Patient Decontamination in a Mass Chemical Exposure Incident: National Planning Guidance for Communities

PRE-DECISIONAL DRAFT
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Federal Points of Contact

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Executive Summary

Introduction

Each day, large quantities of hazardous chemicals are produced, transported, stored, and used for industrial and household purposes. Stockpiles of chemical weapons around the world, known or long-since abandoned, still exist. The formulas and instructions to produce many chemical weapons are available in open source literature, particularly in various terrorist handbooks. These chemicals pose significant risk to public health due to the potential for accidental or intentional release that would harm large numbers of people. Civilian first responders (e.g., fire, hazmat responders, and emergency medical services) and health care first receivers (e.g., health care facility-based and other clinical personnel), along with emergency managers, public health practitioners, and law enforcement officials, must be prepared to respond to such incidents. The potential for a large-scale chemical release requiring decontamination of an overwhelming number of people has garnered wide interest. Guidance and best-practice documents have been published and specialized equipment has been purchased. However, practices have evolved based on sparse evidence. Insufficient research has been conducted on decontaminating people. Mass patient decontamination, like other aspects of disaster response, medicine and public health, would benefit from assessment of the body of evidence, enhanced incorporation of the evidence into planning and practice, and additional study to generate needed evidence. Furthermore, many current guidance and best-practice documents do not address the full spectrum of issues that a community may face when large-scale patient decontamination is necessary in a mass chemical exposure incident.

Emergency response and medical communities and the United States (US) Government have identified a need for evidence-based national planning guidance for mass patient decontamination resulting from a large-scale chemical release. Efforts to enhance preparedness for patient decontamination in a mass exposure incident will also help to improve the care that is provided to individual contaminated patients on a daily basis.

Audience, Scope, and Intent

The intended audience includes senior leaders, planners, incident commanders, emergency management personnel, and trainers of local response organizations and health care facilities. Though the guidance was developed with this specific audience in mind; it may be of value to other audiences, including first responders and first receivers, community leaders, and others from the response and emergency management fields. A basic assumption of this work is that mass patient decontamination will be conducted by the local affected community. Due to the fast-acting nature of chemicals and the need for patients to be decontaminated as soon as possible, the federal government would not be able to participate directly in the response during the appropriate time window. Therefore, this guidance is directed primarily at local officials.

This guidance sets forth patient decontamination principles from a strategic perspective, rather than a tactical one. It is meant to guide, but not specify operational practices. The guidance is evidence-based to the extent possible and the evidence description, or lack thereof, is documented and briefly discussed.

The subject matter considered here is limited to external contamination of living people in a mass casualty incident resulting from an accidental or intentional chemical release. Contamination of patients with chemicals, including toxic industrial chemicals, toxic industrial materials and chemical warfare agents, is the present focus. However, though not specifically addressed here, many of the concepts presented here will likely apply to radiological and biological agents.

The full spectrum of the decontamination operation is addressed, from initial assessment and decision-making through evaluation of decontamination effectiveness. Further, a holistic approach is taken to the
entire affected community with emphasis on coordination between on-scene and health care facility-based response activities and communication on multiple levels. This whole community approach allows applicability of this document to diverse organizations at multiple levels and, once implemented, can lead to increased community resilience.

The planning recommendations presented here were designed to assist local officials in developing or improving current response plans for patient decontamination in a mass casualty incident. The approach is flexible and scalable according to the resource and capability limitations of the organization. The recommendations should be adapted as each unique community sees fit. Examples of how the guidance might be used by local emergency response or health care organizations include:

- Planners: incorporate current evidence-based practices during development or revision of an organization’s response plans.
- Community leaders, public health officials: enhance system-wide coordination and develop plans for communicating with patients and the whole community.
- Trainers: develop, improve or augment training of response personnel for patient decontamination operations, using current best evidence-based practices.
- Emergency managers: generate policy and plans to address issues related to system-wide coordination, the whole community response, and crisis and risk communications, as well as other over-arching issues related to a response to a mass chemical exposure incident.
- Researchers: identify knowledge gaps and conduct research to investigate them.

**Quick Reference Guide and Guidance Statement Format**

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- **Functional Area**: Identifies one of the six functional areas.
- **Guidance Statement**: Full text of the guidance statement.
- **Considerations**: Additional factors that should be considered when implementing the guidance statement.
- **LOC**: Level of Confidence rating (described in Appendix E) for the guidance statement.
- **Discussion**: Briefly describes the evidence applicable to the guidance statement, from reviews of the scientific literature, current practices and subject matter expert opinion and experience.
# Acronyms List

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<th>Description</th>
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<tr>
<td>ASPR</td>
<td>Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response</td>
</tr>
<tr>
<td>ATSDR</td>
<td>Agency for Toxic Substances and Disease Registry</td>
</tr>
<tr>
<td>CAL-OES</td>
<td>California, Office of Emergency Services</td>
</tr>
<tr>
<td>CBRN</td>
<td>Chemical, Biological, Radiological, and Nuclear</td>
</tr>
<tr>
<td>CDC</td>
<td>Center for Disease Control</td>
</tr>
<tr>
<td>CPR</td>
<td>Cardiopulmonary Resuscitation</td>
</tr>
<tr>
<td>CONOPS</td>
<td>Concept of Operations</td>
</tr>
<tr>
<td>CWA</td>
<td>Chemical Warfare Agents</td>
</tr>
<tr>
<td>DHS</td>
<td>Department of Homeland Security</td>
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<tr>
<td>DOD</td>
<td>Department of Defense</td>
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<tr>
<td>DOT</td>
<td>Department of Transportation</td>
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<tr>
<td>ECBC</td>
<td>US Army, Edgewood Chemical Biological Center</td>
</tr>
<tr>
<td>ED</td>
<td>Emergency Department</td>
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<tr>
<td>EMS</td>
<td>Emergency Medical Services</td>
</tr>
<tr>
<td>EPA</td>
<td>Environmental Protection Agency</td>
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<tr>
<td>FDA</td>
<td>US, Food and Drug Administration</td>
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<tr>
<td>HAZWOPER</td>
<td>Hazardous Operations and Emergency Response</td>
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<tr>
<td>HF</td>
<td>Hydrogen Fluoride</td>
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<tr>
<td>HHS</td>
<td>Department of Health and Human Services</td>
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<tr>
<td>ICS</td>
<td>Incident Command System</td>
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<tr>
<td>LEPC</td>
<td>Local Emergency Planning Committee</td>
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<tr>
<td>LOC</td>
<td>Level of Confidence</td>
</tr>
<tr>
<td>MCI</td>
<td>Mass-Casualty Incident</td>
</tr>
<tr>
<td>MSDS</td>
<td>Material Safety Data Sheets</td>
</tr>
<tr>
<td>NFPA</td>
<td>National Fire Protection Association</td>
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<tr>
<td>NIMS</td>
<td>National Incident Management System</td>
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<tr>
<td>NIOSH</td>
<td>National Institute for Occupational Safety and Health</td>
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<tr>
<td>OHA</td>
<td>Department of Homeland Security, Office of Health Affairs</td>
</tr>
<tr>
<td>OSHA</td>
<td>Occupational Safety and Health Administration</td>
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<tr>
<td>PPE</td>
<td>Personal Protective Equipment</td>
</tr>
<tr>
<td>RSDL</td>
<td>Reactive Skin Decontamination Lotion</td>
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<tr>
<td>SDS</td>
<td>Safety Data Sheets</td>
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<tr>
<td>SME</td>
<td>Subject Matter Expert</td>
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<tr>
<td>SOP</td>
<td>Standard Operating Procedures</td>
</tr>
<tr>
<td>START</td>
<td>Simply Triage &amp; Rapid Transport</td>
</tr>
<tr>
<td>TIC</td>
<td>Toxic Industrial Chemical</td>
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<tr>
<td>TIM</td>
<td>Toxic Industrial Material</td>
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<tr>
<td>TRANSCAER</td>
<td>Transportation Community Awareness and Emergency Response</td>
</tr>
<tr>
<td>TLV</td>
<td>Threshold Limit Values</td>
</tr>
<tr>
<td>TSWG</td>
<td>Technical Support Working Group</td>
</tr>
<tr>
<td>US</td>
<td>United States</td>
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<tr>
<td>WHO</td>
<td>World Health Organization</td>
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<tr>
<td>WG</td>
<td>Working Group</td>
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<td>WMD</td>
<td>Weapons of Mass Destruction</td>
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I. Introduction

Purpose

Whether as a result of an accidental release at a chemical plant, a transportation accident, or an intentional military or terrorist action, the threat of exposure of the public to hazardous chemicals is real. The Union Carbide chemical plant in Bhopal, India, released methyl isocyanate into the environment onto the unsuspecting population (Zaidi, 1986). Iraqi military used chemical warfare agents (CWAs) against Iran and Iraqi Kurds (Ghanei et al., 2010; Darchini-Maragheh et al., 2012). Aum Shinrikyo, a religious cult, produced and released sarin, a nerve agent previously possessed only by nations, on multiple subway cars in Tokyo, Japan (Okumura et al., 1996). In Graniteville, South Carolina a rail car accident resulted in the release of chlorine gas in a populated area (Duncan et al., 2011). In each of these cases, significant numbers of people were killed or sickened.

Each day, large quantities of hazardous chemicals are produced, transported, stored, and used for industrial and household purposes. During each of these activities, there is risk that the chemicals could be released due to an accident or intention to cause harm. Rogue nations or terrorist groups could use known or long-since abandoned stockpiles of chemical weapons around the world. The formulas and instructions to produce many of these chemicals are available in open source literature, particularly in various terrorist handbooks. Moreover, chemical suicide, both abroad and in the United States (US), is a rising and troubling trend affecting not only the victims but also the first responders and first receivers rendering assistance. Civilian first responders and health care first receivers, along with emergency managers, public health practitioners, and law enforcement officials, must be prepared to respond to incidents involving the release of chemical agents.

The threat of a chemical release carries with it the possibility that workers, bystanders, or other people may become contaminated. These contaminated patients require assessment for decontamination needs and then potentially, execution of decontamination at the scene of the incident and/or at a health care facility. In recent years, the potential for a large-scale chemical release requiring decontamination of an overwhelming number of people has garnered wide interest. Methods and procedures for civilian mass patient decontamination were developed largely through extrapolating techniques used on hazardous materials responders in personal protective equipment (PPE) and military personnel in protective gear. Additionally, information sharing among fire and emergency services, hazardous material response, and Department of Defense (DOD) chemical, biological, radiological and nuclear (CBRN) defense communities improved these practices. Decontamination practices evolved rapidly and industry responded with customized equipment but without the benefit of evidence to guide such efforts (Levitin et al., 2003). Insufficient research has been conducted on decontaminating people and much of what has been done relies on the military perspective: decontaminating trained professional service members with the end goal being to return them to the operational environment so that they can continue a mission. Mass patient decontamination, like other aspects of disaster response, medicine and public health, would benefit from assessment of the body of evidence, enhanced incorporation of the evidence into planning and practice, and additional study to generate needed evidence (Levitin et al., 2003; Stopford et al., 2005; Auf der Heide, 2006). Various organizations have published guidance and best-practice documents but these generally do not categorize recommendations as evidence-based or not, nor do they describe the pertinent evidence. Furthermore, many current guidance and best-practice documents do not address the full spectrum of issues that a community may face when patient decontamination is necessary in a mass chemical exposure incident.

The emergency response and medical communities and the US Government have identified a need for national planning guidance for mass patient decontamination resulting from a large-scale chemical release that is evidence-based. Efforts to enhance preparedness for patient decontamination in a mass exposure
incident will also help to improve the care that is provided to individual contaminated patients on a daily basis in the US.

**How this work is unique**

“How Patient Decontamination in a Mass Chemical Exposure Incident: National Planning Guidance for Communities” differs from previous planning, guidance, and best-practice documents in two significant ways:

1. The guidance is evidence-based to the extent possible and that evidence, or lack thereof, is documented and briefly discussed.
2. The full spectrum of an incident is addressed, from initial assessment and decision-making through evaluation of decontamination effectiveness. Further, a comprehensive approach is taken to the entire affected community with emphasis on coordination between on-scene and health care facility-based response activities and communication on multiple levels.

**Audience and intent**

The main intended audience includes senior leaders, emergency planners, incident commanders, emergency management personnel, and trainers for emergency response organizations and health care facilities. Though the guidance was developed with this specific audience in mind, it may be of value to other audiences, including first responders and first receivers, leaders of public health organizations, and community leaders.

The guidance sets forth patient decontamination principles from a strategic standpoint, rather than a tactical one. It is meant to guide, but not specify, operational practices. The approach is flexible and scalable according to the resources and capability limitations of an organization within the capacity of the Authority Having Jurisdiction. The guidance statements comply with the framework of the National Incident Management System (NIMS) and the Incident Command System (ICS). This guidance does not promote any additions or changes to the NIMS or ICS structures.

**Scope**

The subject matter considered here is limited to external contamination of live people in a mass casualty incident resulting from an accidental or intentional chemical release. Contamination of patients with chemicals, including toxic industrial chemicals, toxic industrial materials and chemical warfare agents, is the present focus. Radiological materials and biological agents also pose important risks. Many of the concepts presented here will likely apply to those agents; in future work, this guidance can be built upon to address radiological and biological agents. While this guidance is aimed at mass casualty chemical incidents, the recommendations and principles may be applied to individual patients or multi-patient incidents as well.

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1 As defined by the Department of Health and Human Services (HHS) in the PREP Act, Declaration for Pandemic Flu (2009): is the public agency or its delegate that has legal responsibility and authority for responding to an incident, based on political or geographical (e.g., city, county, Tribal, State, or Federal boundary lines) or functional (e.g., law enforcement, public health) range or sphere of authority.

2 Multi-Patient decontamination (defined in Appendix E – Lexicon) signifies a small scale incident of more than one patient requiring decontamination. This incident is well within the resources of the initial responding agencies. Mass Patient decontamination indicates a large scale incident that requires mutual aid from neighboring jurisdictions; this may also indicate a need to utilize crisis standards of care and patient prioritization for decontamination. As an example, think of 5 patients versus 500.
Methodology

This national planning guidance was developed by a federal interagency expert working group, the Mass Human Chemical Decontamination Working Group (WG), with the advice of a larger group of federal and non-federal subject matter experts in emergency response, emergency medicine, toxicology, risk communication, behavioral health and other relevant fields. The WG was established at the request of the White House National Security Staff and co-chaired by the Department of Health and Human Services (HHS), Office of the Assistant Secretary for Preparedness and Response (ASPR) and the Department of Homeland Security (DHS), Office of Health Affairs (OHA).

In order to define the problem, core questions considered essential to performing patient decontamination and most likely to influence on-scene and health care facility approaches were identified. Core questions and their sub-questions naturally fell into three categories, which follow a logical response progression:

1. Risk assessment and decision making
2. Decontamination process and procedure
3. Evaluation of results and patient follow-up

Core questions were further divided so that the three categories were each applied to two distinct situations: individual patient decontamination, when one to a few potentially contaminated patients present for assessment and local resources are not overwhelmed, and mass patient decontamination, when a mass casualty incident results in multiple potentially contaminated patients and local response capabilities may be overwhelmed. This allowed for both (1) questions pertinent to an incident where significant resources and attention can be brought to bear on a single patient or small number of patients and therefore, optimal methods can be considered, and (2) questions unique to a mass casualty situation, when patient needs are likely to exceed available resources, prioritization will be necessary and crisis standards of care may need to be considered. See Table 2 for the core questions and their organization.

An extensive search of the published literature for answers to the resulting six core questions was conducted. The following databases were searched, although this is not an exhaustive list: PubMed, SCOPUS, Web of Science, and Google Scholar. Additional searches were conducted through the National Institutes of Health library. Initial search terms were limited to: human; chemical; decontamination. Additional search terms were topic dependent. Examples include:

- triage; assessment; decision to decontaminate
- risk communications; emergency communications; crowd behavior; disaster crowd management
- hospital preparedness; health care facility response
- detection capabilities; portal sensor technology
- effectiveness criteria; determination of clean

Only articles in English were evaluated, though no limits were placed on the publication date. Once an initial search was completed, the references sections of reviewed articles were used as sources of additional material for evaluation. Throughout this process the WG has sought the assistance of subject matter experts in identifying additional references, unpublished data, and on-going studies.

The literature review results were summarized and presented, along with the core questions and sub-questions, to a group of subject matter experts in the emergency response, emergency medicine, toxicology, research on hazardous chemicals, and other relevant fields at the Symposium on Chemical Decontamination of Humans 2010. Symposium participants helped to identify additional sources of evidence, refine the summaries of the evidence, and initiated lists of knowledge gaps or research needs for each core question.
Table 2: Key Elements of Patient Decontamination

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<tr>
<th>Core Question</th>
<th>Stage of Response</th>
<th>Functional Area</th>
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<tr>
<td><strong>Individual Patient Decontamination</strong></td>
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<td></td>
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<tr>
<td>What criteria can guide the decision on whether the patient needs decontamination or not?</td>
<td>Risk assessment and decision making</td>
<td>Determine the need for patient decontamination</td>
</tr>
<tr>
<td>What are the optimal methods for decontamination of a patient with an unknown level of exposure to an unknown agent?</td>
<td>Decontamination process and procedure</td>
<td>Optimized technical methods for patient decontamination</td>
</tr>
<tr>
<td>What metrics can be used to determine if patient decontamination was effective?</td>
<td>Evaluation of results and patient follow-up</td>
<td>Evaluating the effectiveness of patient decontamination</td>
</tr>
<tr>
<td><strong>Mass Patient Decontamination</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What techniques can be used for assessment and triage of patients (both at the scene and at health care facilities) to prioritize decontamination and medical treatment?</td>
<td>Risk assessment and decision making</td>
<td>Patient prioritization for decontamination</td>
</tr>
<tr>
<td>Where and when should decontamination take place?</td>
<td>Decontamination process and procedure</td>
<td>System-wide coordination of patient decontamination</td>
</tr>
<tr>
<td>Communication: (1) What information should be provided to patients to promote safety and compliance during decontamination and how should it be communicated? (2) How can communication about the incident with the whole community support the response and recovery?</td>
<td>Evaluation of results and patient follow-up</td>
<td>Crisis and emergency risk communication</td>
</tr>
</tbody>
</table>

With strong summaries of the available evidence, as well as the important knowledge gaps, prepared, initial draft guidance was created. The guidance follows the path set by the core questions, which define the essential information needed to conduct patient decontamination. For the guidance, each core question has been converted to a functional area (see Table 2). Each distinct principle is described as a guidance statement, with associated considerations if applicable. Guidance statements are based on published evidence if available, and have been additionally shaped by other guidance, best practice documents, expert opinion, and experience.

The initial draft guidance statements, their considerations, and the supporting evidence (literature review and current practices) were presented to a group of subject matter experts at the Mass Human Chemical Decontamination 2012 Symposium. As a measure of current practice, the WG performed a crosswalk analysis of eight current guidance or best-practice documents for recommendations that address the core questions. The following documents were included in the analysis:

- *Managing Hazardous Materials Incidents* – Vol. I (EMS) and Vol. II (Hospital Emergency Departments)
- Agency for Toxic Substance and Disease Registry (ATSDR)
- *Guidelines for mass casualty decontamination during a HAZMAT/Weapon of Mass Destruction Incident* (Vol. I and II)
- U.S. Army’s Edgewood Chemical Biological Center (ECBC)
• **Best practices for hospital-based first receivers of victims from mass casualty incidents involving the release of hazardous substances**  
  Occupational Safety and Health Administration (OSHA)
• **Best practices for protecting EMS responders during treatment and transport of victims of hazardous substances releases**  
  Occupational Safety and Health Administration (OSHA)
• **Multi-casualty mass decontamination guidance document for first responders**  
  California Governor’s Office of Emergency Services
• **Best practices and guidelines for CBR mass personnel decontamination**  
  Department of Defense; Combating Terrorism Technical Support Office; Technical Support Working Group (TSWG)

Participants reviewed, discussed, suggested revisions and voted their approval or rejection of each guidance statement. The evidence to substantiate each guidance statement was also reviewed. Following the symposium, guidance statements were significantly revised, the supporting evidence was summarized, and a level of confidence (LOC; see Evidence-based guidance section below and Appendix E) was assigned to each statement based on the quality and quantity of supporting evidence. In addition, extensive stakeholder review of this guidance document was conducted, including through professional societies and publication in the Federal Register for public comment, before finalization and distribution to the target audience.

The WG also developed a lexicon for civilian patient decontamination, in an attempt toward standardizing the terms used across varied organizations (included as Appendix B).

**Evidence-based guidance**

The planning guidance provided herein is evidence-based, *when evidence is available*. Additional supporting information is incorporated, including, but not limited to: previous experiences based on case studies, current practices, and subject matter expert (SME) consensus.

A Level of Confidence (LOC) score is assigned to each guidance statement. This confidence rating (based on a five point scale) gives the reader a sense of the strength of evidence substantiating a particular guidance statement. The following list provides a synopsis of the LOC scale (additional information can be found in Appendix E):

- LOC I – The highest recommendation is supported by strong scientific evidence, including clinical or field research, in addition to current practice and strong SME consensus.
- LOC II – The second tier recommendation is supported by some scientific evidence which is not definitive or where methodological problems limit the utility of the stated conclusions, but which is current practice and for which there is strong SME consensus.
- LOC III – Third tier recommendation is one for which very limited scientific literature is informative, but for which there is precedent in current practice and for which there is majority SME consensus.
- LOC IV – The fourth tier recommendation is supported by at least majority consensus and current practice but little or no scientific literature.
- LOC V - The fifth tier reflects an absence of literature and precedent; SME consensus forms the sole basis for the recommendation.

Since this is designed to be a living document, LOC scores may change in future versions when new evidence becomes available to inform the guidance statements. Additionally, the LOC scoring system helps to identify those topics requiring additional research.
**Future plans**

As the evidence-based principles for conducting patient decontamination set forth here are implemented, response plans and operational practices should themselves become more evidence-based. During development, a variety of gaps in the evidence were identified, many of which are outlined in the guidance statement discussions. These knowledge gaps will be formulated into a research road map describing and prioritizing questions for which evidence-based answers could significantly decrease or prevent morbidity and mortality. The research road map will be directed at grant and contract awarding entities and members of the research community, as dictated by current policy. Subsequent revisions to this guidance would reflect updated recommendations based on completion of research studies as well as widely accepted changes to current field practices.

