Chemical Incidents

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Overview

- Definition
- Introduction and History
- Epidemiologic Aspects
- Public Health Consequences In Chemical Incidents
- Principles of Management
  - Planning and Preparedness
  - Response
  - Assessing the impact on public health

Chemical Incident

A chemical incident is the unexpected release of industrial material that is (potentially) hazardous either to humans, other animals or the environment.

EPIDEMIOLOGICAL ASSESSMENT OF HEALTH EFFECTS FROM CHEMICAL INCIDENTS

Paul Cullinan

Occup Environ Med 2002;**59**:568–572

Chemical Incident

Common synonyms include the term "accident" but this presupposes an anticipated failure of control; "incidents" include also unanticipated disasters resulting from mechanical or organizational failures, and occasionally even sabotage.

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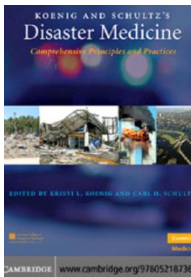
Chemical Substances

- Positive Aspects: Quality of Life
- Negative Aspects: Environmental Contaminations
- Ugly Aspects: Chemical Weapons, Narcotics, other Weapon if Mass Destructions

Introduction

- 100,000 different commercial chemicals are known
- Annual chemical production is estimated at 400 million tons
- Bulk stored and bulk transported
- Risk of large-scale release with resulting environmental and health effects



Koenig and Schultz's. Disaster medicine Comprehensive Principles and Practice. Cambridge University Press: 2009.

The Components of a Mobile Phone

Box: Cardboard
Interior: Moulded polystyrene

Bags: LDPE (Low Density Poly(ethene)

CD-Rom and Sleeve: Poly-carbonate, acrylic, paper, LDPE, Metal

Manual: Paper

Data Cable: PVC coated copper wire, metal con-nectors, PVC coated wire tie

Keys: Polypropylene

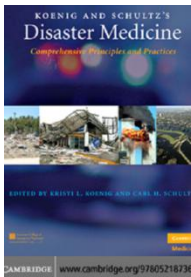
Housing: acrylonitrile-butadiene-styrene poly-carbonate

Charger: acrylonitrile-butadiene-styrene polycarbonate housing, PVC coated copper wire, metal connectors, ceramics

Circuit Board: Fibre-glass/epoxy composite, copper, metals, ceramics

Introduction

- 7,744 acute HazMat emergency events were reported in 13 U.S. states in 2004
- 1,978 chemical incidents in the years 2006 and 2007 in England



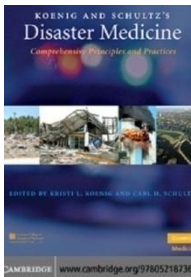
Introduction

- WHO: 3 mil. Admissions and 220000 Mortality Annually out of Chemical Incidents in the World

D.Klaassen C. Casarett and Doull's Toxicology: The Basic Science of Poisons. seven'th ed: McGraw-Hill. 2008.

History of Chemical Weapons

- Since at Least 1000 BC (Natural Materials)
- 670 AD. Naphtha, Sulfur, Saltpeter and Pitch: Inextinguishable for Ships
- 18th Century: Chlorine & Cyanide
- WW I (25% casualties): Chlorine- Phosgene- Sulfur Mustard



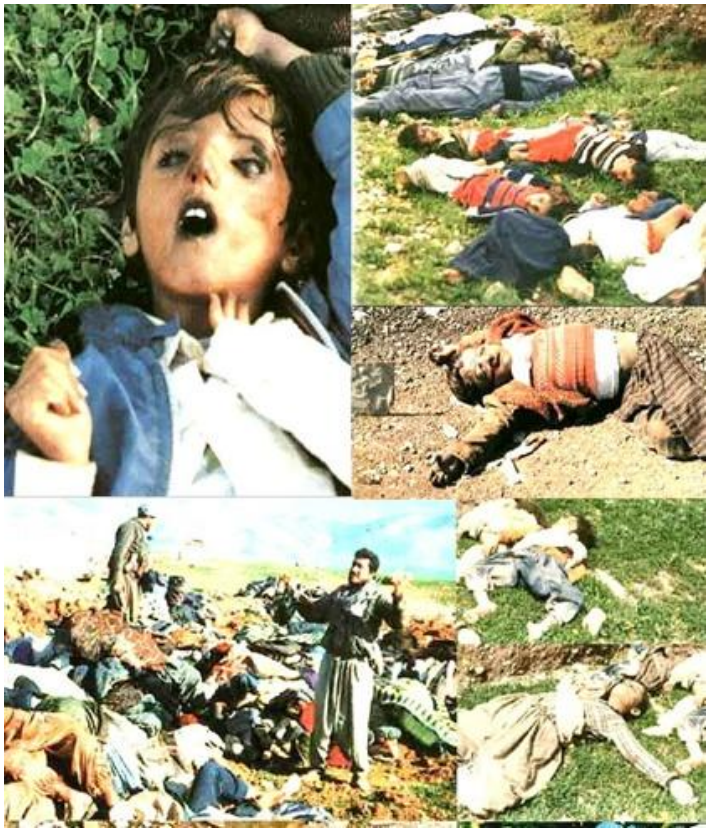
History of Chemical Weapons

- World War II: “Pesticides” especilally “Organophosphates” as “Nerve Agent”
- “Phenoxy” for eradicate Japanese Rice Products

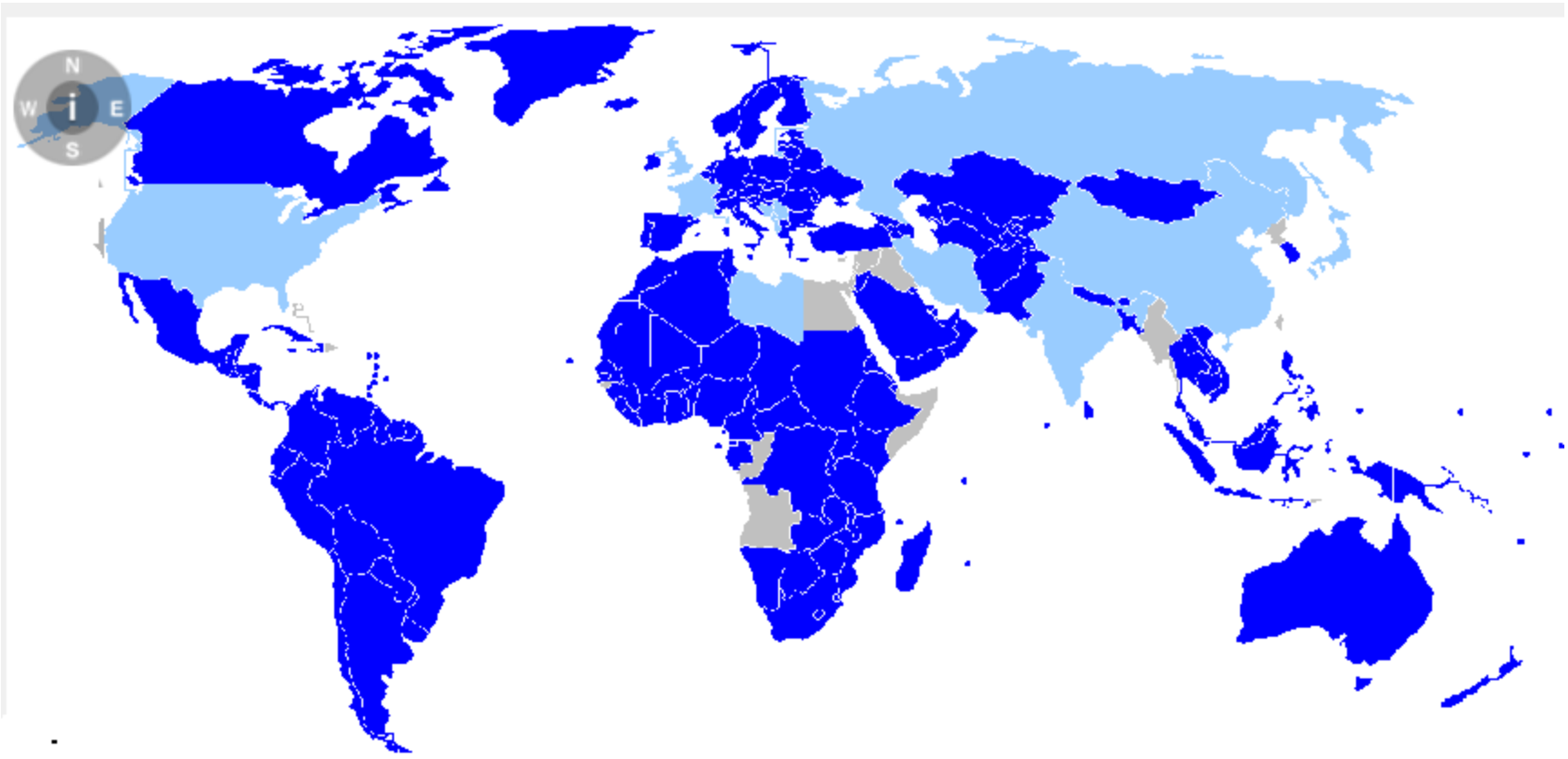
•Sanborn M, D. Cole, K. Kerr, C. Vakil, L. Sanin, and K. Bassil. Pesticides Literature Review. 2004:133.
•Haddad Lester M SMW, Winchester James F. Clinical management of poisoning and drug overdose. 3rd ed: W.B Saunders company.1998.

