Critical Incident Management and the Information Gap

FDIC 2003 INDY Indianapolis

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From First Responder to First Defender

→

Proactive rather than Reactive

→

from HazMat to CBNR

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What is the Information Gap?

Failure to provide adequate, concise and up-to-date information to an Incident Commander, resulting from:

- lack of suitable and sufficient information
- failure in vision of what is foreseeable
- inadequate technical data resources
- failure to distil operationally relevant material
- poor database maintenance leading to out-of-date information
- retrieval system not robust or fail-safe
- communications loss or breakdown
- poor line of authority and concept of primacy
- breakdown of inter-agency communication or liaison
- excessive 'institutional' secrecy between agencies, or even within the Emergency Services

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Information Flow

Knowledge Base

Interpretation

C&C Infrastructure

Transmission

Strategic

Operational

Interpretation

Incident Commander Operations

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Information Flow

Knowledge Base

Interpretation

C&C Infrastructure

Failure

Transmission

Strategic

Operational

?

Interpretation

Incident Commander Operations

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Operational Risk Assessment

- Decision making
  - dynamic - RPD model
  - real-time
  - errors not easily corrected
  - pathologies
    - encystment
    - vagabonding
    - refusal
  - information availability

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Operational Risk Assessment

- Information must be:
  - condensed and concise;
  - accurate and up to date;
  - easily understood;
  - produced as hard-copy;
  - sufficient
    - incident commander
    - specialist adviser
    - Agency officers

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Operational Risk Assessment

- Information must include:
  - Hazmat
  - fire safety measures
  - fixed installations
  - water and foam supplies
  - people
  - access
  - building construction
  - on-site contacts

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Hazardous Materials

- Chemicals - excluding explosives and radioactive substances
- Explosives
- Radioactive substances
- Biological agents

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Hazmat Knowledge Base Required

- Independent of Hazardous Material
  - Quantity
  - Location
  - Protective measures
  - Access
  - Seveso II - Tier 1 or 2
  - Emergency Planning
  - Safety Case

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Hazmat Knowledge Base Required

- Chemical substances - excluding explosives and radioisotopes
  - Identity - UN Number, CAS Registry Number
  - Emergency Action Code (EAC) = Hazchem
  - Risk Assessment Code (RAC) = ADR, HIN
  - Physical properties
    - MPt, BPt, FPt, VapD, MW, density, state
  - Chemical structure and properties
    - reactivity, oxidising/reducing properties
  - Toxicity
    - OEL, STEL, LTEL, environmental impact

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Hazmat Knowledge Base Required

- Explosives
  - Identity - UN Number, CAS Registry Number
  - Class - UN class, e.g., 1.1A
    - major hazard, i.e, primary, secondary, detonating, deflagration
  - Dual classification - presence of diluent
  - Mixed loads and packaging
  - Chemical properties - nitrogen/oxygen ratio
  - Munitions
  - Toxicity - including combustion products

Hazmat Knowledge Base Required

- Ionising Radiation (radioactive materials)
  - Isotope
    - radiation - alpha, beta, gamma, neutron
  - Physical state
  - Chemical formulation
    - reactivity (corrosive, irritant, oxidising, etc.)
  - Toxicity
    - radiological
    - chemical
    - Emergency Action Code = HazRad
  - Legal limits and trigger values

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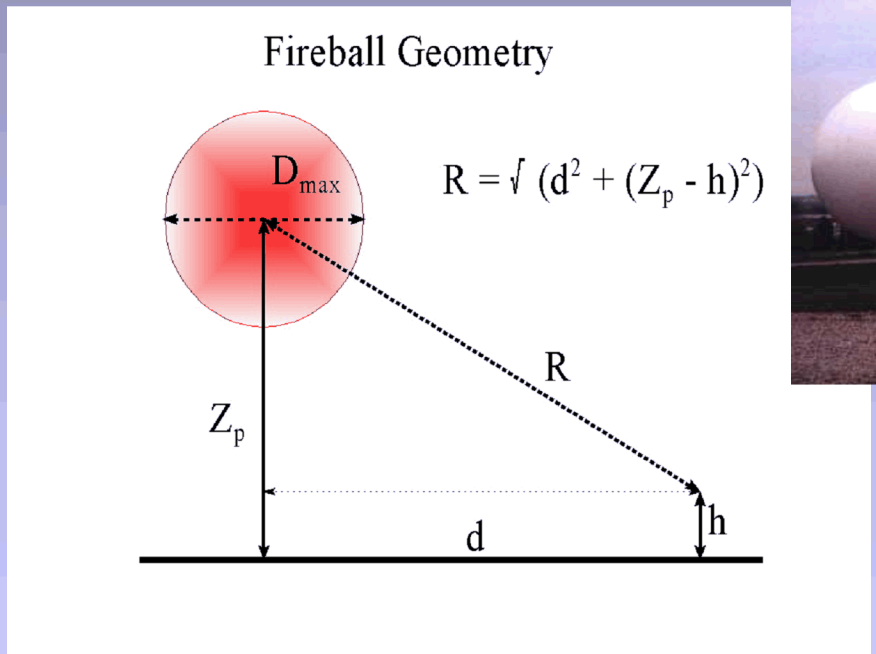
Hazmat Knowledge Base Required

