

The Use of Continuous Flow SAR for Respiratory Protection Against WMD

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What is the general state of Health Care Facility WMD capabilities?

- **“While health care facilities (HCFs) are an essential component of the emergency response system, at present they are poorly prepared for such incidents. The greatest challenge for HCFs may be the sudden presentation of large numbers of contaminated individuals.”** (Macintyre et al JAMA 2000; 283)

Why are Hazardous Materials and Weapons of Mass Destruction different from other Incidents?

- Can compromise hospital ED and the entire hospital (due to secondary contamination).
- Over a 5 year period, 12 hospitals in Washington state had to close their doors due to hazardous material incidents.
- The vast majority (>70%) of patients will bypass the EMS system and self-present at the hospital.

Tokyo- Sarin Attack Hospital Impacts

- Killed 12 victims and sickened 5,500 more.
- **St. Luke's International Hospital**, which is close to several of the subway stations involved, received 500 patients at their emergency department during the first hour; 3 of these were in cardiopulmonary arrest.
 - They ultimately saw 640 patients on the first day and a total of 1,410 in the week following the attack.

Closer to Home- Targets with Chemicals

- In Sacramento County alone,
- there are over 20 facilities that store “more dangerous” hazardous materials in excess of 10,000 gallons, pounds, or cubic feet.
- e.g.,
 - highly flammable,
 - corrosive,
 - toxic, or
 - explosive



Closer to Home

Targets with Chemicals

- Examples include:
 - 88,000 pounds of Hydrazine Hydrate (one of the most flammable materials made)
 - 74,000 pounds of Tetrahydrofuran
 - 1,080,000 pounds of Chlorine
 - 360,000 pounds of SEVIN
 - 131,000 pounds of Hydrochloric Acid
 - 526,700 pounds of Caustic Soda
 - 3,600,000 pounds of ORDRAM

Chemical Warfare Agent Permeation Testing DuPont Tychem Chemical Protective Fabrics

Agent	Common Name	Protocol	Average Breakthru time	Min. detectable permeation (μg per square centimeter)
GB	Sarin	DN5	> 6 hrs.	<0.00012
HD	Thickened Mustard	DN3	> 3 hrs.	<0.10000
L	Lewisite	DN3	> 6 hrs.	<0.10000
VX	VX	DN5	> 12 hrs.	<0.00012

Fabric test protocols. All tests performed in triplicate for DuPont Nonwovens by an independent accredited laboratory at 22 degrees C., 50% RH.

Protocol DN3 – MIL-STD-282, Method T-209 (HD) or modified for Lewisite, for 12 hrs. at 10 g/m².

Protocol DN5 - MIL-STD-282, Method T-209 (GB) or modified for GA, GD, and VX, for 12 hrs. at 10 g/m².

Type/Description	Advantages	Disadvantages
<p data-bbox="85 177 579 277">Self Contained Breathing Apparatus</p> <p data-bbox="85 285 627 813">A compressed air tank (less common is a rebreather system) containing 30 or 60 minutes (usually effective for less than the rated time) of breathable air. It is mounted on a harness worn on the back with a tight fitting facepiece. Weight ~ 25-40 lbs</p>	<p data-bbox="683 177 1155 708">An Atmosphere-supplying respirator. Greater mobility. Can be used for unknowns, in oxygen deficient atmospheres, and atmospheres above the Immediately Dangerous to Life and Health¹ level.</p>	<p data-bbox="1209 177 1870 545">Heavy and bulky (increased overexertion injury hazard). Limited air supply. Users must be fit tested. No facial hair allowed that interferes with mask. High level of training required. High cost.</p>

Supplied Air Respirators (In line system)

A hose attaches the user to a hip mounted regulator that is connected by another hose to either a compressed gas tank, compressor, or piped system. The mask can be either a tight fitting or loose fitting facepiece.

An Atmosphere-supplying respirator. Reduced potential of overexertion injuries. Can be configured for extended use. Loose fitting hoods do not require fit testing and can be used by persons with beards. Can place multiple responders on one system through use of a manifold system. Can be used for unknown substances and atmospheres below 19.5% oxygen.

Greater slip, trip and fall hazard from hoses. Limited range.

<p>Air purifying respirators (APR)</p> <p>A specialized filter attached to either a tight fitting or loose fitting facepiece. Can be of a demand valve or powered type (PAPR).</p>	<p>A filtered air source. High mobility and generally more comfortable. Often less expensive than atmosphere supplying respirators.</p>	<p>Cannot be used for unknown substances, atmospheres below 19.5% oxygen, materials with poor warning properties, or materials present above the Immediately Dangerous to Life and Health level. Same tight fitting facepiece issues as SCBA. Loose fitting facepiece can only be used with PAPR. Filters must be specific to type of contaminant present.</p>
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Use of Air Tanks

- **Medical grade air in “H” tanks on carts**
- **Allows the use of loose fitting facepieces that do not require fit testing and can allow persons with beards to participate. The loose fitting facepieces are generally more comfortable, fog less, and are cooler than the tight fitting facepieces.**
- **A low pressure alarm and a gated ball valve will allow an operator to switch tanks and provide an air supply.**
- **An “H” tank holds 233 ft³. Even with two tanks (466 ft³) four people on the manifold system (4*6cfm=24 cfm) would provide less than 20 minutes of breathing air.**
- **Changing out air tanks may become too burdensome to be feasible.**
- **A pressure demand valve tight fitting facepiece using ~1.4-4 cfm/responder**

Accessing the Facility's Medical Air

- **Does the system provide enough air to meet response needs without compromising patient care**
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- **Delivering the air to the point of use can be accomplished by either running sufficient length of NIOSH approved air hose from the closest port(s) or plumbing a port near the decontamination area.**
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- **Standards issue arises in the use of piped medical air. National Fire Protection Association 99 prohibits the use of medical air for anything but direct patient purposes.**
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- **Ways to address this issue are for the facility to make a determination that the respiratory protection described in this paper is of a life safety nature; or, work with the state or local “jurisdiction having authority” (usually a local fire department or state fire marshal) to waive that section of NFPA 99.**

Conclusions

- **Continuous Flow SARs have a potential use for respiratory protection against WMD**
- **Air compressors or cascade systems may be utilized for breathing air**
- **DuPont Tychem® SL material is resistant to many TICs and to chemical warfare agents**
- **Airline respirators are not subject to the limitations of air purifying elements**