History of Chemical Weapons

The most extreme violation was by Iraq which used mustard and nerve gas against its own people, notably when it killed about 5,000 Kurds in Halabja, in March of 1988



Chemical Weapons Convention 2007



http://mapsof.net/map/chemical-weapons-convention-2007

Chemical Weapons

Widespread Use: Geneva Protocol of 1925

(banned the use of chemical weapons)

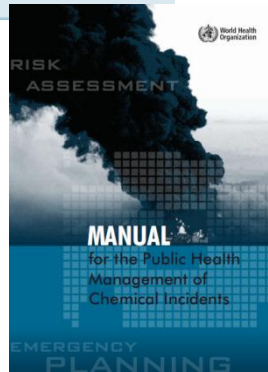
Farahmand Sh. chemical warfare. Available from : www.chem.sc.edu/faculty/morgan/resources/cw/cw.pdf. accessed : 2012.

Examples of Chemical Events

TABLE 1: EXAMPLES OF CHEMICAL INCIDENTS WORLDWIDE.

THESE EXAMPLES ARE DESCRIBED AS CASE-STUDIES IN THIS DOCUMENT. THE PAGE NUMBER OF THE CASE-STUDY IS GIVEN IN HAND COLUMN.

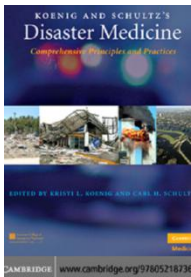
Year	Location	Description of incident	Consequences
2003	Baton Rouge, USA	Release of chlorine gas from a facility	• No human deaths
2004	Neyshabur, Iran	Train explosion due to mixing of incompatible chemicals	• Hundreds of deaths and casualties among emergency responders and onlookers
2005	Songhua River, China	Plant explosion releasing 100 tonnes of pollutants in the Songhua River	• Five deaths • Millions of people without water for several days
2005	Bohol, The Philippines	Inadvertent use of an insecticide in the preparation of sweets	• 29 deaths • 104 hospitalizations
2005	Hemel Hempstead, England	Three explosions in an oil storage facility (Buncefield depot)	• 43 reported injuries • 2000 persons evacuated
2006	Abidjan, Côte d'Ivoire	Dumping of toxic waste in the city of Abidjan	• 10 deaths, thousands made ill
2006	Panama	Diethylene glycol in a cough syrup	• At least 100 deaths
2007	Angola	Sodium bromide confused with table salt	• At least 460 people ill, most of them children
2008	Senegal	Lead from informal battery recycling	• People exposed with many children showing symptoms of lead intoxication



Year	Location	Description of incident	Consequences
1976	Seveso, Italy	Airborne release of dioxin from an industrial plant	• No immediate human deaths • 3 300 animal deaths • 80 000 animals slaughtered
1984	Bhopal, India	Methyl isocyanate (MIC) leak from a tank	• 3800 immediate deaths • 15 000 to 20 000 premature deaths • 500 000 exposed to the gas
1984	Mexico City, Mexico	Explosion of liquefied petroleum gas (LPG) terminal	• 500 deaths • 6400 injuries
1995	Tokyo, Japan	Deliberate release of a warfare agent	• 12 deaths • 54 critical casualties • Thousands of people affected
2000	Enschede, The Netherlands	Explosion of a fireworks factory	• 20 deaths, 562 casualties • Hundreds of houses destroyed • 2000 people evacuated
2001	Toulouse, France	Explosion of 300–400 tonnes of ammonium nitrate in a fertilizer facility	• 30 deaths • 2500 casualties • 500 homes uninhabitable
2002	Galicia, Spain	Shipwreck of the *Prestige*, causing the release of 77 000 tonnes of fuel	• Estimated clean-up costs of US$ 2.8 billion
2002	Jabalpur, India	Mass poisoning due to the use of pesticide containers as kitchen utensils	• Three deaths • At least 10 hospitalizations

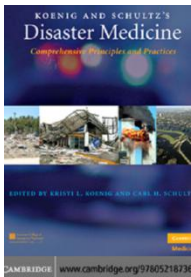
Arsenic Use in 1946 at Stalag

- In Revenge of killing Jews in WW II
- Water and Bread Poisoning
- 1500 Injured
- 207 Hospitalized
- 700-800 Dead or Paralyzed
- Not enough document



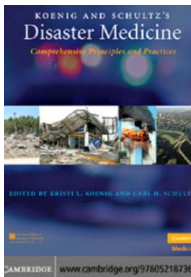
Nerve Agent Use in Japan

- 1994: 201 km Northwest of Tokyo
- Sarin: Organophosphate Poison
- 7 Deaths, Nearly 600 Victims.
- 9 Medical staff had symptoms



Nerve Agent Use in Japan

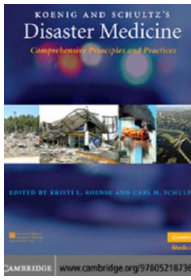
- March 1995: Tokyo subway sarin attack
- 12 Dead, 3,938 Injured, 1100 Hosptal.
- 135 EMT 110 Hospital Staff Developed Clinical Evidence



Bhopal disaster

- 3rd Dec. 1984
- Methyl Isocyanides
- 200’000- 500’000 Affected
- 3800 (3000-15000) Dead: 2-3 %

Death rate



Mishra PK, Samarth RM, Pathak N, Jain SK, Banerjee S, Maudar KK. Bhopal Gas Tragedy: review of clinical and experimental findings after 25 years. Int J Occup Med Environ Health. 2009;22(3):193-202.

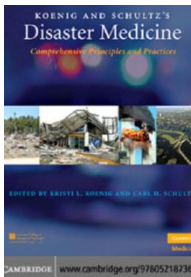
http://visionmundial.org.sv/conoce-al-director/publicaciones-del-director/?aid=90&sa=0.

Factors Contributing to the 1984 Bhopal Disaster

- Multinational industrial producer of chemicals operates in a developing nation and does not adhere to accepted international safety standards
- Financial pressures supersede industrial safety regulations (violation of industrial zoning in the inner city, violation of limits for maximal production)
- No enforcement of international safety operational standards
- Lack of risk reduction in plant location
- Poor public health infrastructure in the vicinity of a major industrial operation
- Poor public utility infrastructure such as drinking water, sewer, electricity, and telephone
- Absence of an emergency response system for industrial accidents
- Lack of infrastructure and technical expertise to manage an industrial incident

Ammonia Release in 2002 – Minot, North Dakota

- Derailment
- Anhydrous Ammonia
- Damage to Local Power Lines
- EMS: 2,800 calls
- 370 Injured, 11 Hosp.



History In Iran

- Arak, Shazand Chemical/Explosion
- Jun 2008
- 21 Dead and 55 Injured

http://www.ravy.ir/content53501.html

Zarghan Incident, Jun 2011

Photography: Fars EMS

Zarghan Incident, Jun 2011

Photography: Fars EMS

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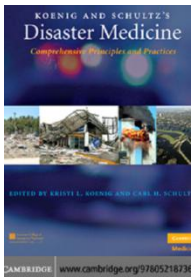
Epidemiologic aspects of Chemical events in US

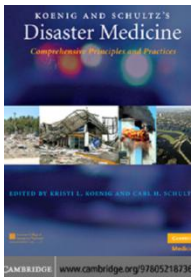
- The Number of Acute HazMat Events 1998 : 5,785 ➔2001: 7,105
- > 50% of Victims are Employees
- Common Causes: Equipment Failure & Human Error
- 85% of Transport Event : Ground



Epidemiologic aspects of Chemical events in US

- 10 Most Frequently Released Chemical:

Ammonia (5%), Sulfur dioxide (5%), Sulfuric acid (2%), Hydrochloric acid (2%), Carbonmonoxide (2%), Sodiumhydroxide (2%), Nitric oxide (2%), Mercury (2%), Paint (2%) and Ethylene glycol (1%)



Top 10 most important Industrial Accident disasters for the period 1900 to 2012

Country	Date	No Killed
Colombia, Explosion	7/08/1956	2700
India, Gas Leak	3/12/1984	2500
China P Rep, Other	26/04/1942	1549
France, Explosion	10/03/1906	1099
Nigeria, Explosion	17/10/1998	1082
Iraq, Explosion	17/08/1989	700
Soviet Union, Explosion	4/06/1989	607
Germany, Explosion	21/09/1921	600
United States, Explosion	16/04/1947	561
Brazil, Explosion	25/02/1984	508