- Biological Agents
  - Class of organism - viruses, bacteria, fungi, parasites
  - Hazard Group - 1 to 4 (most serious)
  - Notation
    - allergenic
    - toxin production
    - records to be kept for 40 years post exposure
    - vaccine availability
  - Level of protection

Hazmat Knowledge Base Required

- Mechanical and Thermal
  - emergency planning



- radiant heat
- blast

Operational issues

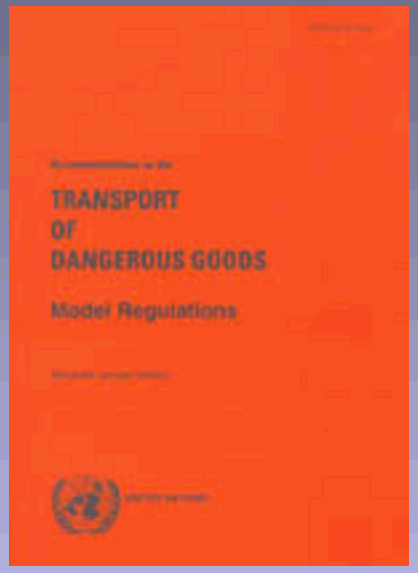
- Controlled areas
  - inner and outer zone
  - protective clothing
    - Fire Service; Police
    - other Agencies and members of the public
- Containment
  - fire water run-off (including impact of foam)
  - discharge to controlled waters and groundwater
  - discharge to atmosphere (“let burn” policy)
  - environmental protection policy (MOU)

Sources available

- UN ‘Orange Book’
  - CDGR (Road/Rail) 1996
    - Approved Carriage List 1996
      - » HazChem List No.10
- ICRP
  - ALIs for radioisotopes
    - IRR 1999
    - PIRER 1992 (REPPIR in draft)

Recommendations on the Transport of Dangerous Goods

Model Regulations

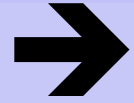


UK sources available

- COSHH Regulations 1999
  - OELs, STEL, LTEL, MTEL - EH40/2000
  - Carcinogens
  - ACDP Approved List 2000
  - GMO (Contained Use) Regulations 2000
- COMAH 1999
  - Tier 1 and Tier 2
- IRR 1999
  - dose limits, risk assessment, reporting

Information Technology (IT)

- Hardware NOT a problem
  - office/domestic hardware not suitable
  - you get what you pay for!
- Software basically not a problem
  - customise available programs for Fire Service
  - use robust OS and programming techniques
- What are the problems?



Information Technology (IT)

- Attitudes
  - Principal Officer awareness
  - Stakeholders - end-users; suppliers
- Knowledge database
  - electronic not hard-copy
  - validated (source pedigree)
  - verified (accuracy)
- Functionality

