Summary: Symposium on Chemical Decontamination of Humans

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U.S. Department of Homeland Security (DHS)
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Final Report

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Handling Instructions

1. The title of this document is *Summary: Symposium on Chemical Decontamination of Humans.*

2. Any views or opinions expressed in this summary of proceedings are those of the individual symposium participants alone, and do not necessarily reflect the official position of the Department of Homeland Security, the Department of Health and Human Services, or their components.

3. The information presented in this symposium summary is unclassified.

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Executive Summary:

The Symposium on Chemical Decontamination of Humans was convened on December 6-7, 2010 by the Department of Homeland Security (DHS) Office of Health Affairs (OHA) and the Department of Health and Human Services (HHS) Office of the Assistant Secretary for Preparedness and Response. Emergency responders, scientific researchers, government planners and other relevant experts from within and beyond the Federal government participated in the event. The general purpose was to define the problem, by:

- Determining the scope of patient decontamination issues to be addressed by the federal government
- Defining and organizing the elements of mass patient decontamination in ways that will be meaningful for reviewing the evidence, developing planning guidance and identifying research needs.
- Assessing the literature review conducted to date for evidence to support patient decontamination practices.
- Identifying gaps in the evidence.
- Recommending next steps regarding patient decontamination planning guidance and research.

To open the Symposium, several critical concepts were presented in plenary session.

- Edward Budnick, Chief, Aberdeen Proving Ground Fire and Emergency Services, described lessons learned regarding patient decontamination on the military base (see Key Points, p.13).
- Dr. Mark Kirk, Director, Chemical Defense Program, DHS/OHA, reviewed toxicological principles that help explain why decontamination should be performed as soon as possible, how it can help to reduce the dose of contaminant received by the patient and therefore, how it potentially saves lives and mitigates adverse health effects (see Key Points, p.14).
- Dr. Michael Schwartz, HHS/Centers for Disease Control and Prevention/National Center for Environmental Health, discussed the lack of a defined outcome-oriented goal for mass patient decontamination and recommended that a specific goal be adopted as part of future national guidance or other policy (see Key Points, p.16).

The elements of mass patient decontamination were organized into two categories: one category focuses on decontamination of a single patient (individual decontamination) and the other addresses the situation in which multiple patients are potentially contaminated (mass patient decontamination). Within each category, three core questions were defined in order to guide the evidence review and future development of planning guidance. A breakout session was conducted for each core question, during which the current evidence to answer that core question (compiled through a literature review prior to the Symposium) was discussed and a list of research needs was initiated. Some of the most significant knowledge gaps are given here with the associated core question.

- Individual Decontamination
    - Core Question #1: What criteria are available to decide if the patient needs decontamination or not?

        - Knowledge gap: insufficient data are available to suggest the best criteria to determine the need for decontamination (see Key Points and Research Needs, p.20).
    - Core Question #2: What is the optimized procedure for definitive decontamination for a multi-peril scenario of unknown agent and unknown exposure?
        - Knowledge gaps: optimal parameters for water-based decontamination have not been determined (e.g., water pressure, temperature, duration); efficacy of clothing removal has not been quantitatively established (see Key Points and Research Needs, p.21).
    - Core Question #3: What is the metric for determining effective decontamination?
        - Knowledge gap: no validated metrics exist for assessing the effectiveness of decontamination (see Key Points and Research Needs, pp.22-23).
- Mass Patient Decontamination
    - Core Question #4: What is the best evidence-based method for assessment and triage of patients (both at the scene and at hospitals) to prioritize decontamination and medical treatment?
        - Knowledge gap: there is a lack of evidence to suggest the best criteria for prioritizing patients for decontamination (see Key Points and Research Needs, pp.25-26).
    - Core Question #5: Where and when should decontamination take place?
        - Knowledge gap: there is little evidence to suggest optimal mechanisms for disseminating information to the community in a mass casualty incident (see Key Points and Research Needs, p.27)
    - Core Question #6: What evidence-based, best-practice crisis communication techniques can best apply to a mass casualty chemical incident to promote patient compliance and safety during decontamination?
        - Knowledge gap: we currently have little understanding of the types of information and other support that could be provided to patients to promote safety and compliance with decontamination procedures (see Key Points and Research Needs, pp.28-29).

In conclusion, needs for near-term development of national planning guidance on how best to perform patient decontamination, based on existing evidence, and long-term filling in of knowledge gaps with research and other evidence, were discussed. Dr. David Marcozzi of the White House National Security Staff explained that there is high level concern about preparedness for chemical incidents and specific visibility on the topic of patient decontamination. Next steps were agreed upon: (1) develop evidence-based national guidance for conducting patient decontamination in a mass casualty chemical incident and (2) create a research roadmap to address the highest priority research needs.

Symposium on Chemical Decontamination of Humans Overview

Background:

The federal government considers chemical attacks perpetrated by terrorists and accidental releases of Toxic Industrial Chemicals (TICs) to be current threats to public health in the United States. Both types of incidents can expose significant numbers of people to dangerous chemicals. Patient decontamination, when performed using appropriate techniques and during the appropriate time frame, limits patient exposure and the toxicity that follows, and protects responders in pre-hospital and hospital settings from secondary contamination. Therefore, patient decontamination is an integral component of the medical response to a chemical incident.