It is crucial to integrate this guidance into training curricula and the WG intends to work closely with Federal partners to do so. Ideally, this guidance will be part of an iterative process of updating training programs, operational response plans and response standards during their normal revision cycles. Additionally, it is important to ensure that the intended audience is aware of the guidance. Promotion will be necessary upon this document’s release and subsequent updates. To support this socialization and periodic updating, a web-based version of the guidance document may be designed and published.
II. Guiding principles

Defining patient decontamination
Patient decontamination is defined as (see also Appendix B, Lexicon):
Any process, method, or action that leads to a reduction, removal, neutralization or inactivation of contamination on the patient in order to: prevent or mitigate adverse health effects to the patient; protect emergency first responders, health care facility first receivers and unexposed patients from secondary contamination; and reduce the potential for secondary contamination of response and health care infrastructure.

This definition is similar to other published definitions of decontamination (e.g., DOD FM 3-11.5, 2006; NFPA 472, 2013) but uniquely focuses on human health. The importance of decontaminating a potentially contaminated patient for protecting that patient’s health, the health of the responders and receivers treating that patient, the health of other community members, and the integrity of the emergency response and health care system are specifically identified. Since actions such as distancing oneself from the site of release, wiping visible contamination from skin and clothing, and removing clothing or disrobing can reduce or remove contamination from a patient, they are considered patient decontamination. Our definition is therefore broad and includes steps that a patient can take on his/her own, even before first responders arrive, to protect the health of him/her and others (see also Tiered risk-based approach and Guidance Statement 2.2).

Decontamination is a medical countermeasure
When conducted within the appropriate time window (which is relatively short for most chemical exposures) and using appropriate strategies (see Functional Area #2), patient decontamination can limit the patient’s exposure and the toxicities that follow from chemical contamination. Patient decontamination is an essential early step in the medical response to a chemical incident and can be considered a type of first aid – an initial action that reduces morbidity and mortality. Life safety is always the highest priority. Patient decontamination should ideally not delay other life saving measures or therapies. However, patient decontamination itself can save lives by preventing or reducing chemical agent absorption. Therefore, the need for patient decontamination must be balanced with other medical needs, taking into account available resources and capabilities. Patient decontamination facilitates detailed medical evaluation and treatment by allowing patients into ambulances and health care facilities, and medical management by responders and receivers unhindered by specialized hazardous materials personal protective equipment (PPE).

Secondary contamination leading to adverse health effects in responders and receivers who handle patients in a chemical incident is a well-documented phenomenon (Merrit & Anderson, 1989; Huff, 1991; Nozaki et al., 1995; Okudera et al., 1997; Okumura et al., 1998a/b; Zeitz et al., 2000; Geller et al., 2001; Kim, 2001; Horton et al., 2003, 2008; Okumura et al., 2005; Scanlon, 2010). Proper use of PPE can minimize the risk of secondary contamination and the associated health consequences. However, especially for health care facility-based receivers, decontamination of the patient prior to entry into patient care areas is the most appropriate way to reduce the potential for secondary contamination and mitigate the adverse health effects on responders and receivers. Similarly, secondary contamination of facilities and equipment, which can cause significant disruptions to emergency health care for a community (Huff, 1991; Burgess et al., 1997; Burgess et al., 1999; Kim, 2001; Horton et al., 2008), is preventable by decontaminating patients before they come into contact with such facilities and equipment.

The health benefits of patient decontamination – mitigating adverse health effects in the patient; permitting faster access to medical care; protecting the health of responders and receivers; and protecting health care infrastructure integrity – warrant its identification as a medical countermeasure. It should be
addressed with the urgency appropriate for a medical countermeasure and integrated into planning for other medical countermeasure utilization.

**Desired end points for patient decontamination**

A long-time weakness in the practice of patient decontamination is the lack of a well-defined, outcome-based goal. Complete removal of chemical contamination could be considered an endpoint, one that requires considerable effort, time, and resources. However, if performing patient decontamination led to no difference in the short-term or long-term health outcome of the patients, did not prevent any secondary contamination of responders and their equipment or receivers and their facilities, or contribute to the safety and resiliency of the community, would decontamination be worth the effort? Military decontamination doctrine has a well-defined and well-recognized goal: restoration of personnel and material to operational status in order to preserve the mission. This goal drives planning, resource and time allocation, informs the level of decontamination necessary, and provides for a measure of effectiveness (i.e., the ability to resume and complete the mission).

Without a health outcome-based goal for mass patient decontamination, decontamination itself becomes the endpoint – clean for clean-sake. This belief in turn drives research, education, and process development and refinement towards the endpoint of “clean” without questioning whether desired goals – such as reductions in morbidity or mortality, or prevention of secondary contamination – are actually being achieved.

The risks of adhering to this paradigm are:

1. The same decontamination suite of processes, tools, and techniques, will be used in every contamination incident, regardless of the specifics of the situation;
2. Certain processes (e.g., water-based decontamination) will be applied without questioning whether the process itself is causing harm (e.g., environmental illness, decontamination-related injuries, and psychological stress);
3. Future efforts in the patient decontamination field will be driven towards getting more people cleaner, faster and with improved tools and equipment, while the link to improved health remains not well established.

This national guidance has departed from previous efforts by focusing on evidence-based determinants of successful patient decontamination which deliver measurable, positive impact on health, infrastructure, and community outcomes. In doing so the WG has identified, not exclusively, the following goals of patient decontamination:

1. Achieving a measurable improvement in patients’ acute health outcomes by reducing short-term morbidity and mortality;
2. Achieving a measurable improvement in patients’ long-term health outcome by preventing delayed morbidity,
3. Protecting the health of responders and receivers by preventing their secondary contamination.
4. Assuring the best health outcome for the most patients. This might result in a departure from the current paradigm by optimizing for decontamination only to a level which insures everyone will get timely decontamination so that:
   a. those patients requiring supportive or definitive medical care receive it in a timely fashion;
   b. the majority of minimally exposed patients may be able to bypass medical evaluation, preserving medical resources for those with the most urgent needs.
Patient Decontamination is a whole community issue
“A Whole Community approach attempts to engage the full capacity of the private and nonprofit sectors, including businesses, faith-based and disability organizations, and the general public, in conjunction with the participation of local, tribal, state, territorial, and Federal governmental partners.”

Patient decontamination as described in this document aims towards such an approach. The response to a chemical release, regardless of circumstances, requires a concerted effort from multiple organizations, which may include first responders, first receivers, emergency management, public health, poison centers, and members of the public. Response to and recovery from these incidents can also require action from the private sector (e.g., emergency medical services providers, health care facilities, chemical companies, transportation companies) as well as from multiple levels of government and may necessitate requesting resources from surrounding jurisdictions through mutual aid. Communication and coordination among these groups is essential, yet evidence from past incidents suggests that improvements are needed. For example, basic information about an incident is not always shared in a timely and efficient manner between responders at the scene and receivers at health care facilities (Auf der Heide, 2006; Kirk and Deaton, 2007). One of six functional areas of this guidance is dedicated to system-wide coordination of patient decontamination in order to ensure that the community acts as a whole to provide care, information and other support to all members in need. The critical importance of risk communication with the public is also recognized, with it being the subject of another of the six functional areas. Risk communication before, during and after an incident supports response and recovery by enhancing preparedness, increasing the likelihood that appropriate protective actions will be taken and inappropriate or potentially harmful actions will not be taken by community members, and mitigating the stress, anxiety and dysfunction that can result from a disaster. Recommendations to plan for the needs of at-risk populations are incorporated at every appropriate point of this guidance. Such planning requires identification and understanding of the specific needs and vulnerabilities of all individuals within a community. Similarly, the concept that response plans will only work if they are based on the actual resources and capabilities available in a community at the time they are needed is repeated throughout the guidance. Developing realistic response plans also requires good understanding of the community to which the plan applies. This guidance’s emphasis on communication, coordination, and understanding a community’s needs and capabilities reflects the view that planning for mass patient decontamination must involve a whole community, a view which is being fostered by the Federal Emergency Management Agency’s (FEMA) current initiative on a whole community approach to emergency management (FEMA, 2011).

One of the major aims of this guidance is to aid local planning for mass patient decontamination in a manner that supports community resilience and self-sufficiency. Resilient communities have been identified as one of the keys to national health security by the Department of Health and Human Services (HHS, 2009, 2012). Through informed and empowered individuals, a resilient community is able to prevent, withstand and mitigate the consequences of a disaster and recover to at least its previous level of functioning (Chandra et al., 2011; HHS, 2012). It is assumed here that patient decontamination in a mass casualty chemical incident will be executed entirely by a local community, perhaps with assistance from neighboring jurisdictions. Due to the fast-acting nature of hazardous chemicals, the federal government will not be able to participate directly in the patient decontamination response; rather, the knowledge provided here represents a tool to be added to a local planner’s toolbox. Several pieces of this tool directly address actions that contribute to resilience. Risk communication with the public is a mechanism for informing and empowering individuals and was identified as a core component of community resilience in a study by the RAND Corporation (Chandra et al., 2011). Providing for the physical and behavioral health needs, functional needs and social well-being of all community members, as is recommended at all relevant points of this guidance, is necessary for community resilience. The whole

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community approach that engages the full range of appropriate organizations and stakeholder groups in emergency planning is embraced, for example, in the functional area on system-wide coordination of patient decontamination. Finally, the decontamination response strategy recommended here is a tiered approach that includes a self-care tier devoted to actions that a patient can take to protect him/herself from the toxic effects of chemical contamination before first responders arrive at the scene (see section on Tiered risk-based response approach section below and Guidance Statement 2.2). Integration of the whole community, including the general public, into disaster planning, response and recovery is supported by a wealth of empirical evidence that the public have the capabilities, the willingness, and actually have made significant contributions to disaster management (Schoch-Spana, 2012).

**Tiered risk-based response approach**

The general approach to patient decontamination presented here is a tiered response strategy designed to match the nature and extent of decontamination to the characteristics of the incident, including the nature and extent of patient contamination, and the capabilities of the responding or receiving organization. Rather than prescribe a specific protocol for all incidents, this approach allows flexibility and a scalable response. The three tiers (self-care, gross decontamination, and technical decontamination) represent a progression from relatively limited actions that can be taken without first responder or first receiver assistance and without specialized equipment and supplies, to a more involved, systematic process that will require equipment and supplies. In some situations, the approach may be executed in a stepwise manner, such that a patient undergoes all three decontamination tiers. In other situations, stepwise completion of the three tiers may not be required. Self-care and gross decontamination tiers aim to reduce contamination as early as possible, while technical decontamination aims at reducing contamination to a level as low as possible. Patients who are minimally contaminated may require only self-care, for example, while other patients may proceed from self-care directly to technical decontamination. The strategy may address a variety of scenarios. The guidance document adheres to a tiered, risk-based approach to patient decontamination as described more fully in Guidance Statement 2.2.

This flexible tiered approach to patient decontamination complements the risk-based response strategy for hazardous materials incidents promoted, for example, by the National Fire Protection Association (NFPA):

> Risk-based response process is defined as a systematic process by which responders analyze a problem involving hazmat/weapons of mass destruction (WMD), assess the hazards, evaluate the potential consequences, and determine appropriate response actions based on the facts, science, and circumstances of the incident.

NFPA 472 (2013 ed.) 3.3.55

Both strategies recommend evaluation of the situation followed by tailoring of the response to the needs and available resources for that specific situation. This should result in the most effective and efficient response possible under the circumstances.

**Practices in mass casualty incidents**

As with any other mass casualty incident, an incident involving mass patient decontamination will likely present challenges with resource constraints. There will presumably be more patients than can be adequately cared for under normal practices. Responders and receivers will need to prioritize patients for decontamination as well as medical care. One of the fundamental principles of responding to mass casualty incidents applies here as well: *do the best you can for the most people with the resources you have.*
III. Guidance Statements

Functional Area 1: Determining the Need for Patient Decontamination

Guidance Statement 1.1
The decision to decontaminate should take into account a combination of information, including (but not limited to):

- Patient displays signs and symptoms of exposure
- Visual evidence of contamination on the patient’s skin or clothing
- Proximity of the patient to the location of the release
- Contamination is detected on the patient using appropriate detection technology
- The chemical identity (if known), characteristics and behavior
- Patient requests or demands decontamination, even if contamination is unlikely

Considerations:
- Signs and symptoms of chemical exposure may present as one or more recognized toxidromes or as single symptoms
- Some signs and symptoms may not reflect actual chemical exposure, but manifest as a result of fear, an acute stress reaction⁴, or somatization due to the patient’s presence at the traumatic incident itself
- Environmental detectors are available for many TICs, TIMs, CWAs but are not readily adaptable to or available for the detection of contamination on patients likely to be encountered in a hazardous materials incident

Level of Confidence: III

Discussion:
Overall, there is little empirical or experimental evidence in the literature that would indicate the best means to assess the decontamination needs of patients. However, each of the indicators described in the guidance statement is represented in the literature, best-practices documents, and is recommended by subject matter experts. In addition, SMEs indicated, to varying degrees, the importance of each of these factors in determining the need to conduct decontamination. The assertions in this guidance statement would be difficult to evaluate in a research investigation in a meaningful way.

Symptoms
The most prominent factor in the available literature, in regards to deciding when to decontaminate, is symptomology – patients displaying apparent signs and symptoms of chemical exposure. Toxidromes, or clusters of symptoms, could be utilized to help distinguish between affected and unaffected individuals (Kirk et al., 1994; Markel et al., 2008). Symptoms or toxidromes are often the easiest method to determine that a patient is contaminated and requires decontamination (Kirk & Deaton, 2007). However, there is some research to suggest that individuals who have a low probability of being contaminated can still exhibit symptoms that do not have an organic origin (Kirk & Deaton, 2007), indicating that additional information is required in deciding the need to decontaminate. Multiple prior existing guidance documents indicate symptomology as a cause for decontamination (DOD TSWG, 2004; OSHA-FR, 2005; CAL-OES, 2006; ECBC, 2009; OSHA-EMS, 2009). A majority of the SMEs, specifically,
first receivers, who commented on this guidance statement indicated that signs and symptoms were a major consideration for determining the need for patient decontamination.

**Visual**
Visual indications of chemical contamination on the patient or the patient’s clothing are another factor that can be utilized to determine the need for decontamination (Ramesh & Kumar, 2010). Visual evidence of contamination indicates an ongoing exposure with increased contact time (Kirk & Deaton, 2007). Other references have also included visual indications as a factor in determining patient decontamination needs (Okumura et al., 2005). In addition, various prior existing guidance documents list visual contamination as a main factor in determining the need for decontamination (DOD TSWG, 2004; OSHA-FR, 2005; CAL-OES, 2006; ECBC, 2009; OSHA-EMS, 2009).

**Proximity**
It has been suggested that individuals in close proximity to the release may need to have decontamination performed on scene or at health care facility; at the very least, this should be used to evaluate the need for decontamination (Vogt & Sorensen, 2002). Patients who are closer in proximity to a release are suspected of having received a higher dose of contaminant and therefore have a higher need for decontamination than a patient further from the release (Kirk & Deaton, 2007). Proximity to the release is cited in various articles as one of the main factors to consider when determining decontamination needs (Ramesh & Kumar, 2010).

**Detection**
There is a lack of discussion in the literature regarding the use of detection and diagnostic technologies that can be used to determine decontamination requirements. Although there are environmental detection technologies available and are used by first responders to characterize hazardous environments (e.g., Fire Fighters, Hazmat Response Teams, DOD), there is little mention within the literature of the use of these devices in regards to determining decontamination requirements. Raber, et al. (2001, 2004) and Volkland (2000) used exposure guidelines to assess the potential of using detection capabilities to determine the efficacy of decontamination, but reached the conclusion that current detection assets are neither sensitive enough nor broad enough to be particularly useful in these situations.

**Known Identity, Characteristics, Behavior**
Some chemicals may not necessitate decontamination (Kenar & Karayilanoglu, 2004). If the identity of a chemical contaminant is known, as in the case of a properly placarded truck or rail-car accident, then this information should be utilized in deciding whether to decontaminate patients. The chemical identity would allow responders and health care receivers to access information about the physical and chemical characteristics from a number of sources (e.g., DOT Emergency Response Guidebook, 2012), which would assist in determining appropriate medical interventions (Kirk & Deaton, 2007). It is unlikely; however, that the chemical will be identified within any meaningful period during a terrorist incident, and even then, the information may be incorrect (Okumura et al., 1998; Zeitz et al, 2000). Communication issues between responders and receivers can also prevent the health care facility staff from learning the chemical identity before patients arrive (Kirk & Deaton, 2007). It is possible that the characteristics of a chemical, even if the identity is not known, can help determine the need for decontamination (e.g., liquid versus a gas contaminant) (Houston & Hendrickson, 2005). First Responders, most often indicated that the identity or characteristics of the contaminant is a main factor in determining the need to conduct decontamination.

**Patient Request**
Participants at the 2012 Decontamination Symposium discussed using patient perception as an indicator for the need for decontamination. Patients who perceive their risk for contamination as high, or who request or demand decontamination, should be provided with this opportunity. Participants in a study
conducted by Gallacher (2007) discussed the potential for unaffected victims to request decontamination for psychological well-being. An acute stress reaction may occur when the person has been exposed to a traumatic event in which both of the following were present: (1) the person experienced, witnessed, or was confronted with an event or events that involved actual or threatened death or serious injury, or a threat to the physical integrity of self or others and (2) the person’s response involved intense fear, helplessness, or horror (DSM-IV, 2000). Somatization is frequent in acute stress reactions and may manifest as symptoms the patient expects might result from the perceived exposure (Fetter 2005). Despite the occurrence of acute stress reactions and/or somatization – each of which could result in unexposed patients nonetheless requesting or undergoing decontamination for symptoms perceived to represent toxic effects. Most authors have demonstrated that panic, or anxiety responses and behaviors which are maladaptive, do not occur frequently in disasters, conventional terrorist attacks, and bioterror incidents (DiGiovanni, 2003; Fetter, 2005).
Guidance Statement 1.2
Decontamination should be performed if the potential contamination on patients requiring transport to, or care in, a medical facility poses a reasonable risk of exposure to first responders/receivers or contamination of critical infrastructure.

Considerations:
As a sole criterion, prevention of secondary contamination alone may not justify patient decontamination; patients meeting the following criteria are unlikely to pose a significant risk to responders and receivers:
- Displaying neither signs nor symptoms
- No visible contamination on skin or clothing
- History that makes exposure unlikely (i.e., not near the location of release)

Level of Confidence: III

Discussion:
The potential for secondary contamination of responders/receivers and/or critical infrastructure is well discussed in the literature and best-practices guides. This guidance recommendation is not likely to be evaluated through a scientific study, but based on the support from subject matter experts and other factors described here, it should be included in developing plans for mass patient decontamination.

First responders and receivers must be cognizant of the potential risk of secondary contamination to both themselves and other citizens. Secondary contamination of responders and receivers was well documented following the sarin attacks in Japan (Nozaki et al., 1995; Okudera et al., 1997; Okumura et al., 1998a/b; Okumura et al., 2005; Scanlon, 2010) and from hazardous materials incidents in the US (Merrit & Anderson, 1989; Huff, 1991; Zeitz et al., 2000; Geller et al., 2001; Kim, 2001; Horton et al., 2003, 2008). Typically, the greatest risk of secondary contamination is during transportation of contaminated patients by emergency medical service (EMS) providers, who are confined within the enclosed environment of an ambulance. However, the potential of exposing receivers at the health care facility remains a high likelihood, particularly with self-evacuating patients (Cone & Koenig, 2005). Several prior existing guidance documents (HHS ATSDR-ED, 2000; OSHA-FR, 2005; ECBC, 2009; OSHA-EMS, 2009) emphasize the necessity of decontamination due to the risk of secondary contamination.

The literature cites the need for decontamination in order to prevent contamination of critical infrastructure, including health care facilities (Huff, 1991; Burgess et al., 1999; Kim, 2001). There is a history of emergency departments (ED) closing and evacuating due to secondary contamination, resulting in loss of a community medical care resource and other essential medical services. Symposium participants indicated that the potential for contaminated patients to effectively shut down an ED or health care facility should be considered when determining the need for decontamination.

While these risk factors must be taken into account when determining the need to decontaminate patients, the risk of secondary contamination must also be considered when determining the decontamination needs of individual patients. The decision to decontaminate must be assessed not only in terms of the risk of secondary contamination, but also the degree to which decontaminating patients is likely to affect their health. Such a risk-based response approach would involve:
- A determination of the need for decontamination by applying the criteria described in Guidance Statement 1.1, including the need to reduce the risk of secondary contamination.
- Assessing the risk of adverse outcomes resulting from the decision to decontaminate
- Considering alternative decontamination practices described in Guidance Statement 2.9.
• Considering relevant chemical and exposure information from the incident scene and unique to the incident, including whether the properties of the contaminant pose a risk of secondary contamination.

Subject matter experts generally agreed that patients who are: not exhibiting symptoms, have no visual signs of contamination, and are unlikely to be contaminated due to proximity to the release are unlikely to require decontamination nor pose a significant risk for secondary contamination.
Guidance Statement 1.3
If the likelihood of adverse consequences of gross or technical water-based decontamination itself outweighs the likely health outcome gains of decontaminating patients, then decontamination should be performed using alternative practices.

Considerations:
- Patient decontamination is not without risk; appropriate measures should be taken to mitigate these risks and reduce the negative impact on patients.
- Refer to Guidance Statement 2.10 for alternative practices.
- Adverse consequences might include contraindications due to weather (e.g., freezing temperatures, cold weather injuries) or chemical reactivity (e.g., water-reactive chemicals or metals, such as, lithium or sodium metal), or delay in lifesaving care or psychological trauma.

Level of Confidence: III

Discussion:
The decision to perform decontamination should take into consideration any and all potential consequences. A risk-based response (as outlined in Guidance Statement 2.1) is necessary to ensure that the benefit of decontamination efforts outweigh the potential consequences of adverse health effects for patients. Responders and receivers must consider environmental conditions, chemical reactivity with water, the potential for mechanical incidents (i.e., slips, trips, falls), and the psychological impact of conducting decontamination (Levitin et al., 2003; Freyberg et al., 2008). Elements of this guidance statement have support in the available literature or could be considered current practice. However, a study to evaluate these recommendations would be difficult to design and conduct. In addition to information presented in the literature, the potential for adverse consequences is discussed in various prior existing guidance documents (ATSDR-EMS, 2000; DOD TSWG, 2004; OSHA-FR, 2005; ECBC, 2009; OSHA-EMS, 2009).

