# How to respond to radiological, biological and chemical threats:

## A guide for the European Front-Line Health Professional

The ETHREAT Scientific Committee

ΕΘΝΙΚΟΝ & ΚΑΠΟΔΙΣΤΡΙΑΚΟΝ
ΠΑΝΕΠΙΣΤΗΜΙΟΝ ΑΘΗΝΩΝ
NATIONAL & KAPODISTRIAN
UNIVERSITY OF ATHENS

# How to respond to radiological, biological and chemical threats

## A guide for the European Front-Line Health Professional

2009

**Introduction**: overview of the new public health threats and basic principles of planning for public health emergencies

**Biological Agents**: overview of the biological agents of hight threat, their clinical symptoms and the principles of their clinical management

**Infection Control**: outline of the transmission based infectin control guidelines

**Chemical Agents**: overview of the groups of chemical agents of hight threat, toxins and industrial chemicals, their clinical symptoms and the principles of their clinical management

**Radiological Emergencies**: overview of radiation exposure, its clinical symptoms and principles of clinical management

**Triage**: overview of the triage principles and process and the START triage system

**Management of Contaminated Patients**: basics of scene management, overview of the decontamination process and basic principles along with special considerations

**Psychological Effects**: overview of the psychological effects of emergencies and terrorist events

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## This handbook is dedicated to the memory of
## **Georgios Gouvras (1948-2006)**

George Gouvras was head of Unit for Health Threats at the European Commission's Directorate for Public Health and he was the person behind the EU Health Security programme, set up in December 2001 to improve preparedness, response and cooperation in the event of biological and/or chemical agent attacks. He also guided the preparedness for the response of the European Community against pandemic influenza.

George helped create the legislation for the ECDC and was member of its first Management Board. He had an astute understanding of the needs of the European Community, and a talent for explaining the need for policy change and paving the Commission's road to actually implement it in order to serve better the citizens of Europe.

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# PREFACE

The new threats to health, resulting from deliberate releases, bring up new needs for the diffusion of existing knowledge. The training of health professionals stands out as a priority that should be coherently addressed at the European level as part of a long-term strategy to respond to the changing environment of public health threats. During its course (2005-2008), the European Training for Health Professionals on Rapid Response to Health Threats (ETHREAT) Project, developed an educational package for front line health professionals (FLHP) that specifically targets the new public health threats.

Six European Member States (Bulgaria, Czech Republic, Germany, Greece, Poland and the UK) participated in the ETHREAT consortium representing highly specialized organisations and institutes on public health issues. The National and Kapodistrian University of Athens was responsible for the management and coordination of the project as well as for the cooperation of the whole partnership with the European Commission (Directorate for Public Health), which co-financed the project.

The aim of the present handbook is to assist training institutions, universities and public health authorities in the education of health professionals, so as to enhance the European human capital on the timely identification, the management and response to events that could be the result of deliberate attacks with the use of biological, chemical and radiological agents. In other words, the educational package contains the basic necessary knowledge

and training material to empower European health professionals, including armed forces health personnel, to clinically recognise and to respond rapidly and adequately to new public health threats, like attacks with biological, chemical and radiological agents.

The material presented in this handbook originates on one hand from an inventory of existing courses and training material from the EU and other countries addressing health professionals, including armed forces and front line public health professionals on the same issues of new threats to public health and on the other from the Endnote© databank library we created, which includes all collected material on the education and training of health professionals on new public health threat issues and all identified sources of information related to the project with the relevant electronic links.

Moreover, the project team explored the opinions of their target audience and of European experts on the existence and appropriateness of currently available programmes, as well as the desired content of an educational package by surveying front line health professionals (FLHP) and PH and CBRN experts in the European Union (EU) member states (MS).

The enclosed CD-ROM contains the presentations and educational material presented in a pilot course that took place in Athens in May 2007. The course was organised in such a way so as to include all the necessary information and guidelines that public health organisations, governments, civil authorities, security agencies and armed forces will need to disseminate to front-line health professionals in emergency situations caused by biological, chemical or radiological forms of terrorism as well as the algorithm guide of actions to be undertaken in case of terrorist attacks for most European Member States.

This handbook is a user friendly basic awareness manual accompanied by electronic material aiming at empowering front-line health professionals (FLHP), to rapidly recognise and adequately respond to new public health threats.

We urge you to disseminate the material in your own country in its current form or to translate it in your own language. The ETHREAT team can assist you with the dissemination or organisation of possible courses. We are more than willing to help with such activities and we are also interested in hearing your opinion or comments regarding the contents of this package in the email address below.

We hope that this handbook provides you with sound basic knowledge and outlines the first steps that you need to take in order to handle the initial phase of an unknown and possibly dangerous situation for your staff and yourself.

On behalf of the ETHREAT Project Team

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# Abbreviations - Glossary

| | |
|---|---|
| **ABC** | Airway, Breathing, Circulation |
| **ARDS** | Acute Respiratory Distress Syndrome |
| **ARS** | Acute Radiation Syndrome |
| **ASAP** | as soon as possible |
| **BAL** | British Anti-Lewisite |
| **bid or bd** | Twice a day |
| **BSA** | Body Surface Area |
| **CAP** | community acquired pneumonia |
| **CBC** | Complete Blood Count |
| **CBRN** | Chemical Biological Radiological and Nuclear |
| **CCHF** | Crimean Congo Hemorrhagic Fever |
| **CD** | communicable Diseases |
| **CDC** | Centres for Disease Control and Prevention, Atlanta |
| **CNS** | central nervous system |
| **COPD** | chronic obstructive pulmonary disease |
| **CSF** | cerebrospinal fluid |
| **CXR** | chest X-ray |
| **d** | day(s) |
| **DIC** | Disseminated Intravascular Coagulation |
| **DMPS** | 2,3-dimercapto-1-propanesulfonic acid, which is a metal chelator |
| **DMSA** | 2,3-dimercaptosuccinic acid, an organic metal chelator |
| **DTPA** | Diethylene-triamine-penta-acetate |
| **EC** | European Commission |
| **ECDC** | European Centre for Disease Control and Prevention |
| **ED** | Emergency Department |
| **EEE** | Eastern Equine Encephalitis |
| **EM** | electron microscopy |
| **ETHREAT** | European Training for Health Professionals on Rapid Response to Health Threats project |
| **EU** | European Union |
| **FLHP** | Front Line Health Professionals |
| **g** | Gram |
| **Gram +/-** | Gram positive/negative |
| **Gy** | Gray (radiation absorbed per unit mass of tissue) |

| | |
|---|---|
| **HAZMAT** | Hazardous Material |
| **HCAI** | Healthcare-Associated Infections |
| **HCW** | Health care worker |
| **HF** | Hemorrhagic Fever |
| **hr(s)** | hour(s) |
| **IV** | intravenous |
| **JE** | Japanese Encephalitis |
| **m** | meters |
| **µ OR µm** | micrometer (1 x 10-6 m) |
| **mg** | milligram |
| **min** | minutes |
| **mm** | millimeter |
| **MCE** | Mass Casualty Event |
| **MCI** | Mass Casualty Incident |
| **MOF** | multiple organ failure |
| **OPCW** | Organisation for the Prohibition of Chemical Weapons |
| **PO** | orally |
| **PPE** | Personal Protective Equipment |
| **PTSD** | Post Traumatic Stress Disorder |
| **RBC** | Radiological, Biological and Chemical agents |
| **RDD** | Radiation Dispersion Device |
| **SARS** | Severe Acute Respiratory Syndrome |
| **SEB** | Staphylococcal Enterotoxin B |
| **sec(s)** | second(s) |
| **Sv** | Sievert (equivalent dose), mSv=milliSievert |
| **TB** | tuberculosis |
| **TBE** | Tick-borne encephalitis |
| **TICs** | Toxic Industrial Chemical(s) |
| **US** | United States |
| **VEE** | Venezuelan Equine Encephalitis |
| **VHF** | Viral Hemorrhagic Fever |
| **w** | with |
| **WEE** | Western Equine Encephalitis |
| **WNV** | West Nile virus |
| **WW I and II** | World War I and II |

# NEW HEALTH THREATS AND PUBLIC HEALTH

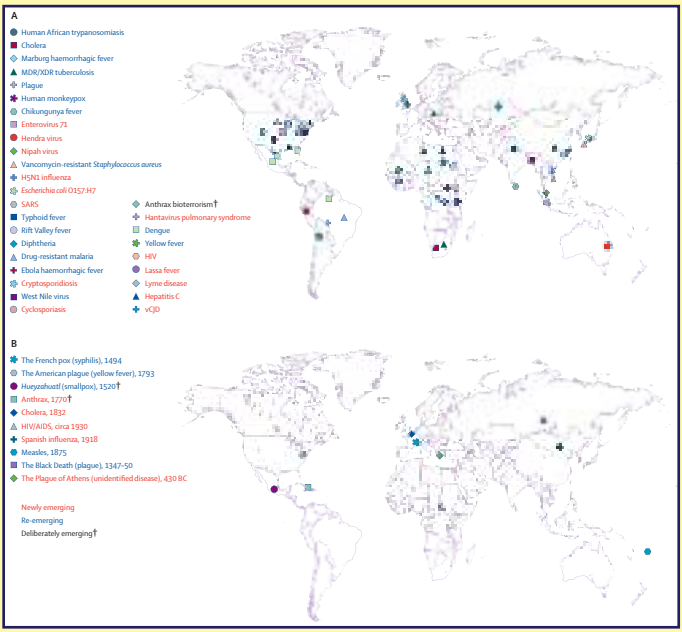



PHOTO: Morens DM, Folkers GK, Fauci AS. Emerging infections: a perpetual challenge. *Lancet Infect Dis* 2008;8:710-19.

**PHI**. A map of the world showing selected emerging diseases of public health importance in the past 30 years. [1]

During the last two decades PH professionals have faced a number of serious PH threats and are increasingly worried over the possibility of international spread and the effects of Communicable Diseases (CD). Predictions based on climatic changes, as well as the global socioeconomic situation indicate that humanity as a whole is going to face in the future increasing number of international outbreaks, as humans on one hand invade more and more tropical forests and come in contact with new agents and on the other travel long distances in large numbers.

Recent experiences of outbreaks or other incidents of international concern (e.g. SARS (2003), Avian Influenza animal outbreaks and human cases (2005-2008), Chikungunya fever epidemic (2005-2007), melamine contaminated milk (2008) to mention only a few) have shown that no nation is completely safe or immune to a spreading epidemic or the effects of globalised trade.

At the same time the global political situation and risk assessment constantly indicates the existing risk of intentional release of a biological, chemical or radioactive substance to cause harm. Although risk assessment and risk perception vary among the European Member States (MS), sometimes significantly, it is generally considered important to keep the awareness of this possibility in the differential diagnosis. It is important to underline that an overall strong Public Health system will be able to respond to various kinds of threats or incidents of natural (e.g. earthquakes, floods etc) or man-made (e.g. terrorist incidents) nature.

The basic principles for the PH system response include:

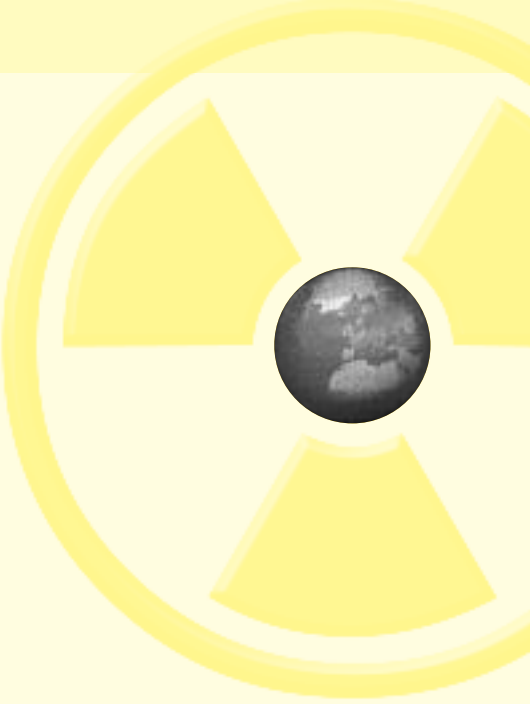
- Detection of a new incident
- Rapid laboratory diagnosis
- Epidemiological Investigation
- PH control measures, including effective communication with the public and decision makers.