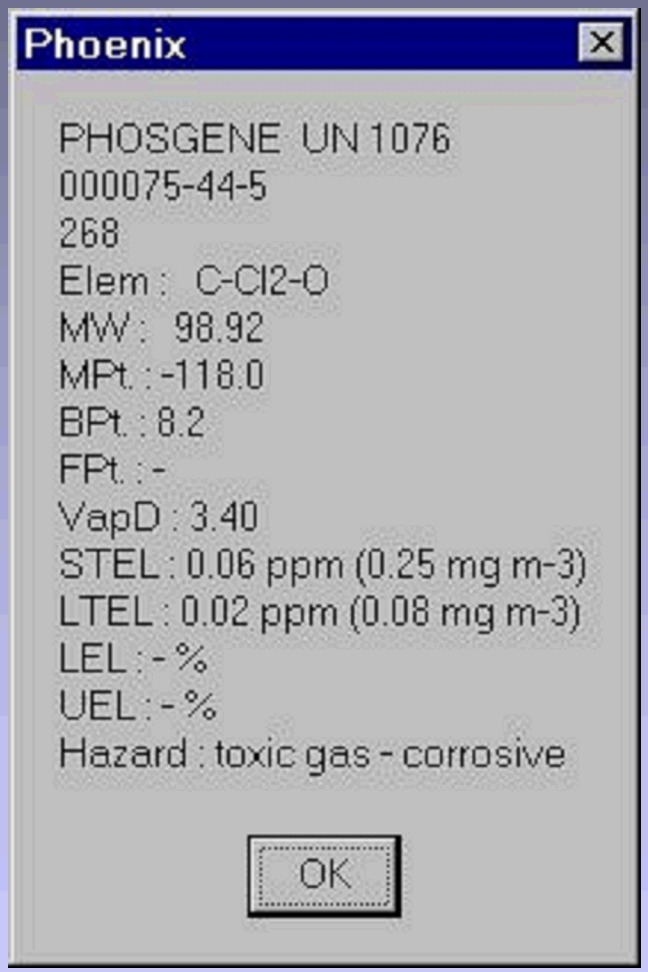
Information Hierarchy

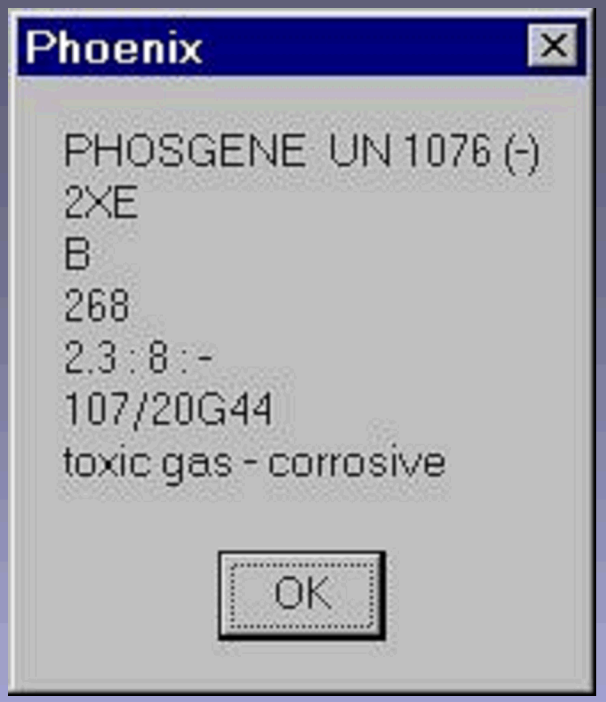
- Primary
  - physical and chemical properties - e.g., BPt, FPt
  - legal limits - e.g., OELs, COMAH
- Secondary
  - derived from 1^{o} data - e.g., ADR, HazChem
- Tertiary
  - liable to change
  - subjective bias
  - typically inspection results

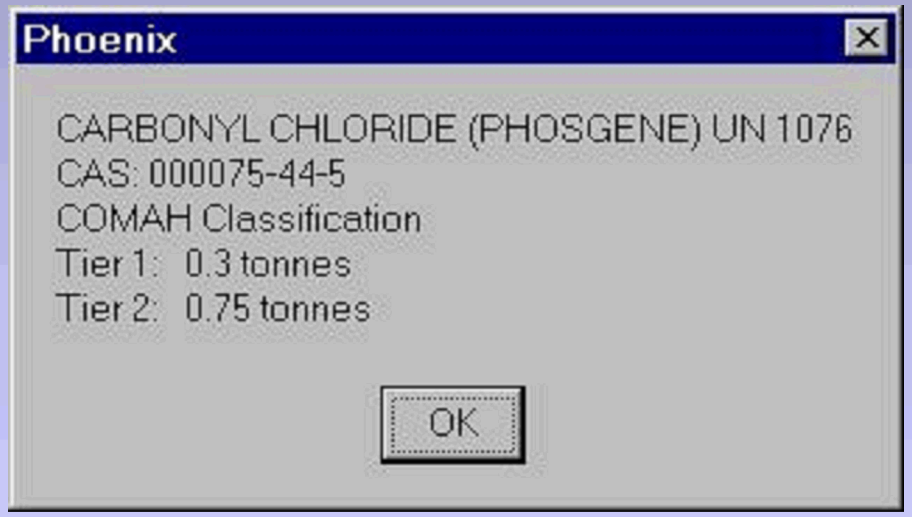
Safety Critical Applications

- Risk Analysis
  - FMEA (failure mode event analysis)
  - Common-mode failures
- Redundancy
- Robustness
- Reliability
- PRF response
- Fail-safe and self-repair