Environmental conditions
Traditionally, decontamination has implied water-based showering. However, other decontamination strategies are better suited for certain conditions and may achieve similar outcomes as traditionally implemented decontamination methods. These alternative strategies include the removal of victims from the contaminated area, removal of clothing, and/or use of an implement (i.e., clean rag) for spot decontamination (Feldman, 2010). These methods may prove especially relevant when environmental conditions present risk of cold weather injuries or other extreme weather (e.g., Freezing rain, icy conditions) (Lepler & Lucci, 2004). Decontamination should be scalable and flexible. If the risk of water-based decontamination in an extremely cold environment is too great, then disrobing victims and providing uncontaminated covering in the short term may be sufficient in substantially reducing the risk of chemical-specific health outcomes without inducing cold weather injuries.

In colder environments, decontamination may require alternative locations in lieu of alternative techniques. Using indoor swimming pools, gymnasiums, or other large shower facilities (e.g., arenas, schools, hotels) have been considered in prior existing guidance documents (ECBC, 2009); response organizations’ plans should consider these as potential alternatives to outdoor decontamination.

Chemical reactivity
Alternative decontamination methods should be considered for chemicals that are deemed water-reactive. Water-reactive substances undergo a dangerous chemical reaction when they come into contact with water. This reaction may release a gas that is either flammable or presents a toxic inhalation hazard. In addition, the heat generated when water activates such materials is often enough for the item
to spontaneously combust or explode, causing severe burns. The U.S. Department of Transportation’s Emergency Response Guidebook (2012) provides a list of water-reactive chemicals that produce toxic-by-inhalation gas(es) when spilled in water. In addition to this list, there are several alkali metals that are violently reactive with water that should be considered.
**Functional Area 2: Optimized Technical Practices**

**Guidance Statement 2.1**

A risk-based approach should be employed by the responding or receiving organization to determine the appropriate response level and associated strategies and tactics (including PPE, medical interventions and decontamination).

**Considerations:**
- Appropriately trained supervisory personnel (e.g., see Hazardous Operations and Emergency Response (HAZWOPER) standards, 29 CFR 1910.120(q) or NFPA 472/473, 2013) should perform a situational assessment.
- PPE determination should be based upon the unique circumstances of the event, in consultation with applicable guidance and regulations (OSHA, NIOSH, and NFPA), subject matter expertise, and manufacturers’ specifications.

**Level of Confidence: IV**

**Discussion:**
The risk-based approach allows hazmat responders and first receivers flexibility in adapting response capabilities to dynamic situations. This approach deviates from standard practice-based response operations by allowing responders and receivers to make critical decisions based on an assessment of the hazards and risks associated with a particular incident. The risk-based response is a systematic approach to responding to an incident that incorporates the knowledge and experience of the responder, the unique circumstances of an event, and the applied scientific principles in order to make informed response decisions. Responders and receivers should incorporate these principles into their planning and training for decontamination operations, using knowledge of the chemical (e.g., identity, characteristics, and behavior), site-specific information, air monitoring, patient signs and symptoms, and other clues for decision making.

Risk-based response has become a common practice of hazmat response following its evolution from street-smart tactics, and is incorporated as a core competency in NFPA 472: Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents (2013), as well as textbooks and training guides. Subject matter experts strongly encouraged guidance which reflects the risk-based response approach as a key element of planning for mass patient decontamination.
Guidance Statement 2.2

A tiered approach to patient decontamination allows the nature and level of decontamination to be based on the nature and level of the contamination, as estimated through risk-based assessment of the incident, as well as available resources. The tiered decontamination response is flexible and adaptable to various types of incidents; each tier can be executed either at the scene or at a health care facility.

Three tiers are recommended:

- **Self-care:** actions that a patient can perform for him/herself, including distancing him/herself from the site of release, removing clothing, and wiping visible contamination from skin and clothing in order to reduce his/her own contamination level immediately, without waiting for a formal decontamination process to be set up. A perceptive patient or one experiencing acute distress from the chemical contamination may execute self-care even before responders arrive; however, most patients will need instructions.\(^5\)

- **Gross decontamination:** actions likely to be performed by or with the assistance of first responders or first receivers in order to achieve a gross or hasty reduction in contamination, significantly reducing contamination on skin or clothing, as soon as possible after contamination has occurred.\(^6\)

- **Technical decontamination:** planned and systematic actions, likely to be performed under the guidance of or with the assistance of first responders or first receivers, to achieve contamination reduction to a level that is as low as possible.\(^7\)

Mass decontamination, the physical process of reducing or removing surface contaminants from large numbers of patients in potentially life-threatening situations in the fastest time possible, may occur within any of the three tiers.

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\(^5\) Self-care is similar to the concepts of self or emergency decontamination (DOD TSWG, 2004; OSHA - First Receivers, 2005; OSHA-EMS, 2009), emergency decontamination (NFPA 472, 2013) and immediate decontamination (DOD FM 3-11.5, 2006).

\(^6\) Gross decontamination is similar to the concept of field-expedient decontamination (DOD TSWG, 2004; OSHA-First Receivers, 2005; OSHA-EMS, 2009) and to DOD’s concept of operational decontamination (DOD FM 3-11.5, 2006) and consistent with NFPA’s concept of gross decontamination (NFPA 472, 2013).

\(^7\) Technical decontamination is similar to the concepts of thorough decontamination (DOD TSWG, 2004; OSHA-First Receivers, 2005; OSHA-EMS, 2009) and definitive decontamination (HHS ATSDR Vol. I, 2000).
Considerations:

- The patient decontamination tiers are not a step-wise system that requires conduct of each in order. They should be applied in a manner that meets the needs of each specific situation.
- Some health care facilities may require that a patient has been technically decontaminated before he/she enters the facility. In this case, local plans should incorporate a technical decontamination capability either at the health care facility or with first responders that will be accepted as sufficient by medical personnel.

Level of Confidence: III

Discussion:
In the tiered approach to patient decontamination, the methods and goals depend on the details of the exposure and the resources available. Self-care and gross decontamination are primarily first aid measures. These measures are aimed at saving patients’ lives and mitigating adverse health effects by reducing the amount of contaminants in the patient’s immediate environment, thereby reducing the amount absorbed and the dose received (Hamilton et al., 2004; Preston, 2008; Amlôt et al., 2010; Braue et al., 2011a/b; Feldman, 2010). Self-care and gross decontamination are the most time-sensitive of the three tiers. Given this, for maximum benefit, they should be performed as soon as possible after contamination has occurred (Hamilton et al., 2004; Braue et al., 2011a/b). The primary objective of technical decontamination is to reduce a patient’s contamination to a level that is as low as possible in order to minimize the potential for secondary contamination of responders, receivers, other people, equipment, and facilities. Once a patient has undergone technical decontamination and contamination is significantly reduced, responders and receivers can handle the patient, evaluate, and administer medical care while operating in a reduced level of PPE. Technical decontamination may also save lives and reduce adverse health effects among patients by limiting additional absorption of surface contaminants, depending on how soon it is executed.

Example (at the scene):
A mass chemical exposure occurring in a jurisdiction with limited resources, where first responders must wait on mutual aid support, may require sequential completion of the tiered response.

- First responders arrive at the scene and instruct patients to move to a specific area upwind of the area of release, remove at least outer layers of clothing, and wait (Self-care).
- Shortly thereafter, patients are guided through a decontamination corridor established at the scene using a Ladder Pipe Decontamination System for decontamination (Gross).
- Subsequently, patients undergo technical decontamination in a mobile tent system also set up at the scene (Technical).

In a well-equipped jurisdiction, the tiers may be completed nearly simultaneously:
- First responders arrive on scene and direct patients to move to a specific area upwind of the site of release, instruct patients to remove clothing and proceed through a mobile tent system for technical decontamination

Many other sequences of events are possible; these examples illustrate how the tiered approach can be flexibly applied to specific situations as part of a risk-based response.

The tiered approach is used to tailor the decontamination response to the specific incident. It is not meant to suggest that decontamination must be a sequential process where self-care is conducted first, followed by gross and then technical decontamination, though some incidents may proceed in such a manner.
Other contingencies may arise for which planning should be conducted. In some mass exposure scenarios, such as one involving only a gas or vapor contaminant, self-care may be sufficient.

Technical decontamination requires more resources and time than gross decontamination, which requires more resources and time than self-care. The capability to perform each tier of decontamination depends on the availability of those resources. The more resource intensive practices can provide greater privacy and comfort, as well as potentially allowing for further removal of contaminants from patients.

Several prior existing guidance documents (HHS ATSDR, 2000; DOD TSWG, 2004; OSHA-FR, 2005; DOD FM 3-11.5, 2006; OSHA-EMS, 2009; NFPA 472, 2013) promote a tiered or phased approach to patient decontamination that is consistent with the recommendations of this guidance document. The specific terms used differ and, in some cases, two rather than three tiers are identified. Nevertheless, the concepts and the rationales are the same between the existing guidance documents and this guidance document. Most importantly, prior guidance emphasizes the urgency of reducing exposure and removing large amounts of chemical contamination from patients as soon as possible with readily available resources (i.e., self-care and gross decontamination). Prior guidance documents also describe a more technical and organized type of decontamination designed to reduce contamination to a level that is as low as possible or as clean as possible in order to limit the spread of contamination and protect responders, receivers, equipment and facilities (i.e., technical decontamination).

The approach is also established in the National Fire Protection Association’s (NFPA) Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents (NFPA 472, 2013), which widely impacts first responder practices, and is implemented by the DOD (DOD FM 3-11.5, 2006). A controlled study of the effectiveness of a flexible, three-tiered approach as defined here would be difficult to design and execute. However, evidence of its successful application in real incidents or even in exercises would be a welcome addition to the field.

Example (at health care facility):

A significant proportion of patients may leave the scene without being decontaminated or evaluated by responders and either proceed directly to a hospital or not seek care right away.

These patients will have performed some, but perhaps not all possible, self-care actions and then undergo gross and/or technical decontamination at the hospital.

Note: Other contingencies may arise for which planning should be conducted. In some mass exposure scenarios, such as one involving only a gas or vapor contaminant, self-care may be sufficient.
Guidance Statement 2.3

Clothing removal for patients who have been visibly contaminated or who are suspected of having been contaminated is an essential aspect of self-care and overall decontamination processes. Efforts should be made to collect and account for clothing and personal items removed for patient decontamination.

Considerations:
- If clothing removal is to be conducted outside, be mindful of environmental risks and, if applicable, ensure warming or cooling methods are available (e.g., warming tent, indoor location, shaded area).
- Some patients may require assistance with removing clothing.
- Ensure proper levels of modesty (e.g., separate lines for males and females and cover from bystanders; cultural and religious practices should be taken into consideration during planning).
- Clothing and personal items should be handled in such a manner to address the following priorities.
  - Protect the health and safety of patients, responders and receivers
  - Evidence collection for law enforcement
  - Logistical capabilities
  - Consider a plan to return valuables to patients if possible and safe
  - Clothing which could be analyzed for contaminants can confirm exposure and/or provide an estimate of degree of exposure in addition to its evidentiary value and any plans to return personal items to patients.
- Patients should be allowed to maintain identification (e.g., ID Card, driver’s license) that can be processed through decontamination without being destroyed or retaining contamination.
- Provisions should be in place to accommodate law enforcement equipment/weapons. If the incident is suspected to be an intentional act, clothing and personal items may become evidence; law enforcement should be incorporated into response planning to develop SOPs for collecting contaminated material and ensuring chain of custody in accordance with (IAW) jurisdictional guidance.

Level of Confidence: II

Discussion:
Quantitative claims have been made frequently in the literature about the efficacy of clothing removal in reducing contaminants on a patient that are not substantiated by appropriate studies. It is often stated that removing clothes may reduce contamination on a person by approximately 80-90%. References are sometimes included and authors seem to imply that there is evidence to support this quantitative claim. However, cited references usually repeat the same estimated percentage of contaminants removed through disrobing without describing any evidence. In fact, there is currently no published study that directly evaluates the question of how much contamination can be removed from a person after chemical exposure by removing the person’s clothing. Such a study could be performed by exposing human subjects to a chemical simulant, or by exposing mannequins or laboratory animals to a toxic chemical, and measuring contaminant levels before and after clothing removal. The results are likely to vary depending on the specific chemical and its physical state (i.e., solid, liquid, vapor or gas), as well as the method of contamination (e.g., dispersion).

There is compelling indirect evidence to suggest that clothing should be removed from a patient who has been exposed to a chemical in order to minimize the amount of contaminant and dose that may potentially be absorbed. Several studies have demonstrated that clothing absorbs and retains chemicals to which it has been exposed. In a study that measured the amount of liquid contaminant absorbed by fabric-covered human skin, Csiszar et al. (1998) reported that the fabrics absorbed most of the applied contaminant (85-95%) and retained it for at least eight hours, resulting in absorption through the skin of only a very small amount of the contaminant (0.1-0.2%). Feldman (2010) also provided evidence that clothing absorbs and
retains chemicals, but additionally demonstrated that significant off-gassing can occur. In the Feldman (2010) study, a variety of civilian clothing articles were exposed to the chemical agent simulant methyl salicylate, which has similar physical properties to sulfur mustard, in vapor form. After the exposure was terminated, methyl salicylate vapor was detected near each article of clothing. Off-gassing continued for several minutes longer for heavier clothing (e.g., jackets and sweaters) than the few minutes noted for lighter clothing (e.g., jeans and t-shirts), suggesting that patients and responders may receive additional exposure from clothing that is not removed and isolated immediately. Two other studies support the concept that clothing provides some protection for its wearer by reducing some chemical absorption through human skin; however, some skin absorption still occurred from the contaminated fabrics (e.g., cotton sheets and fabric of military uniforms). This additionally supports the potential benefit of clothing removal completely as opposed to over-reliance on street clothing to provide significant chemical protection levels when initially exposed (Wester et al., 1996; Wester et al., 2000). Reports of secondary contamination of responders or receivers also indirectly support the recommendation that clothing be removed from contaminated patients. In one of the most cited cases, 13 of the 15 physicians who treated patients in a Tokyo emergency department, after the sarin release on subway trains in 1995, experienced symptoms of sarin exposure. Since none of the patients were decontaminated, it is presumed that the physicians were exposed through off-gassing of sarin from the patients’ clothing (Nozaki et al., 1995).

Prior existing guidance documents reviewed in the crosswalk analysis recommend the removal of clothing for any person suspected of having been exposed to a chemical (HHS ATSDR-ED, 2000; HHS ATSDR-EMS, 2000; DOD TSWG, 2004; OSHA-FR, 2005; CAL-OES, 2006; ECBC, 2009; OSHA-EMS, 2009). Some of the documents also provide specific instructions on how clothing should be removed, such as the ECBC (2009) guidance. There is strong experimental work and other indirect evidence that supports the concept that clothing removal may eliminate a significant amount of a chemical contaminant from a patient, thereby reducing the potential for additional absorption by the patient, as well as the potential for secondary contamination of responders, receivers, other people, equipment or facilities. The recommendation to remove contaminated clothing is found in current guidance documents (HHS ATSDR-ED, 2000; HHS ATSDR-EMS, 2000; DOD TSWG, 2004; OSHA-FR, 2005; CAL-OES, 2006; ECBC, 2009; OSHA-EMS, 2009), as well as experimental and field evidence (Nozaki, 1995; Csiszár et al., 1998; Burgess, 1999; Horton et al., 2003; Feldman, 2010), which justifies a LOC rating of II. Well designed and controlled clinical trials and/or field research to directly test the effectiveness of clothing removal in reducing patient contamination, or on other outcomes, are needed to substantiate commonly made assertions. In the meantime, this Guidance Document endorses clothing removal as an important decontamination step that can be performed without equipment or supplies and in many cases, without the assistance of responders.
Guidance Statement 2.4

Privacy for patients should be incorporated throughout the decontamination process, within the resource limitations of the responding or receiving organization, to include:

- Privacy during clothing removal
- Segregation of males and females during decontamination
- Materials for redressing following decontamination

Considerations:

- Responding and receiving organizations must balance concerns surrounding patient privacy and the urgency of decontamination needs.
- Families, including caretakers, should be permitted to remain together during the decontamination process.
- Patients and/or their family members may not be comfortable with the patient being decontaminated by staff of the opposite gender; allowances for these concerns may not be appropriate in a life or death situation.

Level of Confidence: IV

Discussion:

Privacy is not directly related to a patient’s medical outcome; however, efforts to provide privacy protections may enhance patient compliance with recommended decontamination practices, which can influence patient outcome. A controlled study to test the effects of privacy protections, segregation by gender, or maintaining families together on patient compliance and/or outcome would not be ethically acceptable. Evidence from actual incidents — based on news reports, after action reports, and anecdotes — demonstrates that when patients perceive that they have not been afforded sufficient privacy, they may express dissatisfaction with the decontamination process or the overall way they were treated by responders or receivers. In the suspected biological and chemical incident at B’nai B’rith Headquarters in Washington, DC in 1997, some police officers who were instructed to undergo decontamination initially refused, and tensions ensued between police and EMS personnel, due to the live broadcasting of pictures of the incident scene from news cameras on top of a nearby building (United States Fire Administration, 1997). In some cases, lawsuits have been filed against emergency response organizations alleging that patients' privacy and other rights were violated during decontamination, for which they were requested to disrobe in view of responders of the opposite gender and/or bystanders. It is interesting to note that as part of the settlement of one of these cases, King County, WA helped purchase a mobile decontamination trailer for joint use by local fire and police departments (Gong et al., 1996). Anecdotes suggest that patients may become upset if separated from family members during decontamination and parents may fear that the privacy, safety and welfare of their children are not adequately protected if they are cared for by responders of the opposite gender during decontamination. During a drinking water contamination incident in Spencer, MA in 2007, local fire departments only conducted decontamination with response personnel of the same gender as the patients. However, an insufficient number of female personnel were deployed to the incident, resulting in delays in decontamination of female patients and female personnel having to work longer shifts than male personnel (FEMA, 2007).

Providing for privacy during decontamination requires resources. Curtains or barriers to segregate people, at least by gender if not by individual, can allow for protection of modesty. In a case study of the effectiveness of hospital-based patient decontamination during a simulation, 83% of subjects reported that they felt they were provided a high level of modesty protection while using a fixed decontamination shower setup with multiple curtains (Hood et al., 2011). If some type of simple clothing, such as hospital garments, or blankets or sheets, with which patients can cover up are available, this may not only help to maintain privacy but also provide some comfort, possibly mitigating some of the negative psychological
consequences resulting from a patient having been involved in a traumatic mass exposure incident (Holloway, 1997; DiGiovanni, 1999; Fetter, 2005).

Documentation of the importance of protecting patient privacy during decontamination is difficult. There is little evidence in the scientific literature demonstrating that protection of privacy influences patient outcome or compliance. Seven of the eight current guidance documents included in our crosswalk analysis recommend that patients’ privacy be maintained as resources allow. SMEs unanimously supported this guidance statement while emphasizing the importance of not delaying urgently needed decontamination for the purpose of waiting for materials or equipment to provide privacy.
Guidance Statement 2.5

In the absence of specific information about the contaminant, water is the preferred decontaminant in the case that gross and/or technical decontamination is deemed appropriate.

Considerations:

- Depending on the decontamination system, water variables (e.g., flow, temperature, and pressure) may or may not be easily manipulated.
- Water-based decontamination should be avoided when water-reactive chemicals are involved.
- Water-based decontamination may be contraindicated or delayed due to concerns for weather-related/environmental injuries (e.g., cold weather injuries, heat illness).
  - For ambient temperatures between 36 - 64° F, indoor methods for water-based decontamination should be considered and indoor post-decontamination activities should be implemented.
  - For ambient temperatures at and below 35° F, water-based decontamination should only be conducted indoors (e.g., showers and gyms at schools or other facilities) and indoor post-decontamination activities should be implemented.
- Water used for decontamination may be subject to local or state environmental regulations regarding storage and disposal.
- The efficacy of decontamination may be improved by the addition of mild soap to water.

Level of Confidence: IV

Discussion:

In current literature, there is significant amount of evidence showing the amount of time to get water on contaminated tissue significantly influences the outcome for the patient (Hall et.al, 2002; Zhai et al., 2007; Moffett et al.2010). There are epidemiology studies from burn centers that show the earlier you get water on people, the better the outcome (Leonard et al., 1982; Moran et al., 1987). Reifenrath et al. (1984) looked at the minimum level of characteristics of how you apply water (i.e., find the lowest pressure and amount of time to find maximum efficacy). The article looked at physical removal of contaminant. Subject matter experts state that a fixed showerhead in a fixed facilities has a higher flow rate and better angle of penetration, then does the temporary systems (i.e., trailers, tents, transportable systems), which typically have water flow issues. Nevertheless, Nielsen’s (2010) study demonstrated that percutaneous penetration continues after the exposure and that the penetration rate will decrease significantly by a simple wash after the exposure. This not only reduces the amount of residue present in the upper skin compartments but also significantly reduces total absorption. Torngren, et.al (1998) studied the outcome of the amount of decontaminants removed from the use of water alone versus water and soap. This study showed water was an effective decontaminant when used on two chemicals, one of high water solubility (ethyl lactate with similar properties to sarin) and one with low water solubility (methyl salicylate with similar properties to sulfur mustard). In particular, the water only method did an excellent job with the high water solubility contaminant. The second step of the study utilized soap and water, which removed the remaining low water soluble contaminant. Finally, the third step of the study resulted in a complete drop in measureable contaminants after medical triage and emergent care was provided. Moreover, all the best practice documents and current methods in the field utilize water. Water is the preferred decontaminant; when immediately available and its use causes no delay in the initiation of decontamination, the addition of soap to water may increase the efficacy in certain circumstances (Wester, 1990, 1992). Soap can increase the partitioning of oily or waxy contaminants away from the skin better than a purely aqueous liquid, which may be helpful if a contaminant is oily or viscous.

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8 The temperature ranges listed in this Guidance Statement are a result of existing ECBC (2009) guidance, the literature review, and Subject Matter Expert (SME) input during the symposium.
Matousek (2006) suggests the following characteristics of a decontaminating agent for effective use and availability through industrial ease of mass production:

- Effectiveness against all main types of CW A’s, i.e. universality,
- Speed of decontamination effect,
- Skin non-irritancy,
- Non-damaging on clothing material,
- Simplicity of manipulation,
- Readiness to use,
- Repeated use,
- Low weight,
- Use within a wide temperature range,
- Mechanical resistance,
- Extreme stability on storage,
- Simplicity of manufacturing enabling mass production,
- Accessibility of raw materials,
- Extremely low costs.