Front-Line Health Professionals (FLHP) such as emergency medical services, emergency departments, and primary health care personnel, as well as regional public health personnel should be aware of the basic issues regarding new health threats to PH and RBC threats. FLHPs form the first vital link for the detection of any incident. Astute clinicians are usually the first to understand and notice new clinical syndromes (e.g. West Nile virus encephalitis) and the reporting of these to the regional PH authorities is the first step towards the recognition of the problem.

The ETHREAT scientific committee stresses the fact that generic preparedness builds strong public health systems that are able to respond to various types of threats both natural and man-made. Public Health response is based on common principles for all types of threats. The material in this handbook aims to provide FLHPs with an outline of the basic principles and knowledge regarding the high threat biological and chemical agents, as well as the principles of management of radiation exposure.

**References**

1. Morens DM, Folkers GK, Fauci AS, Emerging infections: a perpetual challenge *Lancet Infect Dis* 2008;8:710-19.



# BASIC CONCEPTS IN HANDLING A HEALTH CRISIS

A health crisis can be defined as any event that threatens the health of citizens because of its nature, risk for spread, increased morbidity, mortality or severity. Oftentimes a health crisis is connected to a disaster, but it can be different. Disasters are defined as any sudden event bringing great damage, loss or destruction.[1] In most cases disasters, either natural or technological, have major impact on the health sector either due to their direct impact on the population (injuries, deaths, psychological effects) or their impact on health systems (hospitals, equipment, utilities) and finally due to their socioeconomic impact on the particular community.

Disaster medicine provides medical care to disaster survivors and also provides for the four phases of in the public health paradigm: Preparation and Mitigation, representing emergency preparedness, and Response and Recovery, representing emergency management.[2, 3]

It should be noted that common basic principles apply to the response of any type of health crisis, natural or technological, accidental or intentional. For the level of a Front Line Health Professional (FLHP) in particular, only few simple facts need to be kept in mind in order to enable the management of the initial phases of such an event.

## Good Practices for health crisis management include:

- **Preparedness planning**: having an appropriate plan for the level of responsibility is very important for the coordination of the personnel involved in their new role in the emergency response phase. "Failing to plan is planning to fail". [4]

## ✦ Basic Planning advice includes knowing:

- what are you planning for
- what are the goals/measures of success and set indicators for evaluation
- what are the available resources and constraints and what is the optimal use of available resources
- what are the deficiencies

in short, it is important to have available a proper risk and vulnerability assessment for the particular facility/structure/community that the plan is being developed for.

### ✦ Basic Plan structure should include:

- clear description of the roles of:
  - i) the different players,
  - ii) the mechanism of alert and
  - iii) the way of moving to the emergency phase, as well as the way back to normal function.
- A coordination structure (e.g. operations centre) along with a clear description of its role and function, for the hospital or facility along with communications (tools and algorithm of information flow)
- Description of the backup situation/plan including built-in redundancies (e.g. in the event of a communications or power failure)

### ✦ Important Adjuncts to the preparedness plan:

Crisis communication is very important for the effective use of any preparedness plan and at the local level, it frequently involves the health care professionals.

### ✦ Good crisis communication practices include:

- simple, straightforward and truthful messages giving basic instructions to the public,
- common messages across the different authorities involved at the regional level,
- one spokesperson is preferred to deliver press communications at regular intervals

Training of the personnel on the implementation of the plan, as well as testing the plan via exercising at different levels.

### ■ Intersectoral collaboration:

disasters and health crises usually go far beyond and involve multiple sectors of the socioeconomic structure. The collaboration with other sectors is vital for the effective response (e.g. response to a deliberate release incident needs the close collaboration with civil protection and law enforcement).


**References**

1. **http://www.merriam-webster.com/dictionary/disaster**
2. **http://en.wikipedia.org/wiki/Disaster**
3. Foltin G, Tunik M, Treiber M, Cooper A. Pediatric Prehospital Disaster Preparedness Resource. New York, NY: *Center for Pediatric Emergency Medicine*; 2008. (http://cpem.med.nyu.edu/frontpage)
4. attributed to Benjamin Franklin

# I BIOLOGICAL AGENTS

## Information on biological agents of High Threat

Although the perception of threat for the intentional release of a biological agent to cause harm is different across the 27 EU MS, the risk is real and should not be ignored by the different levels of the health and public health sector.

Various attempts to prioritize the biological agents of highest concern for PH have been undertaken in order to assign appropriate resources for preparedness.

In the EU a specific matrix was constructed in order to be able to assess the vulnerability of the MS and the EU as a whole against various biological agents[1]. The utility and thinking behind this tool is that provided it has updated information, each PH system can create its personalized priority list according to its own capacity and resources. An overall assessment of the threat posed by various biological agents, according to the knowledge available in 2003, is presented in the following **Table I.1**.

*Table I.1: List of pathogens and diseases of high threat according to the EU matrix assessment*

| List of diseases | Agents of VERY HIGH threat |
|---|---|
| **Anthrax** | *Bacillus anthracis* |
| **Botulism** | *Clostridium botulinum* toxin |
| **Glanders** | *Burkholderia mallei* |
| **Haemorrhagic fever** | Congo-Crimean virus, Ebola virus, Guanarito, Junin virus, Lassa virus, Machupo virus, Marburg virus |
| **Plague** | *Yersinia pestis* |
| **Smallpox** | Variola major |
| **Toxic syndromes** | Ricin, Tetrodotoxin |
| **Tularaemia** | *Francisella tularensis* |

| List of diseases | Agents of HIGH threat |
|---|---|
| **Brucellosis** | *Brucella abortus, B.melitensis, Brucella spp, B.suis* |
| **Chikungunya Fever** | *Chikungunya virus* |
| **Cholera** | *Vibrio cholerae* |
| **Coccidoidomycosis** | *Coccidioides immitis* |
| **Dysentery** | *Shigella dysenteriae* |
| **Hantavirus pulmonary syndrome** | Hantaan virus |
| **Haemorrhagic fever** | Nipah, Rift Valley fever virus |
| **Histoplasmosis** | *Histoplasma capsulatum* |
| **Hemolytic Uremic Syndrome** | *E. coli* O157:H7 |
| **Influenza** | Influenza virus (new strain) |
| **Legionellosis** | *Legionella pneumophila* |
| **Melioidosis** | *Burkholderia pseudomallei* |
| **Meningitis** | *Neisseria meningitidis* |
| **Monkey pox fever** | Monkey pox |
| **Paratyphoid fever** | *Salmonella paratyphi* |
| **Psittacosis** | *Chlamydia psittaci* |
| **Q fever** | *Coxiella burnetii* |
| **Rocky mountain spotted fever** | *Rickettsia rickettsii* |
| **Scrub typhus** | *Orienta tsutsugamushi* |
| **Toxic syndrome** | Conotoxin, Microcystin, Saxitoxin, Palytoxin |
| **Tuberculosis** | *Mycobacterium tuberculosis* |
| **Typhoid fever** | *Salmonella typhi* |
| **Typhus fever** | *Rickettsia prowazekii* |

Another important and well publicized attempt to categorize the biological threats is the one by the CDC, Atlanta-USA, which according to expert consensus proposes three categories of biological agents A, B and C, according to the assessed threat to the US PH system[2].

*Table I.2: List of priority pathogens according to CDC, Atlanta*

| Category A | Category B | Category C |
|---|---|---|
| ♦ variola major (smallpox);<br>♦ *Bacillus anthracis* (anthrax);<br>♦ *Yersinia pestis* (plague);<br>♦ *Clostridium botulinum* toxin (botulism);<br>♦ *Francisella tularensis* (tularaemia);<br>♦ filoviruses,<br>* Ebola hemorrhagic fever,<br>* Marburg hemorrhagic fever;<br>♦ arenaviruses,<br>* Lassa (Lassa fever),<br>* Junin (Argentine HF) and related viruses | ♦ *Coxiella burnettii* (Q fever);<br>♦ *Brucella species* (brucellosis);<br>♦ *Burkholderia mallei* (glanders);<br>♦ alphaviruses,<br>• VEE,<br>• EEE, WEE;<br>♦ ricin toxin from *Ricinus communis* (castor beans);<br>♦ epsilon toxin of *Clostridium perfringens;*<br>♦ SEB<br>♦ Foodborne or water-borne pathogens<br>* *Salmonella, Shigella*<br>* *Vibrio cholerae*<br>* *Cryptosp. parvum* | ♦ Hantavirus<br>♦ Tick-borne HF viruses<br>♦ Tick-borne Encephalitis (TBE) viruses<br>♦ Yellow fever<br>♦ Multi-drug resistant TB |

Clues to keep in mind for the differentiation of natural versus man-made incidents, especially concerning a biological agent, include the following:

- Multiple clinical presentations of a disease
- Similar genetic type of agent from geographically distinct sources
- Unusual, atypical, or genetically engineered strain
- Endemic disease with unexplained increased incidence
- Simultaneous clusters of same illness in different from the usual
  - ❑ geographic areas
  - ❑ age groups
  - ❑ season
- Atypical route of transmission
- Concurrent animal disease

The following pages present an overview of the main disease presentation and management points for the biological agents of high threat from the perspective of a front-line health professional.

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1. A. Tegnell, F. Van Loock, A. Baka, et al. Development of a Matrix to evaluate the threat of biological agents used for bioterrorism. *Cel Mol Life Sci* 2006; 63, 2223-28.
2. Biological and chemical terrorism: strategic plan for preparedness and response. Recommendations of the CDC Strategic Planning Workgroup. *MMWR* , 2000. 49(RR-4): p. 1-14.




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# 1.1 ANTHRAX

**PH2.** *B. anthracis* with the "box car" appearance and spore formation.

PHOTO: Public Health Image Library (PHIL), CDC

## Agent

*Bacillus anthracis*: Gram +, rod-shaped, spore forming bacterium

### Why anthrax?

Anthrax spores are extremely hardy and resistant to high temperatures, UV light and antiseptics. Anthrax has been favored as a biological weapon as it is easy to obtain, to culture and to maintain. If inhaled, it causes a serious illness with significant morbidity and mortality although it is not transmitted from person to person.

### Disease and Clinical forms

Cutaneous, inhalational and gastrointestinal anthrax

### Incubation Period

Usually 2-7d, (range:1-60d)

### Epidemiology

- Zoonosis (affects cattle); spores are very hardy and survive in the soil for decades
- Human cases are rare in the EU. Cutaneous form is the most frequent naturally occurring type and a few cases are reported annually in South Europe, while it is endemic in the Middle East and Africa
- Inhalational anthrax is extremely rare in the EU
- Considered an occupational risk via contact with animals or animal products

## Exposure

- Naturally occurring human disease is usually connected to contact of abraded skin with infected animals or animal products or consumption of contaminated food
- Occupational exposure for farmers, veterinarians and any profession handling animal products like leather or wool or laboratory personnel

- Inhalation of the aerosolized anthrax spores during handling infected animals, in the dust of an infected area, as a laboratory accident or an act of deliberate release

## Transmission

- No person to person transmission

## Signs and Symptoms

### Cutaneous anthrax:

- Usually on hands, forearms, neck, or face
- Initially small itching skin lesion (papule), which progressively enlarges and blisters
- Ulceration over 2-6 d to become a black eschar
- Marked local swelling
- Local lymphadenopathy
- Systemic symptoms: malaise, headache, chills, rarely fever

PHOTO: Public Health Image Library (PHIL), CDC

**PH3.** Cutaneous anthrax lesion with black eschar and prominent local swelling and erythema.

### Inhalational anthrax:

- Febrile, flu-like illness
- Fever with marked sweating
- Malaise, myalgia
- Nausea, vomiting
- Non-productive cough
- Headache, confusion
- 1-2 days later severe sepsis, acute dyspnea, chest pain, respiratory failure,
- Meningism
- Almost 100% fatal, if untreated. 40-60% mortality with full critical care support

PHOTO: Public Health Image Library (PHIL), CDC

**PH4.** PA chest radiograph of a patient with inhalation anthrax (4th day) showing a wide mediastinum and effusion.

### Gastrointestinal anthrax:

- Severe abdominal pain (presentation similar to surgical acute abdomen)
- Nausea, vomiting
    - Bloody diarrhea
- Sepsis, shock
- High mortality even with treatment

## Diagnosis of Anthrax

- ❑ Gram stain of blood, CSF or exudate
- ❑ Culture of blood, CSF, feces, tissue or exudate
- ❑ PCR testing
- ❑ Serology for antibodies
- ❑ Immunohistochemistry (skin, lymph nodes)

## Management of Anthrax

- ❖ Standard precautions during hospitalisation
- ❖ Post-exposure prophylaxis: for persons, who have come in contact with suspicious packages or powder, or are involved in a deliberate release incident may be needed. (ciprofloxacin 500mg bid until environmental testing is complete or for 60d)
- ❖ Vaccine against anthrax is available for certain personnel in the UK and the USA

## Treatment:

- ❍ **1st choice:** Ciprofloxacin (adults: 400mg x 2 IV, children: 10mg/kg x 2 IV) **or**
- ❍ **2nd choice:** Doxycycline (adults:100mg x 2 IV, children >8yr: 2.2mg/kg PO x 2)
- ❍ **in combination** with 1-2 additional antibiotics: clindamycin, penicillin or amoxicillin, vancomycin, rifampin, imipenem or meropenem, chloramphenicol

## Upon serious clinical suspicion of any clinical type of ANTHRAX disease:

- ✔ **Protect yourself and your colleagues: standard precautions for infection control**
- ✔ **Inform senior clinician**
  Do you need to inform the police about a suspicious package?
- ✔ **ID specialist consultation for your patient**
- ✔ **Report ASAP to PH services according to the established procedure in your area/ region/ state**
  A single case of **inhalation anthrax** in any EU MS should be fully investigated as **deliberate release** until proven otherwise.

