Minimal: green
Expectant: black

Initial treatment
- Definitive
- Partial
- Palliative

Re-evaluate over time and change of resources. Triage category may change!

Subsequent treatment
- Definitive
- Palliative

Caro, DeRenzo, Scarce Resources project
Triage category affected by radiation dose and resource availability

**RADIATION ONLY**

- **Radiation Dose**
  - (Gy)
  - \( > 10^* \)
  - Likely fatal (in higher range)
  - \( 6 - 10^* \)
  - Severe
  - \( > 2 - 6^* \)
  - Moderate
  - \( > 0.5 - < 2^* \)
  - Minimal
  - \( <0.5^* \)
  - Minimal

- **Resource availability:** 
  - Normal
  - Conventional
  - Good
  - Contingency
  - Fair
  - Crisis
  - Poor
  - Crisis

- **On line tool available**
Triage category for **TRAUMA and COMBINED INJURY** affected by injury severity, radiation dose and resource availability

**Injury severity**

- **≥ Moderate trauma**
  - Radiation > 2 Gy
- **Severe trauma**
- **Moderate trauma**
- **Minimal trauma**

**Trauma only**

- Immediate
- Immediate
- Delayed
- Expectant

**Combined injury**

- Immediate
- Delayed
- Expectant

**BURN >15% TBSA worsens triage category 1 level**

**Resource availability**

- Normal
- Good
- Fair
- Poor

**Standard of care***

- Conventional
- Contingency
- Crisis

Coleman, Weinstock Scarce Resources project
Assessment of biodosimetry methods for a mass-casualty radiological incident: medical response and management considerations

I. Each assay– Dose range, Time to dose estimate, time period when results useable (Julie Sullivan, *Health Physics*, submitted)
   - Lymphocyte depletion kinetics
   - Premature chromosome condensation
   - Gene expression
   - γ-H2AX
   - Dicentric chromosome
   - Micronucleus
   - EPR

II. Develop Concept of Operations (CONOPS) for laboratory diagnostics for use after nuclear detonation (ASPR/OPEO- BARDA, PHEMCE)
   - How to co-locate people/victims, medical responders, diagnostics, medical countermeasures over time and space

III. Continue working on model and plans for Integrated Laboratory Network: real and virtual (just-in-time) network (ASPR, BARDA, CDC)
   - Gov’t labs (CDC), specialized biodosimetry (incl. int’l), commercial labs, RITN and cancer centers, local hospitals, etc.
New IND “response zones”

(NOTE - personal opinion for presentation purposes)

US, neighbors and partners

Extended regional

Regional
HHS Public Health Emergency Medical Countermeasures Enterprise (PHEMCE)

Science based: Content & Process

Science → Products → Concept of Operations → Playbooks → Diagnosis & Treatment Tools → Network of SMEs → Constant improvements

Goal- When disaster hits- we help you with “WHAT DO I DO!!!”

NIH → BARDA → BARDA and CDC → CDC → CDC and OPEO

Research and Development → Advanced Development → Acquisition → Biosurveillance/Storage/Maintenance → Deployment → Utilization

COORDINATED PLANNING & EXECUTION

FDA

Challenges - opportunities
(NOTE- personal opinion for presentation purposes)

- Models are useful but preparation and response are city/region specific - need regional-national model
- Familiarity with the various tools and systems is needed in advance- education, training (list-serves for updates)
- Scarce resources mitigation- work in progress
  - UMI (DMI)- establishing supply-line bubble needs a jump-start
  - Diagnostics- integrated laboratory network- nat’l & int’l
  - CONOPS needed so that diagnostics, MCMs and personnel are coordinated and used as effectively as possible
- Triage approach for scarce resources needs community decision, agreement and pre-planning
  - Fairness is essential across the region!
  - Further modeling based on injury survival and resources