Phosgene UN 1076







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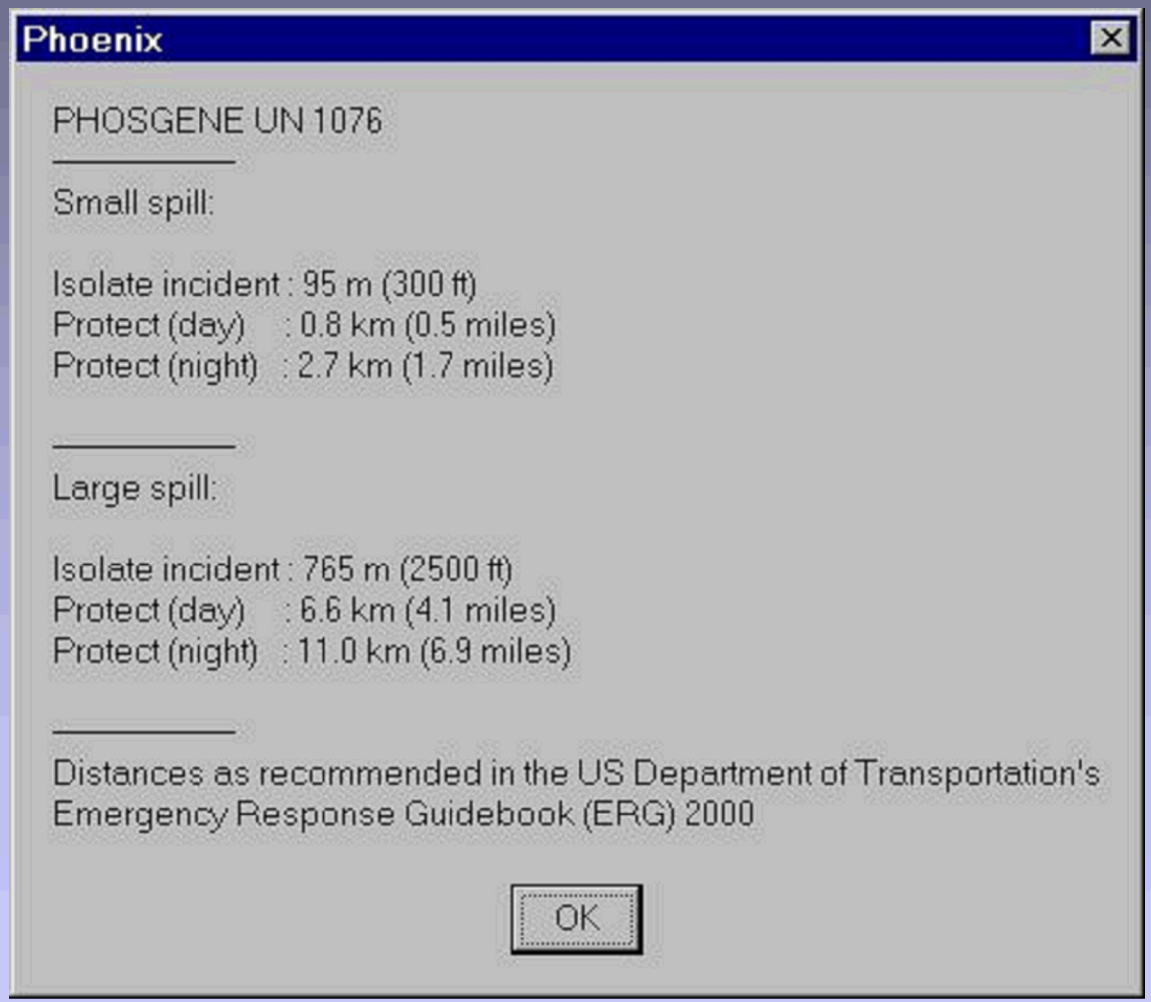
Phosgene UN 1076