Table 1 Selected, major chemical incidents

Place	Year (start)	Agent(s) (contaminants)
Airborne		
Meuse Valley, Belgium	1930	Sulphur dioxide, sulphuric acid, soot
Flixborough, UK	1974	Cyclohexane, related combustion products
Meda (Seveso), Italy	1976	2,3,7,8-tetrachlorodibenzodioxin
Bhopal, India	1984	Methylisocyanate, related combustion products
Schweizerhalle, Switzerland	1986	Agrochemicals, related combustion products
Chernobyl, USSR	1986	Radioactive isotopes
Foodborne		
Morocco	1959	Cooking oil (triarylphosphate)
Minamata, Japan	1965	Sea food (methyl mercury)
Yusho, Japan	1968	Rice oil (polychlorinated biphenyls)
Spain	1981	Rape seed oil (aninline?)
Skin contamination		
France	1972	Baby powder (hexachlorophene)
Ho-Chi-Minh, Vietnam	1981	Baby powder (warfarin)

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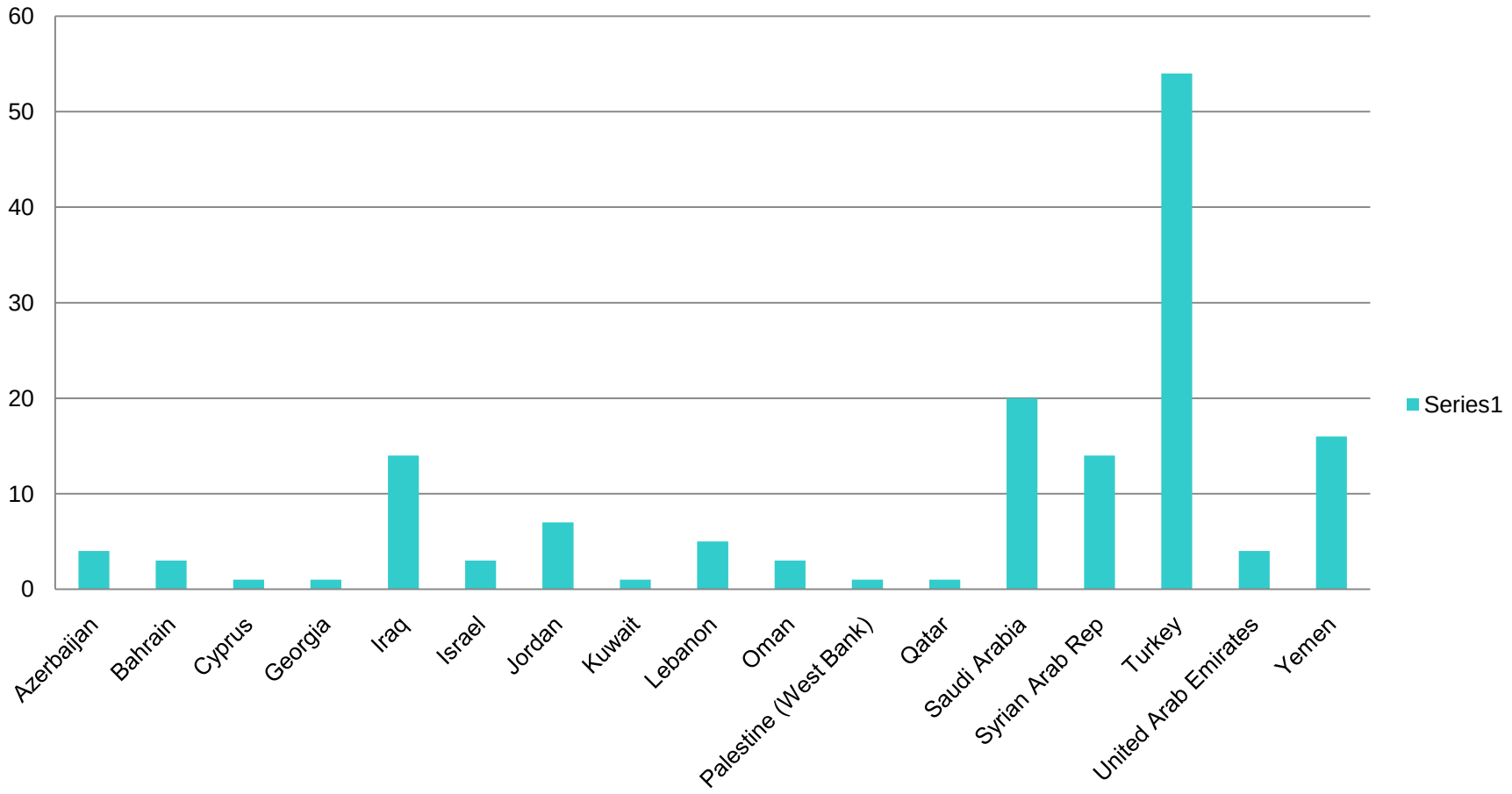
Industrial Accident; Miscellaneous accident; Transport Accident: west Asia:200-2009



Country(ies): Iran Islam Rep;

Year(s): 2000; 2001; 2002; 2003; 2004; 2005; 2006; 2007; 2008; 2009;

Disaster(s): Industrial Accident;

You have choosen to see the number of disasters that occurred by **Country**.

If there is no data for one variable of the set, it is not displayed.

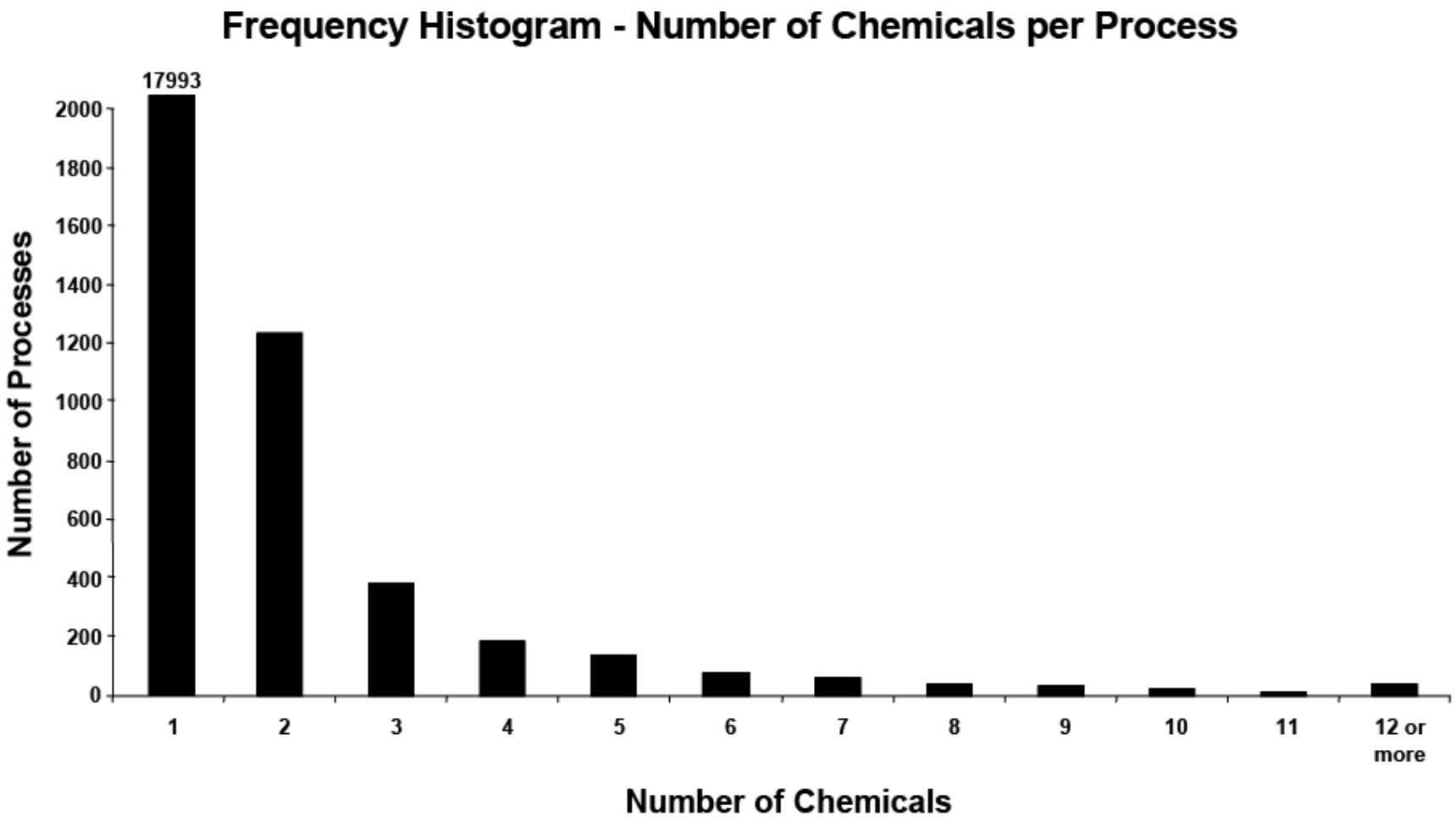
Country	Number	Simple %
Iran Islam Rep	6	100.00
TOTAL	6	100.00

