

DHS SCIENCE AND TECHNOLOGY

Assessing the Risk from Stolen or Diverted Toxic Industrial Chemicals

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**Homeland
Security**

Science and Technology

DHS Science and Technology Directorate
Chemical Security Analysis Center

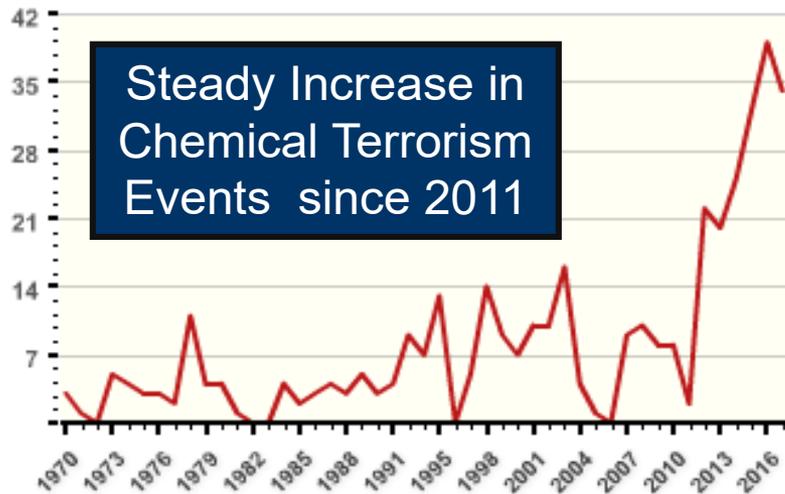
DHS S&T Chemical Security Analysis Center (CSAC)



Chemical Security Analysis Center, Aberdeen Proving Ground – Edgewood Area (APG-EA), Edgewood, MD

- Established in 2006 the CSAC is the nation's only federal studies, analysis and knowledge management center for assessing the threat and hazards associated with an accidental or intentional large-scale chemical release event or attack in the United States.
- Located on Aberdeen Proving Ground, the CSAC integrates Army expertise in the areas of chemical defense, chemical threat agents, and toxic industrial chemicals.

The Chemical Terrorism Threat



According to the Global Terrorism Database:

- **383 Incidents** of Chemical Terrorism have occurred from 1970 to 2017
- **30 Incidents** have occurred in North America



The Threat

- In April 2019 the Chemical Abstracts Service (CAS) Registry had 149 million+ unique chemical substances of which 348,000 substances are regulated.
- This is 4.5 times larger than the 33 million chemicals in April 2009 when the Chemical Facility Anti-Terrorism Standard (CFATS) regulation was promulgated (an average of 18 chemicals per minute for 12 years!)
- Large number of these chemical compounds are highly toxic and used in a number of industries throughout the country. They are transported, stored, processed, sold, and disposed of in large quantities.
- Each of these points provides potential for access or diversion of the material to become a “weapon of opportunity.”
- There are billions of possible scenarios that involve these chemicals of opportunity.