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Hyperlinks

- *UK Legislation and International Chemical Safety Cards*
- *HSE Approved Carriage List 1996*
- *Phoenix Integrated Risk Assessment System*
- *Emergency Response Guidebook 2000*
- *UN Dangerous Goods List*
- *ChemFinder*

Summary

- Information is required which is:
  - reliable (validated)
  - accurate (verified)
  - current (up to date)
  - comprehensive
  - easily assimilated
  - operationally relevant

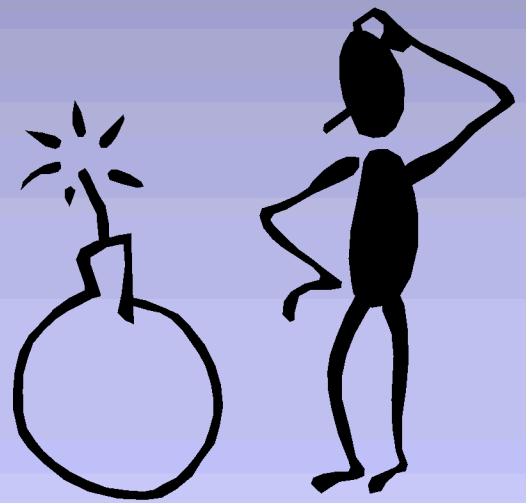
Summary (cont)

- providing guidance in
  - fire fighting and rescue procedures
  - protective clothing
  - occupational exposure limits
  - shelter / evacuation policy
  - fire safety measures including fixed installations
  - building construction
  - legal trigger levels

Summary (cont)

- and is continuously capable of being updated on the incident ground

- .....IS THAT ALL?



Yes - but what happens in a terrorist-induced incident?

Weapons of mass effect / destruction

CBR (NBC) Incidents

- Accidental
  - research establishments
  - process plant
  - transport incidents
  - nuclear power industry
- Intentional
  - one-off individual
  - organised terrorist attacks
  - formal declarations of war

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Chemical

- Toxic
  - synthetic, e.g., nerve gases
  - biological toxins, e.g., botulinus
- Corrosive
  - phosgene, chlorine
- Irritant
  - tear gas
- Explosive
- Flammable

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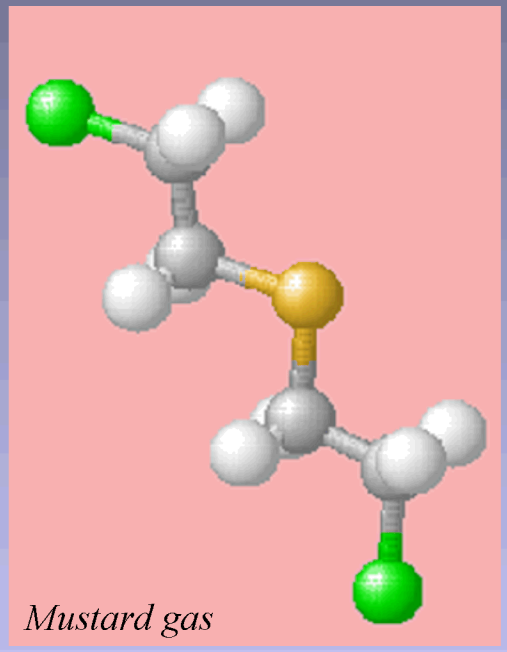
Irritant and Toxic Chemicals

- Phosgene => $Cl_2C=O$
- Chlorine => Cl_2
- Mustard gas => $ClCH_2CH_2SCH_2CH_2Cl$
- Hydrogen cyanide => HCN
- Lachrymators
  - tear gas => e.g., bromoacetophenone
- Vesiculants
  - phosgene oxime => $Cl_2C=NOH$