### References

1. Heptonstall J, Gent N. CRBN incidents: clinical management & health protection. HPA, London, November 2006. **http://www.hpa.org.uk/**
2. Bossi P., Tegnell A., Baka A. et al BICHAT guidelines for the clinical management of anthrax and bioterrorism-related anthrax. *Euro Surveill.* 2004;9(12):pii=500. Available online: **http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=500**
3. CDC, Fact Sheet: Anthrax Information for Health Care Providers: **http://emergency.cdc.gov/agent/anthrax/anthrax-hcp-factsheet.asp**
4. Baka A., Astriti M. et al. *Handbook of Clinical Management of Communicable Diseases and Agents of Deliberate Release*, Hellenic Centre for Infectious Diseases Control, Athens 2004.

# I.2 BOTULISM

PHOTO: Public Health Image Library (PHIL), CDC

**PH5.** *C. botulinum* with spore formation

## Agent

Toxin produced in 7 antigenic forms (A-G) in anaerobic conditions by the bacterium *Clostridium botulinum*: Gram (+), rod-shaped, spore-forming bacterium.

### Why botulinum toxin?

Botulinum toxin is one of the most lethal substances known to man and acts by blocking the release of acetylcholine at the neuromuscular junction. It is also known to cause symptoms even in an inhaled form in laboratory accidents. Although it is hard to produce in a pure form and not transmitted from person to person, it is considered as a very high threat agent, because it causes a serious illness with significant morbidity and mortality and its antidote (botulinum antitoxin) is extremely expensive and relatively scarce in the market.

### Disease and Clinical forms

Food borne, neonatal, wound botulism

### Incubation Period

Usually 12-36 hrs (range: 6 hrs-8d)

### Epidemiology

- Food borne botulism is the most common type of the disease, but rather rare in Europe. Mostly caused by improper preservation or storage of food (e.g. home-canning)
- Wound botulism is reported in IV drug users in Europe and the USA, associated with black tar heroin injection
- Infant botulism results from production of toxin the infant's intestine from ingested *Clostridium spores*, sometimes associated with honey or corn syrup

## Exposure

- Naturally occurring human disease is usually connected to consumption of contaminated food containing the toxin or contamination of open wound or IV drug injection site with Clostridium spores
- Inhalation of pure toxin as a laboratory accident or a deliberate release act.

## Transmission

- No person to person transmission

## Signs and Symptoms

All clinical forms of botulism have similar symptoms

### Early Symptoms:

- No fever
- Ptosis, dry mouth, dilated pupils and sluggishly reacting to light
- 4 Ds: dysphonia, dysarthria, diplopia, dysphagia
- Alert and oriented patient
- Nausea, vomiting and diarrhea sometimes are related to food borne botulism

PHOTO: Courtesy A. Baka

**PH6.** Patient with clinical botulism and difficulty in opening L eyelid.

### Late Symptoms:

- Descending paralysis progressively involving the respiratory muscles and diaphragm, in a proximal to distal pattern
- Autonomic disturbance
- Mortality is associated with airway obstruction and respiratory failure (up to 25% mortality, if left untreated, about 5% mortality with full critical care support).

## Diagnosis of Botulism

- The diagnosis of botulism is **clinical**
- Toxin neutralization bioassay in mice
- Culture of *clostridium botulinum* as corroborating evidence (feces, food sample, wound swab)
- Detection of toxin in food sample/serum (<3days after ingestion)

## Management of Botulism

- Standard precautions during hospitalisation
- Toxoid vaccine available for laboratory personnel
- No post-exposure prophylaxis

## Treatment:

- **ABCs** and specifically respiratory support
- **Critical care support**: in severe cases mechanical ventilation may be needed for extended periods of time (2-8 weeks), as recovery follows the regeneration of new neuromuscular synapses
  - Aminoglycocides should be avoided
- If a deliberate release incident is suspected involving aerosolized toxin:
  - Wash clothes and skin with soap and water
  - Contaminated objects or surfaces can be cleaned with 0,1% hypochlorite solution

### Antitoxin:

- **The decision to give botulinum antitoxin is clinical and should not await testing results**
- Collect relevant specimens for testing **before** antitoxin infusion (serum/feces/food sample/wound swab need to reach a **reference** laboratory for toxin detection)
- Antitoxin is effective in reducing the severity of symptoms, if administered early.
  - The currently available antitoxin is equine and states usually maintain a strategic stockpile in small quantities
  - Antitoxin dose is decided in consultation with ID consultant and pharmaceutical producer

PHOTO: Public Health Image Library (PHIL), CDC

**PH7.** home-canned jalapeno peppers that caused an outbreak of botulism in the USA in 1977

## Upon serious clinical suspicion of any clinical type of BOTULISM disease:

- ✔ **Protect yourself and your colleagues:**
  standard precautions for infection control
- ✔ **Inform senior clinician**
- ✔ **Do you have a suspected source for the botulism infection?**
  If you suspect food borne botulism, try to collect the suspected foodstuff for testing
- ✔ **ID specialist and**
- ✔ **critical care consultation for your patient**
  Procurement of botulinum antitoxin
- ✔ **Report ASAP to PH services, according to the established procedure in your state**
  A single case of clinical **botulism** is considered a **PH emergency** regardless of the suspicion of deliberate release

### References

1. Heptonstall J, Gent N. CRBN incidents: clinical management & health protection. HPA, London, November 2006. **http://www.hpa.org.uk/**
2. Bossi P, Tegnell A, Baka A, et al. BICHAT guidelines for the clinical management of botulism and bioterrorism-related botulism. *Euro Surveill.* 2004;9(12):pii=505. Available online: **http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=505**
3. CDC, Botulism Facts for Health Care Providers, April 2006: **http://emergency.cdc.gov/agent/botulism/hcpfacts.asp**
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# I.3 PLAGUE

## Agent

*Yersinia pestis:* small, Gram (-), coccobacillus

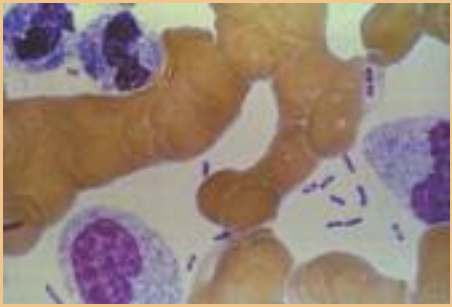

PHOTO: Public Health Image Library (PHIL), CDC

**PH8.** *Y. pestis* in the characteristic "safety pin" shape, Wright stain.

### Why plague?

Plague is transmitted by infected fleas from a rodent reservoir. Plague outbreaks contributed to massive panic in cities and countries where it appeared in the past. The agent has been favored as a biological weapon as it is relatively easy to obtain and culture, causes a serious illness with significant morbidity and mortality, which in its pneumonic form is easily transmitted from person to person. As the clinical presentation of plague is connected to the route of exposure, a deliberate release with aerosolized *Yersinia pestis* would cause widespread epidemic of pneumonic plague.

### Disease and Clinical forms

Bubonic, pneumonic, septicemic

### Incubation Period

Usually 2-4 d, (range: 1-8d)

### Epidemiology

- Zoonosis, also considered an occupational exposure, which does not occur naturally in Europe. Cases are reported from the southwest states in the USA, Africa, India and South East Asia.
- Bubonic plague is the most frequent naturally occurring form of the disease.
- Symptoms are connected to the route of exposure

## Exposure

- Naturally occurring human disease is usually connected to infected flea bites or consumption of contaminated food.
- Occupational exposure (veterinarians, hunters, laboratory personnel)
- Inhalation of the aerosolized bacteria as a laboratory accident or a deliberate release act

## Transmission

- The pneumonic form is transmitted from person to person via droplets (contact <2m)

## Signs and Symptoms

### Bubonic Plague:

- High fever
- Swollen and quite painful regional lymph nodes (bubo), usually in groin, axilla or neck and usually unilateral
- Prostration, hypotension and confusion (may progress to pneumonic, septicemic or plague meningitis)

PHOTO: Public Health Image Library (PHIL), CDC

**PH9.** Bubo in the R thigh.

### Pneumonic Plague:

- Fever, chills, severe malaise
- Nausea, vomiting and abdominal pain
- Cough with progressive dyspnea, chest pain and hemoptysis
- CXR findings: consolidation, infiltrates and effusion
- Progresses to shock/ARDS and respiratory failure
- Mortality 100%, if left untreated

PHOTO: Public Health Image Library (PHIL), CDC

**PH10.** PA chest radiograph of a patient with pneumonic plague showing both infiltrates and effusion.

### Septicemic Plague:

- Fever, chills, sweats
- Gram (-) shock
- Purpura/peripheral gangrene ("black death")
- DIC
- May present as the primary form of the disease, but has usually advanced from untreated bubonic or pneumonic forms

PHOTO: Public Health Image Library (PHIL), CDC

**PHI1.** Gangrene of upper extremity due to purpura in a case of septicemic plague

## Diagnosis of Plague

- ❑ Gram, Wright or Wayson stain of sputum/tracheal aspirate, pus or blood
- ❑ Culture of blood, pus or sputum/tracheal aspirate (preferably BEFORE antibiotics are started)
- ❑ PCR testing
- ❑ Serology for detection of antibodies

## Management of Plague

- ❖ Standard **and** Droplet precautions during first 72 hours after initiation of treatment
- ❖ No vaccine available
- ❖ Post-exposure prophylaxis: for close contacts of a patient with pneumonic plague (ciprofloxacin 500mg bid or doxycycline 100mg bid x 7-10d)

## Treatment:

- ❍ Critical care support
- ❍ 1st choice: Streptomycin (adults:1g x 2 IM, children:7,5mg/kg x2 IM) or Gentamicin (80mg x 3 IV)
- ❍ 2nd choice: Ciprofloxacin (adults: 400mg x 2 IV, children:15mg/kg x 2 IV))
- ❍ Chloramphenicol is still considered 1st choice drug for plague meningitis

## Upon serious clinical suspicion of any clinical type of PLAGUE disease:

- ✔ **Protect yourself and your colleagues:**
  standard and droplet precautions for infection control for the first 72 hours of treatment of any clinical form
  droplet precautions for pneumonic plague
- ✔ **Inform senior clinician**
- ✔ **ID specialist consultation for your patient**
- ✔ **Report ASAP to PH services, according to the established procedure in your state**
  A single case of **plague** in any EU MS is considered a **PH emergency**, regardless of the suspicion of deliberate release

**References**

1. Heptonstall J, Gent N. CRBN incidents: clinical management & health protection. HPA, London, November 2006. **http://www.hpa.org.uk/**
2. Bossi P, Tegnell A, Baka A, et al. BICHAT guidelines for the clinical management of plague and bioterrorism-related plague. *Euro Surveill.* 2004;9(12). Available online: **http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=501**
3. CDC, Plague Information Page: **http://www.bt.cdc.gov/agent/plague/#fact**
4. Baka A., Astriti M. et al. *Handbook of Clinical Management of Communicable Diseases and Agents of Deliberate Release*, Hellenic Centre for Infectious Diseases Control, Athens 2004

# I.4 TULARAEMIA

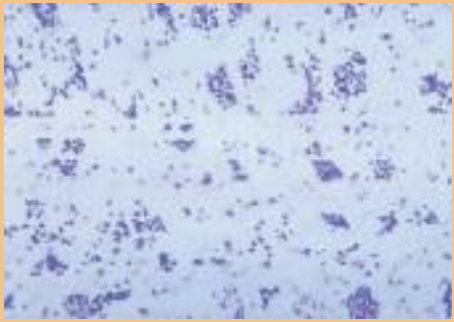

PHOTO: Public Health Image Library (PHIL), CDC

**PH12**. *F. tularensis* is a small coccobacillus.

## Agent

*Francisella tularensis*: very small, Gram (-), coccobacillus with several biovars of varying pathogenicity

### Why tularaemia?

Tularaemia is transmitted by infected arthropods (fleas, mosquitoes, ticks) from a small mammal reservoir (e.g. hares, voles). Tularaemia has been favored as a biological weapon as it is relatively easy to obtain and causes a serious illness with significant morbidity. As the clinical presentation of tularaemia is connected to the route of exposure, a deliberate release with aerosolized *Francisella tularensis* would cause large numbers of pneumonic tularaemia.