Nevertheless, when utilizing water as a decontaminant, first responders and first receivers need to be cognizant of risks. If the contaminant is known to be water reactive (e.g., metals) then an alternative decontaminate should be utilized. Furthermore, provisions should be made to mitigate environmental injuries (e.g., slips, falls, and burned feet) such as the use of non-skid surface liners, etc. Weather-related injuries (e.g., cold weather injuries and heat illness) need to be considered as a relevant increased risk. A report from the US Army Soldier and Biological Chemical Command (2002) stated that firefighters can decontaminate the general population utilizing water when the ambient temperature is at or above 65°F with a minimal risk of incurring cold weather related injuries (e.g., hypothermia), provided that patients are not required to stand outside unprotected from the environment for extended lengths of time. The same study recommends water decontamination outdoors from 36°F to 64°F when the patient is then directed to a heated enclosure after decontamination. Below 35°F, the study recommends water decontamination in a heated enclosure or a form of dry decontamination.
Guidance Statement 2.6
In the absence of specific information about the contaminant, the following parameters are recommended for water-based decontamination:

- Low pressure (~50 – 60 psi)
- High volume
- Tepid (slightly warm, not hot) temperature
- Duration no longer than three minutes and ensure thorough soaking

Considerations:
- Optimal parameters for water-based decontamination have not been established.
- There is some evidence that increased pressure, duration, and/or temperature can lead to increased absorption or penetration of some chemicals; this is known as the wash-in effect.
- Water pressure for pediatric and geriatric populations may need to be adjusted to minimize additional harm.
- Based upon the type, amount, and characteristics of the chemical contaminant, the duration of the shower may vary, but should not exceed three minutes.

Level of Confidence: II

Discussion:
The practice of using water as a decontamination solution is widely used in the field. Nevertheless, the parameters and duration to applying water on patients may widely vary depending upon the chemical(s) involved, the chemical’s state (i.e., solid, liquid), and potential environmental risks.

Studies on water-based decontamination (on humans) exist, but the scientific efficacy varies significantly from one study to another study. In Treffel et.al (1993), the researchers discussed how an increase in pressure would increase the penetration of contaminant into the skin. However, Reinfenrath et.al (1984) conducted experiments revealing the applied water decontaminant is a major contributor to the decontamination effectiveness. However, the same study substantiated Treffel et.al. (1993) showing a correlation in time applying water on the skin furthers chemical dermal absorption. Studies by Chang and Riviere (1993) and Fritsch and Stoughton (1963) substantiate Treffel et al. and Reinfenrath et al. where increased hydration rates on the skin will increase chemical migration into the skin. The scientific conclusion, therefore, is that water decontamination practices serves as a mechanical action to remove chemicals from the skin rather than as a neutralization action.

Chang and Riviere (1993) and Fritsch and Stoughton (1963) examined temperature of water decontaminant. A correlation of increased water temperature exists with increased dermal absorption (of the chemicals).

Application times of water onto the skin showed variability in the results. Amlôt et al. (2010) determined that raising showering durations from 3 to 6 minutes showed no significant increase in the level of decontamination, and thus, argued for reduced showering times (during mass decontamination) in order to increase patient through-put. The Moffet et al. (2010) study used water with a temperature of 35 degrees Celsius and pressure between 60 and 70 pounds per square inch (psi) and observed showering durations of 30 seconds and 90 seconds for patients contaminated with an optical colored baby oil (a non-water soluble material). After 30 seconds, 90% of the patients were completely decontaminated. By 90 seconds, 100% of the patients were decontaminated. Thus, the Moffet et al. study seems to substantiate Amlôt’s conclusion for short shower times, but at specific temperature and pressure parameters. Overall, the described studies centered on the concept of wash-in effect. This is defined as “an enhancement of percutaneous absorption elicited specifically by skin decontamination” (Moody &
Maibach, 2006). The act of washing the skin has shown enhanced chemical absorption. Degradation of the skin barrier, either through removal of oily substances, membrane fluidization, and/or skin irritation, is a causal or contributory factor to the wash-in effect (Moody & Maibach, 2006).

In parallel, studies exist showing water as a major contributory factor to cold injuries. The U.S. Army Research Institute on Environmental Medicine (USARIEM) performed decades of research on the causal and contributory effects of heat and cold injuries to soldiers on the battlefield (Pandolf et.al, 2011). Parsons (2002) described that the American Conference of Governmental Industrial Hygienists (ACGIH) publishes annually Threshold Limit Values (TLV) guidelines, which include guidance on cold injury prevention practices. Hypothermia is a particularly serious cold injury requiring attention whose risk increases when humans are exposed to water and left to remain wet (even in fairly temperate conditions (75 degrees Fahrenheit or below approximately). The Department of the Army has published Medical Technical Bulletin on Prevention and Management of Cold-Weather Injuries (TB Med 508, 2005); in their studies, they determined that convective heat loss is about 25 times greater in water than air. For example, wet clothing and immersion in water increase heat loss substantially, increasing the likelihood of hypothermia. Chemical events occurring in cold temperature conditions require planning to care for patients subjected to water decontaminants. Contingencies should include, but are not limited to, warm shelters, dry blankets, dry towels, dry clothing, and/or immediate removal from the scene (e.g., to go home or to a health care facility). Thus, studies involving cold injuries require careful review when developing decontamination practices involving the use of water (as a decontaminant). Use of water decontaminant varies depending upon the contaminant involved. Water-reactants metals (e.g., Lithium, Phosphorus) require avoidance of any water decontaminant without exception (to avoid increased burns to patients). Physical clothing removal or use of non-water decontaminants requires careful study and analysis as part of mass human decontamination practice.

In general, based on the available studies discussed above, contaminated patients only require less than three minutes of water decontamination, unless credible sources (e.g., manufacturer Material Safety Data Sheets [MSDS] or Safety Data Sheets [SDS] and CHEMTREC technicians) advise an alternate required shower time or use of a specific decontaminant. Otherwise, the risk of increase chemical skin absorption is likely to increase over time resulting in the potential for systemic human health effects.
Guidance Statement 2.7
When water-based contamination is indicated, mild soap, if available, should be added to water for technical decontamination, especially if the contaminant is thick, oily, or otherwise difficult to remove by water alone.

Considerations:
- Do not delay decontamination efforts in order to acquire mild soap.
- Examples of mild soap may include items suitable for daily contact with skin.
- Do not use dishwasher detergent, laundry detergent, cleaning products, abrasive cleaners, or anything not suitable for daily contact with skin.

Level of Confidence: II

Discussion:
Water is a preferred decontaminant based on ease of use, availability, and cost by both responders and exposed persons. The efficacy of the decontamination may be improved by the addition of mild soap to the water. Soap can increase the partitioning of oily or waxy contaminants away from the skin better than a purely aqueous liquid, which may be helpful if a contaminant is oily or viscous. Bjarnson et al. (2008) noted that soapy water has been a top “decontaminant of choice” in cases of mass chemical exposure, citing the inexpensive and universal availability. Bjarnson et al. (2008) also showed that water and RSDL were equally effective in preventing the onset of severe symptoms after exposure to VX in domestic swine over dry Fuller’s earth and bleach; however, the study has several shortcomings that may affect the overall outcomes and findings.

Soapy water is particularly efficacious when attempting to decontaminate areas affected by lipid-soluble chemicals (Maibach, 2006). However, the unavailability of soap should not delay water-only decontamination, nor should water-only decontamination be considered inferior or sub-standard care in terms of decontamination even if a contaminant is known to be oily or waxy. In a small study, Moffett et al. (2010) showed the effectiveness (as it relates to the time necessary to complete decontamination) of water alone for oily (e.g., vesicant) agents. This study used a fluorescently-labeled stimulant (baby oil) applied to volunteers’ arms, after which, a decontamination shower (60-70 psi, 35°C) was effective in removing 100% of the stimulant after 90 seconds.

Wester et al. (1996) decontaminated alachlor, an herbicide, with either a one-to-one ratio of soap to water, or water alone, on rhesus monkeys. The combination of soap and water reduced the percutaneous absorption of alachlor more than water alone after the first wash (73% vs. 36%) and after three washes (82% vs. 50%).

In another study, Braue et al. (2011a/b) demonstrated an increase in the LD_{50}^9 of VX using 1% soapy water over no decontamination in guinea pigs. However, most of this increase in the LD_{50} was likely due to the performance of ANY decontamination as the study did not test a water-only control. Additional studies in guinea pigs, using soman as the contaminant, found that 1% soapy water was nearly as effective as bleach or the M241 kit as measured by an increase in the LD_{50} over control. However, because the study did not test for a water-only control, the advantages of using soapy water as a decontaminant could not be directly assessed in comparison to results from using water without soap as a decontaminant.

While several of the studies from the literature review were extremely well designed, they did not provide a head-to-head comparison of water to soapy water because they utilized undecontaminated, untreated

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9 An increase in LD50 indicates that more contaminant is required to cause lethality in 50% of subjects.
control groups for their efficacy studies. The study by Wester et al. (2000) clearly demonstrated the efficacy of soapy water in a rhesus monkey/alachlor model, revealing more effectiveness than the use of water alone. The small study by Moffett using a simulant suggests that water alone is effective, even with an oily contaminant, and should not be delayed or withheld in an effort to add soap.

A previously released guidance document (DOD TSWG, 2004) also alludes to the marginal increase in decontamination efficacy that soap provides:

a. Soap and water solutions only slightly improve decontamination effectiveness for chemicals.

b. “Soap can aid in dissolving some of the oilier chemical agents like VX or blister agents; however, the marginal improvements in effectiveness over water alone do not justify delaying chemical decontamination in order to add soap.”

c. “If soaps are used for chemical decontamination, liquid rather than solid soaps should be used because they are quicker to employ, reduce the need for mechanical scrubbing, and could reduce secondary contamination risks.”

d. There are several disadvantages of using soap and water solutions for chemical decontamination, including the soap must be readily available; the solutions must be mixed; and the solutions might hydrate the skin, possibly increasing damage by blister agents.

OSHA Guidance for Protecting EMS First Responders (OSHA/EMS, 2009) recognizes the utility of soap and water as efficacious in decontamination: “Decontamination with soap and water remains the best practice for most contaminants under most circumstances of mass decontamination”. The OSHA (2009) guidance goes further in specifying that a “soap, with good surface-active properties (i.e., soaps that help oil dissolve in water) and water” are used for a more technical decontamination.

ECBC (2009) guidance suggests that water is often used for initial decontamination, but that soap and water may be needed for a technical decontamination, especially involving the removal of “oily liquid agents”. Additionally, it specifies that:

Adding soap can improve results by achieving ionic degradation of a chemical agent. Soap (or another emulsifier) aids in dissolving oily substances like blister and nerve agents. Liquid soaps are quicker to use than solids, and may reduce the need for gentle friction, however, when rubbing with a sponge or cloth, victims should be careful not to break or damage the skin. (ECBC, 2009)

SME input strongly supported the addition of soap to water for decontamination and that soap refers to a mild, non-abrasive, liquid soap and not a detergent. There should be no delay of water-only decontamination in an effort to procure or prepare soap and water solutions. No specific ratio or percentage of a soap and water solution has been studied scientifically nor is widely accepted in practice. Subject matter experts recognized the limitations of extrapolating the results of studies based on animal models to humans.
Guidance Statement 2.8

The use of a non-abrasive sponge, washcloth, or similar item may enhance water-based decontamination by increasing the physical removal of a contaminant through lightly rubbing contaminated areas.

Considerations:
- Technical decontamination should not be delayed to acquire specific implements.
- Sufficient implements should be available to avoid reuse and contamination transfer.
- The item used for rubbing will itself become contaminated and may be disposed of as hazardous waste in accordance with jurisdictional guidance.
- Wash items should be different than items that may have been used for self-care (e.g., cloths, handkerchiefs, baby wipes).
- Scrubbing too hard can abrade the skin and lead to enhanced chemical penetration.

Level of Confidence: I

Discussion:

The use of a washing implement, such as a sponge or washcloth, may facilitate decontamination especially a technical decontamination using shower facilities. Much like the addition of soap to water aids in increasing the partitioning of oily, thick, and sticky contaminants, use of a washcloth or sponge may improve the mechanical removal of thick, heavy contaminants that are more adherent to the skin.

However, the use of a sponge or washcloth immediately raises several issues, including abrasion of skin due to scrubbing, which can increase absorption, and risk of transferring contamination between patients if there is insufficient availability of clean implements. Additionally, use of a washcloth may transfer contaminant to a relatively uncontaminated body part, such as from the hands to a clean torso. Further, instructions provided to patients on the proper use of the washing implement require time, which is a critical factor during decontamination. Lastly, all washcloths or sponges require appropriate disposal following the incident.

The literature on use of a washcloth or sponge is limited. Amlôt et al. (2010) conducted a human study of decontamination effectiveness using a three-way interactive design (i.e., no washcloth, washcloth, and washcloth with instructions on its use) at three and six minute intervals after application of the simulant. The exposure model and unbiased measurements of residual contamination, using infrared imaging, were the study’s strengths. Use of a washcloth demonstrated a 20% reduction in contamination. A slight decrease of effectiveness was seen when instructions were provided; the study’s authors concluded that this decrease was directly related to the amount of time the patient spent reviewing the instructions instead of actively washing.

Several prior existing guidance documents and manuals also support the use of an implement to assist with contaminant removal. DOD TSWG (2004) emphasized the importance of replacing sponges or washcloths between every patient. In addition, ECBC (2009) acknowledges the utility of a soft cloth or sponge and that gentle friction may assist with the removal of chemical vapors and aerosols. However, there is the theoretical risk that the use of an implement may spread oily contaminant, such as mustard agent, and, thus, care must be exercised to use only gentle friction in the localized area of contamination (ECBC, 2009). OSHA’s Best Practices for First Receivers (2005) correctly warned against using an implement (e.g., stiff brush, abrasive pad), which could damage the skin and facilitate chemical penetration.

SME input was that use of a washcloth or sponge improves decontamination effectiveness with the understanding that decontamination should never be delayed in order to procure implements. Instructing patients in proper decontamination technique with an implement should emphasize (1) gentle rubbing, (2)
avoidance of traumatizing the skin, and (3) localized rubbing when there is risk of spreading viscous or oily contaminant (e.g., blotting used in the case of sulfur mustard). Sufficient numbers of washcloths or sponges are needed in order to avoid cross-contamination between patients by using the same cloth. It must be emphasized that in the absence of washcloths or sponges, decontamination with water alone should never be delayed. Any patient’s own implements (e.g., scarves, handkerchief, bandana), which may have been initially used by the patient for self-care should not be used for technical decontamination since the patient’s own implement must be considered to be already contaminated during self-care. Additionally, the use of washcloths or sponges for decontamination incurs the issue of waste disposal.
Guidance Statement 2.9
Alternative practices or decontaminants should be incorporated into the decontamination process when water-based decontamination is contraindicated (e.g., due to weather/environmental concerns, chemical reactivity) or delayed (e.g., due to resource or capability limitations or logistics). This planning should include identifying possible alternative locations (e.g., showers at a gym or swimming pool) for water-based decontamination when necessary (e.g., due to weather or environmental concerns).

Alternative decontamination practices in lieu of water-based decontamination may be efficacious for non-liquid contaminants such as vapors or gasses.

- Alternative practices may include:
  - Delaying water-based decontamination
  - Non-water based decontamination techniques, such as self-care (e.g., evacuation or clothing removal) or other techniques (e.g., spot decontamination)

- Alternative decontaminants include:
  - Approved neutralizing agents
  - Contaminant specific decontaminants
  - Absorbent materials (e.g., spill pads, oil-dry, kitty litter, Fuller’s Earth)
  - Adsorbent materials (e.g., activated carbon)

Considerations:
- Efficacy of new products should be evaluated against water-based decontamination, with consideration given to resources and reasonable Concept of Operations (CONOPS) for local responding/receiving organizations.
- RSDL© is approved by FDA only for spot decontamination and only for use with CWAs.
- Bleach solutions are not recommended for chemical decontamination in a civilian mass-exposure incident; the contact time required for effectiveness is too long to be practical and is associated with potential irritation to the exposure pathways which may increase chemical penetration.
- Neutralization of chemical contaminants (e.g., acid with base) is not recommended.

Level of Confidence: IV

Discussion:
Decontamination has the potential to alter or terminate the ongoing exposure to, and uptake of, chemicals. When the decision is made to perform decontamination, it should be conducted at the scene (preferably), as expeditiously as possible to reduce “contact time”, and may involve a sequential approach of self-care, gross, and technical decontamination. The cornerstone of effective decontamination is the removal of contaminated clothing, followed by decontamination with water, as well as with soap and a cloth or sponge, if available.

Decontamination also has the ability to create adverse outcomes itself. These adverse outcomes include:
- patients, with minimal contamination, who subsequently wash contaminant into their eye or inhale aerosolized contaminant due to shower-based decontamination;
- patients decontaminated in cold weather who risk the development of hypothermia in addition to their chemical-specific injuries;
- patients who sustain mechanical injury (i.e., falls, injury from rough handling by responders); and,
- patients for whom an aggressive technical decontamination process (which may include stripping and showering in view of rescuers and other patients) is necessary and in which responders manage casualties insensitively, without sufficient communication between rescuers and patients.
may compound the psychological consequences in patients involved in a traumatic mass exposure incident (Fetter, 2005).

Some water-reactive or exothermic chemical contaminants may be an absolute contraindication to water-based decontamination.

Decontamination is scalable, and if the risk of wet decontamination in an extremely cold environment is too great, disrobing victims and providing uncontaminated covering in the short term may be sufficient to substantially reduce the risk of chemical-specific health outcomes without inducing hypothermia. Technical decontamination may then occur indoors when warm refuge is available. Alternate decontamination practices should be considered when water-based decontamination might be contraindicated. These practices include, but are not limited to:

- Delaying water-based decontamination due to unfavorable weather conditions;
- Forgoing water-based decontamination in favor of evacuation and clothing removal for non-reactive gases;
- Conducting spot decontamination during incidents with very limited exposures;
- Or use of alternate decontaminants such as polyethylene glycol for water-reactive compounds.

In an extremely large review of 2,930 chemical events, involving a variety of contaminants, Preston (2008) found that evacuation occurred in 7.7% of incidents. When controlling for decontamination, which occurred in 10% of all incidents, in evacuation and non-evacuation events, the article found that the act of evacuation alone led to a statistically significant reduction in the number of victims hospitalized per event. Feldman (2010) measured off gassing of a chemical simulant from various articles of clothing, ranging from simple to bulky. It is suggested for patients that have been contaminated for up to 42 minutes, that disrobing alone is an important alternative decontamination practice when water-based decontamination must be delayed. Wenck et al. (2007) found that following the 2005 Graniteville, SC train derailment involving chlorine, overall decontamination frequency was 38% among 280 patients categorized in terms of the severity of their health outcome; decontamination did not alter severity of outcome in this event.

Consideration for adverse outcomes of water-based decontamination, including environmental, and physical and psychological injury to patients, has been previously established in several prior existing guidance documents (DOD TSWG, 2004; OSHA/Receivers, 2005; ECBC, 2009; OSHA/EMS, 2009). Unique contamination situations may require consideration of an alternative decontamination solution. Several formulations are considered more efficacious for chemical warfare agents (i.e., nerve and mustard agents) because the solution itself is designed to specifically neutralize nerve and partition mustard away from the skin. In certain niche industries, a particular chemical or mixture may have an especially effective decontaminant; it is not clear how such unique situations might inform general human decontamination guidelines. Clearly, water-reactive chemicals require consideration of alternative processes such as dry mechanical removal (i.e., water-reactive metals) or an available alternative solution (i.e., glycols [Monteiro-Riviere et al., 2001]).

Subject matter expert input supported considering alternative practices such as evacuation or disrobing as the only decontamination method only insofar as the literature supports evacuation or disrobing in lieu of water-based decontamination for gasses or vapors (Wenck et al, 2007; Preston, 2008).

Another viable but not typically utilized option for non-water based decontamination are alternative decontamination solutions. They are thought to be effective against a very narrow suite of threats, are exceedingly expensive, and universally unavailable in sufficient quantities needed for a large-scale event.
to be considered a reasonable alternative to water. Alternative decontamination solutions may be the only option when water is absolutely contraindicated, such as when a profoundly water-reactive contaminant is involved.

For the purposes of mass patient decontamination in a civilian population, dilute bleach solutions are not recommended as an alternative decontamination solution. While bleach solutions have proven efficacious in certain situations and with specific chemical warfare agents (CWAs), notably some nerve agents and sulfur mustard (Wormser, et. al., 2002; Bjarnson et.al. 2008; Braue, et. al., 2011a/b), their use in civilian population with an unknown chemical contaminant is not recommended. Research on the use of bleach solutions indicates that the concentration and/or contact time required to neutralize chemical warfare agents exceeds the contact time shown to cause skin or eye irritation (Wormser, et.al. 2002). Additionally, the following logistical considerations were identified by SMEs demonstrating that a bleach solution is an impractical alternative solution for a civilian mass patient decontamination. They include (but are not limited to): (1) stocking and storage of bleach for mixing, (2) ensuring the correct ratio is mixed (0.5%) and maintained throughout the decontamination process, (3) and the time required to ensure the correct concentration of bleach solution.
Guidance Statement 2.10:
Responding and receiving organizations should plan for both ambulatory and non-ambulatory patients simultaneously.

- Ambulatory patients should be able to follow verbal, written or posted directions with no physical assistance from first responders or first receivers.
  - May be helped by “buddy” or family member.
- Non-ambulatory patients will need additional personnel to assist them through the process.
  - Specialized equipment will be needed (e.g., backboards, raised working surface/roller tables).

Considerations:
- Planning for ambulatory and non-ambulatory patients should occur for all tiers of decontamination (e.g., non-ambulatory patients may not be able to conduct self-care at all).
- A significant fraction of ambulatory patients is expected to leave the scene prior to decontamination and may self-present at a health care facility.