Evidence-based planning and best practices for patient decontamination procedures are limited, leaving many basic questions about decontamination unanswered. For example, attempting to fully decontaminate every person near a chemical release will slow the identification, decontamination, initial medical management, and transport of seriously ill patients from the scene to hospitals. In this case, inappropriate decontamination protocols might hinder medical mitigation of morbidity and mortality. In addition, past chemical incidents demonstrate that scene perimeters will not be established quickly enough after the release to prevent a large number of people from leaving the scene. These potentially exposed people will show up at hospitals or other facilities without having been evaluated or decontaminated, often ahead of those more seriously ill. Thus, health care facility chemical event response plans should address such scenarios.

Homeland Security Presidential Directive (HSPD)-22, *Domestic Chemical Defense*, calls for the federal government to support the development of state and local plans and protocols for the decontamination of persons. In order to best accomplish this task, the federal government, through the Mass Human Chemical Decontamination Working Group, will attempt to ensure that state and local plans and protocols reflect current best practices. The working group will also identify decontamination issues in need of research and draft a strategic plan for addressing those research gaps.

Mass Human Chemical Decontamination Working Group:

The working group will assess the current capabilities and knowledge base with respect to patient decontamination practices and technologies, then the federal government will recommend methods to facilitate improvement in these areas.

Working Group Membership:

The Departments of Health and Human Services (HHS) and Homeland Security (DHS) co-chair the working group, which the White House National Security Staff Office of Science and Technology Policy facilitates. A wide array of expert participants from federal, state, and local agencies, including academia, military, and civilian emergency response and planning organizations are assisting with the review of the scientific literature and the drafting of national guidance on the chemical decontamination of humans. Appendix 1 is a list of organizations represented on the working group.

Symposium on Chemical Decontamination of Humans:

The purpose of the Symposium on Chemical Decontamination of Humans held on December 6-7, 2010 in Washington, DC, was to evaluate the current state of empirical and experimental evidence for human decontamination operations. The symposium brought together a wider audience than the working group, particularly the first responder and hospital-based responder communities, to review and discuss the evidence. Participation included multiple federal government agencies as well as members of state and local responder communities and academia. Appendix 2 is a list of symposium attendees.

Objectives of the symposium were:

- To assess the validity and completeness of the literature review conducted to date;
- To identify gaps and areas for improvement in the evidence base; and
- To recommend next steps with respect to research, decontamination planning guidance, and the working group's activities.

Based on the literature review conducted during the symposium, the working group will identify research gaps and prioritize future research to carry out. Furthermore, the conclusions arising from the symposium will also help to direct future activities for the working group.

Symposium Agenda:

1. Overview presentations on chemical defense practices, research data, and historical experience.
2. Breakout sessions:
    a. Assess results of the literature review for each of the six core questions developed by the working group;
    b. Identify and propose additional research to answer the six core questions

    Core questions were evaluated by reviewing published research and other types of reports (e.g., on actual events or exercises) relevant to each of the questions and deciding whether the body of literature was sufficient or that further research was warranted.
3. Reports from each breakout session to all symposium participants.
4. Discussion on path forward.

Opening Comments

Welcome:

Dr. Sue Cibulsky, Chemical Science Branch Chief and Acting Director, Division of Medical Countermeasure Strategy and Requirements, Office of Policy and Planning, Office of the Assistant Secretary for Preparedness and Response, Department of Health and Human Services, asserted that much work needs to be done in identifying gaps in the science supporting chemical defense efforts and determining evidence-based best practices for human decontamination. Evidence that currently exists should be identified and evaluated, and key gaps in knowledge must be documented. Symposium participants' feedback will assist in defining the key questions and reviewing the literature for science-based answers to those questions. After identifying scientific and knowledge gaps, the working group will create a research roadmap to describe high priority topics in need of investigation.

Dr. Cibulsky suggested that whether evidence is already available or emerges from future research commissioned specifically to close identified gaps, it should guide decontamination practices where possible. The working group will work to develop national guidance based on the best available evidence and consensus best practices. The process will allow for updating the guidance as new evidence becomes available.

Overview Presentation of the Meeting Objectives and the Process:

Dr. Mark Kirk , Special Advisor for Chemical Defense and Medical Toxicology and Director of the Chemical Defense Program, Office of Health Affairs, U.S. Department of Homeland Security, said that the working group had been in operation for about two years and was sponsored by two organizations: 1) the National Science and Technology Council's (NSTC) Committee on Homeland & National Security (CHNS) via the Subcommittee on Standards CBRNE (SOS-CBRNE), and 2) the Chemical Preparedness and Response Sub-Interagency Policy Committee (sub-IPC) led by the White House National Security Staff. This sub-IPC was established for the purpose of implementing Homeland Security Presidential Directive (HSPD)-22.

Dr. Kirk explained that HSPD-22 addresses all aspects of chemical defense. He added that the impetus for the working group's efforts was the HSPD-22 section that calls for the federal government to support the development of state and local plans and protocols for decontamination of persons. To accomplish this task, the working group should work to ensure that state and local plans and protocols incorporate current best practices, identify decontamination issues in need of research, and draft a strategic plan for addressing research gaps.

Working Group Scope and Philosophy:

The scope of this effort is limited to human decontamination after chemical contamination from an accidental or intentional release of a Toxic Industrial Chemical (TIC) or chemical warfare agent (CWA) that causes a mass casualty incident. While decontamination in biological, radiological, or nuclear incidents is important, the current effort does not encompass those threats. The working group views decontamination as a first aid procedure. The purposes of decontamination are to reduce:

- the amount of agent absorbed;
- symptom severity;
- the need for antidotes and medical support; and
- prevent secondary contamination of other people, equipment and facilities.

Furthermore, Dr. Kirk explained that expedient decontamination permits faster access to medical care, makes it possible for providers to avoid the hindrance of personal protective equipment (PPE), and allows for the use of supportive medical devices without their contamination or damage.