Table Created on: **Jun-24-2012.** Data version: **v12.07**

Frequency distribution of Chemicals used

Chemical	Number of Processes	Percentage of Total
Ammonia (anhydrous)	8343	32.5
Chlorine	4682	18.3
Flammable Mixtures	2830	11.0
Propane	1707	6.7
Sulfur Dioxide	768	3.0
Ammonia (aqueous 20% or more conc.)	519	2.0
Butane	482	1.9
Formaldehyde	358	1.4
Isobutane	344	1.3
Hydrogen Fluoride	315	1.2
Pentane	272	1.1
Propylene	251	1.0
Methane	220	0.9
Hydrogen	205	0.8
Isopentane	201	0.8
All Others	4139	16.1

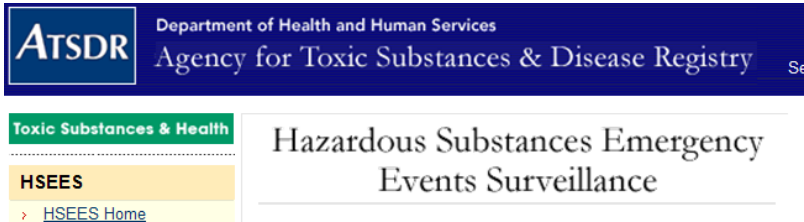
Chemical accident risks in U.S. industry - A preliminary analysis of accident risk data from U.S. hazardous chemical facilities. James C. Belke United States Environmental Protection Agency



Chemical accident risks in U.S. industry - A preliminary analysis of accident risk data from U.S. hazardous chemical facilities. James C. Belke United States Environmental Protection Agency

Most common hazardous materials at *fatal* hazmat incidents

Hazardous Material	%
Pesticides	24.4
Miscellaneous	17.3
Corrosives	16.7
Petroleum products	13.5
Airborne toxicants	7.7



Site Distribution of Chemical Accidents

- Fixed facility
  - Industrial
  - Agricultural
  - Residential
- Transportation-related
  - Highway
  - Railway
  - Airport
  - Port

Amit Gupta
Assistant Professor of Surgery
JPN Apex Trauma Center
All India Institute of Medical Sciences

What HSEES system information has shown

- Approximately 9,000 hazardous substances releases occur annually in the 15 states reporting.
- Transportation-associated releases account for 25%–30% of reported events.
- Most releases occur on weekdays between 6 AM and 6 PM.

What HSEES system information has shown

- Releases tend to increase in spring and summer.
- Equipment failure and human error cause most releases at facilities.
- More than 90% of events involve the release or threatened release of only one hazardous substance.

What HSEES system information has shown

- Releases of hazardous substances most often injure employees, followed by the general public
- Respiratory irritation and eye irritation are the most commonly reported symptom or injury.

Hazardous Substances Emergency Events Surveillance (HSEES)

- 1,691 hazmat incidents:
  - 7,756 patients
- 61 fatal hazmat incidents:
  - 83 fatalities
    - 63 employees (76%)
    - 16 members of the general public (19%)
    - 4 rescue personnel responding to the hazmat incident (5%)
- **1% case fatality rate**
  - 83 of 7,756 hazmat patients died

Amit Gupta
Assistant Professor of Surgery
JPN Apex Trauma Center
All India Institute of Medical Sciences

Fresno County HAZMAT Incident Study

Patient Involvement

- 107 (100%) total incidents
- 97 (91%) incidents without patients
- 10 (9%) incidents with patients

Patient Disposition

- 68 (100%) total patients
- 42 (62%) patients released at scene with on-line medical control
- 26 (38%) patients transported to emergency departments
  - 4 patients admitted
- No fatalities

www.hrdp-idrm.in/live/hrdpmp/hrdpmaster/.../ChemicalTalk

- Avazi and colleagues In Shiraz:
- Out of 1543 Admission of Poisoned 12/3 percent : Pesticides

علی اشرف عیوضی ، عبدالحسین پور نجف، اپیدمیولوژی مسمومیت شغلی باآفت کش ها در کشاورزان استان ایلام ، مجله علمی دانشگاه علوم پزشکی ایلام، سال دوازدهم، شماره 44 و 45 ، پاییز و زمستان 83.

Key Epidemiological Points

- More than one material possible per hazmat incident, however - Most hazmat incidents involve only one material
- Most commonly encountered material is directly related to local economy
- Most hazmat incidents do not involve patients and have low overall fatality
- Most hazmat victims not admitted to hospitals
- Hazmat training must emphasize
  - Personnel protection
  - Proper patient decon

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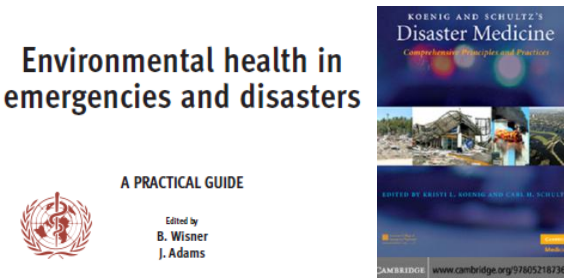
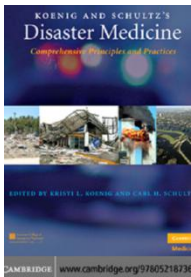
Mechanism of Health Effects of Chemical incidents

- Explosion
- Fire
- Chemicals (Spills and Leaks)
- Structural Collapse



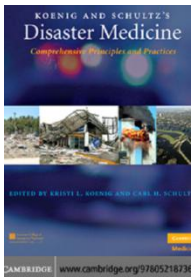
Some Notes about CHEMICAL EVENTS

- Degree and Speed of Symptoms Depends on Amount and Speed of Chemical
- Most Clinical Effect of Chemicals: Study on Young & Healthy Men
- Investigations has Problem: New Chemicals, Multiple Chemical, Non Human Studies



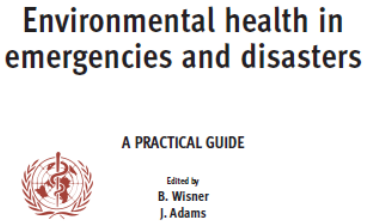
Some Notes about CHEMICAL EVENTS

- Detailed Studies is Needed
- Public Anxiety May Doubt the Data Released by Media and Routine Reporting
- Long-Term Clinical Effects Should be Considered



Health Effects of Chemical Incidents

- Carcinogen
- Irritant
- Corrosive
- Sensitizer
- Reproductive toxin
- Target organ-specific agent



مشخصات فیزیکی یک ماده شیمیایی

قابل اشتعال: به آسانی آتش می گیرد و سریعا می سوزد و به صورت گاز – مایع – جامد وجود دارند . مایعات قابل اشتعال معمولا نقطه اشتعال زیر ۷/۳۷درجه دارند، مانند استن . **Flammable**

قابل احتراق = مشابه موادقابل اشتعال هستند اما به آسانی محترق نمی شوند ومعمولا نقطه اشتعالی بین ۷۲/۳۷تا ۳۳/۹۳ درجه دارند. مانند کروزن. **Combustible**

قابل انفجار: منفجر شونده وموادی که گاز آزاد کرده و سبب انفجار می شود **Explosive**

اکسید کننده= سوختن مواد دیگر را طی واکنش یا تغییر شیمیایی تسهیل می کنند. مانند نیترات آلومینوم **Oxidizer**

مشخصات فیزیکی یک ماده شیمیایی

پراکسیدهای آلی: دارای اکسیژن مزدوج می باشند و فعال و ناپایدار. مانند متیل اتیل کتن پراکسید**Organic peroxide**

ناپایدار= هنگام مواجهه با شوک ، حرارت یا فشار ممکن است به راحتی با مواد دیگر واکنش دهند یا واکنش خود به خودی داشته باشند ودرهنگام حمل و نقل و نگهداری تمایل به تجزیه دارند . مانند پراکسید ها. **Unstable**

واکنش پذیر با آب: با آب واکنش داده ایجاد گاز قابل اشتعال یا یک خطر بهداشتی می کنند. مانند سدیم **Water reaction**

آتشگیر: قابل اشتعال وخود به خود با شعله ای درونی در دمای زیر ۴/۵۴ درجه سلسیوس می سوزند. مانند فسفر سفید **pyrophoric**