Theft and Diversion Threat

Reward of up to £10,000 following the theft of hazardous chemicals

Mexican cargo theft spike rattles shippers

Hugh R. Morley, Senior Editor | Jun 01, 2018 12:41PM EDT

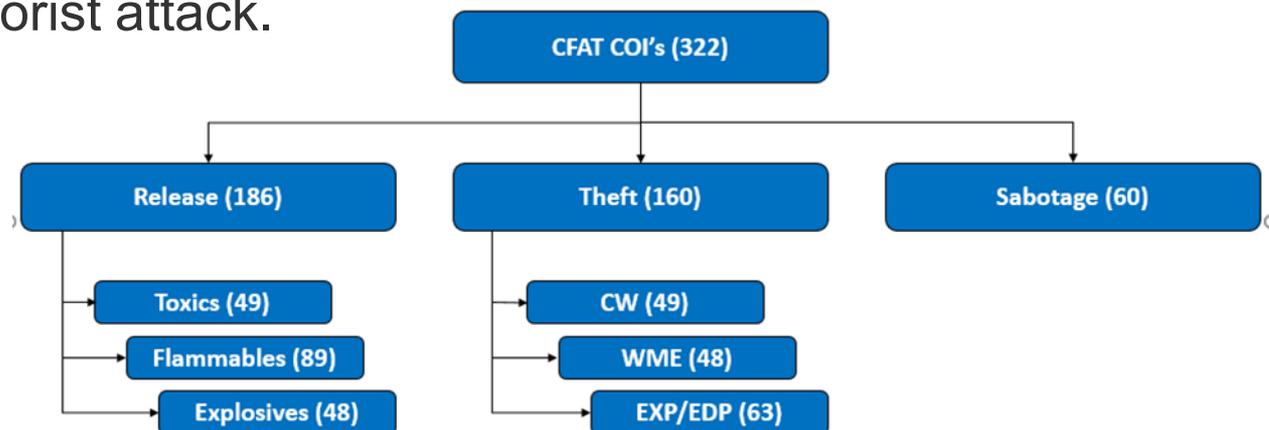
For the purposes of this study, major pharmaceutical thefts were defined as a \$100,000 or more loss in pharmaceutical cargo.