Dr. Kirk stated that this effort seeks to convert science and best practices into practical guidance that can be widely disseminated. Ultimately, the goal is to develop national guidance on mass human decontamination. This guidance will include a systems engineering approach to fitting solutions into a best practices model (or enhancement of current decontamination procedures such as Edgewood Chemical Biological Center (ECBC) guidelines), the development of new training standards to meet decontamination best practices, and a statement of science needs accompanied by a research roadmap.

Dr. Kirk emphasized that best practices and recommendations on some aspects of human decontamination are in place, but the working group should focus on analyzing existing practices and ascertain whether there is consensus on the validity of each approach. Once consensus has been achieved, the working group can move to recommend an approach for future guidance. Currently, in some respects, the answer to why certain decontamination procedures are used is "we've always done it this way" or "it just makes sense." Sometimes empirical or experimental evidence negates the validity for historical precedent. Dr. Kirk said that if the consensus is that the best way to do something is the current way, then he recommended validation with evidence when possible.

Dr. Kirk noted that the guidance is not a short-term deliverable. In the short-term, the working group will focus on:

- Conducting a comprehensive literature review, including a summary of what is known and unknown about mass human chemical decontamination (both technical questions and overall systems or operational questions);
- Identifying and documenting research gaps, useful for translation into a research roadmap; and
- Developing a plan to show the supporting link between short-term and long-term goals, objectives and proposed outcomes.

In reviewing the quality of existing data, the working group must have a clear understanding of how researchers and authors generated their data. The working group may adopt an approach similar to that used by the American Heart Association (AHA) to develop its Advanced Cardiac Life Support recommendations. The AHA critically evaluates evidence and stratifies (and frequently updates) its recommendations based on the strength of the evidence to support it.

Status of tasks undertaken by the working group:

1. Identify priority questions regarding chemical decontamination that would benefit from scientific answers – *Completed*
2. Conduct literature review – *Completed*
3. Document findings, including brief summaries – *Completed*
4. Conduct symposium with subject matter experts to assess findings and identify research gaps – *Objective of this Symposium*
5. Prepare report for Subcommittee on Standards-CBRNE and the Domestic Chemical Preparedness and Response Sub-IPC – *Undergoing Revision*
6. Prepare National Guidance – *Collecting Data/Information*

Decontamination of People at Chemical Incidents:

Chief Edward Budnick, Aberdeen Proving Ground Fire and Emergency Services

Chief Edward Budnick, Aberdeen Proving Ground (APG) Fire and Emergency Services, stated that the APG Fire Department is one of the most scrutinized in the world due to its secure chemical and biological laboratory environment. The APG Fire Department, which covers 72,000 acres on the military base, is one of the largest Department of Defense fire departments, both in and outside of the continental United States (CONUS and OCONUS). APG has biological, chemical and radiological laboratories. In addition, unexploded ordnances (often involving chemical agents) are frequently found on post.

Chief Budnick said that the response priorities for decontamination are to protect the lives of civilians and responders, control the spread of contamination, and stabilize the situation—the very same response priorities as for fires and vehicle accidents.

Response and Lessons Learned:

Chief Budnick provided the following APG Fire and Emergency Services lessons learned regarding human decontamination:

- Chaos at an event, even the smallest event, is an understatement. Accountability, decontamination and cleanliness issues that occur at a small incident may be multiplied a thousand-fold during a large incident.

- Response planning cannot be complex; it has to be simple and ready to execute. A procedure cannot be overly time-consuming or involve measures that are not immediately achievable.
- People will have varying levels of willingness to decontaminate. Some people will understand that an incident has occurred and be willing to go through the decontamination line; however, others will not. APG typically moves the unwilling out of the way so the others can be decontaminated. More often than not, those resisting decontamination do not need it.
- Decontamination takes many forms throughout an event. These forms include removal from the source (e.g., a building), disrobing and scrubbing down.
- Do not solely rely on detectors. Symptoms will indicate who needs decontamination. Field detection has gaps and false readings are frequent. Detection devices can assist responders, but it is important to know the devices' limitations, such as weather-related interference.
- If the number of contaminated patients exceeds response capabilities, an opportunity to decontaminate will eventually be provided; however, not all individuals may be able to go through the process during the initial response. At APG, the first line of response is only nine individuals.

Chief Budnick said the one key factor missing in the decontamination arena is public education. The public has a good idea of what to do in a hurricane, tornado and active shooter situation, but there is no public campaign concerning chemical incidents. Members of the public must know how to protect themselves.

APG Fire and Emergency Services capabilities include monitoring with MINICAMS® and Real-Time Analytical Platforms (RTAPs). The decontamination solution APG uses is soap and water with the capability to warm the water. In addition, APG has access to all detection devices available.

Additional Issues:

- Chief Budnick stressed that once doctrines and policies are developed, there can be a tremendous burden to live up to those standards. Upkeep of equipment and training is crucial.
- What might be achievable for an urban department/metropolitan city may not be achievable for a rural department.
- Chief Budnick mentioned that in all decontamination situations there are always environmental concerns to decontamination methods.
- He noted that simply assessing a situation based on symptomatology may sometimes be difficult.

Decontamination of People at Chemical Incidents
Key Points
• Any response standard must be simple. • Any response standard must account for unwilling victims as well as those who are concerned but not contaminated. • Do not create a burdensome standard. • The limitations of current technology cannot be understated. • A public awareness campaign is necessary.