### Disease and Clinical forms

Ulceroglandular, glandular, oculoglandular, oropharengeal, pneumonic, septicemic

### Incubation Period

Usually 2-5 d, (range: 1-14 d)

### Epidemiology

- Zoonosis, also considered an occupational exposure, which occurs naturally in Scandinavia and Central Europe, the Americas, Asia and Australia
- Ulceroglandular tularaemia is the most frequent naturally occurring form of the disease
- Symptoms are connected to the route of exposure

## Exposure

- Naturally occurring human disease is usually connected to bites from infected arthropods, handling infected animals or consuming contaminated food or water
- Occupational exposure (veterinarians, hunters, laboratory personnel)
- Inhalation of the aerosolized bacteria during handling infected animals, in the dust of an infected area, as a laboratory accident or a deliberate release act

## Transmission

- No person to person transmission

## Signs and Symptoms

### Ulceroglandular and glandular Tularaemia:

- Fever, chills, headache, myalgia
- Ulcer at the site of inoculation, which has progressed from a papule
- Swollen and tender regional lymph nodes, usually near the insect bite/ inoculation site

PHOTO: Public Health Image Library (PHIL), CDC

**PHI3.** Tularaemia ulcer on the L thumb.

### Oculoglandular Tularaemia:

- Results from inoculating the agent in the eye mucosa
- Fever, chills, headache, myalgia
- Unilateral painful conjunctivitis with exudates
- May present with corneal ulcer
- Periauricular regional lymphadenopathy

### Oropharyngeal Tularaemia:

- Fever, chills, headache, myalgia
- Sore throat
- Exudative tonsillitis/pharyngitis/stomatitis
- Cervical lymphadenopathy

### Pneumonic Tularaemia:

- Follows inhalation of organism or is secondary from other site
- Fever, chills, severe malaise, sore throat
- Cough with dyspnea, chest pain
- CXR findings: variable but may show infiltrates, hilar adenopathy and effusion
- Progresses to respiratory failure and death
- Mortality 30%, if left untreated

PHOTO: Public Health Image Library (PHIL), CDC

**PHI4.** PA chest radiograph of a patient with pneumonic tularaemia showing bilateral infiltrates.

### Septicemic Tularaemia:

- Usually secondary from other site
- Fever, chills, headache, myalgia
- Nausea, vomiting, diarrhea, abdominal pain
- Confusion, coma
- Septic shock, ARDS
- DIC and haemorrhage

## Diagnosis of Tularaemia

- ❑ Gram stain of sputum, pharyngeal or ulcer exudate swab
- ❑ Culture of blood, sputum/tracheal aspirate, wound (preferably BEFORE antibiotics are started- multiple sets are needed as organism is hard to grow)
- ❑ PCR testing
- ❑ Serology for detection of antibodies.

## Management of Tularaemia

- ❖ Standard precautions during hospitalisation
- ❖ Vaccine available for laboratory personnel
- ❖ **Post-exposure prophylaxis**: for persons involved in a deliberate release incident (ciprofloxacin 500mg bid or doxycycline 100mg bid x 14d)

## Treatment:

- ❍ **1st choice**: Streptomycin (1g x 2 IM) or Gentamicin (80mg x 3 IV)
- ❍ **2nd choice**: Ciprofloxacin (adults: 400mg x 2 IV, children:15mg/kg x 2 IV))
- ❍ Relapses are common

## Upon serious clinical suspicion of any clinical type of TULARAEMIA disease:

- ✔ **Protect yourself and your colleagues:** standard precautions for infection control
- ✔ **Inform senior clinician**
- ✔ **ID specialist consultation for your patient**
- ✔ **Report ASAP to PH services,** according to the established procedure in your state

In some EU member states a single case of **tularaemia** may be a **PH emergency**

### References

1. Heptonstall J, Gent N. CRBN incidents: clinical management & health protection. HPA, London, November 2006. **http://www.hpa.org.uk/**
2. Bossi P, Tegnell A, Baka A, et al. BICHAT guidelines for the clinical management of tularaemia and bioterrorism-related tularaemia. *Euro Surveill.* 2004;9(12):pii=503. Available online: **http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=503**
3. CDC, Tularemia Information Page: **http://www.bt.cdc.gov/agent/tularemia**
4. Baka A., Astriti M. et al. *Handbook of Clinical Management of Communicable Diseases and Agents of Deliberate Release*, Hellenic Centre for Infectious Diseases Control, Athens 2004.

# I.5 VIRAL HEMORRHAGIC FEVERS

PHOTO: Public Health Image Library (PHIL), CDC

**PH15.** Marburg virus under EM.

PHOTO: Public Health Image Library (PHIL), CDC

**PH16.** Ebola virus under EM.

## Agents

Viruses from families: arena-, filo, bunya- and flaviviruses

### Why VHF?

Viral hemorrhagic fevers describe a heterogeneous family of diseases with the common clinical presentation of fever and bleeding diathesis. Some of these diseases carry significant morbidity and mortality (nearing 90% in the case of Ebola fever), along with the possibility of person-to-person transmission.

### Disease and Clinical forms

Multiple VHF such as: Marburg fever, Lassa fever, Ebola fever, Machupo (Bolivian hemorrhagic fever), Guanarito (Venezuelan hemorrhagic fever), Junin (Argentinean hemorrhagic fever), Rift Valley fever, Crimean-Congo hemorrhagic fever (CCHF), yellow fever, dengue and others.

### Incubation Period

Varies depending on the individual virus, range: 1-21d

### Epidemiology

- ✦ All are zoonoses with varying geographical distribution depending on their animal reservoir.
- ✦ The vast majority of VHFs does not occur naturally in any EU member state, with the exception of CCHF, which occurs in South East Europe.

## Exposure

- Naturally occurring human disease is connected to bites from infected arthropods (mosquito or tick), inhaling infected dust, or consuming contaminated primate meat, depending on the life cycle of each virus
- Occupational exposure for healthcare or laboratory personnel
- Inhalation of the aerosolized virus particles in the dust of an infected area, as a laboratory accident or a deliberate release act

## Transmission

- Person to person transmission through contact with secretions from symptomatic patients (saliva, diarrhea, vomit, urine or blood) or needle sticks
- Asymptomatic patients are rarely infectious

## Signs and Symptoms

All VHFs exhibit a prodrome with fever, malaise, headache, myalgia, nausea and vomiting.

### Ebola/Marburg Hemorrhagic fevers:

- Abrupt onset of febrile prodrome
- Prostration
- Diarrhea (bloody), vomiting
- Maculopapular rash (3-8 d after onset)

PHOTO: Public Health Image Library (PHIL), CDC

**PHI7.** Gingival bleeding in a patient with Ebola fever.

- Bleeding
- Confusion, coma, multiple organ failure
- Ulcer at the site of inoculation, which has progressed from a papule
- Swollen and tender regional lymph nodes, usually near the insect bite/ inoculation site
- Mortality 30-90% in the recent epidemics in central Africa

PHOTO: Public Health Image Library (PHIL), CDC

**PHI8.** Conjunctival bleeding in a patient with Ebola fever.

### Lassa Fever:

- Slow onset febrile prodrome
- Prostration
- Sore throat, conjunctivitis, face edema and chest pain
- Vomiting, diarrhea
- Bleeding
- Effusions (pleural, ascites), encephalopathy
- Mortality <30%, residual sensorineural deafness common

CCHF:

- Abrupt onset febrile prodrome
- Vomiting, diarrhea, abdominal pain
- Sore throat, conjunctivitis
- Lethargy, face edema
- Petechiae and bleeding (usually after day 4)
- Hepatomegaly, encephalopathy
- Mortality in epidemics 30-50%

## Diagnosis of VHF

❑ Viral culture of blood, tissue, sputum/tracheal aspirate (**Important**: the viral culture of these agents is possible **only in a BSL-4 laboratory**)

❑ PCR testing

❑ Serology for detection of antibodies

## Management of VHF

❖ Isolation of patient

❖ Possible need for High Security Isolation Unit admission and hospitalisation in a negative pressure room, by specialized personnel

❖ Standard, contact and airborne precautions

❖ No vaccine available

❖ **Post-exposure prophylaxis**: ribavirin PO for high risk exposure to Lassa fever or other arenavirus and observation for 21 d

## Treatment:

❍ Supportive care

❍ Ribavirin for Lassa and CCHF (adults:30mg/kg IV initial dose, followed by 15mg/kg TID x 4d, 7,5mg/kg IV x 6d)

*VHF Checklist for Front-line Health Professionals*

## Upon serious clinical suspicion of any VHF:

- ✔ **Protect yourself and your colleagues:**
  Isolate suspected patient
  Standard, contact and droplet precautions for infection control
- ✔ **Inform senior clinician**
- ✔ **Urgent ID specialist consultation**
  Decision on need for airborne precautions
  Decision on need for admission in high security isolation unit (under negative pressure ventilation)
- ✔ **Report ASAP to PH services,** according to the established procedure in your state
  A single case of **VHF** is a **PH emergency** and warrants full PH investigation regardless of the suspicion of deliberate release

### References


1. Heptonstall J, Gent N. CRBN incidents: clinical management & health protection. HPA, London, November 2006. **http://www.hpa.org.uk/**
2. Bossi P, Tegnel A, Baka A, et al. BICHAT guidelines for the clinical management of haemorrhagic fever viruses and bioterrorism-related haemorrhagic fever viruses *Euro Surveill.* 2004;9(12):pii=504. Available online: **http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=504**
3. CDC, Viral Hemorrhagic Fevers Information Page: **http://emergency.cdc.gov/agent/vhf/#related**
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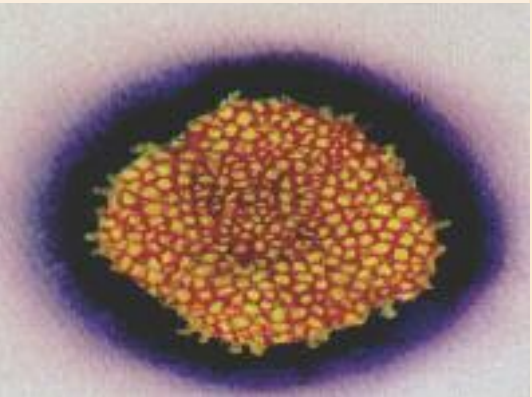

# I.6 VIRAL ENCEPHALITIDES

PHOTO: Public Health Image Library (PHIL), CDC

## Agents

Viruses from various families:
*toga-, flavi-, arena-, bunyaviruses*

### Why encephalitis?

Viral encephalitides describe a heterogeneous family of diseases with the common clinical presentation of fever and encephalitis syndrome (confusion, paralysis, convulsions etc). Some of these diseases carry significant morbidity and/or mortality. In particular Venezuelan Equine Encephalitis (VEE) has been studied in programs of biological weapon production in the past as an incapacitating agent. The VEE virus can be readily aerosolized and infects almost 100% of exposed.

