Decontamination of Chemical, Biological, and Radiological Agents

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HCA Overview

- Accounted for approximately 5% of major hospital service in U.S.:
  - Admissions > 1.5 million
  - Patient Days > 7.6 million
  - Deliveries > 0.23 million
  - Total Surgeries > 1.3 million
  - ED Visits ~ 6 million
- 164 hospitals, 106 freestanding surgery centers, and 400 physician practices in 20 states and England
- Hospitals range from complex tertiary referral & academic medical centers to urban and suburban community medical centers
- ~ 194,000 employees
- 35,000 affiliated physicians
- More than 38,000 licensed beds
- ~ 150,000 Health Care Workers
Disaster Response

• 2001- Amerithrax
• 2005- Hurricane Katrina
• 2008- Hurricanes Gustav and Ike
• 2009- H1N1 Pandemic
• 2010- Haiti Earthquake, Nashville, TN Floods
• 2011- Hurricane Irene
• 2012-Virginia Storms, Hurricanes Isaac and Sandy, Fungal Meningitis Outbreak
Goal

• Discuss best practices for decontamination of patients exposed to chemical, biological, and radiological agents

• Discuss considerations during mass causality decontamination
Scope of Course

• Decontamination Overview
• Get Out of My Emergency Department
• Mass Causality Considerations
• Chemical Agent Decontamination
• Biological Agent Decontamination
• Radiological Agent Decontamination
Decontamination Defined

• Decontamination: A process that reduces toxic chemicals, pathogenic biological organisms, or radiological materials to levels that minimize the risk of (1) further harm to the victim and (2) cross contamination.

• Best Practices and Guidelines for CBR Mass Personnel Decontamination, DHHS, Sep 2004
Decontamination Methods

• There are two basic methods of decontamination
  – physical removal
  – neutralization

• Physical removal involves mechanical action with techniques such as gentle friction with a soft cloth or sponge, blotting, and washing.

• Neutralization involves methods and/or materials to counteract the harmful effects of the contaminant.
Decontamination Goals

• Remove the agent from the victim’s skin and clothing, thus reducing further agent exposure and physical effects.

• Protect emergency responders, medical personnel and others from secondary transfer exposures.

• Prevent victims from spreading contamination over additional areas.
Decontamination Steps

• 1. Initial Size-Up
• 2. Victim Control and Decontamination Triage
• 3. Decontamination Setup
• 4. Decontamination Execution
• 5. Post Decontamination
Step 1: Initial Size-Up

- Performed in accordance with standard guidelines for first responders when arriving at an incident scene.
- Perform a safety assessment and attempt to identify signs/symptoms of exposure to determine whether decontamination is necessary.
Step 2: Victim Control and Decontamination Triage

- Gain initial control of the victims and direct them to area(s) of safe refuge so responders can provide guidance and instruction.

- Decontamination triage involves separating victims into prioritized groups for decontamination.

- Rapidly identifying victims who may not require decontamination can significantly reduce the time and resources needed to perform decontamination.
Step 3: Decontamination Setup

- Establish incident scene zones and set up the actual decontamination site.
Step 4: Decontamination Execution

- Perform decontamination
- Identification of victims who have been decontaminated and directing them to an area(s) of safe refuge for observation
- Decontamination with an emulsifier such as soap may be necessary if an oily liquid hazard (e.g., sulfur mustard) is involved and initial decontamination is performed with water only.
- Use of a soap-water solution is best for physical removal of all hazards.
Step 5: Post Decontamination

• Observe victims for delayed symptoms and evidence of residual contamination;

• Perform secondary decontamination as necessary; arranging for clothing/cover for

• Recover personal items (if possible);

• Transport victims to medical facilities for follow-on care.
Hospitals

- First receivers, not first responders
- Level C for unknowns is acceptable
- Do you decontaminate again?
- “Hi, I’m contaminated!”
  - come here
- A tale of two ricins
- Tent city
HOSPITAL DECONTAMINATION

- 44,000 events reviewed / 2,562 events affected hospital workers
- Fifteen (0.05%) events were identified in which secondary contamination occurred.
- At least 17 medical personnel were injured as a result of secondary contamination while they were treating contaminated victims.
- 12 were emergency medical technicians and 5 were hospital personnel.
- Respiratory irritation was the most common injury sustained.

Mass Causality Considerations

- DO NOT DELAY initial decontamination to set up decontamination tents, shelter tents, or to add soap.
- Three minutes is great, 30 seconds may be practical.
- Adequate spacing.
- Patients per hour?
- When the contamination involves oily, liquid chemical agent (e.g., sulfur mustard), rubbing without the aid of soap is not recommended.
Important Tips

• Removing clothes is the single most critical step in mass decontamination and **may** remove 80-90% of physical contamination.

• Do not delay removal of clothes or application of a high-volume, low pressure water shower to set up tents, additional equipment or to create a soap-water solution.

• Conduct decontamination triage prior to administering a high-volume, low-pressure water shower.
Important Tips

• Wash time should be between 30 seconds and three minutes, depending on the situation.