Foundation of Toxicology Principles and Decontamination of Chemical Agents:

Mark Kirk, MD, Office of Health Affairs, Department of Homeland Security

Dr. Kirk reviewed exposure routes (inhalation, ingestion and dermal absorption) and emphasized why using the concept of dose-response is important.

Chemicals exist in gas, liquid and solid states. A chemical's physical state and the route of exposure influence toxicity. Various conditions such as temperature, combustion or escape from a pressurized container allow a product to change states. The change in state can occur rapidly and is most often the reason for hazardous chemical exposure in an accident. Chemicals may be more of a risk for producing human health effects in one state than in another and the chemical state often determines the route of exposure. For example, gases, vapors, airborne powders and aerosolized liquids are inhalation risks. For many chemicals, the toxic effects occur at the site of absorption. Chemicals in contact with the skin can cause local effect but may also enter the circulatory system and cause effects beyond the entry point. Acids and alkalis injure tissues on contact and may penetrate to surrounding tissues. Organophosphate insecticides are fat-soluble chemicals that rapidly penetrate the skin and enter the bloodstream to circulate to distant sites. Not all chemicals can penetrate the skin easily; their unique properties determine how readily they absorb through the skin. Skin exposure can produce a delayed onset of systemic effects as compared to the rapid entry through the lungs.

Evaluating clinical effects based on the amount of exposure is a basic toxicology principle called dose-response. The dose is the total amount of chemical absorbed during exposure. It depends mostly on the concentration of the chemical and duration of contact.

Concentration is the amount of chemical present in a product and is measureable. When determining a person's potential exposure, especially in an accident, environmental monitoring will not measure exactly the conditions the patient experienced. Concentrations are lessened by dilution with substances such as water or air (e.g., concentrated versus diluted acids).

Additionally, they are influenced by the location of exposure, such as an enclosed space versus the outdoors. The closer a person is to an airborne release of a toxic gas, the higher the concentration. The farther away a person stands from the release, the lower the concentration because of dilution with air.

The dose received also depends on time. Longer contact time allows for a greater amount of agent to be absorbed. An acid placed on the skin will cause more tissue destruction the longer it stays in contact with the tissues. Flushing with water after splashing a concentrated sulfuric acid on the skin will decrease the chemical's concentration and decrease the duration of exposure, thus limiting injury.

A contaminant can cause systemic effects by entering through the skin into the bloodstream. The quicker the removal of contaminants the better. Dr. Kirk teaches that contaminated patients be considered on "fire" because it is important to remove the contamination urgently before it is absorbed. Decontamination with copious amounts of water may decrease concentration and contact time, therefore reducing the dose. It is not wise to set up a multi-step decontamination system before tending to the first patient. As stated in the *Medical Management of Chemical Casualties*[1], "The most important decontamination to minimize injury to the patient is immediate decontamination since it reduces the patient's exposure to a toxic agent. It is most effective if performed within one or two minutes after exposure, particularly with sulfur mustard, but the dose will still be reduced to some degree if decontamination is performed later than this."

Foundation of Toxicology Principles and Decontamination of Chemical Agents
Key Points
• Chemicals in contact with the skin can cause local effect but may also enter the circulatory system and cause effects at distant sites from the entry route (systemic toxicity). • Quick removal of contaminants is imperative. • The extent of skin injury and the amount of chemical absorbed during exposure depend mostly on the concentration of the chemical and duration (contact time) of the exposure. • Rapid removal of clothing or flushing with water after chemicals contact the skin may decrease the chemical's concentration and decrease the duration of exposure, thus limiting injury.

Decontamination or "Contamination Reduction":

Michael Schwartz, MD, Centers for Disease Control and Prevention

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[1] Department of the Army, United States Army Medical Research Institute of Chemical Defense, 4th Edition (2007).

There is currently no comprehensive policy for the management of multiple patients with chemical contamination. Without an outcome-based goal for human decontamination (whether it be a patient-oriented health outcome goal, a medical resource preservation goal, or an economic or sustainability goal), there really is no hope for the development of an official strategy or national guideline for mass human decontamination. In the absence of an explicit health outcome-based goal for decontamination, the process of decontamination itself becomes the objective—clean for clean-sake. This current dogma in turn drives all research, education, and process development and refinement in the field of human decontamination. The lack of an outcome-oriented goal for mass human decontamination acts like a technological imperative: a wet decontamination imperative where all progress in the field is simply geared toward getting more people cleaner, faster, with improved tools (tents, decontamination solutions) and methods. The risks of simply adhering to this clean for clean-sake paradigm are myriad:

1. The same rationale, tools, and techniques will be used in responding to every mass contamination event regardless of the specifics of any given incident (inappropriate wet decontamination of hundreds of "victims" of a natural gas leak, for example).
2. The process of wet decontamination will be universally applied without questioning whether the practice itself creates additional harm (such as hypothermia, decontamination-related injuries, or psychological trauma), which actually outweigh any marginal improvement with respect to short- or long-term patient health;
3. If no serious discussion of decontamination goal(s), endpoints or desired outcomes occurs, then any effort to develop a national policy or guidance for mass human decontamination will be nothing more than an endorsement of the current practice for wet decontamination as it stands today. The result is that future funding and investment in educational efforts and a research portfolio in support of national guidance will only deliver marginal improvements in the tools and tactics already being used. At worst, this might have no positive effect on public health.

In the process of defining a goal for decontamination, review of the literature of past incidents is necessary to research what health outcomes were reported and could be compared between those decontaminated and those not. This would likely involve epidemiologic study possibly with present day follow-up of survivors to assess long-term physical and psychological outcomes. Once a decontamination goal is established, the actual level of mass human decontamination needed to achieve this goal will become clear: all-or-none wet decontamination, simple evacuation from the source of exposure and observation, or evacuation and disrobing. At that point, a research initiative, educational efforts, and even an evidence-based, public risk communication effort aimed at changing the expectations of the public can be undertaken. With all of these questions and issues addressed, the development, distribution and widespread acceptance of any national guidance for mass human decontamination will be successful.