... Already this year (2015)`, a spate of cargo vessel hijackings in the Asia Pacific region has resulted in millions of liters of fuel oil and, to a lesser extent, chemicals, being lost to the black market.

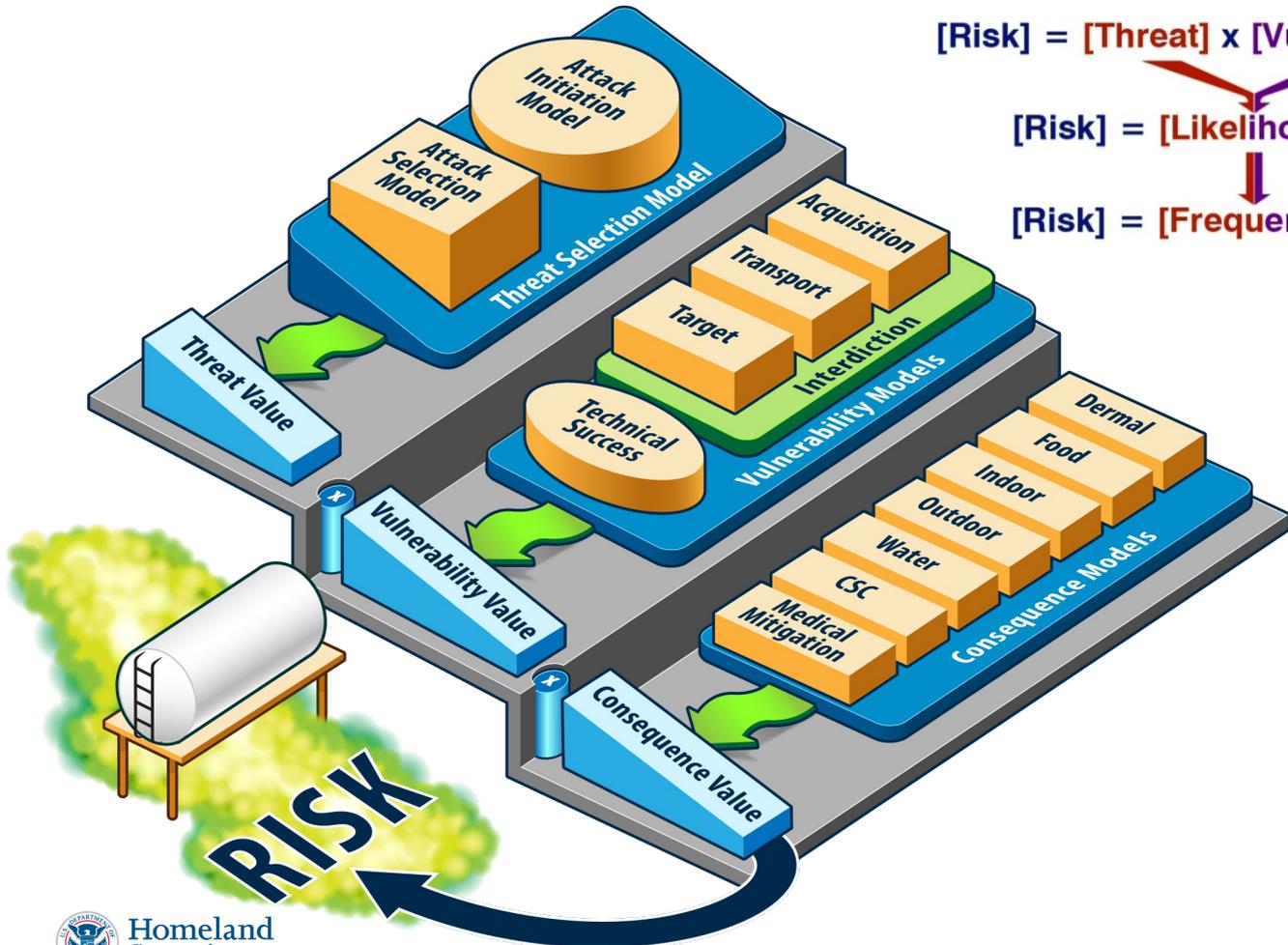
Several cases of Odyssey DLX herbicide were stolen from a farm yard near Burr, Saskatchewan on June 12.