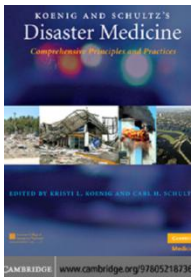
Most Common Fatal Injuries

- Most common reported *fatal* injuries
  - Trauma (65%)
  - Thermal burns (16%)
  - Respiratory irritation with airway obstruction &/or respiratory failure (10%)
  - Chemical burns (6%)
  - Other causes (3%)

www.hrdp-idrm.in/live/hrdpmp/hrdpmaster/.../ChemicalTalk

Fatal Injuries

- 3 to 5 % of Exposed: Lethal Sequelae
- Primarily Respiratory in Nature

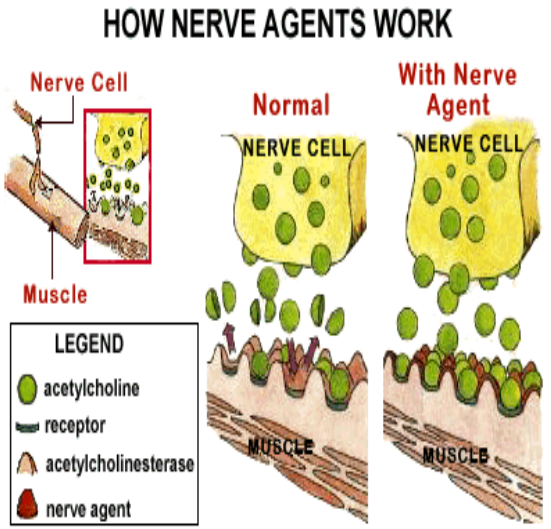


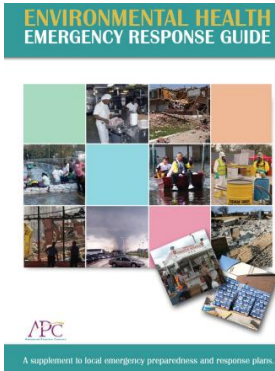
What is wrong with the patient

- Physical Trauma
- Exposure to Chemical HAZMAT
  - Inhalation
    - Most common
  - Skin & mucous membranes
    - Common
  - Ingestion & Injection
    - Unlikely
- Toxicity
  - Local
  - Systemic

Chemical Weapons

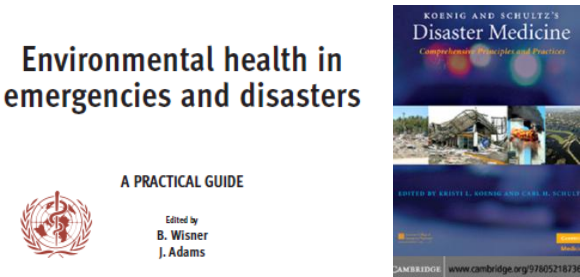
- The Four Basic Classes of Chemical Agents
  - Nerve
  - Blistering
  - Blood
  - Respiratory





Public-Health Effects of Chemicals

- Stress and Anxiety
- Deaths and Illness
- Societal and Economic Costs
- Environmental Effects(Insidious and Cumulative)
- Animals and Plants Effects



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  - Response
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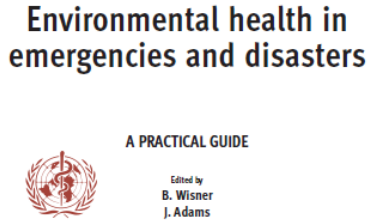
Operational Planning and Preparedness

- Multidisciplinary public-health working arrangements
- Vulnerability assessment
- Local incident surveillance and environmental monitoring
- Baseline health assessment
- Health impact assessment
- Baseline environmental assessment



Multidisciplinary public-health working arrangements

Table 12.1 **Organizations and groups involved in planning for, and managing, chemical incidents**

Public-health/environmental-health departments and institutes	Public and community groups
Poisons centres	Emergency services/civil defense
Toxicology laboratories	— fire
Local hospitals	— police
Specialist hospitals	— ambulance
Occupational health services	— transport
	— emergency medical responders
Food safety organizations	Military
Local government	Specialist environment agencies
Central government	— rivers
Major local chemical industries	— ocean/sea
Environmental groups, pressure groups and watchdogs	— wildlife
	— transport
Nongovernmental organizations /Red Cross/Red Crescent	— agricultural
	— air quality
	Pollution control agencies
	— factories inspectorates
	Weather services

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Vulnerability assessment

- Identification of hazardous chemical sites, pipelines and transport routes
- Identification of possible incident scenarios and their exposure pathways
- Identification of vulnerable populations, facilities and environments
- Estimation of the health impact of potential chemical incidents and the requirements for health-care facilities.

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Operational Planning and Preparedness

- Liaison with the local community
- Public-health plans for chemical incidents
- Databases
- Reducing the probability of incidents
- Reducing the health risks of incidents
- Establishing routine procedures
- Conducting exercises and training

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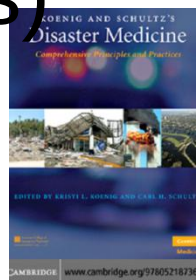
Standards of Chemicals

- Chemical Abstracts Service (CAS): US
- four-digit United Nations Substance Identification Number (UN SIN or UN Number)
- Labeling (Various Systems)
- Material Safety Data Sheets (MSDSs)
- International Chemical Safety Cards (ICSC)
- TREMCARDS (transport emergency cards)



سازمان های استاندارد

- اداره ایمنی و بهداشت شغلی (OSHA) www.OSHA.gov

درزمینه بهداشت و ایمنی شغلی فعالیت دارد و برای بیش از 600 ماده شیمیایی راهنما دارد.

- انسیتو ملی ایمنی و بهداشت آمریکا (NIOSH) www.cdc.gov/niosh
- کنفرانس دولتی بهداشت صنعتی آمریکا (ACGIH) www.acgih.org
- آژانس حفاظت محیط زیست (EPA) www.epa.gov

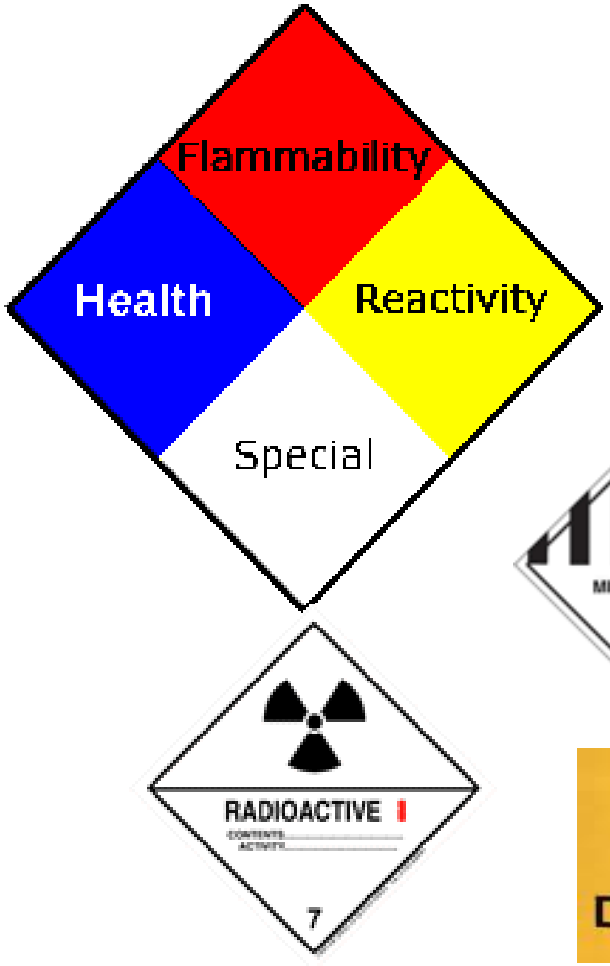
-OCCUPATIONAL SAFETY AND HEALTH ADMINSTRATION

- NATIONAL INSTITUTE OCCUPATIONAL SAFETY AND HEALTH

-AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS

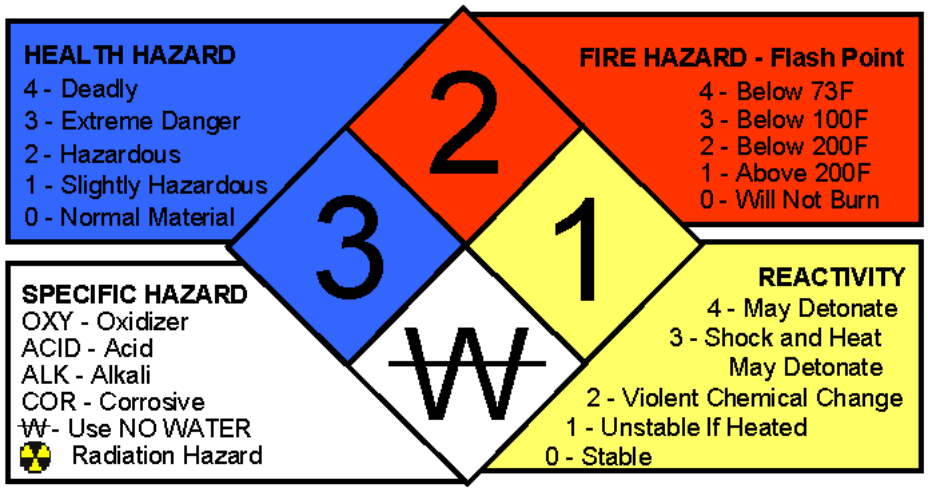
- ENVIRONMENTAL PROTECTION AGENCY

Standards Hazard Labels



Standards Hazard Labels

Labels (example)