Mustard gas

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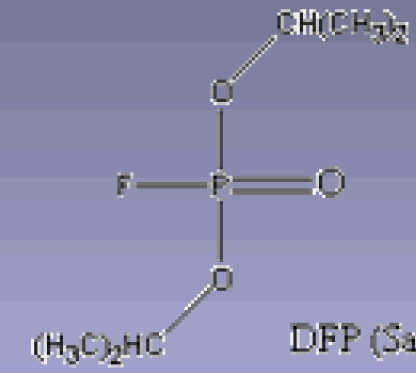
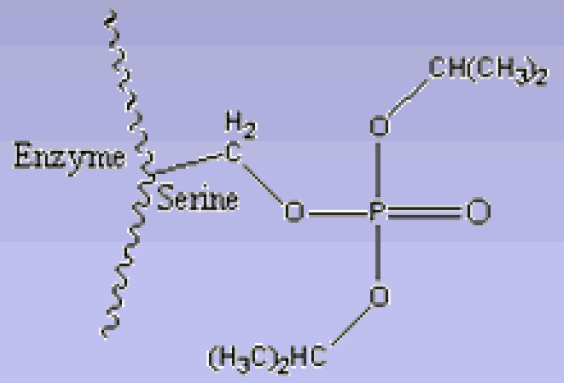
Sarin (Diisopropylfluorophosphidate, DFP)

- Nerve gas
- Blocks acetylcholinesterase irreversibly
- Synaptic block
- Antidote available
  - pralidoxime
  - atropine
- Tokyo 1995



DFP (Sarin)



DFP (Sarin) Enzyme Complex

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Ricin (from Ricinus communis)

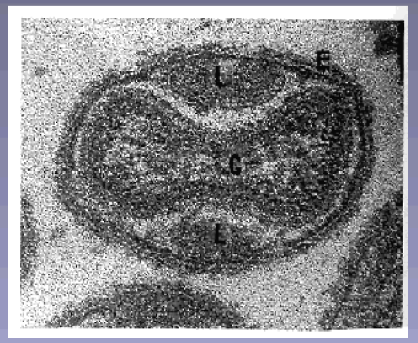
- Plant glycoprotein toxin
- CNS active
- blocks synapses
- London 1978

Biological

- Bacteria - e.g., anthrax, plague
- Viruses - e.g., smallpox, Ebola
- Fungi and protozoa
  - e.g., naegleria
- Infectious
- Contagious
- Toxin production
- Vaccine availability
- Treatment availability

Smallpox (Variola major)

- Virus
- Infectious +++
- Contagious +++
- Morbidity +++
- Mortality ++
- Vaccine available



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Anthrax (Bacillus anthracis)

- Bacterium
- Spore-forming
- Infectious +++
- Contagious -
- Morbidity ++
- Mortality ++++ (lung)
- Antibiotic/vaccine

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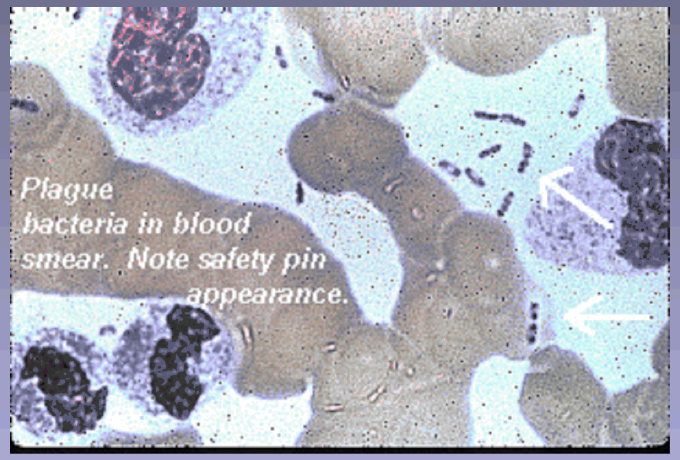
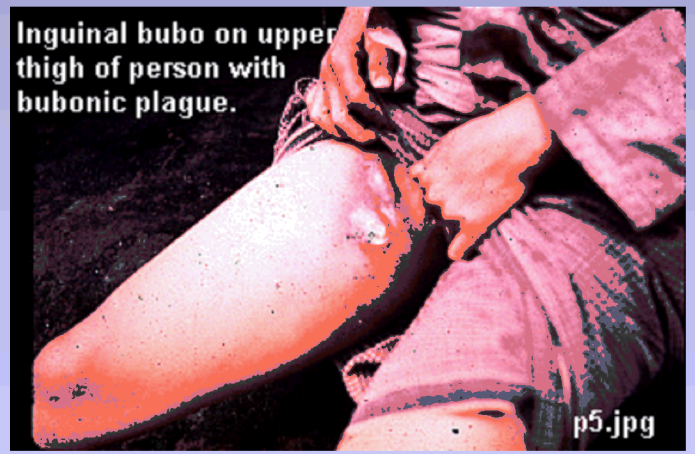
Bubonic Plague (Yersinia pestis)