Chemical Risk Reduction: CFATS

- The Chemical Sector converts various raw materials into more than 70,000 diverse products. Several hundred thousand U.S. chemical facilities use, manufacture, store, transport, or deliver chemicals along a complex, global supply chain. The majority of chemical manufacturing, transportation, storage, and warehousing
- The CFATS program works with facilities and industry groups to ensure they have reasonable security measures in place to reduce the risks associated with certain hazardous chemicals, prevent them from being exploited in a terrorist attack.



Risk Assessment Methodology

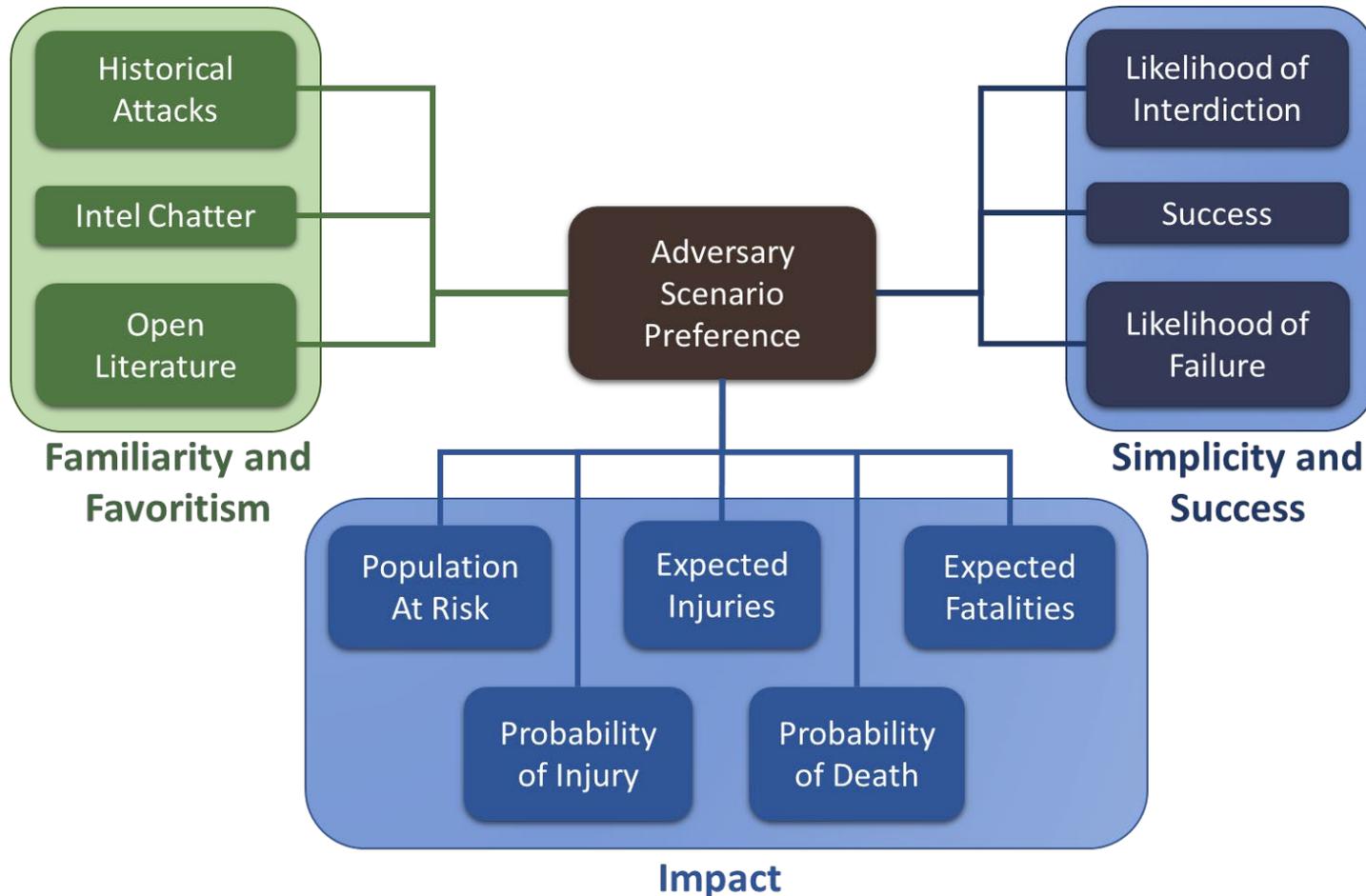


$$[\text{Risk}] = [\text{Threat}] \times [\text{Vulnerability}] \times [\text{Consequences}]$$