### Disease and Clinical forms

Multiple encephalitides such as: Venezuelan Equine Encephalitis (VEE), Eastern Equine (EEE) and Western Equine Encephalitis (WEE), St. Louis Encephalitis (SLE), Japanese Encephalitis, and others.

### Incubation Period

Varies depending on the individual virus, range: 1-15d

### Epidemiology

- Mostly zoonoses with varying geographical distribution depending on their animal reservoir
- Some encephalitides occur in Europe, such as Tick-borne complex Encephalitis (TBE) in central-north Europe and West Nile Encephalitis in South Europe

## Exposure

- Naturally occurring human disease is connected to bites from infected arthropods (EEE, WEE, VEE and WNV by Aedes or Culex mosquitoes, TBE by ticks), to exposure to tissues/secretions of infected animals, to consumption of raw milk from goats, sheep, or cows or to inhalation of infected dust

- Occupational exposure for laboratory personnel
- Inhalation of the aerosolized virus particles in the dust of an infected area, as a laboratory accident or a deliberate release act

## Transmission

- No person to person transmission

## Signs and Symptoms

Infection may be asymptomatic or cause non-specific influenza-like illness

### Venezuelan Equine Encephalitis (VEE):

- Incubation 2-6d
- Fever, headache, malaise
- Sore throat
- Nausea, vomiting, diarrhea
- Headache and photophobia

  May recover or deteriorate
- Severe headache and backache
- Prostration
- Confusion, altered mental status and coma
- Convulsions, ataxia, paralysis
- Mortality up to 20%, children tend to exhibit severe form in outbreaks and survivors have high frequency of neurological sequelae

### West Nile virus Encephalitis (WNV):

- Incubation 3-14d
- Fever, chills, malaise
- Rash
- Nausea, vomiting, diarrhea
- Headache and photophobia
- Cough
- Confusion, altered mental status and coma
- Mortality 12-14% in encephalitis patients and higher in elderly with predisposing morbidity, residual neurological sequelae in >50% of survivors

### Tick-borne Encephalitis (TBE):

- Incubation 7-14 d
- Influenza-like, febrile prodrome with headache and myalgia
- Asymptomatic phase lasting 1-3 d to 3wks
- Meningitis, encephalitis or meningo-encephalitis symptoms
- leukopenia and thrombocytopenia
- TBE is more serious in adults than children
- Long lasting sequelae in up to 20% of patients
- Mortality is usually 1-2% but has been reported up to 25%

## Diagnosis of Viral Encephalitis

- ❑ Viral culture from blood, tissue, CSF
- ❑ PCR or RT-PCR testing
- ❑ Serology for detection of antibodies

PHOTO: Public Health Image Library (PHIL), CDC

## Management of VHF

- ❖ Standard precautions for hospitalisation
- ❖ There are vaccines available for some viruses (such as TBE and JE)

## Treatment:

- ❍ Supportive care

***Encephalitis Checklist for Front-line Health Professionals***

### Upon serious clinical suspicion of any viral encephalitis:

- ✔ **Protect yourself and your colleagues:**
  Standard precautions for infection control
- ✔ **Inform senior clinician**
- ✔ **ID specialist consultation**
- ✔ **Report ASAP to PH services, according to the established procedure in your state**
  In most EU MS viral encephalitides are not endemic, although occasional cases may be diagnosed


**References**

1. Heptonstall J, Gent N. CRBN incidents: clinical management & health protection. HPA, London, November 2006. **http://www.hpa.org.uk/web/HPAweb&Page&HPAwebAutoListName/Page/1158934607980**
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3. Baka A., Astriti M. et al. *Handbook of Clinical Management of Communicable Diseases and Agents of Deliberate Release*, Hellenic Centre for Infectious Diseases Control, Athens 2004.
4. CDC, Special Pathogens Branch **http://www.cdc.gov/ncidod/dvrd/Spb/mnpages/dispages/TBE.htm**

# I.7 Q FEVER

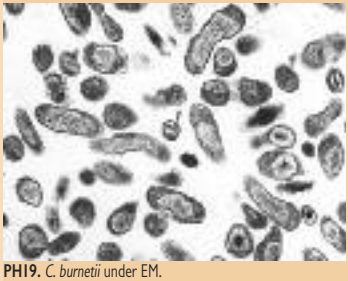

PHOTO: wikipedia/NIH

**PHI9.** *C. burnetii* under EM.

## Agent

Rickettsia *Coxiella burnetii*: Gram (-), pleomorphic, intracellular coccobacillus

### Why Q Fever?

While Q fever is not a lethal disease but rather an incapacitating one, it is considered a high threat agent as very few *C. burnetii* organisms are able to cause human infection. As an agent it is quite hardy, resistant to heat, dryness and many disinfectants. It has been known to cause natural outbreaks in wide areas via exposure to contaminated dust from infected animals.

### Disease and Clinical forms

Infection may be asymptomatic, acute or chronic

### Incubation Period

Usually 18-21 d, range: 4-40 d

### Epidemiology

- Zoonosis with worldwide geographical distribution and reservoirs in sheep, cattle, domesticated pets, small mammals, pigeons and ticks
- Animals are asymptomatic but shed the agent in feces, urine, reproductive fluids and placentas

## Exposure

- Naturally occurring human disease is connected to exposure to tissues/secretions of infected animals or to inhalation of infected dust and rarely to arthropod bites (ticks)
- Occupational exposure for farmers, veterinarians, laboratory personnel
- Inhalation of the aerosolized agent in the dust of an infected area, as a laboratory accident or a deliberate release act.

## Transmission

❒ No person to person transmission

## Signs and Symptoms

### Acute disease

- High fever, chills and sweats
- Headache, confusion and lethargy
- Myalgia and pharyngitis
- Nausea, vomiting, diarrhea and abdominal pain
- Cough, chest pain, pneumonia (25%)
- Hepatitis

### Chronic disease

- Fever, weight loss, malaise
- Aseptic meningitis/meningoencephalitis
- Endocarditis (75%)

## Diagnosis of Q Fever

❑ Serology for detection of antibodies

❑ Culture from blood, tissue (difficult)

❑ PCR testing

❑ Immunohistochemistry

## Management of Q Fever

❖ Standard precautions for hospitalisation

❖ No licensed vaccine available

❖ **Post-exposure prophylaxis**: for persons involved in a deliberate release incident (doxycycline 100mg PO BID x 7d or co-trimoxazole 960mg PO BID x 7d)

## Treatment:

❍ Supportive care

❍ **1st choice**: Doxycycline (adults: 100mg IV/PO BID x 14-21d, children >8yr: 2,2mg/kg BID x 14-21d)

❍ **2nd choice**: Co-trimoxazole or fluoroquinolones

❍ In chronic disease multi-drug treatment protocol is needed with doxyxycline in combination with fluoroquinolone or doxycycline and hydroxychloroquine


PHOTO: wikipedia/NIH

**PH20.** *PA chest radiograph of a patient with Q fever pneumonia with a large effusion.*

## Upon serious clinical suspicion of Q FEVER:

- ✔ **Protect yourself and your colleagues:** Standard precautions for infection control
- ✔ **Inform senior clinician**
- ✔ **ID specialist consultation**
- ✔ **Report ASAP to PH services,** according to the established procedure in your state

### References


1. Heptonstall J, Gent N. CRBN incidents: clinical management & health protection. HPA, London, November 2006. **http://www.hpa.org.uk/**
2. Bossi P., Tegnell A., Baka A. et al. BICHAT guidelines for the clinical management of Q fever and bioterrorism-related Q fever. *Euro Surveill.* 2004;9(12):pii=508. Available online: **http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=508**
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4. Baka A., Astriti M. et al. *Handbook of Clinical Management of Communicable Diseases and Agents of Deliberate Release*, Hellenic Centre for Infectious Diseases Control, Athens 2004.

# I.8 GLANDERS

PHOTO: http://frontier.k-state.edu/images/

**PH21.** *B. mallei* a small bacillus.

## Agent

*Burkholderia mallei*: small Gram (-) bacillus

### Why glanders?

Glanders is quite rare and was considered a bioweapon in the World Wars I and II, when horses and mules were vital parts of the movement of personnel and equipment. It is considered a high threat agent as it can infect humans via inhalation but at the same time there is currently very little clinical experience in recognizing and treating the disease.

### Disease and Clinical forms

Localized, pulmonary, septicemic, chronic

### Incubation Period

Usually 10-14 d

### Epidemiology

- Zoonosis mainly affecting horses, donkeys, mules but also goats, dogs and cats
- Endemic in Africa, Asia, Central and South America, while in the EU it has not been reported since the '40s
- Immuno-compromised patients are more susceptible

## Exposure

- Naturally occurring human disease is connected to exposure to infected animals or their carcasses and products
- Occupational exposure for farmers, veterinarians, abbatoir workers, laboratory personnel
- Inhalation of the aerosolized agent in the process of handling infected animals, as a laboratory accident or an act of deliberate release

## Transmission

❒ Person to person transmission **very** rare

## Signs and Symptoms

### Localized disease

- Fever, chills and sweats
- Headache, myalgia
- Local and generalized pustular rash that ulcerates
- Lymphadenopathy
- Nasal discharge

### Pulmonary glanders

- Fever, chills and sweats
- Headache, myalgia
- Cough, chest pain, dyspnea
- CXR: multifocal consolidation, effusion, cavitation, lung abscess

### Septicemic glanders

- Fever, chills and sweats
- Headache, myalgia
- Septic shock
- Multiple abscesses(liver, kidney, spleen)
- Multi organ failure

## Diagnosis of Glanders

❑ Culture from blood, sputum, pus, urine

## Management of Glanders

❖ Standard precautions for hospitalisation

❖ No vaccine available

❖ **Post-exposure prophylaxis**: for persons involved in a deliberate release incident (doxycycline 100mg PO BID x 7d or co-trimoxazole 960mg PO BID x 7d)

## Treatment:

❍ Supportive care

❍ **1st choice**: Ceftazidime (adults: 2g IV TID x 14d, children:120mg/kg TID x 14d)

❍ **2nd choice**: Meropenem/Imipenem (1g IV TID x14d)

❍ **3rd choice**: Gentamicin (5mg/kg IV QD x 14d) and Co-trimoxazole (8/40mg/kg/d PO x14d)

**to be continued to complete 20 weeks** with

- doxycycline PO and co-trimoxazole PO **or**
- amoxicillin/clavulanic acid PO

❍ Relapses are common, long term follow up is needed

*Glanders Checklist for Front-line Health Professionals*

## Upon serious clinical suspicion of GLANDERS:

- ✔ **Protect yourself and your colleagues:**
  Standard precautions for infection control
- ✔ **Inform senior clinician**
- ✔ **Exclude immuno-compromised staff from patient care**
- ✔ **ID specialist consultation**
- ✔ **Report ASAP to PH services,** according to the established procedure in your state
  A single case of **glanders** may be a **PH emergency** regardless of suspicion of deliberate release

### References


1. Heptonstall J, Gent N. CRBN incidents: clinical management & health protection. HPA, London, November 2006. **http://www.hpa.org.uk/**
2. Bossi P, Tegnell A, Baka A. et al BICHAT guidelines for the clinical management of glanders and melioidosis and bioterrorism-related glanders and melioidosis. *Euro Surveill.* 2004;9(12):pii=507. Available online: **http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=507**
3. CDC, Glanders page: **http://www.cdc.gov/nczved/dfbmd/disease_listing/glanders_ti.html**
4. Baka A., Astriti M. et al. *Handbook of Clinical Management of Communicable Diseases and Agents of Deliberate Release*, Hellenic Centre for Infectious Diseases Control, Athens 2004.


# I.9 MELIOIDOSIS

PHOTO courtesy of Graham Lloyd, HPA.