HMIS LABEL

HEALTH HAZARD

4 - Deadly
3 - Extreme Danger
2 - Hazardous
1 - Slightly Hazardous
0 - Normal Materials
* Chronic Hazard

REACTIVITY HAZARD

4 - May Detonate
3 - Shock & Heat May Detonate
2 - Violent Chemical Change
1 - Unstable if Heated
0 - Stable

FIRE HAZARD

4 - Very Flammable
3 - Readily Ignitable
2 - Ignited with Hea
1 - Combustible
0 - Will not Burn

PERSONAL PROTECTIVE EQUIPMENT RECOMMENDATIONS

Hazard Labels and Classes

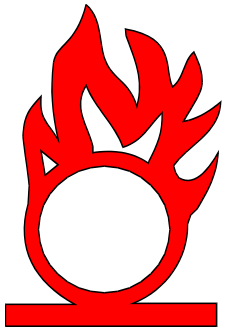
- Explosives
- Gases
- Flammable Liquids
- Flammable Solids
- Oxidizing Substances
- Toxic and Infectious Substances
- Radioactive Material
- Corrosives
- And Miscellaneous Dangerous Goods

IATA

Graphic Hazard Signs

Flammable

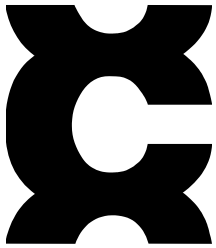
Explosive



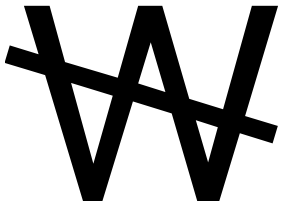
Oxidizer

Corrosive

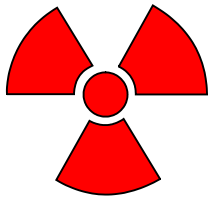
Toxic



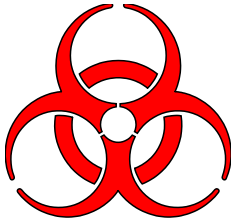
Carcinogenic



Water Reactive



Radioactive



Biohazard

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM

HMIS®

HAZARD INDEX

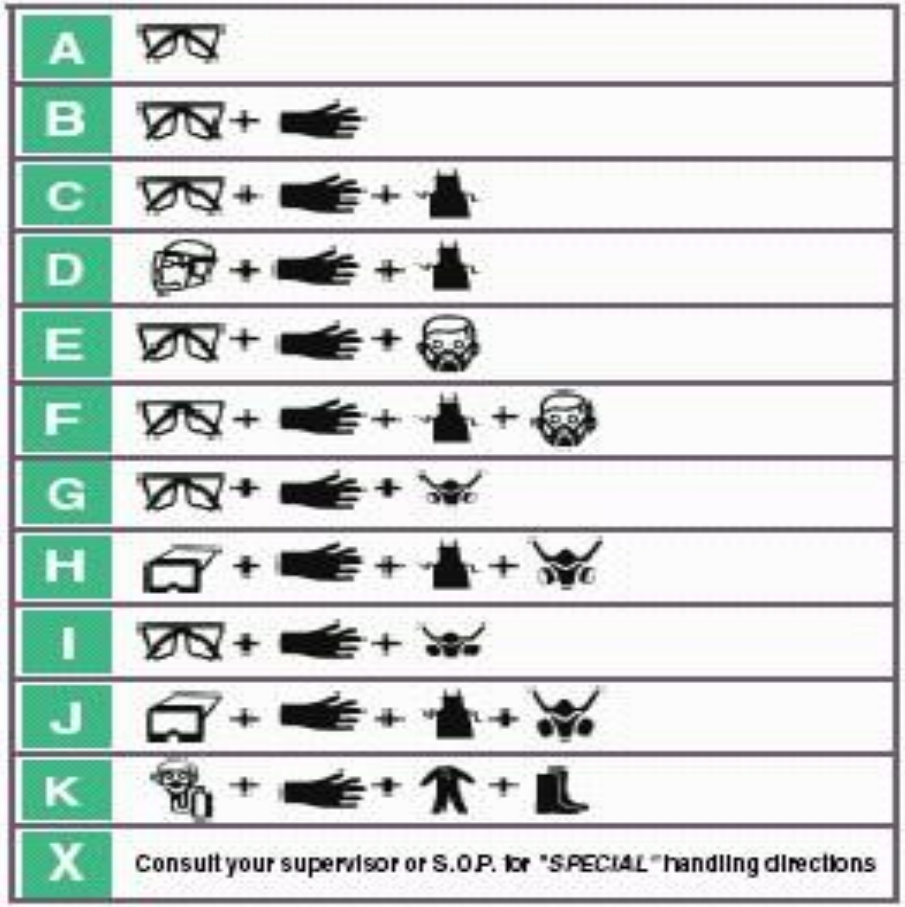
4 = SEVERE HAZARD
3 = SERIOUS HAZARD
2 = MODERATE HAZARD
1 = SLIGHT HAZARD
0 = MINIMAL HAZARD

An asterisk(*) or other designation corresponds to additional information on a data sheet or separate chronic effects notification

Additional Information

PERSONAL PROTECTION EQUIPMENT

PERSONAL PROTECTION INDEX



Personnel Protection Equipment

Photo credit: MJ Moradian

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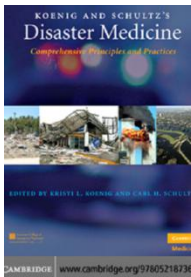
of the Ministry for Emergency Situations
of the Republic of Belarus

Personnel Protection Equipment

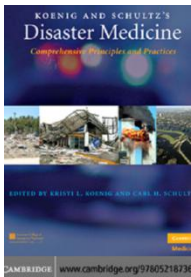
Hospital HazMat Response Notes

- Hazards and vulnerabilities identified in a HVA
- Estimated time before arrival based on location of hazard
- Casualty care areas
- Decontamination procedures and protocols



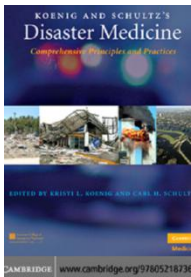
Hospital HazMat Response Notes

- Secondary contamination and containment of contaminated equipment and run-off water
- Safety: personal protection equipment
- Communications at decontamination area
- Heating, ventilating, and air conditioning and in-place protection



Hospital HazMat Response Notes

- Medical management – antidotes
- Interfacility transfers – patients with special needs, burn patients
- Knowledge resources for hazardous materials



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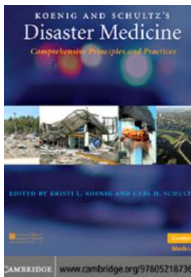
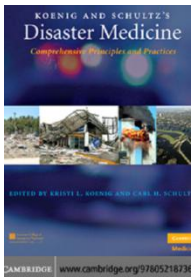
General Indicators of Possible HazMat Event

- Unusual occurrence of dead or dying animals (such as dead birds)
- Unexplained casualties (multiple victims with the similar signs and symptoms such as skin, respiratory system, vision, and nervous system involvement)



General Indicators of Possible HazMat Event

- Increase in the frequency of those with the aforementioned signs and symptoms in the direction of prevailing winds
- Unusual liquid or vapor clouds (droplets, unexplained odor, or taste)
- Mass casualties without any conventional injuries

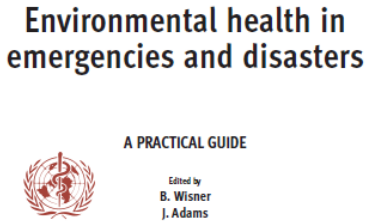


Response to Chemical Incidents

- Alerting the health-care services
- Best outcome assessment/estimation
- Information and Risk communication skills
- Advice on protection
- Sheltering or evacuation/removal
- Other restrictions to protect health
- Organizing registers and samples

Response to Chemical Incidents

- Collection of samples—biomarkers of chemicals and their effects
- Environmental monitoring



Restrictions of Oil spread on the water

Photo credit: MJ Moradian

Belarus, 2009

Restrictions of Oil spread on the water

Photo credit: MJ Moradian

Belarus, 2009

Restrictions of Oil spread on the water

Photo credit: MJ Moradian

Belarus, 2009

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Table 2 Specimen collection for biomarkers following a chemical incident

Specimen	Preservative	Volume*	Agents
Blood	Lithium heparin	10 ml	Unknown, pesticides, herbicides
Blood	EDTA	5 ml	Unknown, solvents, metals, trace elements
Blood	None (for separation and retention of both serum and clotted blood)	10 ml	Unknown, rodenticides
Urine	None	50 ml	Unknown, metals, trace elements, pesticides, herbicides
Hair	None		Unknown, trace elements

* Halve for children.