$$[\text{Risk}] = [\text{Likelihood}] \times [\text{Consequences}]$$

$$[\text{Risk}] = [\text{Frequency}] \times [\text{Consequences}]$$

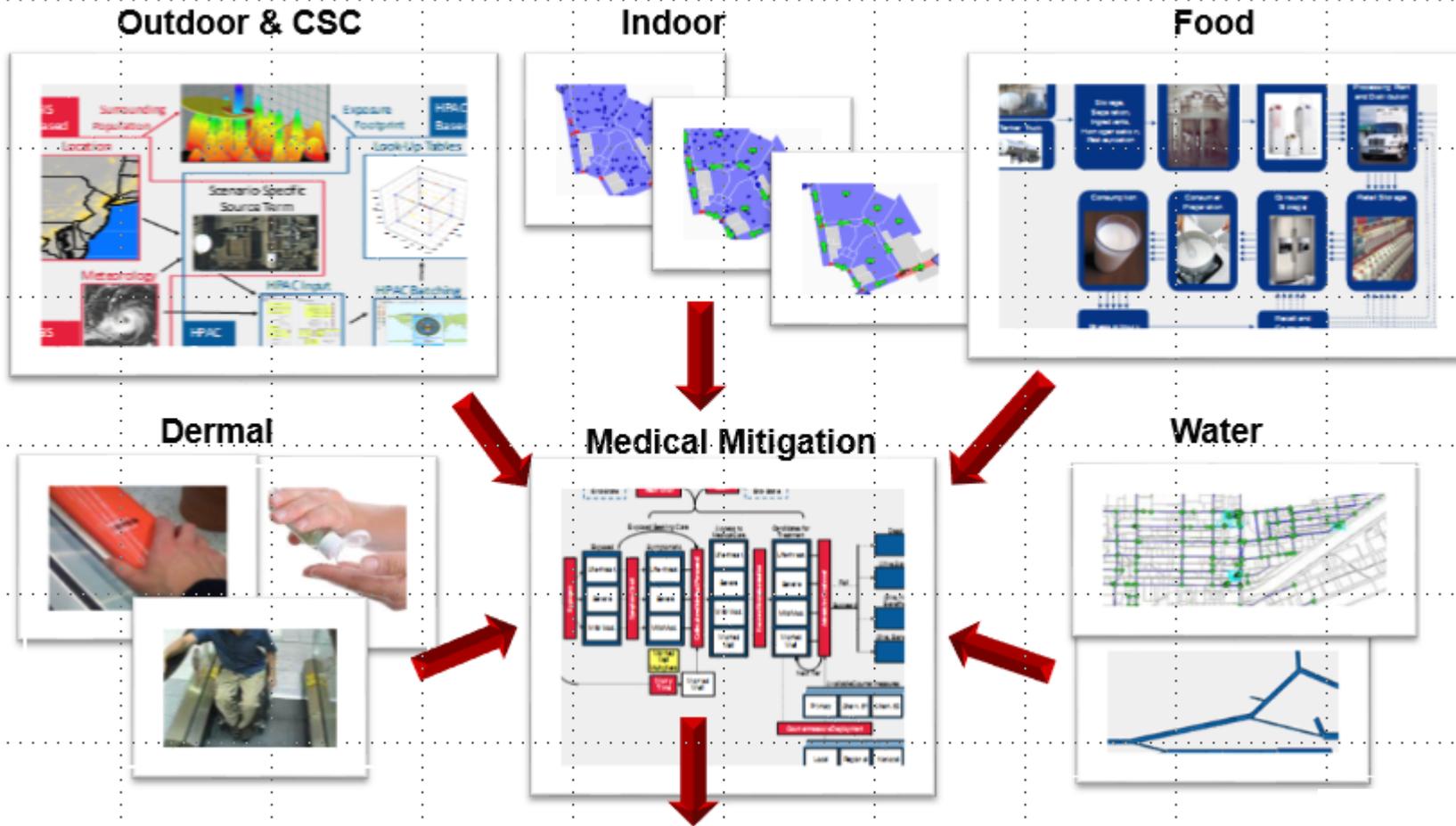
Attack Selection Model



Representative Targets

Major Target	Representative Targets	Major Target	Representative Targets
Indoor	<ul style="list-style-type: none"> •Cruise ship •Airplane •Subway •Museums •Hospitals •Office buildings •Airport terminal •Shopping mall •Religious center •Legislative building •Theaters •Arenas 	Food Representatives selected from 55,000 foods that were analyzed and clustered by like characteristics	<ul style="list-style-type: none"> •Processed cheese •Frozen egg patties •Milk •Bagged salad •Apple juice •Ground beef •Frozen meat pizza •Grapes •Seasoned chips •Tomato sauce •Bottled water
Chemical Supply Chain (CSC)	<ul style="list-style-type: none"> •Railcar •Bulk highway •Non-bulk highway •Barge •Pipelines •Chemical plant 	Outdoor	<ul style="list-style-type: none"> •Stadium •Urban center •Urban event
		MWS consumption and dermal	<ul style="list-style-type: none"> •Apartment back flush •Hydrant back flush
		Dermal	<ul style="list-style-type: none"> •Railing •Hand cleanser