Decontamination or "Contamination Reduction" Briefing and Discussion
Key Points

- The goal of decontamination should drive the research agenda and strategy. The working group should recommend adoption of a goal to be a part of the national guidance/policy. Examples of goals for the working group's consideration include:
  - To achieve a measurable improvement in patients' acute health outcome
  - To achieve a measurable improvement in patients' long-term health outcome and/or prevent delayed morbidity
  - To protect the healthcare infrastructure from secondary contamination
  - To preserve the capability to provide supportive and definitive (antidotal) care to those patients for whom the emergent provision of such care will in turn improve their acute and long-term health outcome
  - To assure the best short-term outcome for the most patients by only decontaminating to a level that ensures everyone will get timely decontamination. Alternately, decontaminating to a level after which the majority of trivially exposed will be able to bypass medical care altogether, thereby preserving medical resources for those who still need it after sufficient—but not exhaustive—decontamination
- Altered standards of care would need to be explicit and communicated well.
- Every second spent in decision making delays decontamination.
- A default procedure for unknown agents would have to differ from procedures for known agents.
- Document implicit knowledge as explicitly as possible.

Identifying the Core Questions and Reviewing the Literature:

The working group sought to address operationally relevant questions by providing current evidence or defining important research gaps to answer each question.

The working group evaluated the decontamination process from both "Individual Decontamination" and "Mass-Patient Decontamination" perspectives. Questions in the section on individual decontamination targeted care for a single patient. Questions in the second category pertained to the treatment of large numbers of patients following a mass casualty incident.

The working group defined six core questions about human decontamination that have guided the literature review and defined the symposium's individual breakout sessions:

Individual Decontamination:

- What criteria are available to decide if the patient needs decontamination or not?
- What is the optimized procedure for definitive decontamination for a multi-peril scenario of unknown agent and unknown exposure?

- What is the metric for determining effective decontamination?

Mass Patient Decontamination:

- What is the best evidence-based method for assessment and triage of patients (both at the scene and at hospitals) to prioritize decontamination and medical treatment?
- Where and when should decontamination take place?
- What evidence-based, best-practice crisis communication techniques can best apply to a mass casualty chemical incident to promote patient compliance and safety during decontamination?

Core Questions and Key Points

INDIVIDUAL DECONTAMINATION

Core Question #1: What criteria are available to decide if the patient needs decontamination or not?	
Key Points	***Research Needs***
• Consensus/current practice is that decontamination should be performed if the patient has symptoms. • Consensus/current practice is that decontamination should be performed if there is visible evidence of contamination on skin or clothing. • Current practice calls for decontamination if exposure appears to exceed an established health guidance value with an implied adverse health outcome basis, such as those set by Acute Exposure Guideline Levels (AEGL) and/or Immediately Dangerous to Life or Health (IDLH) concentrations. • Currently, no detection capability/technology makes clear when decontamination should be performed. • Often, the decision to decontaminate is made based on the patients' perception of risk and for reassurance regardless of implicit need for decontamination. • Consensus/current practice is to decontaminate to prevent secondary contamination of first responders and first receivers regardless of implicit need for decontamination. • Most current recommendations and consensus documents emphasize "How-To" decontaminate, but not how to decide on the need to decontaminate.	• Determine if toxidromes or clusters of symptoms could be utilized to help distinguish between affected and unaffected individuals. • Develop a method to validate the current decontamination decision making of response agencies (symptoms, history, detector, prevention of secondary contamination, etc). • Determine what amount of visible contaminant on skin or clothing requires what level of decontamination (simple safe passage, undressing, or full wet decontamination). • Determine what exposure thresholds ─ based on environmental measurements (if timely) ─ could inform the need to decontaminate based on health outcome implicit to the Health Guidance Values (HGV). • Develop better detection capabilities. • Determine what factors (distance from release, maximum exposure time, meteorological/wind conditions) could be utilized to determine the need and location for decontamination. • If the sole purpose of decontamination is preservation of medical resources and expedited definitive care (antidote, supportive), then research is needed to determine, irrespective of patient benefit or harm, what degree of decontamination is necessary to ensure minimal risk of secondary contamination. • Perform risk assessment of first responders and first receivers wearing a spectrum of PPE. • Conduct cognitive task analysis of what data inform responders' behavior and decision making on the need for decontamination. Develop training materials for first responders on chemical warfare agent exposure symptom recognition for matching triage classification and transport priorities to different chemical agents (chemical warfare agent categories have different triage considerations).