- Bacterium
- Carriers - rat, mouse, fleas
- Infectious ++++
- Contagious ++++
- Epidemics
  - 430 BC; 262 AD
  - 1334-1351; 1603-1665
  - 1894-1914
- Pulmonary or cutaneous





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Radiological

- External irradiation
  - Isotopes
    - alpha, beta, gamma, x-ray
    - neutron
  - Sources
- Internal irradiation
  - ingestion
  - absorption
  - inhalation
  - surface contamination

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Chemical Weapons Convention

- Chemical Weapons Convention 1994
  - Schedule 1
    - *chemical weapons or precursors with no use which is not prohibited under the Convention*
  - Schedule 2
    - *may be used as a weapon or precursor and is not produced in large commercial quantities for purposes not prohibited under the Convention*
  - Schedule 3
    - *as in (2) but produced in large commercial quantities for purposes not prohibited under the Convention, so-called "dual use" substances*
- Chemical Weapons Act 1996

CWC Schedules

- Schedule 1
  - Part A; toxic chemicals
    - Sarin, Tabun, VX, Sulphur and nitrogen mustards, Lewisite, Saxitoxin, Ricin
  - Part B: precursors
    - DF (methylphosphonyldifluoride), QL (O-ethyl-2-diisopropyl-aminoethyl-methyl-phosphonite), chlorosarin, chlorosoman

CWC Schedules

- Schedule 2
  - Part A; toxic chemicals
    - Amiton, PFIB, BZ
  - Part B: precursors
    - Dimethyl methyl-phosphonate, phosphoramidates, $AsCl_3$, diphenyl-hydroxyacetic acid, quinuclidinol, certain aminoethane-2-ols and -2-thiols, phosphonothiolothionates, thiodiglycol, pinacolyl alcohol

CWC Schedules

- Schedule 3
  - Part A; toxic chemicals
    - Phosgene, cyanogen chloride, hydrogen cyanide, chloropicrin
  - Part B: precursors
    - $POCl_3$, PCl_3, PCl_5, dimethyl, diethyl, trimethyl and triethyl phosphite, SCl_2, SO_2Cl, methyl- and ethyl-diethanolamine, triethanolamine

CWC Schedules

- Problem?
  - Industry uses large quantities of Schedule 3 chemicals quite legitimately, for example in pesticide manufacture
- Issues
  - security of stocks
  - foreign subsidiaries
  - unauthorised sales to suspect organisations
  - site inventory and inspections

Information Needs

At a CBNR Incident

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How does a CBNR Incident differ from a standard HAZMAT Incident?

- No knowledge (necessarily) of the agent
- Malign intent to cause
  - casualties
  - panic and fear
  - maximum damage and disruption
  - intentional loss of containment
  - damage to societal infrastructure
- Very high risk to first responders
- Problems of scale

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What is Reasonably Foreseeable?

- Do NOT think as a reasonable person!
- Think how you would
  - cause maximum damage
  - engender panic and fear
  - cause maximum spread and loss of containment
  - maximise the numbers of casualties
  - maximise the difficulties of decontamination
  - put first responders at maximum risk
  - make identifying the material used as difficult as possible
  - cause normal Command and Control procedures to break down

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Why Make Life Difficult for Yourself (the Terrorist)?

- Nerve gases, radioactive materials, biological agents and explosives are difficult to make or get hold of without being traced
- Therefore use everyday materials such as chemical industry feedstocks or fuels

What Agent is Being Used?

- Unusual use of normal materials
  - Aviation spirit in aircraft fuel tanks (= 9/11)
  - LPG, LNG or H_2 in large storage facility
  - chemical feedstock in road or rail tanker
    - phosgene
    - vinyl chloride
    - chlorine
    - hydrogen chloride / fluoride
    - ammonia
    - sulphur dioxide, etc.
  - ship or barge, e.g., ammonium nitrate
  - chemical process plant or refinery attack

Unusual Methods of Dispersal or Detonation

- Weaponised containers or tankers with internal bursting charge
- Stored energy of fuel gases or liquids
- Difficult to detect triggers, e.g., X-ray transparent, X-ray sensitive ionisation chamber
- 'Dirty' bombs