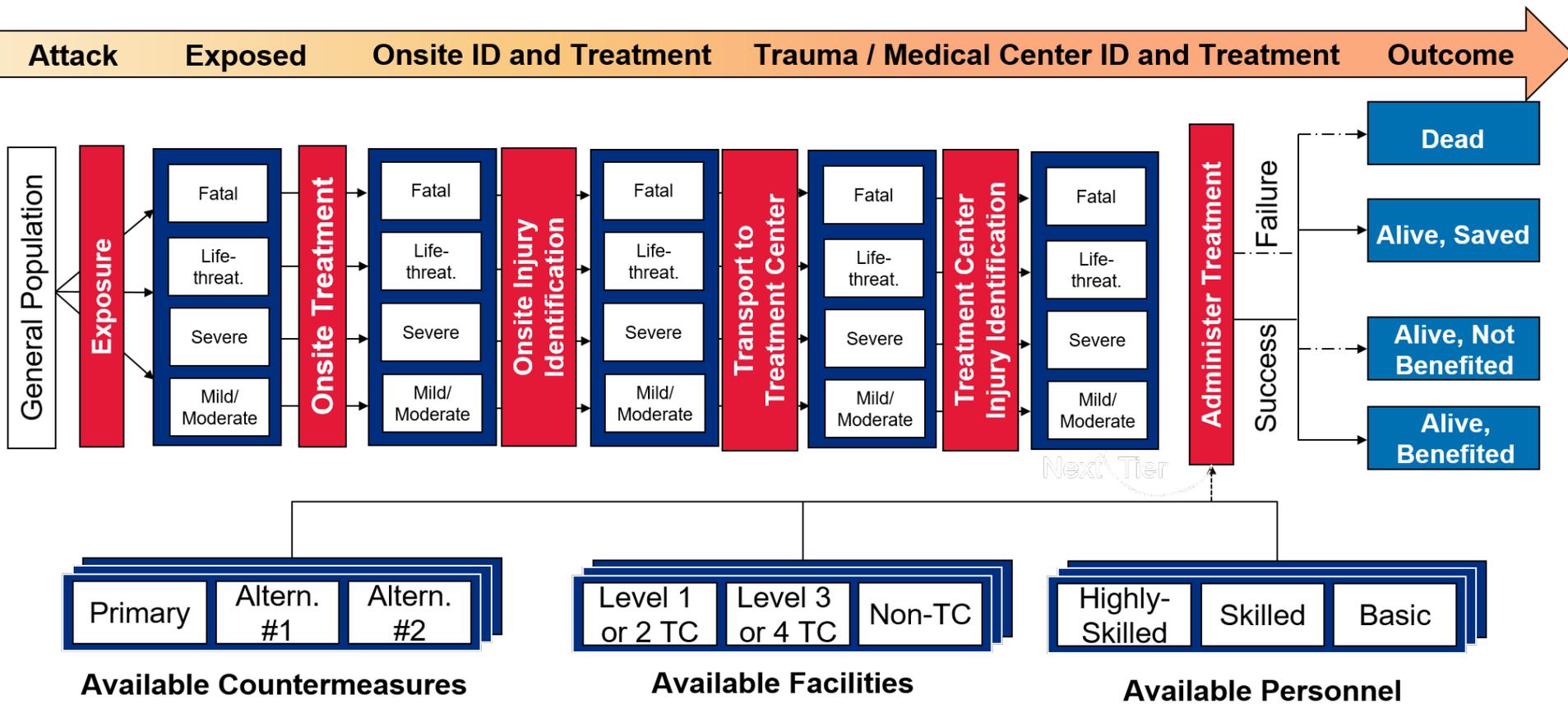
Chemical Consequence Models



Toxidromes

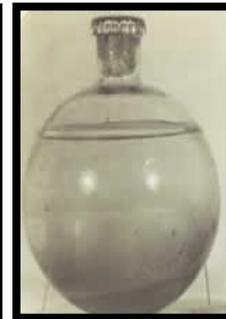
Toxidromes	Exemplar Chemical	Description
Metabolic	Mercuric chloride, carbon disulfide	Predominantly composed of inorganic metals/metalloids which act via interference with multiple receptors and/or intracellular processes, leading to multiple organ dysfunction. Many of these share early gastrointestinal symptoms, with subsequent hair, nail, kidney, and/or neurological abnormalities.
Opioid	Fentanyl, carfentanil	Opioid agonism leading to pinpoint pupils (miosis), and central nervous system and respiratory depression.
Sympathomimetic /Stimulant	Nicotine, caffeine	Stress- or toxicant-induced catecholamine excess or central nervous system excitation leading to confusion, panic, and increased pulse, respiration, and blood pressure
Irritant/Corrosive (includes upper & lower inhalation (INH) subdivisions)	Lower: phosgene, chlorine Upper: Hydrochloric acid, vanadium pentoxide, ammonia	INH - Immediate effects to the respiratory/pulmonary tract presenting as nasal and oral secretions, coughing, wheezing, and/or respiratory distress that may progress to rapid systemic toxicity ING - Immediate effects to the oropharynx and gastrointestinal (GI) tract presenting as burns, drooling, nausea, vomiting, and diarrhea that may progress to rapid systemic toxicity. TOP - Immediate effects range from minor irritation to severe skin, eye, and mucosal membrane effects, which may progress to rapid systemic toxicity.
Vesicant	HD, HN3, L	Same as irritant/corrosive

Medical Mitigation

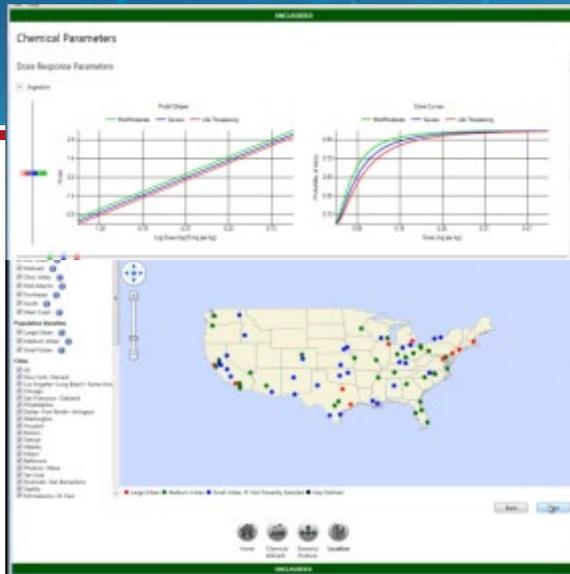


A Complex Set of Scenarios

- **Chemicals** - including pesticides, toxic industrial chemicals (TICs), Chemical warfare agents (CWAs) and other chemicals of high concern that may be obtained