• When the contamination involves chemical vapors, biological or radiological material, using gentle friction, such as rubbing with hands, cloth or sponges is recommended to aid in removal of the contamination.

• Rubbing should start with the head and proceed down the body to the feet.

• Secondary decontamination should be performed as necessary.
Special Considerations

• Non-liquid
  – If responders suspect the contamination is biological, radiological, or a gas/vapor, a water-only shower is typically adequate.

• Liquid
  – A secondary decontamination shower that includes a soap-water solution will likely be required for liquid contamination to ensure effective physical removal of agent.
  – When removing liquid chemical contamination (e.g., sulfur mustard), rubbing without the aid of soap is not recommended as it may increase spread of the agent over a larger surface area of the body, resulting in increased medical risk.
Special Considerations

- Cold Weather
  - Above 36 degrees, water is fine, and the cold can be tolerated.
  - Below 36 degrees, use dry decon (wiping, blotting, clothi) and use water when at a heated facility.
Clothing

• Removal of clothing down to the undergarments may remove as much as 80-90% contamination from the victims.

• When most of the victim’s skin is covered with clothing, such as long pants and shirts, there is a greater likelihood of significant or total contamination removal.

• During warm weather when shorts and short-sleeve shirts are common, it is likely that a higher percentage of contamination will be directly on the skin of the victims.
Chemical Agents

- Include gross liquid, aerosol and vapor hazards
- Direct absorption of the chemical through the skin, and/or inhalation of aerosols and vapors.
- Effects may be immediate or delayed.
- For oily based chemical agents (e.g., VX nerve agent, sulfur mustard blister agent), decontamination with a water only shower may not remove all contamination from a victim’s skin.
Chemical Agents

• Applying gentle friction, especially without soap, to oily based chemicals could cause victims to spread the agent over a larger percentage of their body and increase medical risk.

• They MUST remove clothes!
Biological Agents

- Symptoms typically delayed.
- Liquid or dry powder agent.
  - Quality counts!
- May be psychological benefit only.
- Soap and water.
- NO BLEACH!!!
- Risk of reaerosolization is low, no need to wet clothing first.
Biological Agents
Radiological Agents

• Easiest to detect (with the right equipment).

• Typically, not immediate effects, you can treat first.

• Inhalation hazard.

• Risk of reaerosolization is low, no need to wet clothing.
## Radiation Doses and Dose Limits

<table>
<thead>
<tr>
<th>Procedure/Condition</th>
<th>Dose Limit (mrem)</th>
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<tbody>
<tr>
<td>Annual public dose limit</td>
<td>100</td>
</tr>
<tr>
<td>Annual natural background</td>
<td>300</td>
</tr>
<tr>
<td>Fetal dose limit</td>
<td>500</td>
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<tr>
<td>Barium enema</td>
<td>870</td>
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<tr>
<td>Annual radiation worker dose limit</td>
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<tr>
<td>Heart catheterization (skin dose)</td>
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<tr>
<td>Life-saving actions guidance (NCRP-116)</td>
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<td>Mild acute radiation syndrome</td>
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<tr>
<td>LD$_{50/60}$ for humans (bone marrow dose)</td>
<td>350,000</td>
</tr>
<tr>
<td>Radiation therapy (localized &amp; fractionated)</td>
<td>6,000,000</td>
</tr>
</tbody>
</table>
Radiological Agents

• Carefully remove and bag patient’s clothing and personal belongings (typically removes 95 percent of contamination).

• Survey patient and, if practical, collect samples.

• Handle foreign objects with care until proven nonradioactive with survey meter.

• Decontamination priorities:
  – Decontaminate wounds first, then intact skin.
  – Start with highest levels of contamination.

• Change outer gloves frequently to minimize spread of contamination.
Radiological Agents

- Protect non-contaminated wounds with waterproof dressings.
- Contaminated wounds:
  - Irrigate and gently scrub with surgical sponge.
  - Extend wound debridement for removal of contamination only in extreme cases and upon expert advice.
- Avoid overly aggressive decontamination.
- Change dressings frequently.
- Decontaminate intact skin and hair by washing with soap & water.
- Remove stubborn contamination on hair by cutting with scissors or electric clippers.
- Promote sweating.
- Use survey meter to monitor progress of decontamination.
Radiological Agents

• Cease decontamination of skin and wounds:
  – When the area is less than twice background, or
  – When there is no significant reduction between decon efforts, and
  – Before intact skin becomes abraded.

• Contaminated thermal burns
  – Gently rinse. Washing may increase severity of injury.
  – Additional contamination will be removed when dressings are changed.

• Do not delay surgery or other necessary medical procedures or exams . . . residual contamination can be controlled.
Radiological Agents

• Wound care, burn care, and surgery should be done in the first 48 hours or delayed for 2 to 3 months (> 100 rem).

• ALARA
Conclusion

• Do something now.
• Soap is good.
• No bleach.
• Water down to 36 degrees.
• Lots of people, or just a few, or something in between.