Hazmat Incident Priorities

- Communication and coordination
- Protection of emergency responders
- Prevention of secondary contamination
  - Decon
- Decreasing morbidity & mortality
  - Medical management

EPIDEMIOLOGICAL ASSESSMENT OF HEALTH EFFECTS FROM CHEMICAL INCIDENTS

Paul Cullinan

Occup Environ Med 2002;59:568–572

Protection of Responders: Hazmat Scene Control Zones

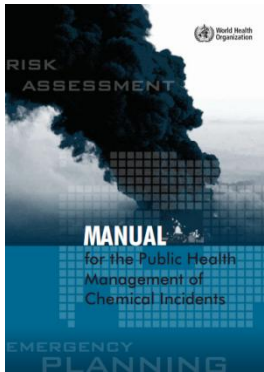
- **Hot Zone**
  - Primary contamination
- **Warm Zone**
  - Decon of victims, rescue personnel, & equipment
- **Cold Zone**
  - Incident command center
  - Definitive Triage and immediate treatment of decontaminated patients

South Fars Chemical Exercise 2009

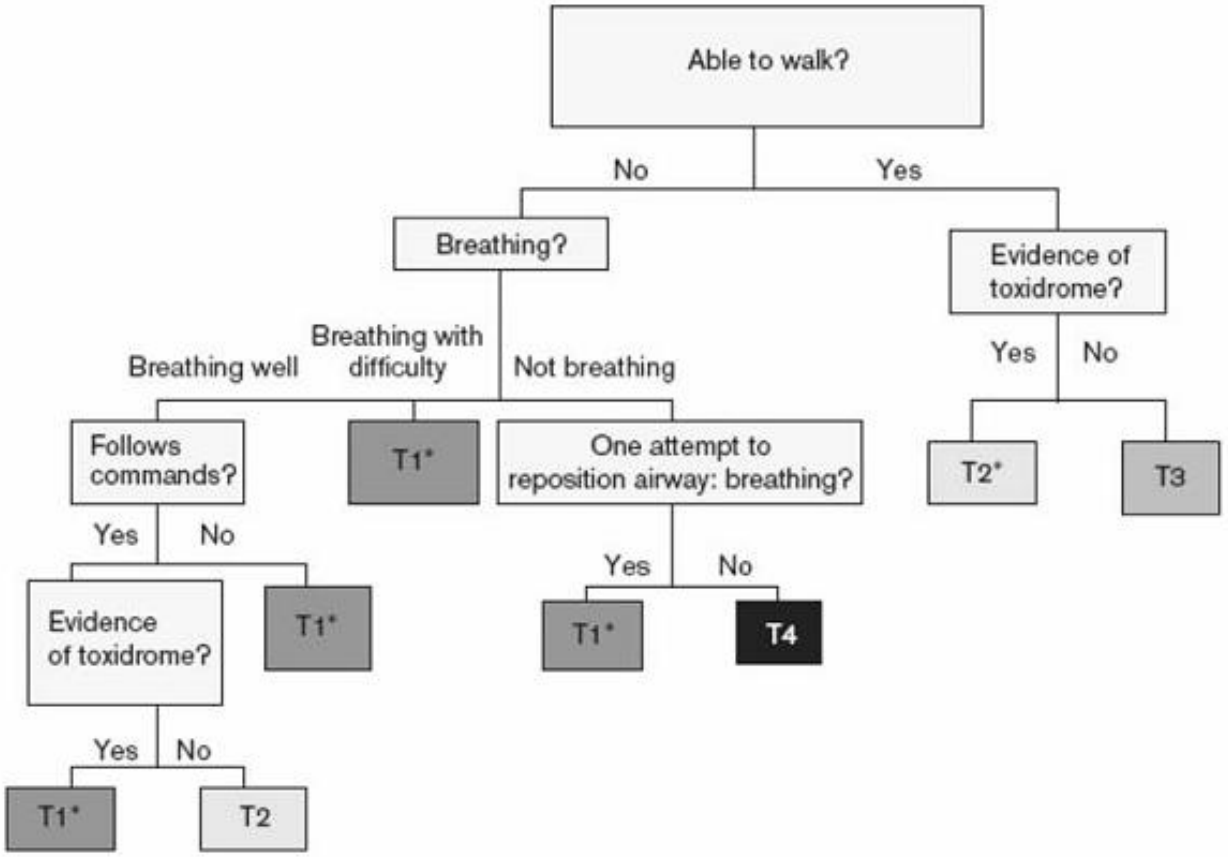
Photo credit: Fars EMS

Medical Management of Hazmat Victims

- Decon
- Primary Survey & Resuscitation
- Hazmat Patient Assessment
  - AMPLE History
  - Secondary Survey
- Poisoning Treatment Paradigm™



Triage In Chemical Incidents



Trauma and chemical triage. *Give antidote if available and logistically feasible. Decontaminate all patients prior to transport.

Figure 31.3. Trauma and chemical triage.[66]

Skin Decontamination (Decon)

- 2 goals
  - Prevent secondary contamination
  - Alter absorption
- **Is skin decon necessary?**
  - Usually not for gases & vapors
    - Unless irritant gas causes signs or symptoms
  - **Necessary for adherent solids or liquids, including aerosols**
    - If water-soluble, then use water
    - If not, then use water & mild liquid detergent
- Dilution is the solution to pollution
- Performed in warm zone

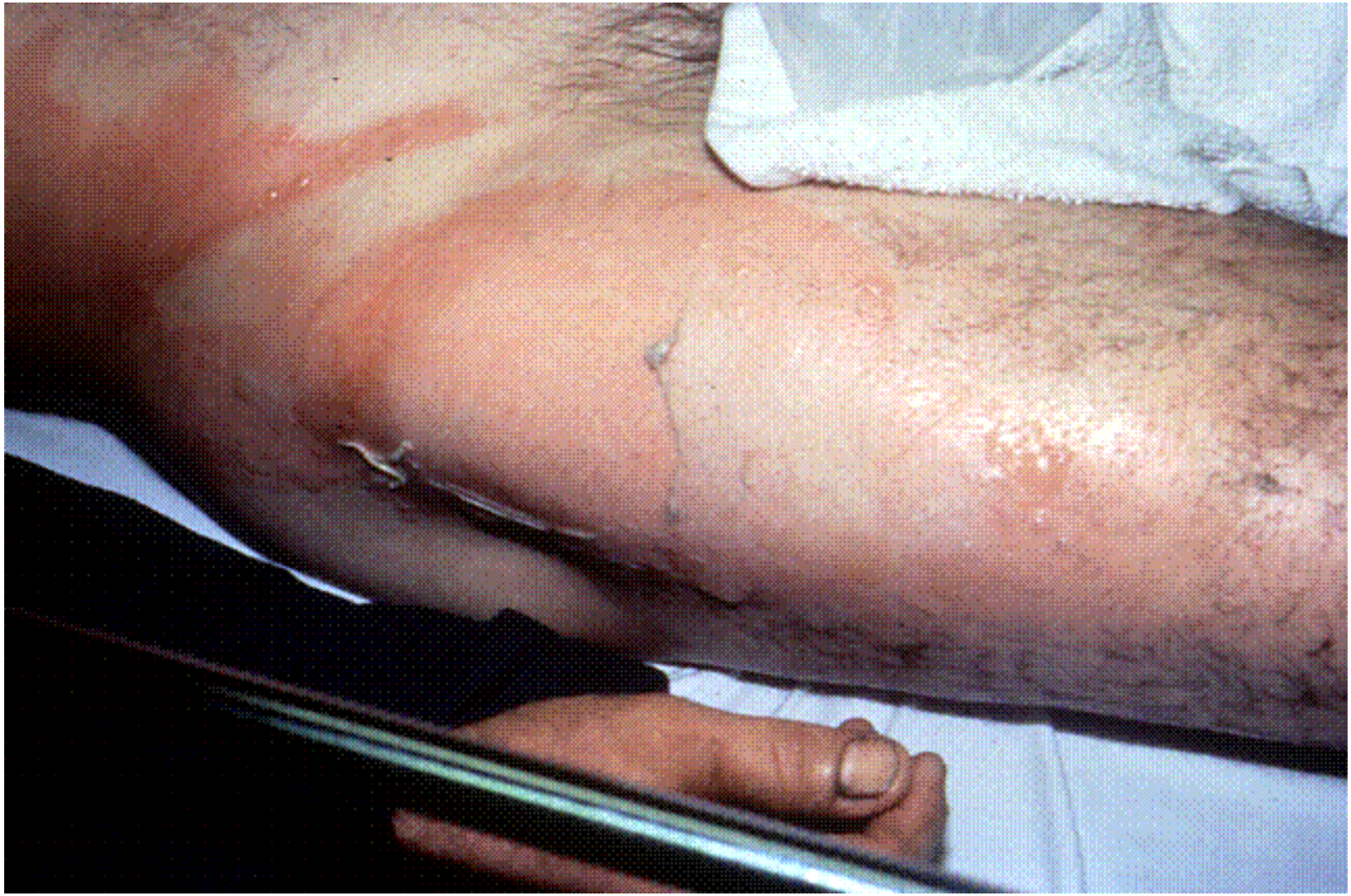
Skin Decon

2-step process

- 1st - Remove all clothing, jewelry, shoes, & adherent material
  - Bag, tag, & leave possessions at scene
  - Brush away adherent solids
  - Blot away adherent liquids
- 2nd – Meticulously wash with large quantities of water
  - Use mild liquid detergent if adherent solids or liquids are not water-soluble or are unknown materials
  - Pay attention to exposed skin in skin folds

Man dropped bucket of silver paint that splattered onto areas of body commonly ignored or forgotten during decon.