Core Question #2: What is the optimized procedure for definitive decontamination for a multi-peril scenario of unknown agent and unknown exposure?	
Key Points	***Research Needs***
• Water remains the "universal decontaminant" • Water provides passive decontamination by physical removal of contaminant from the skin. • Risks of water-based decontamination include facilitated absorption of contaminant owing to pressure, temperature and humidity. Researchers have not thoroughly studied the efficacy of water and the optimal values for parameters such as temperature, volume, pressure and duration. • Deleterious effects of decontamination, including environmental hazards (hypothermia, mechanical injury) and psychological trauma should be considered in implementing any decontamination program. • Adverse consequences of decontamination may supersede marginal improvements in patient health outcome. • Active decontamination systems ─ Reactive Skin Decontamination Lotion (RSDL) ─ may be a better answer for the military than for civilian response. • Clothing provides some initial protection, until it becomes saturated or the chemical penetrates ("breaks through") the material. • Current literature assessing the effectiveness of clothing removal is insufficient.	• Determine how to encourage the general public to comply with decontamination activities that are unpleasant, or that potentially conflict with religious or cultural mores. • Comparing the effects of water and showering with other types of decontamination could help to alleviate the uncertainty surrounding water-only decontamination. • Determine the efficacy of water-based and water-based plus surfactant decontamination. • Determine the optimized water-based protocol, to include the following parameters: temperature, volume, pressure, duration, etc. • Additional research into the rub-in or wash-in effect is required. How does rub-in and wash-in affect abraded skin, burns or wounds? How are different skin types affected? • Determine whether external devices such as a washcloth may be required for effective physical removal of contaminants and the potential harm from using such devices. Does the use of external devices have negative consequences? • Specific research into vapor residency in clothing after exposure. • Further research on the level of PPE required when performing mass casualty decontamination in the hospital and in the field. • Determine specific special procedures for decontaminating wounds and vulnerable populations such as children, pregnant women and older adults.

Core Question #3: What is the metric for determining effective decontamination?	
Key Points	***Research Needs***
• Definition of a metric varies among the public, responders and grantmakers. • Importance of metrics: o Objective measures are important to develop standardized processes that can be validated. o An established metric can serve as a response endpoint and reduce duplicative efforts, greatly assisting in resource-limited scenarios. o A metric can promote confidence in decontamination and help give people ease of mind. o Decontamination is a multi-agency/multidisciplinary process that calls for realistic metrics and consensus among stakeholders. • Ideal metrics: o Focus on first responder/first receiver needs. o Must expand beyond time to decontamination versus number decontaminated (this metric alone is insufficient). Current grant guidance and equipment vendor claims are typically based only on this measure. o Should focus on an unknown chemical exposure rather than on the infrequently encountered situation involving response to known chemical(s) where chemical characterization placards are used. Alternately, could have two approaches for known versus unknown. o Establish an outcome-oriented decontamination endpoint in the field that may not necessarily equate to "zero" contamination. o Should incorporate a series of critical actions such as time to critical decisions (e.g., decision to decontaminate or not), effectiveness of procedures (e.g., adequate contamination reduction), frequent process reassessment, (e.g., adequate patient flow) and critical communication	• Build a lexicon to clarify definitions and encourage greater precision with respect to the use of metrics. • Establish threshold levels of exposure (evidence from clinical/animal studies) that would lead to illness or injury. • Research the possibility of a "safe enough" decontamination level that is practical, achievable, affordable, and maintainable and ensures acceptable patient health outcome(s) as well as responder and receiver safety. • Establish measures of decontamination process effectiveness based on patients' clinical course and disposition. • Create a matrix that estimates the likelihood of illness/injury for given exposure (route and concentration) for each chemical class. This matrix could be used as a rule of thumb for determining the extent of contamination and the need to decontaminate. • Conduct a risk assessment to identify the highest risk chemicals that would cause harm without decontamination. • Develop and validate a risk management strategy for EMS and hospitals regarding transport/movement of patients from one area to another (e.g., for hand-off between EMS and ED). Strategy should include "safe enough" levels of PPE for first responders, first receivers and others delivering care beyond the immediate treatment areas. • Develop adequate handheld field screening technology to provide an objective measure of effectiveness of contamination reduction. • Define metrics that will provide researchers with reproducible measures of decontamination effectiveness for use when performing comparative studies of decontamination processes (e.g., effectiveness of clothing removal alone or effectiveness of soap and water versus a new decontamination solution). • Develop research models, tools, and metrics that define the

requirements (e.g., such as between first responders and the hospital).
• Other points:
  o Metrics achievable for small-scale incidents may not be achievable for large-scale incidents.
  o The metric does not have to be scientifically measured; it can be the correct implementation of an effective procedure. Science will catch up to the best practice.
  o Equipment standards should exist based on preparedness goals, effectiveness metrics and health outcomes.
  o Screening to a "zero" level may be unachievable and may be overkill (beyond needs or current capabilities).
	parameters of systematic delivery of decontamination to a large number of patients (e.g., establish research methods to measure time for each patient to travel through multiple steps of decontamination procedure).
	• Develop a measure for determining successful adoption and implementation of new policies, plans or protocols.
	• Develop a process for peer review and stakeholder focus group review to ensure practical, operational, feasible, evidence-based recommendations, as well as realistic metrics for performance measures and grant guidance.