Level of Confidence: IV

Discussion:
While all cross-walked documents address the issue of first responders and first receivers being prepared for both ambulatory and non-ambulatory patients, scientific studies are entirely lacking. Nor would circumstances in any real event, with the exception of an exercise, provide the opportunity for scientific study of 100% ambulatory versus 100% non-ambulatory decontamination. In terms of planning, it is prudent to be prepared for both ambulatory and non-ambulatory patients. However, providers should be prepared to treat everyone as non-ambulatory to ensure appropriate resources. Non-ambulatory patients will require and will consume the most resources. These resources include trained decontamination specialists, which typically includes additional first responders or first receivers per patient, other personnel and equipment (e.g., backboards, roller systems, stretchers). In addition, time should be a consideration when examining resources, as the non-ambulatory patients will take additional time to complete the decontamination process. Tiered decontamination (i.e., self-care, gross and technical decontamination) must take into account that non-ambulatory patients cannot perform self-care and may not be able to participate in gross decontamination. On the other hand, ambulatory patients should be able to follow commands and should be self-sufficient in conducting decontamination, including, self-care; following instructions for alternative decontamination (i.e., evacuation/marshaling to an alternative site, disrobing, and spot decontamination); and assisting other ambulatory and non-ambulatory patients. The utilization of a buddy system, such as a parent or caretaker assisting a child or the elderly through the decontamination process, may facilitate those that require minimal assistance to utilize the ambulatory route. In addition, a child, family member, or friend can translate instructions into a familiar language to aid others in understanding the decontamination process.
Guidance Statement 2.11

At-risk populations require additional assistance. Responder and receiver organizations should implement planning and training to assist at-risk populations through the decontamination process.

- At-risk individuals have needs in one or more of the following functional areas: communication, medical care, maintaining independence, supervision, and transportation.
- At-risk populations may include, children, the elderly, and pregnant women, as well as people who have functional or mobility impairments, live in institutionalized or congregate settings, are from diverse cultures, have limited English proficiency or are non-English speaking, and/or have cognitive impairments.

Considerations:
- Planning, training and communication with members of at-risk populations should be practiced prior to an incident.
- Ensure response plans include integration of additional personnel to assist patients through decontamination.
- Make every effort to keep a child with a parent or trusted adult.
- If a child is alone, a responder/receiver should make eye contact and try to explain what is going to happen and, if possible, assist the child through decontamination.
- A method to hold or carry an infant through decontamination must be in place (e.g., laundry basket, baby bath).
- Closely observe patients for evidence of cold-weather injuries; provide additional resources for heat or shade as necessary.
- Ensure notification of child advocates for all unaccompanied minors is incorporated in response plans.
- Use a responder to assist in the process or pair patients with an ambulatory patient to assist.
- Have a plan for service animals; integrate personnel trained in animal triage (as resources allow) in your process; efforts should be made to keep animal with patient.
- Patients with mobility challenges (e.g. in wheelchairs) may need to be transferred to a backboard or gurney and treated as a non-ambulatory patient.
- Patients should retain, to the greatest extent possible, all materials required for “normal” functionality (e.g., prosthetics, hearing aids, eyeglasses).
- Provide written and pictographic instructions for the decontamination process; translate to the most commonly used languages within the population (see also Functional Area 6).
- Integrate interpreters into response plan or have pre-recorded messages in the most used languages within the population, as resources allow.
- Integrate behavioral health professionals early in the response to address potential severe reactions of patients; as resources allow.
- Every effort should be made to keep at-risk patients with a trusted person/caretaker.

Level of Confidence: IV

Discussion:
Scientific studies are lacking for specifics of how to assist at-risk populations through the decontamination process. Many of the cross-walked documents cite the need for additional planning for at-risk populations, but they do not cite the rationale. For example, the DOD TSWG (2004) document

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10 Note that this term is used throughout the document and is representative of all similar terms to include: special needs, vulnerable populations, and access or functional needs. This definition can be found on the HHS/ASPR website at: http://www.phe.gov/Preparedness/planning/abc/Pages/atrisk.aspx.
recommends escorting the visually impaired patients through the process or direct another patient to escort them. As another example, in some circumstances in which healthy adults may not be at-risk for hypothermia, nonetheless, certain patients – such as the very young and very old – may still be susceptible to hypothermia due to body composition (infants) and impaired thermoregulation (the elderly). The DOD TSWG (2004) also recommends an escort be provided for unaccompanied children and, if possible, to keep children with an adult family member. In addition, this Guidance Document recommends that additional preparation should take into account the expected populations – their demographics, ethnic make-up, language barriers, and socioeconomic status and resources/resiliency - present within the area being coordinated. Actions that allow at-risk populations to maintain self-control should be taken into consideration (e.g. maintaining eyeglasses, reduce anxiety by stating the process before the patient enters). Disaster research shows that animals (both service animals and pets) will be coming with evacuees. It is much easier to build this component into a community’s plan up front than to have to deal with it under fire. In the case of service animals, decontamination personnel may establish a parallel animal decontamination line to make your operation successful. More specifically, it can be assumed that approximately 1-2 out of every 10 people may bring a contaminated animal with them (T. Vannieuwenhoven, personal communication, June 20, 2012). Additional information on specifics for communication with the at-risk populations can be found in Guidance Statements in Functional Area 6.
**Functional Area 3: Evaluating the Effectiveness of Decontamination**

**Guidance Statement 3.1**

Decisions on whether contamination has been reduced to a level that is and/or additional decontamination is necessary can be guided by the following indicators (and others as appropriate):

- Elimination of visible contamination from the skin and/or clothing
- Observable improvement in signs and symptoms which prompted the decision to perform decontamination
- Patient perceptions of the effects of decontamination
- Results from appropriate detection technologies
- Guidelines in Functional Area 2 were followed

If an effective decontamination practice, which is known to be appropriate given the nature of the incident and chemical involved, is properly executed, then a reduction in contamination can be implied.

**Considerations:**

- The effectiveness of decontamination may not be objectively measurable with current capabilities; however the above can be used as subjective indicators of achievement of the end points of providing first aid to patients and protecting responders and receivers from secondary contamination.
- Detection technologies must be appropriate to the chemical, properly calibrated, and the user properly trained

**Level of Confidence: III**

**Discussion:**

Within the available literature, there are no universally accepted guidelines to determine the effectiveness of patient decontamination operations. The topic of assessing decontamination efficacy in real life situations is rarely touched upon in any aspect. Though there is an overall lack of scientific data, the literature and best-practices guides provide considerations to include in an assessment of decontamination efforts. Based limited examples in the literature and current field practices decontamination efforts can be subjectively evaluated using factors listed in this guidance. The assertions in this guidance statement could be evaluated in a research investigation, and should be considered as a moderate priority for research. The first, second, and fourth indicators listed in the bullet points above and described below are directly related to factors in Guidance Statements 1.1 and 4.1 (used to determine if a patient requires decontamination and for decontamination prioritization, respectively).

Elimination of visible contamination and alleviation of signs and symptoms of exposure can be used as guides to implement effective decontamination. However, patient symptoms may become systemic and require antidotes or other medical treatment before the symptoms can be resolved. Given this, it should be cautioned that using reduction in symptomology as a singular factor is not recommended.

Some detection methods commonly used in the first responder community can be used as a determinant for decontamination efficacy, but only if specific guidelines were in place. The lack of accepted and scientifically based guidelines is a hindrance as discussed in the literature (Volkland, 2000; Raber, et. al., 2001, 2004). Limitations in contamination detection methods undermine the capabilities of responders in determining and measuring the efficacy of decontamination.

In addition to the evaluation metrics above, patient perception can also be used to evaluate efficacy of decontamination. This measurement is particularly useful with those patients requesting or demanding decontamination who may not have been at a high risk for exposure. Though there is no mention of this in the literature as a determinant of efficacy, SMEs noted the importance of this factor.
The guidance presented in Functional Area 2 represents the best practical guidance based on available scientific research, expert opinion, and common practices in the field. Though the guidance statements do not outline an operational step-by-step practice for decontamination operations, incorporating the guidance from Functional Area 2 into the decontamination plans can help to ensure an effective operation. Finally, specific decontamination practices that are known to be effective, for known contaminants or specific incident types, should be utilized. If the specific practices are followed accurately, then this could be considered a measurement of efficacy.
Guidance Statement 3.2
Timeliness and efficiency are critical elements of effective decontamination: an individual patient needs to be decontaminated with minimal delay and patients need to be decontaminated expeditiously in a mass casualty incident in order to do the greatest good for the greatest number. However, a rapid pace must be balanced with quality and consistency of patient care to achieve the end points of providing first aid to patients and protecting responders and receivers from secondary contamination.

Considerations:
- Patient throughput or resource utilization alone, without consideration of impact on the health of patients and/or responders, is not useful measures of achievement of the desired end points.

Level of Confidence: V

Discussion:
Patient decontamination needs to be conducted thoroughly and monitored closely. While minimizing time between exposure and decontamination is desirable, systematic and comprehensive decontamination should not be compromised for the sake of increasing patient throughput. The desired end points for decontamination should be considered when describing or evaluating the efficacy of decontamination:
- reduce contamination on a patient to a level that is safe for the patient
- reduce contamination on a patient to permit medical evaluation and treatment without harm to the first responder/receiver
- reduce the potential for secondary contamination of people or infrastructure
- ensure the safety and security of the health care infrastructure
- ensure the safety and security of the community as a whole

In addition to determining the efficacy of decontamination, there are measurements to determine the efficiency of the process. First and foremost, the efficacy of decontamination is about health-based outcomes of the patient while also important to the safety of responders, receivers, other patients, and health care infrastructure. As mentioned under the considerations, the patient throughput and resource utilization may not be indicative of effective decontamination. However, once the safety and efficacy of the process are established, throughput and resource utilization can be considered in order to increase the efficiency of the operation.

Rapid decontamination and high patient throughput are often discussed in the literature and best-practices guides. However, there is no literature support for this particular guidance statement. Similarly, it cannot be considered common practice in the field, as patient throughput is often used as a measure of effective decontamination, noted in first responder/receiver interview data and exercise reviews.
**Functional Area 4: Patient Prioritization for Decontamination**

**Guidance Statement 4.1**

Immediate, lifesaving medical care and/or antidotal therapy should ideally be a priority, over patient decontamination, as resources and capabilities allow.

**Considerations:**
- Responders must be appropriately trained and have the proper PPE in order to implement medical care prior to decontamination.
- Lifesaving medical care will be defined by the Authority Having Jurisdiction.

**Level of Confidence: III**

**Discussion:**

The balance between the need for lifesaving medical care and decontamination is tenuous and requires responders and receivers to perform a risk and capabilities assessment to determine whether it is appropriate and feasible to provide medical interventions in the “warm zone” while patients await decontamination. The literature suggests that there is an on-going debate related to when medical care should be given following a chemical exposure. Although there is still some debate about providing lifesaving medical care and/or antidotal therapy prior to, or in conjunction with, patient decontamination, there is enough research to support this practice if responders are properly trained and protected. In the US, medical care following a chemical exposure is typically conducted after patient decontamination (Hick et al., 2003b; Horton et al., 2003; Koenig et al., 2008). Plans have been implemented to ensure responder and receiver safety, preventing secondary contamination of emergency personnel. Personnel trained to provide life-saving medical care are not always trained to wear and conduct operations in PPE, whereas personnel trained to wear PPE do not always have the skills necessary to render medical care to patients.

Since setting up decontamination operations often takes time, it may be necessary to administer immediate, life-saving care prior to decontamination (Laurent et al., 1999). However, non-lifesaving measures, such as diagnostic testing and regular vital-signal assessments, should be postponed until decontamination operations are completed and the victim is in a clean environment (Hall, 1995; Laurent et al., 1999; Jagminas, 2008a; and Ramesh & Kumar, 2010). Patient decontamination should not be delayed when lifesaving medical care or antidotal therapy are needed and available. Alternatively, if resources are available, lifesaving medical care or antidotal therapy should not be delayed while waiting for decontamination. Providing medical care and antidotal therapy in the warm zone while patients are awaiting decontamination requires properly trained personnel in appropriate PPE (Laurent et al., 1999; Okumura et al., 2003; and Markel et al., 2008).

While medical intervention is often delayed until after decontamination in the US, other countries, including France, Japan, Israel, and the United Kingdom advocate for allowing properly trained medical providers wearing appropriate PPE to provide life-saving medical care in the warm zone (Laurent et al., 1999; Okumura et al., 2003; Markel et al., 2008; Pillin, 2008). Some existing guidance documents also advocate for providing medical care in the warm zone, particularly when the condition or injuries sustained impose a greater risk to the patient than the contamination itself (ATSDR – ED, 2000; ATSDR – EMS, 2000; DOD TSWG, 2004).
Guidance Statement 4.2
Prioritize patients for decontamination by estimating relative risk and grouping patients into immediate and delayed decontamination groups. Risk assessment should take into consideration the following criteria (and others as appropriate):

- Need for immediate lifesaving care or antidotal therapy (See Guidance Statement 4.1)
- Visual evidence of contamination on patient’s skin or clothing
- Patients displaying signs and symptoms of exposure
- Proximity of patient to the location of release
- Contamination detected on patient using appropriate detection technology

Considerations:
- Priority should begin with those patients who require decontamination in order to receive immediate care for life threatening conditions or injury, or antidotal therapy.
- Children should be prioritized before adults within the same decontamination priority group.
- Age, pregnancy and chronic medical conditions should also be considered when estimating relative risk and prioritizing patients for decontamination.
- Concerned citizens who are at low risk of contamination may request to undergo decontamination.
- In a mass casualty chemical incident, patients needing decontamination most urgently may not be the first to present; ambulatory patients may reach first responders or first receivers more quickly than non-ambulatory patients.
- Self-reporting patients arriving at a health care facility should also be prioritized according to these criteria.

Level of Confidence: III

Discussion:
There is a general lack of empirical or experimental evidence suggesting the best means to triage or prioritize patients according to their need for decontamination. A variety of triage systems are proposed in the literature, many based on traditional mass-casualty incident medical triage protocols (e.g. START, SALT, SIEVE) (Cieslak et al., 2000; Kenar & Karayilanoglu, 2004; Cone & Koenig, 2005; Subbarao et al., 2005; Okumura et al., 2007; Neal et al., 2010; Ramesh & Kumar, 2010). With the exception of assessments of two triage systems, no attempts have been made to evaluate these prioritization schemes empirically or validate them as providing a decrease in morbidity or mortality (Bond, 2008 Cone et al., 2008).

In addition to a lack of evaluation of these decision matrices, it is also noted in the literature that there is no standard agreed-upon evaluation method. Before an applicable decision matrix can be examined, a standard evaluation method needs to be established (Ramesh & Kumar, 2010). The use of triage protocols or other methods to prioritize patients is also well represented in best-practice guides – seven of the eight documents examined mention prioritizing patients for decontamination. Interviews with first responders and receivers support the concept of prioritizing patients for decontamination – most interview participants indicated that they would prioritize patients. The assertions in this guidance statement, however, are difficult to evaluate in a research investigative approach.

The list of criteria proposed in guidance statement 4.1 is an extension of the criteria listed in guidance statement 1.1 and used to determine if a patient requires decontamination. In guidance statement 4.1, these criteria are used to prioritize patients in a resource- and/or time-constrained response, where some patients may require decontamination more quickly than others. Upon evaluation, patients should be categorized into immediate or delayed categories based on the criteria listed; this evaluation is in addition to, and should take into account, traditional medical triage.
Need for medical care or antidotal therapy
Patient decontamination should not be delayed when lifesaving medical care or antidotal therapy are
needed and available. Alternatively, if resources are available, lifesaving medical care or antidotal
therapy should not be delayed while waiting for decontamination. Providing medical care and antidotal
therapy in the warm zone while patients are awaiting decontamination requires properly trained personnel
in appropriate PPE (Laurent et al., 1999; Okumura et al., 2003; Markel et al., 2008).

Visual
Visual indications of chemical contamination on the patient or the patient’s clothing are another factor
that can be used to determine the need for decontamination (Ramesh & Kumar, 2010). Visual evidence
of contamination indicates an ongoing exposure with increased contact time (Kirk & Deaton, 2007).

Symptoms
Toxidromes, or clusters of symptoms, could be utilized to help distinguish between affected and
unaffected individuals (Kirk et al., 1994; Markel et al., 2008) and between priority levels (immediate and
delayed). However, there is some research to suggest that individuals who have a low probability of
being contaminated can still exhibit symptoms that do not have an organic origin (Kirk & Deaton, 2007),
indicating that additional information is required in deciding the need to decontaminate.

Proximity
Patients in closer proximity to a release are suspected of having received a higher dose of contamination
and therefore have a higher need for decontamination than a patient further from the release (Kirk &
Deaton, 2007). Proximity to the release is cited in various articles as one of the main factors to consider
when determining decontamination needs (Ramesh & Kumar, 2010).

Detection
Historically, there is a lack of discussion in the literature regarding the use of detection and diagnostic
technologies that can be used to determine decontamination requirements. Although there are
environmental detection technologies available and are used by first responders to characterize hazardous
environments, there is little mention of the use of these devices in determining decontamination
requirements.

In addition to the prioritization criteria listed, considerations are included in this guidance statement that
will assist with the prioritization. Based on a number of physiological factors, that within a given priority
group, children should be prioritized before adults. Age, pregnancy, chronic medical conditions, and
need for lifesaving medical care or antidotal therapy should also be factored in to the prioritization for
decontamination, with the assumption that patients in these categories may have a higher risk of injury
due to the chemical contamination. Historical examples indicate that in a mass patient incident, those
needing a higher level of care are not the ones to reach responders and receivers first (Okumura et al.,
1996; Scanlon, 2010). In these cases, decontamination should still be conducted until patients of a higher
risk category arrive for decontamination and treatment.
Functional Area 5: System-wide Coordination of Patient Decontamination

Guidance Statement 5.1
Attempt to immediately decrease ongoing exposure by removing all patients out of the area of release and provide an area of refuge.

Considerations:
- First responders should not enter area of release (i.e., hot and warm zone) without appropriate PPE and training.
- A determination of the subsequent need and level of decontamination may be decided according to criteria in Guidance Statement 1.1.

Level of Confidence: V

Discussion:
One of the first steps in contamination reduction is to prevent ongoing exposure by removing victims from the hot zone. No decontamination practice, such as disrobing, self-care, and gross or technical decontamination is of any use if performed in an environment in which patients will continue to be exposed. Whether evacuation from a contaminated area in and of itself leads to better health outcomes has only been studied in select circumstances. Evacuation may suffice for gas or vapor exposure, such as during exposure to carbon monoxide or natural gas, when moving out of the contaminated household obviates the need for any water based decontamination.

Determining the size of an affected area, or the evacuation distance is most often based on a criterion such as that referenced in the 2012 DOT Emergency Response Guidebook. While establishing the French emergency response plans, Laurant et al. (1999) estimated the likely affected hot zone based on the properties of a chemical threat. It was noted that a liquid hazard area extended 350 ft diameter. On the other hand, a vapor hazard area – with winds <1 m/s – rarely exceeded a radius of 1700 ft and extended downwind in a 20° arc.

Preston (2008) examined 2,930 chemical events in which decontamination was infrequent, occurring during only 10% of incidents. Of the 2,930 incidents, 7.7% resulted in evacuation. When controlled for decontamination, it was determined that those incidents in which there was an evacuation resulted in fewer victims per event overall; however, the difference in number of victims was only significant (p<0.05) for events involving gasses or vapors (specifically, chlorine, ammonia, and acid gasses).

While removal from ongoing exposure in the hot zone is supported by several prior existing guidance documents, including DOD TSWG (2004), OSHA/EMS (2009), and ECBC (2009), the idea of evacuation as a decontamination strategy is not described. Specific reference is made to moving patients out of the hot zone, preferably upwind of the release, to a safe refuge while a decision on decontamination and preparations for decontamination are made (ECBC, 2009).

Subject matter expert input was that while evacuation to an uncontaminated area constituted exposure mitigation, it is not decontamination per se. Once safely away from ongoing exposure, a determination still needs to be made as to whether decontamination is needed. It is well understood that patients may evacuate themselves to a location they feel is safe and that this may occur prior to the arrival of first responders. Having patients marshaled in one location makes it easier to evaluate large numbers for the need for decontamination, easier to provide instructions, and easier to perform decontamination. However, experts also considered the possibility that grouping all patients together might raise the risk of
transferring contamination between patients as those who are more heavily contaminated are co-mingling with those with little or no exposure.

Lastly, since self-evacuation is likely, and since a proportion of those retained at the scene may ultimately be told they do not require decontamination. Communication is critical. Instructions to patients who are not decontaminated, but held at the scene, must emphasize appropriate follow-up. Communication to those who may have already left and who subsequently develop symptoms, become worried and seek medical care, or who are concerned about exposing family members, is even more important since they may present to any number of different sites or facilities requiring decontamination at some time after decontamination at the scene of the incident has ceased.
Guidance Statement 5.2

If decontamination is indicated, it should be performed as soon as possible, preferably at the scene if not contraindicated by safety considerations.

Considerations:
- The location for patient decontamination should be upwind, uphill and far enough away from the release location to prevent re-contamination.

Level of Confidence: II

Discussion:
Once the decision is made to decontaminate, the best location for decontamination is at the scene or as soon as possible if there are contraindications to gross decontamination such as extreme weather, safety concerns, or a risk of additional release. The preference for decontamination at the scene is based on several observations:
- Only one decontamination set up is required;
- First responders are for the most part more proficient in decontamination than first receivers, based on their training, frequency of use (Keim et al., 2003):
  - They are more skilled in the use of PPE,
  - They are more familiar with decontamination equipment
  - They exercise and re-train frequently
- Decontamination at all potential receiving facilities requires more resources and introduces considerable variability in the thoroughness of decontamination;
- Decontamination at a facility risks contamination of transport assets;
- Decontamination at a facility increases the risk of secondary contamination of medical infrastructure and personnel;
- Decontamination at a facility introduces a delay and ongoing uptake or absorption of contaminated patients.

Kirk and Deaton (2007) contended that decontamination is a first aid procedure and that any delay in its execution increases the “contact time” patients have with a chemical. Considerable concern exists with regard to secondary contamination. Okamura et al. (2005) noted that 9.9% of fire service personnel and 23% of medical personnel had exposure to sarin vapor following the 1995 Tokyo subway attack; however, it should be emphasized that no decontamination – either on scene or at the primary receiving hospital – was performed. Burgess (1999) examined 11 ED secondary contamination events and found that ED evacuations that resulted lasted from 1-10 hours during which between 0 and 50 ED patients had to be moved. In addition, between 0 and 15 medical personnel had to be treated for exposure. Several prior existing guidance documents describe decontamination on-scene as the preferred approach (DOD TSWG, 2004; ECBC, 2009) when not precluded by contraindications such as weather or safety concerns.

Subject matter experts asserted that decontamination at the scene, if possible, is the preferred approach. First, rapid removal of contaminant and prevention of secondary contamination are an obvious advantage. Secondly, estimation of resource and manpower needed is easier when based on the number of patients marshaled at the scene, rather than when decontamination is performed at multiple alternative sites or receiving facilities. Third, triage of patients to appropriate medical facilities is easier from one location rather than between several different facilities. Fourth, uniformity of assessment of the need for decontamination, quality of that decontamination, and determination of the need for medical evaluation is easier from the scene. It is possible that medical resources may be more readily available for those
patients most in need if decontamination is performed at the scene, which may eliminate the need to transport the patient to hospital health care facility. In such instances, some patients may be found not to need decontamination and be released, or some patients may undergo decontamination and be released following a period of asymptomatic observation;

Provision of aftercare and follow-up instructions is easier on-scene. Provision of special resources (e.g., translation, behavioral health/psychological support, special access equipment) and wastewater containment and disposal is easier at one location.