**PH22.** *B. pseudomallei* a small bacillus.

## Agent

*Burkholderia pseudomallei*: small Gram (-) bacillus

### Why melioidosis?

Melioidosis is quite rare in Europe, <10 imported cases are reported annually. It is considered a high threat agent as it can infect humans via inhalation, it causes a high morbidity and mortality disease but at the same time there is currently very little clinical experience in recognizing and treating it.

### Disease and Clinical forms

Localized, pulmonary, septicemic, chronic

### Incubation Period

Usually 1-21 d (range: 1 day- years after exposure)

### Epidemiology

- Melioidosis occurs in South and SE Asia, Northern Australia, but also in Africa and the Americas.
- Immuno-compromised patients are more susceptible

## Exposure

- Naturally occurring human disease is connected to contaminated water exposure through skin lesions or consumption/aspiration of contaminated water
- Occupational exposure for farmers, rice workers and laboratory personnel
- Inhalation of the aerosolized agent in the process of work in rice fields, as a laboratory accident or a deliberate release act

## Transmission

❒ Person to person transmission is **very** rare, occurring via contact with blood and patient fluids

## Signs and Symptoms

### Skin, soft tissue disease

- Fever, chills and sweats
- Headache, myalgia
- Subcutaneous nodules
- Multiple soft tissue abscesses
- Local lymphadenopathy
- Skin pustules

PHOTO courtesy of David Dance, HPA.

**PH 23.** A Thai child with parotid abscess due to *B. pseudomallei.*

PHOTO courtesy of David Dance, HPA.

**PH 24.** A Thai man with multiple soft tissue abscesses due to melioidosis.

### Pulmonary melioidosis

- Fever, chills and sweats
- Headache, myalgia
- Cough, chest pain, dyspnea
- CXR: multifocal consolidation, effusion, cavitation, lung abscesses

PHOTO courtesy of David Dance, HPA.

**PH25.** PA chest radiograph of a patient with L lung abscess.

### Septicemic melioidosis

- Fever, chills and sweats
- Headache, myalgia
- Septic shock
- Multiple abscesses (liver, kidney, spleen, brain)
- Multi organ failure
- Mortality 100%, if untreated and 40% with treatment

## Diagnosis of Melioidosis

❑ Culture from blood, sputum, pus, urine

❑ Serology for detection of antibodies

## Management of Melioidosis

- ❖ Standard precautions for hospitalisation
- ❖ No vaccine available
- ❖ **Post-exposure prophylaxis**: for persons involved in a deliberate release incident (doxycycline 100mg PO BID x 7d or co-trimoxazole 960mg PO BID x 7d)

## Treatment:

- ❍ Supportive care
- ❍ **1st choice**: Ceftazidime (adults: 2g IV TID x 14d, children:120mg/kg TID x 14d)
- ❍ **2nd choice**: Meropenem/Imipenem (1g IV TID x14d) **to be continued to complete 20 weeks** with
  - doxycycline PO and co-trimoxazole PO **or**
  - amoxicillin/clavulanic acid PO
- ❍ Relapses are common, long term follow up is needed

*Melioidosis Checklist for Front-line Health Professionals*

### Upon serious clinical suspicion of MELIOIDOSIS:

- ✔ **Protect yourself and your colleagues:**
  Standard precautions for infection control
- ✔ **Inform senior clinician**
  Exclude immuno-compromised staff from patient care
- ✔ **ID specialist consultation**
- ✔ **Report ASAP to PH services, according to the established procedure in your state**
  A case of **melioidosis** merits **full investigation** regardless of suspicion of deliberate release

## References


1. Heptonstall J, Gent N. CRBN incidents: clinical management & health protection. HPA, London, November 2006. **http://www.hpa.org.uk/**
2. Bossi P, Tegnell A, Baka A. et al BICHAT guidelines for the clinical management of glanders and melioidosis and bioterrorism-related glanders and melioidosis. *Euro Surveill.* 2004;9(12):pii=507. Available online: **http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=507**
3. CDC, Melioidosis page: **http://www.cdc.gov/nczved/dfbmd/disease_listing/melioidosis_gi.html**
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# I.10 SMALLPOX

PHOTO courtesy of Graham Lloyd, HPA

**PH 26.** Variola virus under EM.

## Agent

*Variola virus*: the largest DNA virus

### Why smallpox?

Smallpox (variola) is the only known communicable disease that has been eradicated from our earth through international PH cooperation and collaboration. The eradication meant also interruption of the vaccination programs and loss of clinical expertise for the recognition and management of the disease. Smallpox has caused significant outbreaks in the past, claiming the lives of millions of people and it is known that the virus was studied in bioweapons programs in the past. The modern society is deemed highly susceptible to this virus, which has a very low infectious dose (10-100 virions) and causes a disease with significant morbidity and mortality. As the period of contagiousness is quite long, the disease is able to be readily transmitted from person to person.

### Disease and Clinical forms

- *Variola major*, which may present as ordinary, modified, flat and hemorrhagic smallpox
- *Variola minor*

### Incubation Period

12-14d, range: 7-17d

### Epidemiology

- ✦ Smallpox does not exist as a natural disease since 1977. In most EU member states the last cases were reported in the '40s or '50s
- ✦ The smallpox virus is only stockpiled in two laboratories in the world, in the USA and the Russian Federation
- ✦ There is no known animal reservoir for smallpox

## Exposure

- Currently there is no naturally occurring human disease
- Inhalation of the aerosolized virus particles as a laboratory accident or an act of deliberate release

## Transmission

- Transmitted from person to person mostly through droplets with prolonged face-to-face contact, contact with patient fluids (saliva, vesicle fluid, scabs) or contaminated objects such as clothing

  ***Attention!*** there are documented cases of airborne transmission from patients with significant cough and bronchial lesions

## Signs and Symptoms

### Variola Major:

#### Ordinary Smallpox (>90%)

- Abrupt onset febrile prodrome with high fever, headache and backache (2-4 d)
- Prostration
- Enanthem (rash) in the mouth marks the beginning of the contagious period
- Maculopapular rash (+2-4 d after fever) that spreads to the whole body (24hrs) but appears to have centrifugal distribution and may involve palms and soles
- The rash gradually but **uniformly** develops to vesicles (3-5d after onset), then deep embedded pustules with central dimple (6-12 d after onset)

PHOTO: WHO slide set on diagnosis of smallpox

**PH 27.** Child with smallpox rash with centrifugal distribution.

PHOTO: WHO slide set on diagnosis of smallpox

**PH 28.** Smallpox rash appearing on soles and its resolution.

- Gradually the rash crusts over and scabs form, which fall off about 3 weeks after the appearance of the rash leaving scars
- The patient is not contagious anymore **only after the scabs have fallen off**.
- Average mortality 25-30%, highest in infants and the elderly

Uncommon forms of Smallpox (about 5% each):

- Abrupt onset febrile prodrome
- *Modified*: fewer lesions, faster evolution of the rash maybe without the pustular phase
- *Hemorrhagic*: Rash becomes hemorrhagic and DIC develops
- *Flat*: the rash remains flat and soft, was reported in infants
- Historically mortality 95-100% for the flat and hemorrhagic types

### Variola Minor

- Clinically undistinguishable from *variola major*
- Fewer systemic symptoms
- Fewer lesions without residual scarring
- Mortality about 1%

## Diagnosis of Smallpox

- ❑ Clinical picture is quite specific, but new generations of medical personnel have no clinical experience with this disease any more. The most important fact is to differentiate from varicella (chickenpox)
- ❑ Electron Microscopy for orthopoxvirus recognition
- ❑ PCR testing
- ❑ Viral culture of vesicle fluid, sputum/tracheal aspirate (**Important**: the viral culture of smallpox is possible **only in a BSL-4 laboratory**)
- ❑ Serology for detection of antibodies

*Table I.10.: Differential diagnosis of Smallpox (Variola) and Chickenpox (Varicella)*

| | Chickenpox (Varicella) | Smallpox (Variola) |
|---|---|---|
| Incubation Period | 14-21d | 12-14d |
| Febrile prodrome | None to mild | 2-4d duration: Severe headache, backache |
| Rash | Centripetal: dense on trunk, less on face and extremities | Centrifugal: dense on face and extremities, less on trunk maculopapular rash (2d), |
| | Itchy rash, evolves quickly in crops from superficial papules to vesicles to pustules | **uniformly** develops to vesicles (1-2d), deep embedded pustules (+5-14d) |
| | Usually spares palms and soles | Present in palms and soles |
| | Rash dries quickly and scabs fall (<15d) | Rash dries (+10-14d) and scabs fall off (+14-28d) slowly |
| Agent | DNA herpes virus | DNA orthopox virus |
| Treatment | Acyclovir is effective, if given<72hrs | Supportive care |


PHOTO: WHO slide set on diagnosis of smallpox

**PH29.** Comparative evolution of the rash in smallpox and varicella.


PHOTO: WHO slide set on diagnosis of smallpox

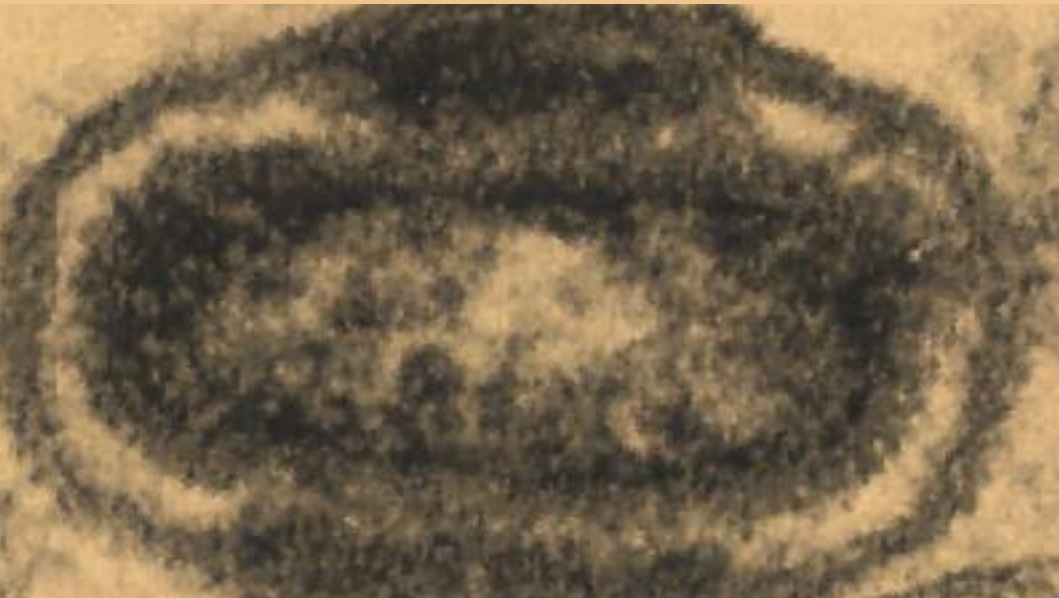
**PH30.** difference in the distribution of the rash in smallpox and varicella.

## Management of Smallpox

- Isolation of patient
- Possible need for High Security Isolation Unit admission and hospitalisation in a negative pressure room, by specialized personnel
- Standard, contact and airborne precautions, unless the staff has been recently vaccinated (<10 yrs ago), in which case standard precautions are sufficient
- Vaccinia vaccine is available and effective (95%), but its use is connected with significant side effects
- Trained and vaccinated medical or emergency response personnel exist in EU member states according to their individual national planning
- Vaccinia vaccine can also be **effective as a post-exposure measure**, if given soon (< 4-7days) after exposure. Therefore close contacts of patients should be immediately traced, isolated and vaccinated (ring vaccination strategy)

## Treatment

- Supportive care
- Cidofovir, an antiviral drug used to treat cytomegalovirus retinitis, may have an effect against smallpox virus but its use is accompanied by serious side effects (e.g. kidney failure, high intraocular pressure)



*Smallpox Checklist for Front-line Health Professionals*

## Upon serious clinical suspicion of SMALLPOX:

✔ **Protect yourself and your colleagues:**
Isolate suspected patient
Standard, contact and droplet precautions for infection control

✔ **Inform senior clinician**
Trained or vaccinated staff only to care for this patient
Exclude immuno-compromised staff from the care of this patient
Follow protocols according to existing national smallpox management plan

✔ **Urgent ID specialist consultation**
Exclusion of varicella (chickenpox) and herpes virus infection
Decision on need for airborne precautions
Decision on need for admission in high security isolation unit (under negative pressure ventilation)
Follow protocols according to existing national smallpox management plan

✔ **Report IMMEDIATELY to PH services, according to the established procedure in your state**

✔ **A single case of SMALLPOX is a global PH emergency and warrants full PH investigation**

### References


1. Heptonstall J, Gent N. CRBN incidents: clinical management & health protection. HPA, London, November 2006. **http://www.hpa.org.uk/**
2. Bossi P, Tegnell A, Baka A. et al. BICHAT guidelines for the clinical management of smallpox and bioterrorism-related smallpox. *Euro Surveill.* 2004;9(12):pii=502. Available online: **http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=502**
3. CDC, Smallpox Information Page: **http://www.bt.cdc.gov/agent/smallpox/**
4. Baka A., Astriti M. et al. *Handbook of Clinical Management of Communicable Diseases and Agents of Deliberate Release*, Hellenic Centre for Infectious Diseases Control, Athens 2004.