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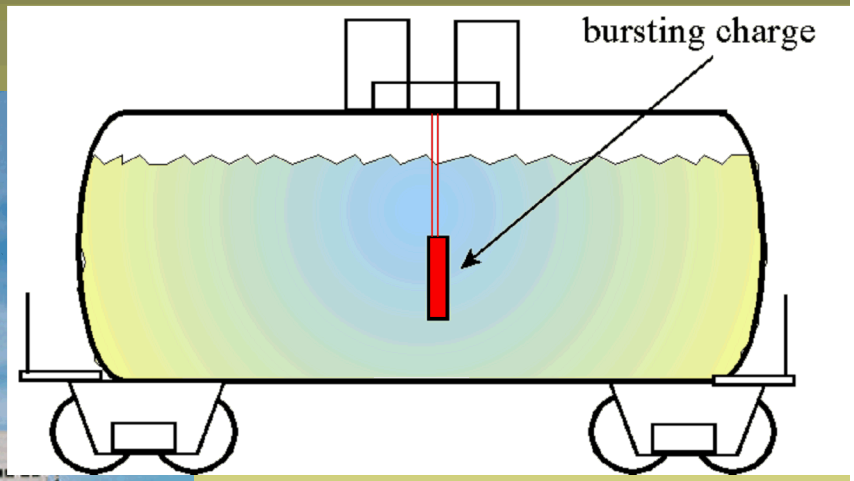
Unusual Methods of Dispersal or Detonation



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Hazardous Materials

- Chemicals - excluding explosives and radioactive substances
- Explosives
- Radioactive substances
- Biological agents

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Initial Risk Assessment?

- Risk assesment within minutes requiring
  - On-site immediate detection capabilities?
    - Mass spectrometry
    - Photoionisation detection (PID)
    - UV/IR Spectroscopy
    - Scientific infrastructure
  - Knowledge database and management systems
    - not restricted to known CW agents!
  - Officer training
  - Medical support

Command and Control Issues

- Prevention of Cross-Contamination
  - strict fireground discipline
  - crowd control
  - movement control
    - fire department personnel
    - other emergency services, especially Police and Ambulance
    - members of the public
    - media and journalists
- Zoning
  - hot, warm, cold = red, orange, green

Decontamination

> Decontamination procedures

> Containment

> Protective clothing

Protective clothing

- gas-tight suits
- respirators
- chemical resistance and permeability
- shielding factor
- temperature-resistance
- personnel coverage
- protection of civilians

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Decontamination procedures

- efficiency
- controllability
- containment
- complexity
- training required
- ability to neutralise contaminant
- equipment needs
- societal issues
- cultural sensitivity
- modesty
- language
- population at risk
- planned versus emergency
- medical services

Containment and disposal

- chemical form - gas, liquid, dust
- reactivity
- ease of spread
- volume of decontaminant
- control of run-off
- toxicity
- infectivity

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Practical Aspects of Decontamination

- CBR contaminants have similarities ...
- Modified Triage
  - externally contaminated
  - internally contaminated
- Treatment
  - absorbents
  - wash-off (where? volume?)
  - destruction if possible
- Scalability

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Practical Aspects of Decontamination

- Spread
  - protection of the environment
  - protection of emergency services personnel
  - protection of public
- Equipment used
  - decontamination
  - amount required
- Facilities
  - containment

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CBR Contaminants Compared ...and differences ...

- Chemical
  - » detection relatively quick and specific
  - » inactivation possible
- Biological
  - » relatively easy to inactive
  - » spores can be a problem
  - » detection takes time
- Radiological
  - » detection immediate and specific
  - » inactivation NOT possible

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Summary

- The problem is primarily one of the availability and suitability of information on which to base an incident ground assessment of risk
- Without suitable and sufficient information, which must also be timely and operationally relevant, proper command and control cannot be exercised
- Critical incident management will fail in terms of having the 'authority'
  - to allocate and control resources
  - to achieve co-ordination and direction
  - and to complete assigned activities and functions correctly

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And last but not least .....

- ".... If organizational efforts are poorly handled and if the agencies resist cooperation, counter-terrorism efforts could be severely set back ...." **

** *article on the Science and Technology Directorate within the new US Department of Homeland Security Chemical & Engineering News 80 (49), 2002, 25-28*

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