MASS PATIENT DECONTAMINATION

Core Question #4: What is the best evidence-based method for assessment and triage of patients to prioritize decontamination and medical treatment?	
Key Points	***Research Needs***
• Determining the need for mass casualty decontamination at the scene is the responsibility of the on-scene incident commander; however, there is little empirical or experimental evidence to determine under what circumstances mass casualty decontamination is required. • The literature proposes numerous triage systems for use in determining if a patient requires decontamination. However, in most cases, these systems have not been evaluated empirically or validated as providing a decrease in morbidity or mortality. (Many of these systems are extensions of currently utilized and accepted triage systems for conventional injuries.) • There is no standard, agreed-upon evaluation method for triage systems. • Any recommended triage for decontamination should build upon existing models such as the sort, assess, life-saving interventions, treatment and/or transport (SALT) and simple triage and rapid treatment (START) triage schemes. • Any model should consider simple decision points such as “ambulatory” versus “litter”. • The literature lacks discussion on the use of detection and diagnostic technologies to determine decontamination requirements. • There is general consensus that the presence or absence of toxidromes or clusters of symptoms could help distinguish between affected and unaffected individuals. • Information gathered from patients, to include location, time, and any clinical symptoms, could also assist in identifying	• Determine which currently accepted triage system for conventional mass casualty operations is most amenable to a chemical mass decontamination scenario. • Determine which medical interventions, if any, performed prior to or in parallel with decontamination could lead to improved health outcomes. • Determine if there are any credible threat scenarios where mass casualty decontamination is unnecessary or can cause greater harm than the effects of the chemical itself. • Develop any detection capability/detector that can identify who needs decontamination. • Examine the usefulness of a brief set of questions or symptoms for guiding decisions on the need for decontamination. • Determine which set of circumstances — time of potential exposure, distance from release, and lack of symptoms — makes the likelihood of contamination remote. • Determine the optimum period of observation or immediate disposition of non-decontaminated individuals given a range of chemical threats. • Design research studies using past literature and reports of hazardous material/chemical release incidents (such as the Sarin attack in the Tokyo subway system or the train accident in Graniteville, South Carolina involving chlorine gas) in a case-control fashion to study the impact of any newly proposed triage system on patient outcome. Research would include stratifying patients on decontamination status and performing a retrospective case-control study looking at

those needing decontamination. • There is little empirical or experimental research to define the best practice method for providing life- and limb-saving medical interventions within a contaminated environment. • Self-triage at incidents does occur.	different outcomes related to triage versus no triage. • Investigate the determinants of self-triage, such as the presence of loved ones in the same event, access to a personal means of transportation, and/or wait time for responders to arrive. • Determine what set of circumstances warrant the creation of a victim roster and/or victim registry.

Core Question #5: When and where should human decontamination occur?	
Key Points	***Research Needs***
• There is no definitive, evidence-based determination for how and where mass decontamination should be conducted. • Experience has shown that the location of decontamination is not determined by protocols but by behavior of patients. • Military doctrine that on-scene decontamination is preferable is not readily applicable to the civilian setting. • Self-triage at incidents frequently occurs, and any standard should encompass a combination of hospital, pre-hospital and self-decontamination. • Even if the evidence base unequivocally identified an optimal location for decontamination, the current infrastructure to support such a strategy is insufficient. • Hospitals do not have the resources (staff experience, equipment maintenance, ongoing training) or time to establish and maintain an effective decontamination program. • In addition, several legal and regulatory issues have yet to be resolved so that hospitals can conduct decontamination operations. • Established relationships and common understanding among governments, the public at large, first responders, and hospital personnel in the United States to support standard goals, procedures and practices for decontamination are lacking.	• Establish a database of current decontamination capabilities of community response and hospitals. • In order for hospitals to be prepared to effectively perform decontamination operations, research must determine the most appropriate PPE, the optimal decontamination process, equipment, location within hospital, and appropriate staff training. • Research on regulatory and legal issues for both facility-based and scene-based decontamination should examine potential economic and operational impacts on organizations to inform recommendations for best solutions. • Research on the spectrum of current informal expectations and formal relationships (e.g., mutual aid agreements) between responders and hospitals will help guide recommendations for the most effective decontamination program for a given community. • Determine the most effective public education program and communication strategy to align public expectation with the best community mass decontamination program, including provisions for self-decontamination (e.g., “Stop, Drop and Roll”). • Review observational data and reports of past incidents to define the expected behaviors as evidence for developing community mass decontamination protocols.

Core Question #6: What evidence-based, best practice crisis communication techniques can be best applied to a mass casualty chemical incident to promote patient compliance and safety during decontamination?	
Key Points	***Research Needs***
• Authorities historically have found it difficult to communicate with the public following a mass casualty event and have often mishandled the process. • Conducting effective decontamination operations requires an understanding of and a focus on the behavioral tendencies of affected populations. • Adopt the philosophy that plans should address what people are LIKELY to do, not what they SHOULD do. • Disaster literature suggests that panic is not a typical response to many disasters; however, there is limited, useful evidence for understanding or predicting human behavior following a large-scale chemical incident. • Current well-ingrained public expectations and beliefs about decontamination will need to change prior to the introduction of any new paradigm or guidance for mass human decontamination. • There is a need to address public understanding of health risk(s) and chemicals. • There is a need to enhance public knowledge regarding the where, when, and what of decontamination should be enhanced. • The public needs to be educated about — and instill a sense of responsibility for — its role in a chemical event. • Effective risk and crisis communication is a teachable skill based on evidence derived from studies on human behavior. • Sociologists and behavioral experts must take part in the formulation and implementation of effective mass human	• Develop objective screening processes to determine significant exposure and identify those with greatest potential benefit from decontamination. Conversely, provide reassurance to potentially exposed patients through objective screening process that identifies those who will be safe without decontamination. • Promote original research to better understand the psychology, behavior and messaging that may prove effective in mass chemical exposure events. • Promote field research studies (prospectively or immediately following real events to minimize recall bias) to better understand patient behaviors and expectations and identify interventions to address them. • Develop and validate public education campaigns on self-protection and the establishment of public responsibilities during events (such as "Stop, Drop and Roll"). • Design and validate techniques that will influence crowd behavior for optimal design of mass decontamination lines. • Review past (non-chemical) incidents that involved uncontrolled mass movement (e.g., stampedes, fires). • Hold focus groups to better understand public attitudes, perspectives, and expectations, as well as how trust may be established and violated with respect to mass human decontamination. Obtain input from patients of actual events. • Perform focus group studies to validate effective messages pre- and post-event. • Review existing multidisciplinary studies and current

decontamination guidance.	evidence-based recommendations to effectively communicate in other types of events, such as fire drills at schools, mass social gatherings and radiation emergencies. Then, assess validity for use in chemical incidents. • Conduct prospective or retrospective studies of chemical incidents to identify which elements of the decontamination process contribute most to psychological trauma (e.g., waiting, uncertainty, loss of control, public nudity, physical discomfort/cold, separation). • Determine if alternate processes exist; focus messaging to minimize the trauma if alternative steps are not feasible.