# II Basic Principles of INFECTION CONTROL

Infection control involves all the processes, the mentality and the organisational framework that prevents the transmission of diseases

from patient to patient in the health care setting

from health care workers to patients

from patients to health care workers

Transmission of healthcare-associated infections (HCAI), which are infections that patients acquire during the course of receiving treatment for other conditions within a healthcare setting, have become one of the highest leading causes of death in the EU and the developed world. Approximately 4 in every 100,000 patients are estimated to acquire a healthcare-associated infection (HCAI) in the EU every year. The number of deaths occurring as the direct consequence of these infections is estimated to be at least 37,000.

Drawing from this definition infection control is not just about the four types of precautions used by health care workers for patients with certain diseases. It includes

working practices (hand hygiene, sharp disposal etc)

training and availability of PPE, as well as monitoring of PPE use

environmental measures (disinfection, laundering etc)

patient placement protocols

isolation options (appropriately ventilated rooms etc)

monitoring of health care workers for occupational injuries, vaccination status, prophylaxis etc

In the following pages the four basic infection control guidelines based on disease transmission are outlined:

- Standard Precautions
- Droplet Precautions
- Contact Precautions
- Airborne Precautions

# Standard Precautions

## Hand Hygiene

- **Before** and **After** any patient contact
- **Before** and **After** any medical procedure on a patient and contact with patient secretions
- **Before** and **After** you eat or touch your face
- **After** removing your gloves
- **After** handling/touching equipment
- **After** using the lavatory

Always wash hands if visibly soiled.

Regular hygiene: Use running water and antimicrobial soap, count slowly up to 50

**or**

Use alcohol-based hand rub

## Wear gloves

- for invasive procedures
- for any anticipated contact with potentially infectious body fluids or material
- change gloves after procedure, wash hands before attending next patient

Single use (latex, vinyl or nitril)

**Eye and face protection,** if there is risk of spray or splash to your eyes, nose and mouth

Use single-use surgical mask, mask with face shield or mask and goggles

**Wear a gown** or disposable plastic apron, appropriate to the task, to protect skin and prevent soiling or contamination of clothing during procedures

**Dispose of sharps** and soiled PPE appropriately

CDC, Minnesota Department of Health

**Respiratory Hygiene/Cough Etiquette**

For patients, accompanying persons and Health Care Workers

***attention!***

- *Standard Precautions apply to ALL PATIENTS, for ALL STAFF, at ALL SETTINGS regardless of suspected or confirmed infection status, ALL THE TIME*
- *Select your PPE according to the extent of anticipated blood, body fluid, or pathogen exposure*

## Contact Precautions

*in addition to Standard Precautions*

- A single patient room is preferred
- limit transport and movement of patients outside of the room to medically-necessary purposes
- instruct patient to wear a mask and follow respiratory hygiene/cough etiquette depending on respiratory symptoms and diagnosis
- single-use disposable patient equipment preferred

If not available consult infection control team

ensure proper decontamination of regular equipment and environment

### Hand Hygiene

- **Before** and **After** any patient contact
- **Before** and **After** any medical procedure on a patient and contact with patient secretions
- **Before** and **After** you eat or touch your face
- **After** removing your gloves
- **After** handling/touching equipment
- **After** using the lavatory

Always wash hands if visibly soiled.

Regular hygiene: Use running water and antimicrobial soap, count slowly up to 50

**or**

Use alcohol-based hand rub

### Wear gloves

- Wear gloves upon entry into patient room
- Change gloves after procedure
- Remove gloves before exiting the patient room

Single use (latex, vinyl or nitril)

**Eye and face protection,** if there is risk of spray or splash to your eyes, nose and mouth

Use single use surgical mask or mask with face shield or mask and goggles

## Contact Precautions in addition to Standard Precautions *cont'd*

**Always wear a gown,** or disposable plastic apron (depending on patient's symptoms) **upon entry into the patient room**

Remove gown before exiting the patient room

**Dispose of sharps** and soiled PPE appropriately


CDC, Minnesota Department of Health

**Respiratory Hygiene/Cough Etiquette**

For patients, accompanying persons and Health Care Workers

***attention!*** • *Remember hand hygiene after removing PPE*

## Contact Precautions

Are intended for agents that spread via

- direct contact with a patient or
- indirect contact with contaminated environment,

especially when there is

- wound drainage,
- diarrhea or incontinence
- other secretions.

Some examples where Contact Precautions are needed:

SARS

Multi-drug resistant bacteria (e.g. MRSA, VRE)

*Salmonella, Shigella* infections

RSV infections

Skin infestations (e.g. scabies, lice)

*C. difficile* infections

Rotavirus infections

Hepatitis A infection

# Droplet Precautions

*in addition to Standard Precautions*

- A single patient room is preferred
- In multi-patient rooms, cohorting is advisable and a distance 1-2m between patients is desirable.

If not available consult infection control team

- instruct patient to always wear a mask and follow respiratory hygiene/cough etiquette

Patient to wear single-use surgical mask

- limit transport and movement of patients outside of the room to medically-necessary purposes.
- single-use disposable patient equipment preferred

Ensure proper decontamination of regular equipment and environment

## Hand Hygiene

- **Before** and **After** any patient contact
- **Before** and **After** any medical procedure on a patient and contact with patient secretions
- **Before** and **After** you eat or touch your face
- **After** removing your gloves
- **After** handling/touching equipment
- **After** using the lavatory

Always wash hands if visibly soiled.

Regular hygiene: Use running water and antimicrobial soap, count slowly up to 50

**or**

Use alcohol-based hand rub

## Wear gloves

- Wear gloves upon entry into patient room
- Change gloves after procedure
- Remove gloves before exiting the patient room

Single use (latex, vinyl or nitril)

## Eye and face protection

- **Always wear a mask upon entry into the patient room or patient contact <2m**
- **Eye protection** if there is risk of spray or splash to your eyes, nose and mouth

## **Droplet** Precautions in addition to Standard Precautions *cont'd*

**Always wear a gown,** or disposable plastic apron **upon entry into the patient room**

Remove PPE before exiting the patient room, according to the order shown:


**Dispose of sharps** and soiled PPE appropriately


CDC, Minnesota Department of Health

**Respiratory Hygiene/Cough Etiquette**

patient and accompanying person to wear a mask



***attention!***

- ***Donning PPE sequence: gown, mask, goggles, gloves***
- ***Remove PPE before exiting the patient room, according to the order shown above***
- ***Remember hand hygiene after removing PPE***

Droplet Precautions are intended to prevent transmission of pathogens spread through close respiratory or mucous membrane contact with respiratory secretions. Respiratory droplets are large-particle droplets >5µ in size that are generated by a patient who is coughing, sneezing or talking. Due to their large size, respiratory droplets are not able to travel long distances airborne and fall with 1-2 m from the patient.

Examples where droplet precautions are needed include:

- SARS
- influenza
- pneumonic plague
- monkeypox
- *Mycoplasma pneumoniae*
- adenovirus
- pertussis (whooping cough)
- group A streptococcal infections
- rubella
- mumps
- Parvovirus B19 infections
- meningococcal infections (*Neisseria meningitidis*)

# Airborne Precautions

*in addition to Standard Precautions*

| | |
|---|---|
| • **Single patient room with negative pressure ventilation** | If not available consult infection control team |
| • Restrict entry to essential personnel and visitors | All entering room to wear appropriate PPE |
| • Limit transport and movement of patients outside the room to medically-necessary purposes | Patient to wear single-use surgical mask and follow respiratory hygiene/cough etiquette |
| • Single-use disposable patient equipment preferred | Ensure proper decontamination of regular equipment and environment |

## Hand Hygiene

| | |
|---|---|
| • **Before** and **After** any patient contact | Always wash hands if visibly soiled. |
| • **Before** and **After** any medical procedure on a patient and contact with patient secretions | Regular hygiene: Use running water and antimicrobial soap, count slowly up to 50 |
| • **Before** and **After** you eat or touch your face | **or** |
| • **After** removing your gloves | Use alcohol-based hand rub |
| • **After** handling/touching equipment | |
| • **After** using the lavatory | |

## Wear gloves

| | |
|---|---|
| • Wear gloves upon entry into patient room (depending on the disease you may need double gloves) | Single use (latex, vinyl or nitril) |
| • Change gloves after procedure | |
| • Remove gloves before exiting the patient room | |

## Eye and face protection

| | |
|---|---|
| • Always wear a **mask and** | Use properly fitted FFP3 respirator |
| • Always wear **eye protection** (goggles) upon entry into the patient room | |

## **Airborne** Precautions in addition to Standard Precautions *cont'd*

**Wear appropriate dermal protection** water resistant surgical gown or whole-body suit from water resistant material

Remove PPE before exiting the patient room

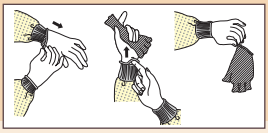
**Dispose of sharps** and soiled PPE appropriately



***attention!***

- ***Donning PPE sequence: gown, FFP3 respirator, goggles, gloves***
- ***Removing PPE sequence as follows:***

Step 1. Remove gloves



Step 2. Remove goggles/visor

Step 3. Remove gown/suit by peeling

Step 4. Remove respirator

- ***Remember hand hygiene after removing PPE***

Airborne Precautions are needed for agents that are transmitted via core respiratory particles (<5μm) that can remain suspended in air and travel long distances with air currents or through ventilation systems in a building.

Examples where droplet precautions are needed include:

- rubeola virus [measles]
- varicella virus [chickenpox]
- *Mycobacterium tuberculosis*
- SARS-CoV, in some instances
- Smallpox, in some instances
- viral haemorrhagic fevers (VHFs) in the last stages of clinical disease

### References


1. Heptonstall J, Gent N. CRBN incidents: clinical management & health protection. HPA, London, November 2006. **http://www.hpa.org.uk/**
2. CDC, Infection Control Guidelines Pages: **http://www.cdc.gov/ncidod/dhqp/guidelines.html**
3. WHO, Infection Prevention and Control in Health Care: **http://www.who.int/csr/bioriskreduction/infection_control/en/index.html**
4. Baka A., Astriti M. et al. *Handbook of Clinical Management of Communicable Diseases and Agents of Deliberate Release*, Hellenic Centre for Infectious Diseases Control, Athens 2004.

# III CHEMICAL AGENTS

## Chemical agents of High Threat

There are reports of chemical substance use in war in the histories of many civilizations such as the Chinese, the Greeks and Byzantium.

Unfortunately World War I marks the landmark use of gas warfare in such extent that approximately 1 million of the 26 million casualties of this conflict is attributed to use of chemical warfare. Chlorine, phosgene, cyanogens and vesicants were used in battlefields across Europe by both sides and caused significant number of deaths and injuries with residual effects in the armed forces.

In the years between World War I and World War II, new chemical weapons and protective gear were developed but were not used in battlefields. Nevertheless all of the major nations involved in WW I and several other countries developed chemical weapons programs. Cyanide was consistently used in the Nazi concentration camps.

Chemical weapons were used in major wars around the world during the remainder of the 20th century.