Subject matter experts recognize several limitations to the guidance provided in this statement: many patients may self-evacuate and the need for decontamination at facilities may be still required (Okumura et al, 1998a/b; Vogt & Sorensen, 2002; US Chemical Safety and Hazard Investigation Board [CSB], 2008). At the same time, some patients will still insist on medical evaluation even if the possibility of exposure has been ruled out; they too may first undergo decontamination at the facility at which they seek such evaluation. Finally, some facilities may perform a second decontamination despite assurances that patients have already been decontaminated at the scene.

The health outcome benefits of reducing “contact time” sooner rather than later – if weather or safety concerns do not require consideration of an alternative approach – are axiomatic. Decontamination at the scene, or as soon as possible thereafter is optimal, even if not completely achievable.
Guidance Statement 5.3
Self-care and/or gross patient decontamination actions should occur as quickly as possible, without delay, while a technical decontamination corridor is established.

Considerations:
- A determination of the need for technical decontamination, or any contraindications necessitating an alternative practice, should be decided according to the guidance in Functional Areas 1 and 2.
- Non-ambulatory or mobility impaired patients may not be able to perform self-care.

Level of Confidence: II

Discussion:
There is no one, all-encompassing form of decontamination. The importance of early decontamination to reduce “contact time” and therefore reduce the opportunity for absorption, internalization, and, thus, “dose” cannot be overstated. Phases of decontamination, such as self-care (e.g., removing oneself from the source of exposure, wiping chemical off the skin or face, shedding contaminated clothing), gross decontamination (e.g., using a first responder-provided source of high volume water), and technical decontamination (e.g., showering with soapy water and a soft cloth) all differ in the amount of preparation, time, and resources needed. Early and expeditious forms of decontamination, such as self-care and gross decontamination, sacrifice thoroughness for the speed with which each can be instituted.

Self-care may occur instantly, be executed by patients using what they have with them, such as a handkerchief or scarf, and performed before first responders arrive. Gross decontamination involves providing patients with rapid access to a high volume of water, such as from a fire hose, in an effort to quickly reduce contact time with the chemical contaminant. Lastly, technical decontamination involves showering with, ideally, soapy water and a washcloth or soft rag, in an effort to completely remove an unabsorbed chemical, thereby terminating further “dose”.

The importance of rapidly implementing self-care and gross decontamination is described by Kirk and Deaton (2007) who likened decontamination to a “first aid” procedure. The act of removing clothing, a potential self-care action, is described in the literature as potentially removing between 70% and 90% of contamination; although there is no experimental evidence to support this claim. In combination with showering, Koenig (2003) emphasizes the importance of clothing removal as a critical element early in the process of decontamination.

Several operational and prior guidance documents describe rapidly initiating decontamination actions, such as disrobing (DOD TSWG, 2004; ECBC, 2009), as the best means of rapidly reducing contamination, even before showering as a technical decontamination action.

Subject matter expert input was that while the overall guidance provided in this statement is strong, provisions need to be made for non-ambulatory patients. Disrobing is an important element of self-care and gross decontamination, and it is presupposed for technical decontamination. There is still a need to correctly identify who will perform each decontamination step (e.g., gross decontamination is performed by the first arriving responder units able to perform the action). The thoroughness of self-care or gross decontamination is not clear, and in some instances, it was felt that self-care (i.e., spot decontamination of an isolated point of contaminant or disrobing if only an outer garment has trivial contaminant on it) could be definitive, though more studies are necessary. Since self-care (i.e., self-removal, disrobing) may occur before first responder units arrive, some patients may present with no specific indication for further decontamination (e.g., absent symptoms, signs, visible contaminant, or any request on their part to be decontaminated) in which case, self-care may be the only decontamination needed in a particular case.
Guidance Statement 5.4

Patients who require technical decontamination should first execute self-care and/or gross decontamination and receive life-saving medical interventions and antidotal therapy as required.

Considerations:
- Lifesaving medical care will be defined by the Authority Having Jurisdiction.
- This guidance should be followed as best as possible within the resource and capability limitations of the organization.
- Responders must be appropriately trained and have the proper PPE in order to implement medical care prior to patient decontamination.
- A determination of the need and level of decontamination will be decided through the application of Functional Area 1 criteria.
- Refer to the lexicon for definitions of self-care, and gross and technical decontamination.

Level of Confidence: III

Discussion:
Very little literature describes the implementation of medical procedures before, or during, decontamination. The premise that certain critical interventions – such as antidote administration or ventilator support – are necessary to sustain life even before gross or technical decontamination commences is a source of great debate. The old adage that “there are no points for a clean corpse” is borrowed from radiation contamination doctrine, but may be applicable to some chemical incidents. When a patient could be saved by immediate life-saving medical care, then decontamination may be delayed until medical care is initiated. Though decontamination did not take place after the October 2002 Moscow theatre siege, delay in administration of an opioid antidote was felt to be responsible for a majority of the hostage deaths (Wax, Becker, & Curry, 2003). Had a similar situation occurred in which decontamination took precedent over antidote administration or ventilatory support, the number of patients succumbing to the opioid toxidrome would be very high. Similarly, must an unconscious, apneic individual pulled from a house with a carbon monoxide leak undergo decontamination before oxygen and ventilatory support are administered?

Being prepared to implement critical medical interventions in a contaminated environment, or at the least on not-yet-decontaminated patients, presupposes adequate PPE11 for first responders and medical personnel. Byers (2008) suggested rapid triage and lifesaving care, such as antidotes and trauma care, to patients by fire service personnel wearing Level A PPE and medical providers in Level C PPE. However, Byers (2008) recommendation of Level C PPE for use in hazards that have not been fully characterized may not allow for adequate protection of medical personnel. Laurent et al. (1999) expanded this theory by suggesting that medical personnel enter the hot zone in PPE to administer life-saving interventions. One drawback to the Laurent et al. (1999) model may be the need for multiple levels of triage, staging, and transport, especially if patients are first triaged for care, then triaged for decontamination, and then triaged for transport to facilities.

Several prior existing guidance documents support the performance of life-saving interventions before (for a life threatening contaminant) or simultaneously with decontamination (DOD TSWG, 2004). OSHA’s Best Practices for First Receivers describes stabilizing those with life threatening conditions, such as shock and respiratory failure, prior to entering decontamination (2005). Medical interventions administered before or during decontamination should be more likely than not to result in survival of the patient, or at least survival through the decontamination process in order to reach additional critical

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11 Note that PPE levels based on OSHA’s Occupational Safety and Health Standards, 29 CFR 1910.132/134.
medical care. It may be practical to support respirations of a non-ambulatory patient as they move through decontamination and an invasive airway can be established; it might also be possible to administer a nerve agent antidote to prevent respiratory failure and terminate seizures for a non-ambulatory patient as they move through decontamination. It may not be possible to perform CPR through decontamination, and the likelihood of surviving a cardiopulmonary arrest out-of-hospital is abysmal, even absent a chemical exposure; hypocalcemic cardiac arrest following HF exposure might be an exception. Cyanide antidotes and nerve agent autoinjectors are provided as examples of interventions that are time-dependent.

While the document recommends this guidance, it is noted that:

- There needs to be a balance between the patient’s likelihood of survival (at least through decontamination) and the risk to responders and resources.
- There must be adequate PPE for any responders potentially caring for a contaminated patient, and the intervention must be doable while wearing PPE.
- Care is not definitive, but rather a temporizing measure until decontamination and the administration of follow-on care can take place.
- The lethality of many chemical warfare agents, even at low levels of exposure, suggests that minimal amounts of contamination could result in severe signs and symptoms.
Guidance Statement 5.5

Anticipate self-evacuation from the scene prior to decontamination and develop a coordinated whole community response plan to manage the entire spectrum of patients, which include:

- **At scene:** Ambulatory and non-ambulatory patients who remain at the scene; individuals other than responders who arrive at the scene after the release and become exposed (e.g., news reporters, bystanders).
- **Self-evacuated:** Patients who travel without the assistance of responders to a health care facility (e.g., hospital, physician’s office, or urgent care center).
- **Left scene:** Patients who leave the scene and do not seek care (e.g. return home or to work, travel elsewhere), or seek care later due to delayed onset of signs and symptoms.

**Considerations:**

- The response community should be prepared for a spectrum of patients who may seek delayed care, including:
  - those who remain without symptoms but who present out of concern based on media reports
  - those who may be especially susceptible to low levels of secondary contamination introduced to the home by an asymptomatic patient who left the scene.
- Patients should remain at the scene or medical facility for observation and/or treatment as long as suggested by responders and/or receivers.

**Level of Confidence:** III

**Discussion:**

During an incident, there will be various routes patients use to reach medical care. Numerous literature articles site two major events that have resulted in chemical contamination, in which the patients self-evacuated and sought medical care. Scanlon (2010) described the 1943 Bari, Italy bombing with mustard gas and the 1995 subway attack in Tokyo, Japan with sarin. In Bari, Italy, patients left the seaside and reported to the hospital to seek treatment for burns and respiratory injuries. In Tokyo, Japan, many patients walked or used a taxi to get to the closest hospital. In a separate article, Wenck et al. (2007) described the January 2005 liquid tanker car derailment that caused the release of chlorine into the air in Graniteville, SC. In the article, those involved in the incident that sought medical treatment were interviewed. Transportation data was collected for the 57% of patients that were treated within 24 hours; 63% transported themselves in a privately owned vehicle to a medical center; only 35% were transported by EMS and 2% were transported by the police (Wenck et al., 2007). The results of this study indicate that many patients will not wait for EMS and will leave the scene with possible delayed onset of symptoms. These patients may still be contaminated and could potentially spread the contamination to others. Many may travel across a city to their preferred medical center for treatment because they feel more comfortable and secure. This scenario has been demonstrated in major cities where people travel into the city center for work, but will seek health care near their residences. Nevertheless, Scislowski (1997) and Auf der Heide (1989, 2006) described that in nearly all mass casualty incidents the walking wounded arrive first while the most seriously injured arrive last for medical treatment. Medical personnel should be prepared and able to manage contaminated patients. In both the Bari, Italy and Tokyo, Japan incidents, the medical staff did not initially decontaminate the patients. In the Tokyo attack, 39% of nursing assistants, 27% of nurses, 26% of volunteers, 22% of physicians and 18% of clerks became ill with symptoms (Okurma et al., 1998; Scanlon, 2010). Burgess (1999) stated that the first steps for treating contaminated patients are to recognize the presence of chemical contamination, and if possible, identify the hazardous substance, and determine its level of toxicity and risk for secondary contamination. By being prepared, the patients will receive the best care and first responders/first receivers will be protected.
Since patients leave the scene and/or return home prior to receiving medical care, information should be provided to advise on the proper self-decontamination procedures. This includes recommending that clothing be removed, sealed in a bag and then sealed into another bag (i.e., double-bagged). A tepid shower, be taken. Emphasizing the use of a standard bar soap and light rubbing with a washcloth is added to the shower. Then seek medical care if exhibiting specific signs and symptoms described by the local medical community involved in the chemical incident.
Guidance Statement 5.6

A formal rapid communication procedure should be utilized to provide advance notice to area health care facilities of a hazardous chemical incident and to specifically alert facilities to the possibility of self-evacuated patients needing assessment of contamination and arriving unannounced to health care facilities.

Considerations:

- First responders and first receivers should have ongoing communications throughout the incident.
- Communication systems should be redundant, interoperable, multi-directional and include notifications to all emergency response partners.
- A pre-scripted template indicating critical information requirements should be produced during planning between first responders and first receivers (see Functional Area 6).
  - Initial communications should include, but are not limited to, the following basic information: initial scene assessment; identity of the involved chemicals (and their toxicity if known), common signs and symptoms; patient decontamination efforts underway at the scene.
  - Updates from the scene to health care and other receiving facilities should include, but are not limited to: identity of hazardous chemicals to which persons might have been exposed; estimated numbers of patients being transported to hospitals; their triage categories; estimated times of arrival; and the status of patient decontamination.
  - Updates from receiving health care facilities to the scene should include: the status of facility-based patient decontamination efforts (if any); expected hospital capacity; re-routing of traffic around hospitals or ambulance diversions; information on chemical identification and toxicity which may not yet be known on scene (e.g., through hospital laboratory testing); delayed symptoms manifesting in patients; feedback on the status of patients decontaminated on scene (if necessary to alter the decontamination triage and appropriate lifesaving measures of patients still on scene in real time).
- Regional poison centers can serve as an authoritative information resource for both responders and receivers regarding the human health effects of toxic chemical exposure. A central point of information will prevent conflicting recommendations.
- All communication pathways should be pre-established, frequently rehearsed, and include written protocols for the most effective use of resources. Clearly establish expectations and critical information needs among all response stakeholders regarding information sharing.
- The volume of information to be expected on communication systems in mass casualty events is often underestimated. It is important that response plans include provisions to rapidly augment communications capacity and personnel.

Level of Confidence: IV

Discussion:

While there is a large amount of anecdotal literature concerning this topic (Okumura, 1998a/b; Auf der Heide, 1989, 2006), Hood et al. (2011) described an exercise where a decontamination team provided care and the event was monitored and evaluated. Initially, the decontamination team provided care without training. The study measured the degree of contamination removed from the patients, and then feedback was provided to the decontamination team. After this critical feedback, the team performed the task again; this time with improved results. One significant finding of the study was first receivers took 40-minutes to setup and don appropriate PPE before handling the first patient. Tokuda and colleagues asserted, the ability of the ED to provide timely and effective treatment is enhanced by the information coming from hazmat teams at the scene (2006). This emphasizes the need for rapid and early communication from the field to the medical care centers. Such early communication will allow receiving health care facilities to prepare for the self-evacuating patients who, many times, show up
before first responder-transported patients. Additionally, this communication allows health care facilities to coordinate transport of non-critical patients to neighboring hospitals; increase staffing levels; identify and collect materials; medication and references needed to treat incoming patients; and possibly coordinate patient load based on availability of resources at a given institute, as well as coordinate in the event a hospital must be evacuated due to secondary contamination. In mass casualty events of all types, coordination of patient distribution is often lacking. At least in large part, this is because casualties self-transport (Auf der Heide, 1989, 2006; Zoraster et al., 2007). Okumura et al. (1996) suggested that if large numbers of patients requiring mechanical ventilation exceeds the number of ventilation machines available at a particular hospital, then there is a need for pre-hospital coordination to determine patient distribution.

Nevertheless, many communities require first responders to notify first receivers of any transport to their facility. The communication between on-scene first responders and first receivers is a critical ongoing requirement (Auf der Heide, 1989). Despite this requirement, many subject matter experts believe that this coordination does not occur most of the time because of ineffective communication networks between first responders, first receivers, poison centers, and other emergency response entities. For example, cellular and telephone systems are unreliable in disasters because if they are not damaged, they quickly become overloaded and non-functional (Auf der Heide, 2007). A potential approach to the issue of communication needs in a chemical incident is to begin to adapt these communication procedures and networks for more routine emergencies to increase responders’ familiarity with them and to identify problems with the communication system itself (lack of interoperability; lack of redundancy). Another issue to consider is the accuracy of information being conveyed between on-scene responders and receiving medical facilities. However, literature suggests that most secondary contamination occurs because the health care facility is not ready to receive patients (Okumura et al, 1998a/b). Thus, it is better for any available information regarding chemical identity, route/duration/severity of contamination, toxidrome or symptom complex, and extent of decontamination efforts to be communicated without delay. For planning purposes, other suggestions include establishing a fill-in-the-blank form that would help first responders notify health care facilities of pertinent information (e.g., chemical substance, if known; state of chemical; sign and symptoms patients are presenting; patient’s response to antidotes, if given; number of patients; and what type of decontamination, if any, is being performed at the scene).
Guidance Statement 5.7

Notification, by visual, written, or verbal means, and ideally a combination of all three, should be used to record scene decontamination practices for clear communication and coordination with health care facilities.

Considerations:
- If a physical documentation system is used, it should be durable and tamper proof.
- Notification systems should be redundant, interoperable, and multi-directional and include notifications to all emergency response partners.
- If a physical notification system is used, the amount of time the notification tool is valid after the incident is over should be determined.

Level of Confidence: III

Discussion:
Triage categories are largely discussed throughout the literature with many of the cross-walked documents recommend the utilization of such tools to help organize patients. However, even though triage tools are currently utilized, survey studies show that trust is an issue in hospitals. Given this, clear guidelines need to be set for language used in correlation with the triage tools. These guidelines can standardize communication between responders and receivers, making decontamination conducted by receiving hospitals more efficient and avoid duplication of efforts. When large numbers of casualties arrive at the ED in a short amount of time, difficulty arises in the ability of ED staff to differentiate between those that are contaminated and those who have been decontaminated in the field (Clarke et al., 2008). The market place has developed numerous tags that convey similar information including baseline vital signs, medical counter measure/antidotes given, if and how much decontamination has occurred, location of injury, etc. However, others such as Okumura et al. (2007) are developing “a system for the initial triage and decontamination of victims of a chemical release [by]…using colored clothes pegs where red indicates the need for emergency care, yellow for semi-emergency care, green for non-emergency care, black for expectant, white for dry decontamination, and blue for wet decontamination”. Okamura et al. (2007) determined that two clothes pegs would be used per person. Once the patient had completed wet decontamination, the patients were switched back to conventional paper triage tags.

Additionally, most EMS and hazmat systems already utilize the START (Simple Triage & Rapid Transport) model for categorizing patients’ injuries. Modifying the SMART system to communicate exposure and decontamination information would leverage a system already in common practice. Whichever triage tool is chosen, it should be employed at the scene of the incident, with initial triage occurring in the hot zone. This will help to prioritize resuscitation, antidotal therapy, decontamination, and then evacuation from the scene. Zoraster et al (2007) criticized that the current triage system has challenges, of particular concern is the mal-distribution of patients to appropriate health care facilities. Once triage has been initiated, additional bi-directional communication will need to be used. First receivers should be sending messages back to first responders on the effectiveness of the decontamination and initial treatment in the field; this will allow responders to alter practices in real-time; identify the need for specific intervention/antidote (if the health care facility is first to identify the poison); or alert responders of adverse effects (e.g., patients are arriving hypothermic). In the same manner, first responders must communicate incident, exposure, and chemical-specific information to receiving facilities to better inform medical management. If decontamination is not or cannot (due to environmental conditions) be performed, this must be communicated to health care facilities and may result in routing contaminated patients to facilities with decontamination capabilities.
First receivers can also help first responders identify triage categories for patients. Another issue that needs further discussion is defining the amount of time the notification tool is valid after the incident is over. All parties involved in the incident, including individuals at the scene and those receiving patients, need to know when the incident, has ended. Patients may have been triaged during the incident but may have left the scene. These patients may later end up at a health care facility, but the staff will not know if these patients have been initially contaminated, decontaminated or re-contaminated.
Guidance Statement 5.8

PPE selection, training and use should be based on applicable regulations (OSHA), standards (NFPA), and/or guidance (NIOSH), subject matter expertise, and manufacturer’s specifications, in conjunction with scene evaluation and risk assessment.

Considerations:
- PPE selection should incorporate the contingency that responders may conduct life-saving medical interventions, supportive care, and/or antidote administration for contaminated patients prior to the conduct of technical decontamination.

Level of Confidence: III

Discussion:
Studies on personal protective equipment (PPE) efficacy against a variety of chemical agents and among first responder and receiver communities are well founded (Myers, 2000; Ziskin et al, 2003). Both recommended and regulatory agencies and associations advise a risk-based approach when determining the type and use of PPE. Horton et.al (2008) describes the level of PPE and respiratory protection needed by hazmat personnel varies greatly and depends on their anticipated work activities. The factors to consider in the selection of PPE include toxicity of substance, routes of exposure, degree of contact, and the specific task assigned to hazmat personnel. In addition, different PPE will allow the provider to perform a limited amount of care due to dexterity of the equipment. Berkenstadt et al., (2003) describes past studies that show emergency medical technicians wearing increased PPE levels have decreased dexterity. Koenig (2003) also described the physiological burdens of PPE to the human wearer and concluded the importance to create appropriate PPE guidance minimizing responders’ and health careworkers’ abilities to perform their primary duties. Furthermore, Clarke et.al (2008) explained the limitations include the limited life span of the respiration filters and the time it takes to replace these filters: rotation of staff members to avoid fatigue and heat exhaustion; and the cumbersome nature of the PPE suits that cause decreased dexterity and interfere with communication between ED staff and patients.

Therefore, PPE requires extensive pre-event training and manual practice regularly to attain skills, sustain skills, and achieve familiarity with the physical restrictions. When performing mass human decontamination, PPE wear will significantly affect total patient decontamination numbers over time, and thus, planning and logistical management (e.g., decontamination personnel rotations, replacement of air purifying filters or swamping out self-contained breathing air tanks) must account for this factor.
Guidance Statement 5.9
Scene response and health care facility emergency planners should work with federal, state, and local government officials to ensure any guidance, practices, and plans properly address decontamination water run-off, facility safety, and environmental impact issues.

Considerations:
- Environmental concerns need to be subordinate to life-safety concerns.
- Coordination through the Local Emergency Planning Committee (LEPC) or state and local agencies may be necessary.
- Current EPA guidance suggests decontamination performed for life-saving operations takes precedence over containing or on-site treatment of water run-off.

Level of Confidence: IV

Discussion:
Scientific literature and regulatory guidance points toward the requirements of containing hazardous waste (which includes decontamination run-off). Dealing with contaminated patients requires ED staff to consider key aspects of readiness, including mitigation, preparedness, response and recovery (Adini et al., 2006). Title III of the Superfund Amendment and Reauthorization Act (SARA) of 1986 requires hospitals to participate in community disaster planning for hazmat incidents (Cox, 2009). The Environmental Protection Agency (EPA) is charged with carrying out the responsibilities of SARA, Title III, which states local emergency planning committees (LEPC) must develop a community hazardous substance emergency contingency plan to be followed by facility owners, police, hospitals, local emergency responders, and emergency medical personnel. The U.S. Environmental Protection Agency (2007) however has issued the following statement:

During a hazardous materials incident (including a chemical/biological agent terrorist event), first responders should undertake any necessary emergency actions to save lives and protect the public and themselves. Once any imminent threats to human health and life are addressed, first responders should immediately take all reasonable efforts to contain the contamination and avoid or mitigate environmental consequences. EPA will not pursue enforcement actions against state and local responders for the environmental consequences of necessary and appropriate emergency response actions.