Final Comments and Discussion:

Dr. David Marcozzi of the White House National Security Staff said there is very high visibility on this topic and concern about general preparedness for chemical incidents involving large quantities of known or unknown chemicals. Knowing how municipal, state and federal authorities respond is of utmost importance. Even so, officials must emphasize the speed of response. Empowering locals to swiftly respond is a priority. Dr. Marcozzi affirmed that determining a research agenda would help fill the knowledge gaps. There are two stages to this process: 1) the near-term development of national guidance based on existing knowledge about how best to perform decontamination, and 2) future work to fill in knowledge gaps through research and other evidence.

The facilitator opened up the discussion to all participants to solicit final comments and responses to questions. Participants shared the following thoughts:

- Any policy should reflect urgency and focus on two approaches: 1) what would happen if an incident occurred tomorrow, and 2) what we would do in a perfect world.
- Any recommendations or guidance would benefit from a ground-up approach so that guidance development begins with the responder community. More often than not, a top-down approach to guidance is not adequate.
- It would be beneficial to have an ASTM International[2] best practice that would be the basis for training.
- An industry day was recommended to determine what manufacturers are producing and how products might fit into a concept of operations.
- Participants expressed an interest in ensuring public health personnel were involved with the working group activities moving forward. Also, include local health officials, smaller jurisdictions and the private sector.
- To date, technology has not been satisfactory; reliance cannot be placed on current technology.
- The working group was unique in the respect that all have familiarity with decontamination and come from different areas of expertise. There is value in keeping the group relatively small so that it remains manageable; however, expanding the group and the contributions received can only increase the credibility of the recommendations.
- Although it cannot be mirrored, consider work done on preparedness for an Improvised Nuclear Device (IND).
- The working group would benefit from presenting at the Continuing Challenge Conference (www.hazmat.org) in Sacramento. In addition, the group should be careful to account for weaknesses of decontamination including entry into wounds and eyes.
- Recommend alignment with activities of the Technical Support Working Group (TSWG).

[2] ASTM International was formerly American Society for Testing and Materials.

- Recommend alignment with the Interagency Board (IAB) regarding types of equipment and procedures.
- Next steps include beginning to work on developing national guidance.

Final Discussion and Recommendations	
Key Points	• Involve additional stakeholders, including public health officials, smaller jurisdictions, the private sector, TSWG, IAB and others, in research and discussions. • Consider that a ground-up approach tends to be more all-encompassing. • Identify research that will provide long-term benefits, but in the meantime develop guidance based on the best currently available knowledge for the short term. • Consider work being performed in the IND and biological threat areas.

Conclusion:

The purpose of the Symposium on the Chemical Decontamination of Humans was to evaluate the current state of empirical and experimental evidence for decontamination operations as determined by a literature review. Objectives included:

- To assess the validity and completeness of the research conducted to date;
- To identify gaps in the research; and
- To recommend next steps with respect to research and the working group activities.

In order to support state and local response to mass casualty chemical incidents, the working group intends to use the results of the symposium to inform a national guidance document based on the current level of knowledge and capabilities. This process will include examining currently available guidance and best practice documents and describing current practices of responders and health care receivers. The working group will evaluate current guidance and practices through the lens of the best available scientific evidence. This step will allow the working group to identify specific research gaps and prioritize future research efforts. Additionally, this analysis will make it possible in the new guidance to identify the practices that evidence supports versus others based on expert opinion.

During this process, various stakeholders will continually be engaged for feedback and improvements upon the process. One of the goals of this process is to create a standardized lexicon that can be used across all stakeholder groups. A draft of this national guidance is anticipated to be complete in early 2012.

Appendix One:

Federal Working Group Members:

1. U.S. Department of Health and Human Services (HHS)
   - Assistant Secretary for Preparedness and Response (ASPR)
     - Office of Policy and Planning (OPP)
     - Office of Preparedness and Emergency Operations (OPEO)
     - Biomedical Advanced Research and Development Authority (BARDA)
   - Centers for Disease Control and Prevention (CDC)
     - National Institute for Occupational Safety and Health (NIOSH)
     - National Center for Environmental Health (NCEH)
   - Agency for Toxic Substances and Disease Registry (ATSDR)

2. U.S. Department of Homeland Security (DHS)
   - Office of Health Affairs (OHA)
   - Science and Technology Directorate (S&T)
   - Plum Island Animal Disease Center (PIADC)
   - Federal Emergency Management Agency (FEMA) CBRNE

3. U.S. Department of Defense (DoD)
   - Edgewood Chemical Biological Center (ECBC)
   - U.S. Army CBRN School
   - DoD Joint Program Executive Office (JPEO)
   - U.S. Marine Corps (USMC) Chemical Biological Incident Response Force (CBIRF)
   - U.S. Army Medical Research Institute for Chemical Defense (USAMRICD)

Advisors:

1. Dartmouth University

2. District of Columbia Fire & EMS Department (DC-FEMS)

Appendix Two:

2010 Symposium Attendees:

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    Science & Technology Directorate

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    FEMA CBRNE

30. McKay, Chuck (MD)
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