- **Locations** - foreign or domestic
- **Methods of acquisition** - production, theft, purchase or chemical supply chain
- **Target classes** - Indoor, Outdoor, CSC, Food, Water, Dermal, consisting of
- **Targets** disseminated by
- **14 dissemination techniques**
- **Terrorist groups** - International, Domestic, and Small Groups/Individuals causing exposure via
- **3 exposure routes** - inhalation, ingestion and dermal leading to
- **3 public health consequences** - life threatening, severe, mild/moderate injuries and worried well



Chemical Consequence and Threat (C-CAT)



- All C-CAT models & data are incorporated into a fast, flexible, easy to use platform
- Specific scenario

- Millisecond run time allows real time focused follow-up studies
- Range of possible outcomes captured
- Data Filtering
- Parameter correlation mapping
- Inline statistical analysis & graphing

- Time resolved data analysis for a single simulation to analyze critical points along the scenario timeline
- Animated injury tracking

Summary

Chemical theft and diversion is an important part of a larger risk characterization.

A very large number of risk scenarios – each with their own probability of success or failure is incorporated into the overall risk of a specific scenario.

Once the spectrum of risk is known, individual components can be examined... e.g., ranking theft and diversion substances against total chemical terrorism risk.

CFATS considers theft and diversion as a chemical facility concern.

We are hoping to update and improve the theft and diversion algorithm to incorporate expert opinion (many of you!) on where the risk exists.

Questions?





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