However, this proclamation does not confer immunity from state environmental regulations. Responder and health care organizations should ensure that they comply with all applicable local, state, and federal regulations.

The LEPC identifies a local health care facility that has agreed to accept and treat victims of emergency incidents. However, evidence is lacking to show that self-transporting patients are aware of this designation or that they will go to the designated hospital even if they were aware (Auf de Heide, 2006). There are numerous historical examples of the low percentages of patients arriving to the hospital via ambulance. They include: 33% of known casualties in the bombing of the Murrah Federal Building, Oklahoma City in 1995; less than 11% of the victims in the sarin attack, Tokyo, Japan, in 1995; and 6.8% of patients injured from the terrorist attack on the World Trade Center, New York City, NY in 2001. Therefore, non-LEPC designated health care facilities should also plan and prepare to treat chemically contaminated patients.

Further, the EPA issued a Chemical Safety Alert to address the possibility of environmental degradation from contaminated runoff (Feldman, 2010). Provisions at the decontamination site must be made to collect wastewater and prevent it from running over lawns and into sewer drains (Cox, 2009). Ideally,
this is accomplished by the use of a portable, outside decontamination unit or a dedicated decontamination facility with appropriate ventilation and water containment (Burgess et al., 1999). This assumes there is either a separate wastewater containment system or sewer system for the health care facility that has the capacity to treat the low concentrations of chemical contaminants (Burgess et al., 1999). Wastewater can be kept in sealed containers for later disposal (Burgess et al., 1999). Portable pools can be used for collection, but provisions must be made to prevent access to these prior to removal (Cox, 2009). Despite these efforts, in a large-scale event, containment of wastewater may be impossible. This issue should be addressed through comprehensive planning that includes local environmental and water authorities (Macintyre et al., 2000). By working with local environmental and water authorities, plans for the management of contaminated materials and equipment is less subjective and fortified by scientific input (Koenig et al., 2008). Similarly, solids must be collected and properly stored prior to disposal (Cox, 2009). Contaminated material must be safely stored in approved hazmat containers away from the health care workers (Feldman, 2010). Plastic bags (3 or 6 ml) are likely to provide adequate protection for transport to storage, but also should be kept in a centralized hazmat storage container (Feldman, 2010).

Pre-planning is highly recommended among first responder and first receiver communities in plans. Although life saving measures is a priority over requirements for proper decontamination containment, responder and receiver communities, knowing that they are mandated to perform mass human decontamination as part of their mission, should conduct pre-planning.
Functional Area 6: Crisis and Emergency Risk Communication

Guidance Statement 6.1

Communication is an essential component of effective disaster management. Crisis and emergency risk communication\(^{12}\) should be incorporated into all stages of disaster management, so that planning addresses communication before, during and after an incident. All personnel expected to respond to a mass casualty chemical incident should receive job-appropriate training in crisis and emergency risk communication. Use these principles for effective communication with the public:

- Building trust
- Announcing Early
- Transparency
- Listening
- Planning

Considerations:

- Crisis and emergency risk communication training can be incorporated into existing curricula in order not to increase the training burden on emergency response personnel. However, additional training focused on crisis and emergency risk communication may be appropriate in some cases, such as for personnel expected to serve as a public information officer during an incident.
- Effective crisis and emergency risk communication is a learned skill. Personnel at all levels who will be involved in the response to a mass casualty chemical incident (from first responders and first receivers up through high-level managers) should be trained in effective crisis and emergency risk communication principles.

Level of Confidence: II

Discussion:

Clinical trials on the subject of the role of communication in shaping outcomes in a mass casualty incident are lacking and not likely to be conducted in the near future. However, a great deal of empirical evidence is available, including results of case studies of actual incidents, upon which an emphasis on the importance of effective communication to successful disaster management is based. Community members’ responses to a disaster can influence morbidity and mortality; in turn, communication with the public can influence their responses. Effective communication enhances the likelihood that at-risk community members will take appropriate protective actions and reassures those at lower risk (Rogers et al., 2007). Many of the cases analyzed in the literature demonstrate the detrimental effects of poor communication on patients and/or community members’ behavior or health. An implication of such findings is that improved communication could have led to better outcomes; though it is perhaps more difficult to demonstrate directly through case studies that effective communication positively influenced health outcomes. Since empirical evidence relevant to this guidance statement has been reviewed in the literature by numerous experts in the fields of communication, risk management, behavioral health and others and is too extensive to cover comprehensively in this discussion, a few example cases are highlighted along with select articles.

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\(^{12}\) Crisis and emergency risk communication is defined by the CDC as “the effort by experts to provide information to allow an individual, stakeholder, or an entire community to make the best possible decisions about their well-being within nearly impossible time constraints and help people ultimately to accept the imperfect nature of choices during the crisis” (CDC, 2002).
In the Tokyo sarin attack, passengers on the affected subway trains generally acted calmly and without panic (Murakami, 2000). However, some passengers reported becoming fearful when their calls to emergency services were not answered in a timely manner (Sheppard et al., 2006; Murakami, 2000). A number of factors may have contributed to the nervousness and unease including: false announcements on trains, news media reports of confusion, chaos and, patients becoming ill, and later, limited information and a lack of openness from officials (Pangi, 2002).

The Centers for Disease Control and Prevention (CDC) received angry feedback from postal workers after they learned they would receive a different antibiotic (doxycycline) than Congressional members, Congressional staff, and television network employees (ciprofloxacin) after the mailing of anthrax in letters in the U.S. in 2001. A message explaining the distribution of doxycycline to at-risk postal workers was distributed by the CDC. These communications failed to adequately explain the reason for the different antibiotic distribution provided to postal workers. As a result, postal workers expressed the perceptions that they were being treated as second-class citizens and perhaps being discriminated against (Vanderford, 2003; Sheppard et al., 2006).

Improved crisis and emergency risk communication potentially could have reduced the intense fear and stress-induced physical effects such as vomiting, diarrhea, blisters, burns, and reddening of the skin, as well as longer term negative consequences including discrimination experienced by residents of Goiania, Brazil at the time of the radiation accident in 1987 (Becker, 2004).

Perhaps one of the most compelling examples of less than optimal communication leading to detrimental behavior is Israeli citizens dying due to improper use of gas masks during the 1991 Persian Gulf War (Barach et al., 1998). At least 13 people reportedly died from asphyxiation after failure to follow instructions for and demonstrations of proper use of protective masks and infant carriers in response to a missile attack alarm (Hiss & Arensburg, 1992).

In a study of the types of information desired by the public during a hypothetical attack using plague, subjects predicted that they would be fearful as they learned about the attack and resulting casualties. However, many reported that their fear would be reduced by communication suggesting that emergency responders were responding to the incident. Most subjects said they would seek out information about the attack and use that information to decide what actions to take for themselves and their families (Wray & Jupka, 2004).

These cases help to illustrate the roles of crisis and emergency risk communication in both instructing people to take appropriate protective actions to benefit their health and safety and reassuring people and easing their fears when the risk is low. After the 2001 anthrax attack in the U.S., effective communication was needed to support the treatment of those determined to be at-risk with antibiotics for post-exposure prophylaxis. In Israel during the Persian Gulf War, precise instructions for the use of respiratory protective devices, a complex activity not without risk itself, was necessary to promote proper use and prevent injury. The cases of the Tokyo sarin attack, the anthrax letters, the radiation accident in Goiania and the hypothetical plague attack illustrate the need to provide complete, accurate and timely information, explanations for official actions, and reassurance when appropriate. Gaps in communication led to intense fear, stress-induced physical effects and large numbers of people seeking potentially unnecessary medical care.

Motivated by the emergence of severe acute respiratory syndrome (SARS) in 2001, the World Health Organization (WHO) convened a meeting in 2004 to consider the role of public communications in a disease outbreak. Risk communication and public health experts from multiple countries and international organizations reviewed the risk communication literature and their own experiences with outbreak response. Based on the gathered evidence, these experts identified best practices for communicating with the public during a disease outbreak in order to rapidly contain the outbreak while minimizing the disruption to economies and society (WHO, 2004). Although this effort was focused on
infectious disease outbreaks, there are no apparent reasons why the best practices or principles would not apply to chemical incidents or other public health emergencies.

- Building trust: trust in the people managing and communicating about an emergency enhances the likelihood that community members will comply with recommended protective actions. It also reduces the likelihood of suspicion that information is being concealed or downplayed and the potential for community members to act on such suspicion.

- Announcing early: communicating with the public about an emergency as soon as possible allows for protective actions to be taken during the effective time window. It also supports confidence and trust that authorities are being honest and forthcoming with the information that they hold. The first message about an incident is often the most important and influences all subsequent communications.

- Transparency: communication that is candid, easily understood, complete and accurate provides transparency, which in turn helps to build and maintain trust.

- Listening: the concerns of community members should be considered legitimate and addressed in messages. The community will comprise many different audiences, based on how they are affected by or their roles in managing the incident.

- Planning: as much advanced planning as possible should be done in order to avoid rushed efforts that can cause mistakes.
Guidance Statement 6.2

Develop a strategic communications plan for delivering various types of messages during an incident. Prepare as much material in advance as possible: identify message topics and their audiences; write pre-scripted messages; identify appropriate spokespeople or messengers for each type of message. Communication needs to be coordinated across all organizations so that a single message is spoken with many voices throughout the community.

Considerations:

- Ensure messages are developed for and disseminated to all stakeholders:
  - Those who were exposed and decontaminated
  - Those who may have been exposed but left the scene without being decontaminated or evaluated
  - Those who were at the scene and have a low likelihood of having been exposed
  - Those with family members or loved ones who were at the scene
  - Community members who were not at the scene
  - Emergency response organizations
  - Health care providers
  - Public health community

- Utilize an authoritative source, such as an elected official (e.g., mayor), a public health officer, a medical association or a well-known local physician, to deliver messages to the public for greater credibility.

- All elements of crisis communication and instruction during an incident should be redundant and interoperable, verbal and non-verbal, and be available in all common languages spoken in the community.

- Communication challenges may include hearing impairment, language barriers, illiteracy, inability to read due to lighting levels, impairment caused by the chemical exposure itself.

- Communicating information about why decontamination is necessary and about the process, (e.g., segregation of patients by gender, keeping families and caretakers together) how possessions and functional needs will be handled (e.g., eyeglasses, walkers, prostheses), may increase compliance with the process.

- Give simple, clear instructions using an authoritative voice broadcast through a public address or voice amplification device. It is essential to direct patients – expect people not to act quickly and not to panic.

- Patients should be informed of potential health risks to themselves and family members if they neglect decontamination treatment.

- Evidence suggests that panic is not a common response by people involved in a mass casualty disaster. However, psychosocial intervention that provides the following elements can mitigate acute stress reaction that may occur at the time of or up to several weeks after a disaster and promote recovery:
  - A sense of safety
  - Calming
  - A sense of self- and community efficacy
  - Connectedness
  - Hope

- Integrate behavioral health professionals early in the response to address potential acute stress reaction in patients, as resources allow.

Level of Confidence: II
Discussion:
As with several other guidance statements, the effects of the recommendations made here on patient outcomes are not likely to be tested in clinical trials. However, the content above is substantiated by rigorous survey or interview-based research and some by empirical evidence from actual events.

After the 2001 terrorist attacks in the US the Center for Disease Control and Prevention (CDC) funded a series of studies to aid planning for effective communication in chemical, biological, radiological or nuclear (CBRN) terrorist incidents. Several research teams utilized focus groups and individual interviews to assess the types of information that members of the public wish to receive during such an incident. This was based on the premise that in order to be optimally effective, messages must take into account the recipients’ needs and concerns. Experts in the fields of risk communication, behavioral health, and public health have recommended that crisis and emergency risk communications include what members of the public want to know in addition to what government officials want them to know (Rogers et al., 2007; WHO, 2004). This Pre-Event Message Development Project worked with a total sample size of 1013 individuals in several different regions of the US. The project gathered data through purposive sampling to provide adequate representation of ethnic groups, urban and rural dwellers, proficiency in the English language, age, socioeconomic status, education level and gender (Wray et al., 2008; Becker, 2004; Glik et al., 2004; Henderson et al., 2004; Wray and Jupka, 2004). Participants in these studies expressed their desires for information about the nature of the threat, how to protect themselves and their families, and the official response to the situation. Specifically regarding protective actions, they wanted to know how to avoid exposure, recognize symptoms and treat effects. In addition, they wanted as much protective information as possible. Information needs did not differ among regions of the U.S. nor among other sub-groups. Study participants reported that one of the immediate actions they will take is active information seeking, which supports the best practice of announcing early. Study results also suggest that people will seek and compare information from multiple sources, substantiating the recommendation that communication be coordinated across organizations so that a single message is delivered. Inconsistencies will not only cause confusion for the public but can undermine their trust and confidence in the government and other authorities (Wray et al., 2008). Members of the public want to know that the information they receive about an emergency is credible. Many participants in the Pre-Event Message Development Project studies stated that they wanted to know the source of the information, so that they can judge credibility for themselves. Some offered examples of respected sources, which included both local and national level authorities: local health departments, fire departments, police departments, the CDC, the American Red Cross, the US President, the military/national guard, and other organizations having relevant expertise (Wray et al., 2008).

The influence of non-verbal instructions on the effectiveness of patient decontamination has been assessed in one study. A pictorial aid was provided to subjects in one group in addition to verbal instructions on what actions a subject should perform for decontamination and the proportion of contaminant removed from these subjects was compared to the proportion removed from subjects who received only verbal instructions. Decontamination effectiveness was not significantly different between the group who had received verbal plus non-verbal instructions and the group who had received only verbal instructions (Amlôt et al., 2010). This result seems counterintuitive and contradictory to the guidance provided here. However, the investigators have provided additional explanatory information in a subsequent article that suggests that the pictorial instructions were misinterpreted, at least by the adult study subjects (Winfield, 2011). In addition, many circumstances and challenges that could arise during a mass patient decontamination incident would seem to warrant the inclusion of non-verbal instructions in a response plan. These include verbal instructions not being available in all languages spoken by patients and difficulty hearing and/or understanding verbal instructions spoken by responders wearing respiratory protection devices. The latter was recently reported in a study of participants in patient decontamination field exercises (Carter et al., 2012).
The recommendation to expect people not to act quickly and not to panic is based on numerous case studies (Auf der Heide, 1989; DiGiovanni et al., 2003; Sheppard et al., 2006; Murakami, 2000; Sullivan & Bongar, 2007). First, it is important to be clear about the definition of panic and recognize that fear, anxiety and a sense of urgency are often appropriate and necessary responses to an emergency, as they can facilitate protective actions, such as evacuation and decontamination, in a timely manner. In the context of an emergency affecting a community, panic is characterized by irrational behaviors, hope of receiving apparently scarce resources, a focus on achieving personal safety rather than assisting others, and contagiousness of the spread of contamination, in addition to the heightened anxiety and fear of dying associated with panic in other situations (Keating, 1982; Sheppard et al., 2006). DiGiovanni and colleagues (2003) analyzed several natural disasters and concluded that people generally acted with composure and did not exhibit irrational behaviors. The authors added a caveat, however, that people might behave differently in terrorist attacks with CBRN agents than in natural disasters. However, four terrorist attacks (the Tokyo sarin attack, the 9/11 World Trade Center attack, the U.S. anthrax letter mailings and the July 7, 2005 London bombings) were analyzed by Sheppard and colleagues (2006) and in all cases it was concluded that the affected community members generally acted calmly and rationally, rather than with panic. Many occupants of the World Trade Center towers did not evacuate even when smoke and flames were visible. Individuals on the train cars involved in the Tokyo sarin attack and the London bombings reported unity and cohesion among those affected (Sheppard et al., 2006). Others have described the composure exhibited by community members in the Tokyo sarin attack (Murakami, 2005) which was disrupted by slow responses by emergency service personnel and images of chaos and severely ill patients in the news media (Pangi, 2002).

Distinct from the question of how people behave during and in the immediate aftermath of an incident is the issue of relatively longer-term psychological effects of a disaster on the people impacted. Evidence from actual incidents, including many of the cases mentioned above, suggests that the psychological impact of terrorist attacks, CBRN incidents, or other disasters can be significant, both in terms of the numbers of people affected and the severity of effects (Sullivan & Bongar, 2007; Bleich et al., 2003; Murakami, 2000). The types of symptoms experienced can be described by mass psychogenic illness, acute stress reaction, post-traumatic stress disorder and other syndromes or disorders (Sullivan & Bongar, 2007; Bleich et al., 2003). In order to support tools for mitigating such psychological effects, a large body of empirical evidence was compiled by a panel of experts on the study and treatment of individuals exposed to disaster and mass violence and used to define by consensus a set of evidence-informed psychosocial intervention principles (Hobfoll et al., 2007). The authors recommend that these elements be incorporated into intervention efforts during the short and mid-term period (immediate hours to several months) following a disaster or terrorist attack. The principles are: (1) promote sense of safety, (2) promote calming, (3) promote sense of self-efficacy and collective efficacy, (4) promote connectedness and (5) promote hope. Each of these measures can be addressed at least partially through crisis and emergency risk communication. For example, safety includes safety from bad news and sources of additional stress, which are often conveyed through the media in a disaster. Education about behavioral health responses to disaster, techniques for managing anxiety, signs of severe illness and sources of professional evaluation and treatment, all of which help to promote calming, can be provided through community outreach.

Self-efficacy and community efficacy, which are directly related to the self-care tier of patient decontamination described in this guidance, can be promoted pre-incident through public education campaigns and during an incident through messages delivered by emergency responders, receivers, public health officials and other trusted community leaders. Resilient communities encourage perceptions of both self-efficacy and collaborative support of one and other during times of need. Hobfoll et al. (2007) note that the positive role of social support and connectedness in mitigating stress and trauma is probably the best empirically supported of their five recommended principles, yet there is little evidence suggesting how to apply it for effective intervention in a disaster. This principle is integrated into several parts of the
guidance presented here. Keeping families and loved ones together during decontamination and especially keeping children connected (or reconnecting them) with parents or caretakers (Guidance Statements 2.4 and 2.11) will support the connectedness recommended by Hobfoll et al. (2007). Facilitating the reconnection of family members who were in different locations at the time of the incident (Auf der Heide, 1989) as well as reaching out to community members who may be socially isolated or lack strong social support may also allow connectedness to help shape an effective community response to a disaster. Hobfoll et al. (2007) emphasized that a sense of hope can be enhanced by many external factors and is not solely an internal attribute held by an individual. They suggest that a community can foster hope by “helping people focus on more accurate risk assessment, positive goals, building strengths that they have as individuals and communities, and helping them tell their story” (Hobfoll et al., 2007).
Guidance Statement 6.3

Public education can be achieved by using naturally occurring opportunities to communicate patient decontamination goals, potential practices, responsibilities of responders, receivers and patients, and expected outcomes. A strategic plan for pre-event communication to enhance community preparedness should be developed to include information about patient decontamination in community outreach by fire service and EMS organizations, public service announcements, and other planned events.

Considerations:

- Prioritize communities that are at-risk, due to the presence of an industrial site or a transportation route, for messaging tailored to the community’s specific hazards.
- Integrate pre-event communication about patient decontamination should be integrated into ongoing efforts by the chemical industry and other organizations (e.g., LEPC, Transportation Community Awareness and Emergency Response [TRANSCAER]).
- Public interest in learning about and preparing for rare hazardous materials incidents may be low. Some communities may decide that it would be more efficient to prepare public messages for dissemination at the time of an incident than to engage in a pre-event public education campaign.

Level of Confidence: III

Discussion:

From the perspective of an individual living in the US, hazardous materials incidents are rare; the likelihood that an individual will be involved in or affected by such an incident is relatively low. Therefore, it is not surprising that members of the public are generally not well informed about hazardous materials. CDC’s Pre-Event Message Development Project found that study participants had limited understanding of CBRN agents or the differences between categories of agents (e.g., infectious vs. non-infectious) (Wray et al., 2008). Pre-event education could improve the public’s understanding of hazardous materials, what to expect from responders, receivers and officials during a response and what they can do to protect themselves and their families. In turn, the increased knowledge and enhanced understanding among the public can improve the potential for an effective response in an actual incident by promoting appropriate protective actions. The influence of a pre-event public education campaign on the effectiveness of a response to a chemical or hazardous materials incident (e.g., using health outcomes or protective actions by the public or some other measure of effectiveness) has not been studied and would be difficult to demonstrate through a controlled study. This would require measuring disaster response effectiveness before and after a public education campaign in the same community or comparing disaster response effectiveness in two similar communities, one of which had conducted a public education campaign and one of which had not. However, public health practitioners use public education campaigns regularly to promote healthy behaviors, with demonstrated success in areas such as smoking cessation and the prevention of HIV transmission. The effects of an effort to educate the public on hazardous materials on their pre-event knowledge and understanding of the information could be assessed more easily than disaster response effectiveness but no such studies have been described in the literature.

Community resilience depends on informed, empowered and prepared community members. This requires education, two-way communication, and collaborative planning. HHS and FEMA both recommend that significant pre-incident work be conducted on an ongoing basis to engage the whole community in emergency planning. Communities should leverage existing programs and events while also initiating additional activities focused on emergency preparedness (FEMA, 2011; HHS, 2012).

This guidance statement acknowledges that time and attention of the public are limited, especially for topics that they perceive as low risk to themselves, and time and other resources of emergency response and public health organizations are limited. Therefore, the guidance statement emphasizes efficiency -
education about hazardous materials, patient decontamination and protective actions associated with self- and community efficacy should be incorporated into community outreach efforts and planned events as appropriate.
Guidance Statement 6.4
To facilitate effective two-way communication during and after an incident:
- Provide patients with pre-scripted and printed follow-up information before they leave the scene or prior to discharge from the health care facility.
- Obtain patient contact information prior to release from the health care facility to allow for follow-up by the public health community.
- Establish an easily accessible mechanism for patients to obtain additional information or advice and for authorities to respond directly to patients’ questions or comments.
- Provide follow-up information for other community members who were either at the scene and not decontaminated or not at the scene.