Photo credit: Mike Vance, MD

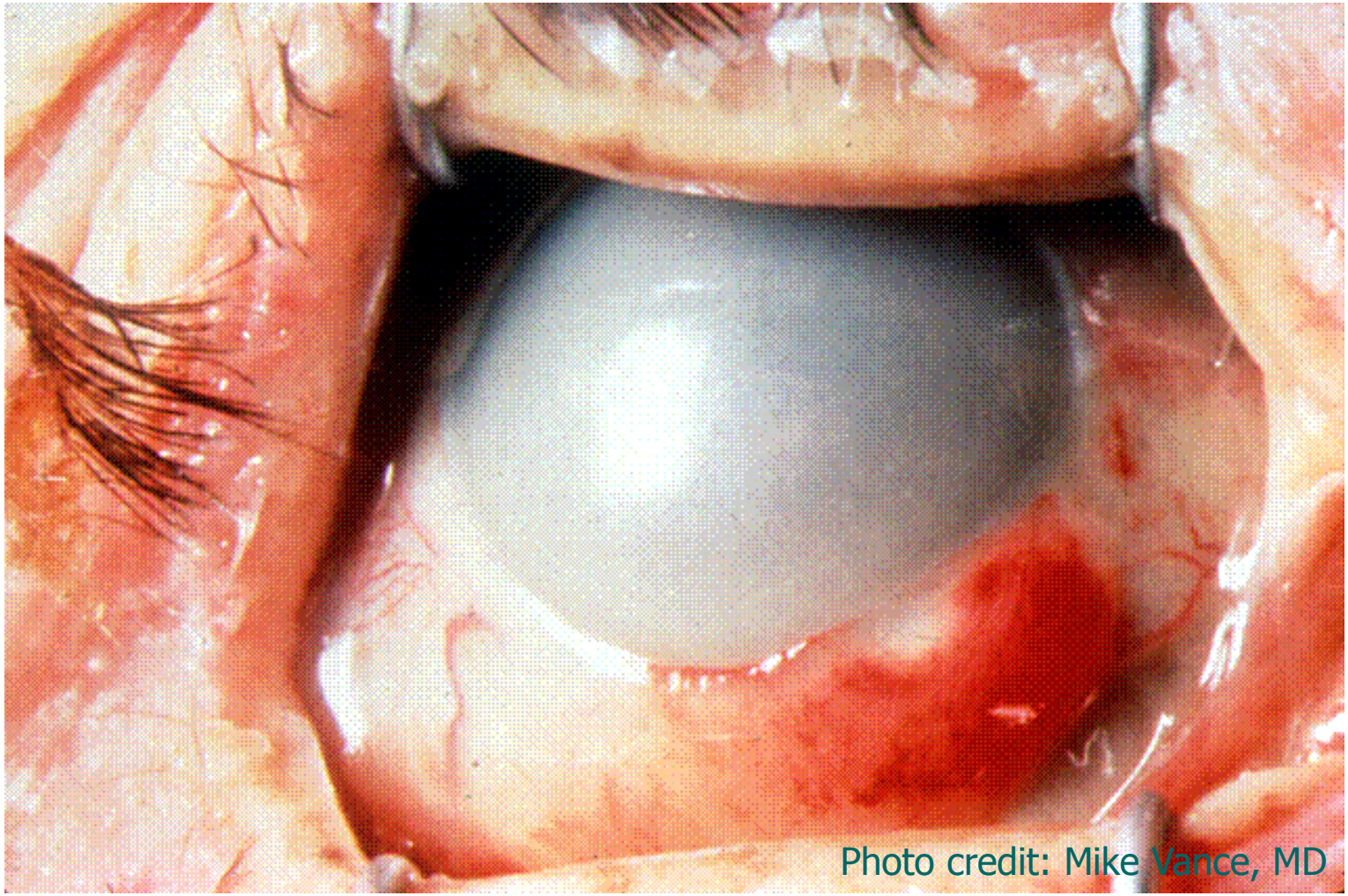


Can of mace went off in pants pocket & pants not removed in timely manner.

Photo credit: Mike Vance, MD

Eye Decon

- Irrigate exposed, symptomatic eyes immediately & continuously
  - Use water or saline
    - **Water is best**
      - Readily available in large quantity
      - Efficient
- Check for & remove contact lenses



Severe corneal chemical burn

- Opaque cornea
  - Blind eye
- Requires cadaver corneal transplant

Primary Survey & Resuscitation: The Basics

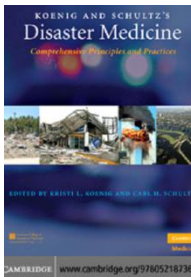
- Performed only after adequate decon in warm zone / ED Decon area
- Only two procedures performed before decon
  - Open airway
  - Spine precautions
- Use common sense
- Safety comes first

www.hrdp-idrm.in/live/hrdpmp/hrdpmaster/.../ChemicalTalk

Recognize Toxic Syndromes

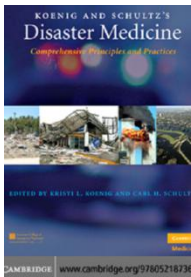
- 5 fundamental hazmat toxidromes
  - Irritant gas
  - Asphyxiant
  - Cholinergic
  - Corrosive
  - Hydrocarbon & halogenated hydrocarbon

Toxic + syndrome = Toxidrome (Page 522: Table 31.6)



Available Life-saving Antidotes for HazMat and Chemical Weapons[56]

Antidote	*Chemical*
Calcium	Hydrofluoric acid or fluoride
Hydroxocobalamin	Cyanides
Atropine	Organophosphates, carbamates, nerve agents
Amyl nitrite	Cyanides, nitriles, sulfides
Methylene blue	Methemoglobin-forming compounds
Oxygen	Simple asphyxiants, systemic asphyxiants, methemoglobin-forming compounds, carbon monoxide, cyanides, azides and hydrazoic acid, hydrogen sulfide and sulfides
Oximes	Organophosphates, nerve agents
Pyridoxine	Hydrazones



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Assessing the Impact on Public Health

- Aims:
  - To offer advice about exposure and protection
  - To offer advice about treatment
  - To contribute to the public health toxicological information base

Assessing the Impact on Public Health

- Stages:
  1. Preparedness
  2. Rapid health-risk assessment
  3. Exposure assessment
  4. Assessment of acute health effects
  5. Assessment of longer-term health effects
  6. Epidemiological studies

Epidemiological Study for Chemical Incidents

Table 12.2 **Different types of epidemiological study**

Analytical studies	Descriptive studies
Panel studies	Ecological studies
Cohort studies	Cluster investigations
Case-control studies	Disease and symptom prevalence studies
	Cross-sectional studies

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Principles For Epidemiological Assessment

- Communication and coordination
- Populations at risk
- Case definitions
- Exposure assessment
- Cross sectional survey
- Case referent study
- Cohort study

EPIDEMIOLOGICAL ASSESSMENT OF HEALTH EFFECTS FROM CHEMICAL INCIDENTS

Paul Cullinan

Occup Environ Med 2002;59:568–572

What Can We Do for Chemical Incidents?

- Before the incident:
  - Prepare for that
  - Reduce the risk
  - Map the risky sites
  - Stabilize EWS
  - Educate all groups
  - Develop plans
  - Stock Equipments
- After that:
  - EWS
  - Locate the site
  - Detect the substances
  - Limit the zones
  - Dispatch responders
  - Decontaminate
  - Treat the injured
  - Do surveys

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Main Reference

- Koenig and Schultz's. Disaster medicine Comprehensive Principles and Practice. Cambridge University Press: 2009. Chapters:28 and 31
- Wisner B, Adams J. Environmental health in emergencies and disasters. WHO. 2002; chapter 12. Available from: *whqlibdoc.who.int/publications/2002/9241545410_eng.pdf. Accessed: 2012*