Considerations:
- Develop follow-up information in consultation with appropriate medical, technical, behavioral health and communication experts.
- Include instruction sheets in the most common languages used in the community; confirm that translations use proper syntax.
- This information should be accessible electronically and through multiple mechanisms or locations.
- Engage the public health community, Poison Control Centers, and other community resources to help coordinate delivery of patient follow-up information and develop patient registry for further communication.
- The Agency for Toxic Substances and Disease Registry (ATSDR) Medical Management Guidelines, available on the internet (at http://www.atsdr.cdc.gov/mmg/Index.asp), include a printable Patient Information Sheet and Follow-Up Instructions for dozens of specific chemicals as well as guidance for responders and receivers treating patients exposed to an unknown chemical.
- All medical information disseminated to patients and community members must have a consistent message and be coordinated across the entire response.

Level of Confidence: III

Discussion:
Providing written, in addition to verbal, follow-up or discharge instructions to patients is common medical practice and has been shown to increase patient compliance with medical recommendations compared to verbal instructions alone. Preparation of patient follow-up information in advance of an incident allows for thorough review and input by medical experts and enhances preparedness. The printable Patient Information Sheets and Follow-Up Instructions available on ATSDR’s website (at http://www.atsdr.cdc.gov/mmg/Index.asp) have been developed by experts in medicine and toxicology and are regularly reviewed and updated.

The CDC’s Pre-Event Message Development Project which conducted over 1000 focus group and individual interviews, found that study participants would actively seek information about how to protect their health and that of their families in a CBRN terrorism incident (Wray et al., 2008). In the study of a hypothetical plague attack, participants reported that after initially seeking information from local and national authorities, over time, they would use the internet and newspapers to find more in-depth information (Wray & Jupka, 2004). Therefore, the internet and newspapers could be used to disseminate follow-up and provide additional information to patients and other community members as the incident, response and recovery proceed. The same mechanisms could provide means for collecting and responding to patients’ and community members’ questions and comments.
Obtaining patient contact information allows for additional medical or other information related to the incident to be communicated to patients later, if necessary. Most importantly, such communication should address patients’ physical, behavioral and mental health needs. Additionally, data on the impacts of the incident and the effectiveness of countermeasures can be collected through post-event communication. Assessment of patients exposed to sarin vapors in the 1994 Matsumoto and the 1995 Tokyo, Japan attacks has led to documentation of acute and long-term health effects as well as data on the efficacy of medical interventions (Yanagisawa et al., 2006). This type of analysis provides information on the effects of hazardous materials on humans that is difficult to obtain, helps to fill in significant knowledge gaps, and can be used to improve emergency preparedness and response.
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Appendix A: Working Group Charter and Membership

Mass Human Chemical Decontamination Working Group
Subcommittee on Standards-CBERNE
Committee on Homeland and National Security
National Science and Technology Council

Background
Chemical attacks perpetrated by terrorists and accidental releases of toxic industrial chemicals are recognized as current threats to public health in the United States. Both types of events can potentially expose significant numbers of people to dangerous chemicals that would overwhelm local response capabilities. Patient decontamination, when performed using appropriate techniques and during the appropriate time frame, limits patient exposure and the toxicity that follows as well as protects responders in the field and in the hospital setting from secondary contamination. Therefore, patient decontamination is an integral component of the medical response to a chemical event. Patient decontamination also impacts the flow of casualties at many levels of a mass casualty chemical event, meaning that decisions about decontamination will impact the entire emergency response. Thus various aspects of patient decontamination are of interest to multiple responder agencies, such as fire/hazmat, emergency medical services, hospitals, public health officials and emergency preparedness planners.

Patient decontamination plans and procedures have evolved over time with only limited guidance based on scientific evidence; many basic questions about decontamination have not yet been addressed by research. Evidence-based planning and best practices are thus limited. For example, attempting to fully decontaminate every person in the vicinity of a chemical release will slow the transport of seriously ill patients from the scene to hospitals. In this case, inappropriate decontamination protocols might hamper, rather than contribute to, 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 being decontaminated. Health care facility chemical incident response plans should address such scenarios. The recent closure of two St. Louis hospital emergency departments due to suspected secondary contamination of the facility from exposed patients illustrates the need for scrutinizing the patient decontamination process.

Homeland Security Presidential Directive-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 (WG), will attempt to ensure that those 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 such research gaps.

Purpose
The WG will assess the current state of capabilities and the current knowledge base regarding patient decontamination practices and technologies. Recommendations will then be made as to how the Federal government could facilitate improvements in these areas.

Scope
The WG will address a variety of issues including operational analysis and research, technology research and development, emergency preparedness planning, education, training, exercises and assessments.
Objectives

- Prepare a strategy that addresses the following (estimated timeline: 1 year from 1st meeting):
  - Review national standards of care for mass casualty human decontamination, compare and contrast differing standards and assemble a gap analysis
  - Provide an assessment of current human decontamination education, training, exercises, and assessments for fire, EMS, and hospital systems
  - Perform a literature review of patient decontamination research, identify current research activities, and describe research questions that need to be addressed.
  - Assess decontamination solutions
    - Evaluate current decontamination solutions (e.g., soap & water, dilute bleach, RSDL) for effectiveness/feasibility/cost/barriers and safety (e.g., intact skin, eyes, open wounds, prolonged contact, environmental run-off)
    - Define role of each solution in Concept of Operations (CONOPS)
  - Develop optimizing strategies for decontamination that may be employed recognizing constraints in equipment, training, time, and capability at local response levels and provide proposals for evaluation and validation. Proposed strategies will consider current capabilities and time constraints for mass casualty decontamination.
  - Establish CONOPS for mass decontamination after chemical exposure
  - Define metrics for mass patient decontamination after a chemical exposure (e.g., the % patients or number that must be deconned per hour by “system”)
  - Provide Working Group recommendations to Target Capabilities Working Group
  - Implement plans to address highest priority areas (estimated timeline: year 2 and beyond)

Mass Human Chemical Decontamination Working Group Membership

Co-Chairs

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Office of the Assistant Secretary for Preparedness and Response

Joselito Ignacio
Department of Homeland Security
Office of Health Affairs

Mark Kirk (Former Co-Chair)
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William A. Lake  
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U.S. Army Material Command  

Adam D. Leary  
Gap Solutions, Inc. Contract Support  
Department of Health & Human Services  
Office of the Assistant Secretary for Preparedness and Response
Additional subject matter experts are invited as necessary. The working group may interact with and receive ad hoc advice from various non-Federal persons and entities, provided such interactions occur in a manner that maintains the working group’s status as compliant with the Federal Advisory Committee Act.

**Reporting Structure**
The Mass Human Chemical Decontamination Working Group reports to the Subcommittee on Standards-CBRNE, under the Committee on Homeland and National Security of the National Science and Technology Council within the Executive Office of the President. The WG also works closely with the White House National Security Staff through the Domestic Chemical Preparedness and Response Sub-Interagency Policy Committee.
Appendix B: Lexicon

**General Definitions**

**Contaminant:**
Any hazardous chemical (solid, liquid, or gas) that is capable of causing harm to life or health and found in the area around the person, internally, or on the person’s body or clothes.

**Patient Decontamination:**
Any process, method, or action that leads to a reduction, removal, neutralization or inactivation of contamination on the patient in order to: prevent or mitigate adverse health effects to the patient; protect emergency first responders, health care facility first receivers and unexposed patients from secondary contamination; and reduce the potential for secondary contamination of response and health care infrastructure.

**Patient Decontamination Prioritization:**
Any method used by responders or receivers in an effort to ensure that patients who have a higher relative risk of contamination or are in a higher medical triage category are decontaminated ahead of lower risk patients or those with a lower medical triage category. This may be part of the broader triage effort used to determine medical needs.

**First Responder:**
An appropriately trained member of a response organization dispatched to the incident scene for purposes of incident management

- *Examples: Fire and Rescue services; Emergency Medical Services; Hazmat Technician; Law Enforcement officer*

**First Receiver:**
An appropriately trained member of a hospital or other health care facility who may encounter and work with contaminated or potentially contaminated patients from a hazardous materials incident

- *Examples: member of hospital decontamination team; emergency department personnel; security officer*

**Patient:**
Any individual who was at or near the location of a hazardous materials release and who is potentially contaminated and may require some form of care (e.g., decontamination, supportive medical care, lifesaving interventions, antidotal therapy, communication and reassurance, etc).

- Not all patients will require follow-on treatment or evaluation at a health care facility
- Some patients will leave the incident scene prior to responders arriving (i.e., self-evacuation)
- Some individuals who were not at or near the scene, are not likely to have been contaminated, or may not require any medical assistance, may present for evaluation and treatment
**Patient Categories**

**Ambulatory:**
Patients who can walk without assistance or with minimal assistance, follow responder or receiver directions, and conduct certain decontamination tasks without assistance from responders or receivers (e.g., remove clothing)

Some patients in this category may require buddy-help or responder/receiver assistance to complete the decontamination procedure.

- These patients may include: minor-to-moderately wounded (e.g., ocular injuries, lacerations, breaks or strains); members of at-risk populations (e.g., pediatrics, sight and/or hearing impaired, elderly); and patients with minor symptoms.

**Non-ambulatory:**
Mobility impaired (e.g. Stretcher, wheelchair bound) patients. This category of patient may require response personnel to complete decontamination actions with limited, if any, assistance from the patient.

- Decontamination of these patients is very resource and time intensive and typically requires specialized equipment (rollers, chemical resistant backboards, etc.)
- Additional personnel may be required to decontaminate a single non-ambulatory patient

**Descriptors of Scale**

**Individual Patient Decontamination:**
Decontamination activities conducted for a single contaminated patient. These activities should almost always fall within the resource and capacity limitations of the properly prepared responding or receiving organization.

**Multi-Patient Decontamination (Resource Sufficient):**
Decontamination activities conducted for multiple contaminated patients in a situation in which resources are not limiting. Requests for additional resources or assistance should not be required for this level of decontamination. The number of casualties that constitutes multi-casualty decontamination is dependent on the jurisdiction, responding agency, and system capacity.

**Mass Patient Decontamination:**
Decontamination activities conducted for a number of contaminated patients that exceeds the typical response capacity of an organization, which may require additional resources or personnel from surrounding jurisdictions and requires that patients be prioritized for the decontamination process. Mass decontamination generally requires much higher levels of resource coordination than multi-casualty or individual decontamination situations. The number of casualties that constitutes mass decontamination is dependent on the jurisdiction, responding agency, and capacity.
Tiers of Patient Decontamination

Self-Care:
Actions that a patient can perform for him/herself, including distancing him/herself from the site of release, removing clothing, and wiping visible contamination from skin and clothing in order to reduce his/her own contamination level immediately, without waiting for a formal decontamination process to be set up. A perceptive patient or one experiencing acute distress from the chemical contamination may execute self-care even before responders arrive; however, most patients will need instructions.

Gross decontamination:
Actions likely to be performed by or with the assistance of first responders or first receivers in order to achieve a gross or hasty reduction in contamination, significantly reducing contamination on skin or clothing, as soon as possible after contamination has occurred.

Technical Decontamination:
Planned and systematic actions, likely to be performed under the guidance of, or with the assistance of first responders or first receivers, to achieve contamination reduction to a level that is as low as possible.
Appendix C: Glossary

Acute Stress Reaction
When an individual who has been exposed to a traumatic event develops anxiety symptoms, re-experiencing of the event, and avoidance of stimuli related to the event lasting less than four weeks they may be suffering from this Anxiety Disorder.

At-Risk Populations
As defined by HHS/ASPR\(^{13}\) as those who have needs in one or more of the following functional areas: communication, medical care, maintaining independence, supervision, and transportation. At-risk groups may include children, senior citizens, and pregnant women, as well as people who have disabilities, live in institutionalized settings, are from diverse cultures, have limited English proficiency or are non-English speaking, are transportation-disadvantaged, have chronic medical disorders, or have pharmacological dependency.

Authority Having Jurisdiction
As defined by the Department of Health and Human Services (HHS) in the PREP Act, Declaration for Pandemic Flu (2009): is the public agency or its delegate that has legal responsibility and authority for responding to an incident, based on political or geographical (e.g., city, county, Tribal, State, or Federal boundary lines) or functional (e.g., law enforcement, public health) range or sphere of authority.

Crisis and Emergency Risk Communication\(^{14}\)
The effort by experts to provide information to allow an individual, stakeholder, or an entire community to make the best possible decisions about their well-being within nearly impossible time constraints and help people ultimately to accept the imperfect nature of choices during the crisis.

\(^{13}\) Note that this term is used throughout the document and is representative of all similar terms to include: special needs, vulnerable populations, and access or functional needs. This definition can be found on the HHS/ASPR website at: http://www.phe.gov/Preparedness/planning/abc/Pages/atrisk.aspx

\(^{14}\) Note that this definition is from the CDC’s Crisis and Emergency Risk Communication Manual which can be found at: http://www.bt.cdc.gov/cerc/.
Appendix D: Toxic Chemical Syndrome Lexicon

Introduction
The Department of Homeland Security (DHS) Office of Health Affairs (OHA), with the National Library of Medicine (NLM), sponsored a technical workshop on May 8-9, 2012 to discuss and develop a consistent lexicon to describe toxic chemical syndromes or toxidromes. The goal aimed at consensus on a list of syndromes, their definitions, and designated syndrome names to establish a common language for chemical defense planners, policy makers, first responders, first receivers and hazardous materials (HAZMAT) stakeholders. The syndrome list aims to provide this common lexicon to assist key stakeholder communities in quickly and accurately identifying the broad chemical agent category (if not the specific chemical agent type involved) by which a patient was exposed in order to rapidly determine appropriate emergency treatment. Comprehensiveness, accuracy, and clear understanding of the lexicon served as the primary criteria in developing this lexicon.

Background
Tens of thousands of chemicals are harmful to humans and knowing the specific toxic effects of even a large portion of the possible chemical agents would be an impossible task. Toxic chemicals can often be grouped into classes, whereby all the chemicals in a given class cause similar types of adverse health effects. These constellations of toxic effects or syndromes comprise a set of clinical “fingerprints” for groups of toxins. Moreover, all the toxic chemicals associated with a given toxic syndrome are treated similarly. Hence, during the early phases of a toxic chemical emergency, when the exact chemical is often unknown, identification of the toxic syndromes that are present can be a useful decision making tool that can overcome many of the problems associated with the lack of information on chemical identity.

Toxic syndromes are easily identified with only a few observations, such as:
- Vital signs
- Mental status
- Pupil size
- Mucous membrane irritation
- Lung exam for wheezes or rales
- Skin for burns, moisture, and color

Toxic syndrome recognition is important because it provides a tool for rapid detection of the suspected cause and can focus the differential diagnosis to consideration of only a few chemicals with similar toxic effects. By focusing on certain chemicals, specific diagnostic testing and empiric therapies can be rendered based on objective clinical evidence. Specifically, during a mass exposure, recognition can provide a triage tool for identifying toxic effects and also provide a common “language” so that all personnel, from emergency responders on the scene to the hospital emergency department, can clearly communicate a clinical message (Figure 1). With the extraordinary number of chemicals in use, this tool does not apply to every chemical but to most of the commonly encountered chemicals reported in HazMat incidents. The use of toxic syndromes as a diagnostic tool is fundamental to an effective and timely medical response.

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15 Workshop attendees agreed that the terms toxic syndrome and toxidrome can be used interchangeably as toxidrome is a contraction of “toxic syndrome.”
**Toxidrome Names and Descriptions**

<table>
<thead>
<tr>
<th>Toxidrome Name</th>
<th>Toxidrome Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Topical Irritant/Corrosive</strong></td>
<td>Immediate effects range from minor irritation to severe skin, eye, and mucosal membrane effects, which may progress to rapid systemic toxicity.</td>
</tr>
<tr>
<td><strong>Inhalation Irritant/Corrosive</strong></td>
<td>Immediate effects to the respiratory/pulmonary tract presenting as respiratory dress, coughing, wheezing, and/or nasal and oral secretions, which may progress to rapid systemic toxicity.</td>
</tr>
<tr>
<td><strong>Oral Ingestion Irritant/Corrosive</strong></td>
<td>Immediate effects to the oropharynx and gastrointestinal (GI) tract presenting as burns, nausea, vomiting, diarrhea, and drooling, which may progress to rapid systemic toxicity.</td>
</tr>
<tr>
<td><strong>Knockdown/Asphyxiants</strong></td>
<td>Altered state of consciousness, progressing from fatigue and lightheadedness to coma, with possible seizures and cardiac signs, secondary to disrupted cellular oxygen delivery and/or utilization.</td>
</tr>
<tr>
<td><strong>Anticoagulants</strong></td>
<td>Alteration of the blood coagulation that results in abnormal bleeding, indicated by excessive bruising, bleeding from mucous membranes, and longer bleeding from other soft tissue trauma.</td>
</tr>
<tr>
<td><strong>Cholinergic</strong></td>
<td>Overstimulation of cholinergic receptors leading to first activation and then fatigue of target organs, leading to pinpoint pupils (miosis), seizing, wheezing, twitching, and leaking all over.</td>
</tr>
<tr>
<td><strong>Cellular-Asphyxia (Cyanide-like)</strong></td>
<td>Inability to use oxygen, leading to acute-onset gasping, convulsions, loss of consciousness, breathing cessation, and cardiac arrest.</td>
</tr>
<tr>
<td><strong>Convulsant</strong></td>
<td>CNS disinhibition or excitation (glycine or GABA antagonism, glutamate agonism) leading to generalized convulsions.</td>
</tr>
<tr>
<td><strong>Opioid</strong></td>
<td>Opioid agonism leading to pinpoint pupils, and central nervous system (CNS) and respiratory depression.</td>
</tr>
<tr>
<td><strong>Stress-Response/Sympathomimetic</strong></td>
<td>Stress- or toxicant-induced catecholamine excess or CNS excitation leading to confusion, panic, and increased pulse, respiration, and blood pressure.</td>
</tr>
<tr>
<td><strong>Anticholinergic</strong></td>
<td>Under-stimulation of cholinergic receptors leading to dilated pupils (mydriasis), decreased sweating, elevated temperature, and mental status changes, including characteristic hallucinations.</td>
</tr>
<tr>
<td><strong>Acute Exposure to Solvents, Anesthetics, or Sedatives</strong></td>
<td>Decreased level of consciousness (progressing to coma in some cases), depressed respirations, and in some cases ataxia (difficulty balancing and walking) from acute exposure to solvents, inhalational anesthetics, or sedative-hypnotic compounds.</td>
</tr>
</tbody>
</table>

*For the full report, please see the Toxic Chemical Syndrome Lexicon developed by the National Library of Medicine and the Department of Homeland Security, Office of Health Affairs, Chemical Defense Program.*
Appendix E: Level of Confidence (LOC) Rankings

Purpose
A formal process for evaluating and scoring the quality and quantity of evidence to substantiate each guidance statement was established by the WG.

Background
A Level of Confidence (LOC) score for each guidance statement reflects the WG’s expert judgment of the strength of evidence underpinning the recommendation. The LOC is not a value judgment. The LOC is also not a measure of appropriateness of a given practice: the circumstances of a particular chemical incident and aftermath determine the proper course of action for successful patient decontamination. A recommendation of LOC IV or V may save lives every day even if strong scientific evidence to substantiate it is not available. Rather, the LOC represents the strength, breadth, quality, and quantity of evidence supporting a particular recommended practice.

a. In 2010, the Symposium on Chemical Decontamination of Humans was held in Washington, DC. This symposium clarified six core questions considered essential to performing patient decontamination. Preliminary results of reviews of the scientific literature addressing each core question were discussed.

b. Extensive scientific literature reviews and a crosswalk analysis of current guidance or best-practice documents for each core question were conducted in 2011. For more information, see the Methodology section.

c. Based on the available evidence gathered from published literature and current guidance or best-practice documents, guidance statements to address all six core questions were drafted. The draft guidance statements were reviewed by a group of subject matter experts (SME), who then voted either in favor of or against each statement during the 2012 Mass Human Chemical Decontamination Symposium.

Rating Scale
Three main sources of knowledge were used together to establish a rating scale that helps to distinguish guidance statements based on the strength of the supporting evidence: published literature, current practice and SME opinion and experience.

Definitions

Literature Quality - A published article was assigned one of the following quality levels:
A = strong clinical (human or trial data) or field research supports study’s conclusions;
B = strong basic science (in vitro or in vivo models) research supports study’s conclusions; or an uncontrolled study, field report of an actual response, or findings from an exercise;
C = consensus panel recommendations when not based on original research; or review of other studies, editorial, or opinion paper

Current practice – A specific principle or operational element is considered current practice if it is supported in two or more of the eight previously published guidance or best-practice documents included in the crosswalk analysis (for more information, see Methodology section).

SME Consensus - Defined as a group decision-making process that seeks the consent, not necessarily the agreement, of participants and the resolution of objections. For the 2012 Symposium, consensus was achieved through one of the following results:
a. Strong consensus – Two-thirds or more of the participating reviewers all vote, in writing, in support of the particular guidance statement;
b. Simple consensus - 50% or more of the participating reviewers all vote, in writing, in support of the particular guidance statement;

**LOC Ratings Definitions**

LOC I - The highest recommendation is supported by strong scientific evidence, including clinical or field research, in addition to current practice and SME consensus.

a. Substantiated by strong scientific literature (including at least one Level A article),
b. Current practice,
c. Strong SME consensus.

LOC II - The second tier recommendation is supported by some scientific evidence which is not definitive or where methodological problems limit the utility of the stated conclusions, but which is current practice and for which there is SME consensus.

a. Substantiated by adequate scientific literature (>three Level B articles),
b. Current practice,
c. Strong SME consensus.

LOC III – The third tier recommendation is one for which very limited scientific literature is informative, but for which there is precedent in current practice and for which there is majority SME consensus.

a. Substantiated by limited scientific literature (at least one Level B article),
b. Current practice,
c. At least majority SME consensus.

LOC IV- The fourth tier recommendation is supported by at least majority SME consensus and current practice but little or no scientific literature.

a. Substantiated by very limited scientific literature (no Level A or Level B evidence support the statement),
b. Current practice,
c. At least majority SME consensus.

V - The fifth tier reflects an absence of literature and precedent; SME consensus forms the sole basis for the recommendation.

a. No Level A, B, or C articles,
b. Not a current practice,
c. At least majority SME consensus.

The WG contends that to varying degrees, additional primary research (basic, epidemiological, clinical trial or observational) is needed for all of the present guidance statements. Additional study could validate a particular recommendation, and its LOC might therefore rise. Additional research may also lead to the conclusion that a particular practice is not scientifically supported, in which case its LOC would fall and the recommendation would be reconsidered. The LOC score reflects the current state of evidence on which a guidance statement is based. Any guidance statement in this document may be amended as science leads to better understanding of the best practices for mass patient chemical decontamination.