The Chemical Weapons Convention treaty was finalized in 1993 and is currently signed by more than 140 countries around the world. It prohibits the development, production, stockpiling, and use of chemical weapons and provides for the verification and destruction of known stockpiles. Despite diplomatic efforts, chemical weapons still remain a certain threat in warfare and have become a potential terrorist weapon in recent years. In 1994, a religious cult, Aum Shinrikyo, released nerve gas in a residential area in Matsumoto, Japan, and in 1995 the same group undertook the well publicized sarin attack in the Tokyo subway.

Nevertheless dangerous chemical substances are manufactured daily in huge quantities by industry many of which are highly toxic for humans, animals let alone the environment.

The ease with which chemical substances are accessible and may be used for terrorist purposes and cause mass casualties is of increased concern, although the hazard Toxic Industrial Chemicals (TICs) pose in general to the health of communities around the world is tremendously higher if we take into account the possibility of transport or storage accidents. Taking these chemical incidents into consideration, the FLHPs need to be aware of the basic principles of managing patients exposed to chemicals at any time.

The following pages present a brief overview of the background, the symptoms and the management of the classes of chemical agents considered of highest threat.

# III.I TOXIC INDUSTRIAL CHEMICALS (TICs)

## Agents

A wide variety of substances used in large quantities in the chemical industry, such as acids, ammonia, bases, chlorine, other inorganic substances. These commonly also include carbon disulfide, allyl alcohol, hydrazine, nitrobenzene, di-nitro-toluene, hydrogen sulphide, chloride and many others.

## Exposure

Depending on the agent and the type of exposure (occupational accident or accidental environmental release) any route is possible (inhalation, dermal, eye, ingestion).



## Signs and Symptoms

Mainly respiratory irritation, burns (skin, ocular or respiratory tract), anxiety

## Diagnosis of Exposure to TICs

- ❑ Diagnosis is mainly clinical

## Management of related Syndromes

- ❖ Decontamination (preferably on-site), if heavy exposure to liquid is suspected involving any chemical agent:
- ❖ Remove patient from the agent/area of exposure and
- ❖ Remove agent from the patient
  - Remove clothes and dispose appropriately
  - Wash patient's skin with warm soap water
  - Remove contact lenses and irrigate eyes thoroughly with NaCl 0,9%, check for corneal injury

## Treatment

- ABCs
- Critical care support
- Symptomatic treatment
- In some cases antidotes are available e.g. calcium gluconate and corticosteroids for hydrofluoric acid

***TICs Checklist for Front-line Health Professionals***

### Upon clinical suspicion or information of exposure to TICs:

✔ **Protect yourself and your colleagues:**
Select appropriate Protective Equipment
May need proper skin protection (water resistant PPE)

✔ **Inform senior clinician**

Critical care consultations may be needed for your patient
Poison centre/toxicology
*(tox database, material safety data sheets (MSDS) of the agent involved, medical management advice)*

✔ **Report ASAP to Poison Centre or other responsible agency** (e.g. civil protection), according to the established procedure in your region/state


**References**

1. Heptonstall J, Gent N. CRBN incidents: clinical management & health protection. HPA, London, November 2006. **http://www.hpa.org.uk/**


# III.2 PULMONARY AGENTS (Choking agents, Respiratory tract irritants)

## Agents

Phosgene, chlorine, ammonia, hydrogen sulphide, hydrogen chloride

### Why pulmonary agents?

Phosgene and chlorine were among the agents widely used during WWI causing thousands of deaths and incapacitated among the troops. Currently these same chemicals pose a much more significant threat as they are produced, stored and transported in enormous quantities in the industrialized world (plastics and pesticide industry). As an example phosgene production is calculated in millions of tons each year! This class of agents is the most commonly involved in industrial chemical releases and pose a significant hazard to the health of multiple communities around the world.

### Odor

- Phosgene: white to pale yellow gas, smells like mown grass or musty hay
- Chlorine: greenish gas, smells like bleach
- Hydrogen sulphide: smells like rotten egg

### Latent Period

Usually minutes to 48hrs

### Mechanism of Action

- These are gases that are heavier than air and therefore accumulate in low-lying areas.
- Reaction with water in mucous membranes and production of corrosive substances, such as hydrochloric acid (chlorine, phosgene) or nitric acid (ammonia)
- Destruction of the alveolar-capillary membrane of the respiratory tract and leak of fluid in the interstitial tissue, resulting in ARDS

## Exposure

- Inhalation of gas
- Skin and eye contact with gas
- In a liquid form the agents may contaminate water or food and people can be exposed via consumption

## Effects and clinical syndrome

Damage depends on the water solubility and direct tissue reactivity, the dose and the duration of exposure to each agent.

### Early:

- Eye irritation and tearing with blurred vision, chemical conjunctivitis or corneal injury
- Nose and throat irritation
- Skin irritation and burn-like lesions, when in contact with liquid
- Cough, choking, chest pain, chest pressure
- Nausea and vomiting
- Laryngeal edema in massive exposures

## Effects and clinical syndrome of pulmonary agent exposure

Latent:

- Dyspnea on exertion progressing to dyspnea at rest
- Bronchospasm, frothy or blood tinged sputum
- Hypoxia and pulmonary edema
- ARDS

## Diagnosis of pulmonary agent exposure

❑ The diagnosis of exposure to a pulmonary agent is CLINICAL

## Management

**Decontamination** (preferably on-site):

❖ Remove patient from the agent/area of exposure **and**

❖ Remove agent from the patient

- Remove clothes and dispose appropriately
- Wash patient's skin with warm soap water
- Remove contact lenses and irrigate eyes thoroughly with NaCl 0,9%, check for corneal injury

## Treatment

❍ NO specific antidote

❍ ABCs and supportive care, with frequent reassessments

❍ Aggressive respiratory support: administration of high flow $O_2$, inhaled broncholidators and corticosteroids

❍ Bed rest and observation at least for 24hrs

## Upon serious clinical suspicion of exposure to PULMONARY AGENTS:

✔ **Protect yourself and your colleagues:**
Make sure that patient is decontaminated **or**
Wear appropriate PPE

✔ **Inform senior clinician**

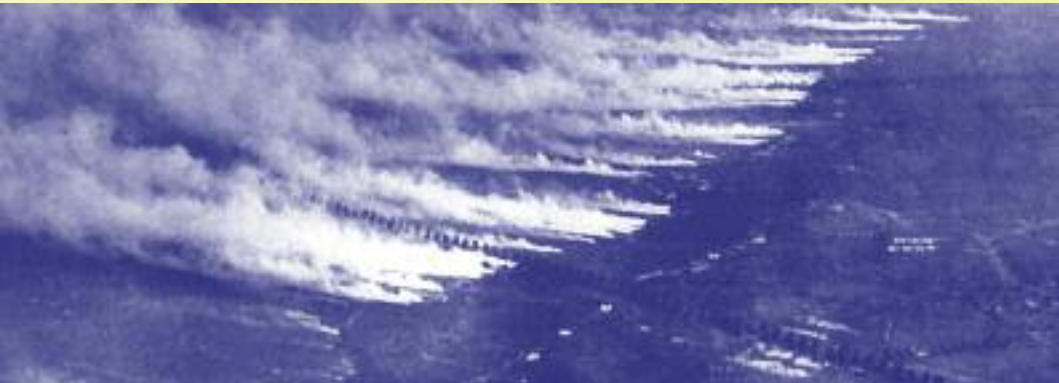
Poison centre
Pulmonary medicine consultations may be necessary
Ophthalmology

✔ **Report ASAP to PH, law enforcement or other services** (e.g. civil protection) according to the established procedure in your state



### References


1. Heptonstall J, Gent N. CRBN incidents: clinical management & health protection. HPA, London, November 2006. **http://www.hpa.org.uk/**
2. Kales SN, Christiani DC. Acute Chemical Emergencies N Engl J Med 2004;350:800-8.
3. CDC, Chlorine and Phosgene Information Pages: **http://emergency.cdc.gov/agent/chlorine/ and http://emergency.cdc.gov/agent/phosgene/basics/facts.asp**
4. Baka A., Astriti M. et al. *Handbook of Clinical Management of Communicable Diseases and Agents of Deliberate Release*, Hellenic Centre for Infectious Diseases Control, Athens 2004.

# III.3 HEMOTOXIC AGENTS (Blood agents or Chemical asphyxiants)

## Agents

Cyanide, cyanogen chloride, cyanide salts (sodium or potassium cyanide)

### Why cyanide?

Cyanide was manufactured as a chemical weapon in large quantities between WWI and II, and was used in concentration camps and in the Iran-Iraq war in the '80s. Cyanide has been used often for assassinations and suicides. Cyanide is widely used in the industry (plastics, fertilizers, photography) and is also a combustion product in house fires, considered to play a significant role in smoke inhalation morbidity.

### Odor

- Colorless gas or white solids, smells of bitter almonds

***Note**: only some people are genetically able to smell it*

### Latent Period

Immediate, seconds to minutes

### Mechanism of Action

- Usually gases that are lighter than air and very volatile liquid or solid salts
- Chemical asphyxiants are agents that replace oxygen in the hemoglobin molecule and inhibit oxygen transport to the cells causing tissue hypoxia
- Some cyanide salts may also be corrosive to skin and eyes

## Exposure

- Inhalation of gas
- Skin and eye contact with liquid or solid
- Ingestion

## Effects and clinical syndrome

Damage depends on route of exposure, concentration and duration of exposure

### Severe Exposure:

- Gasping
- Convulsions
- Coma and dilated pupils
- Respiratory arrest
- Sudden collapse and death

### Mild Exposure:

- Eye and nose irritation from cyanogens
- Dizziness, headache
- Nausea, with vomiting in moderate exposure
- Confusion and agitation
- Dyspnea, chest tightness
- Persistent hypotension and acidemia, despite good arterial oxygen levels

## Diagnosis of cyanide exposure

❑ Blood cyanide level

***Note**: the decision to administer antidote is CLINICAL and should not await test results*

## Management

❖ Prompt decontamination of exposed patients is recommended as follows:

❑ Remove patient from the agent/area of exposure **and**

❑ Remove agent from the patient

- Remove clothes and dispose appropriately in double, sealed bags
- Wash patient's skin with warm soap water or 0,1% hypochlorite solution
- Remove contact lenses and irrigate eyes thoroughly with NaCl 0,9%, check for corneal injury
- Do not induce emesis, consider gastric lavage or activated charcoal PO for ingestions

## Treatment

- Administer Cyanide Antidote IMMEDIATELY IF PATIENT SYMPTOMATIC
  - Altered mental status (GCS<8) and/or
  - Respiratory depression
- Cyanide Antidote
  - **Hydroxocobalamin 5%(CyanoKit©)**: 5g IV diluted in 0,9%NaCl over 15min. Dose may be repeated once, if severe exposure (max 10g)
  - **Dicobalt Edetate**: 300mg IV over 1 minute followed by 50ml glucose 50%
  - **Amyl Nitrite** with **Sodium Nitrate** and **Sodium Thiosulphate (Cyanide Antidote Package)**: 1 ampule Amyl Nitrite broken and inhaled in front of the face of the patient **every 1min**, until able to administer 300mg (or 10ml of 3%) sodium nitrite IV over 5-20 minutes; followed by 12,5g (or 25ml of 50%) sodium thiosulphate IV over 10 minutes
  - Need simultaneous blood pressure monitoring
- ABCs and specifically administration of 100% $O_2$
- Supportive care, ECG and pulse oximetry monitoring

*Cyanide Checklist for Front-line Health Professionals*

### Upon serious clinical suspicion of exposure to CYANIDE:

✔ **Protect yourself and your colleagues:**
Make sure that patient is decontaminated **or**
Wear appropriate PPE

✔ **Administer ANTIDOTE**

✔ **Inform senior clinician**

Poison centre
Critical Care Medice
consultations may be necessary

✔ **Report ASAP to PH, law enforcement or other services** (e.g. civil protection) according to the established procedure in your state

## References


1. Heptonstall J, Gent N. CRBN incidents: clinical management & health protection. HPA, London, November 2006. **http://www.hpa.org.uk/web/HPAweb&Page&HPAwebAutoListName/Page/1158934607980**
2. Kales SN, Christiani DC. Acute Chemical Emergencies N Engl J Med 2004;350:800-8.
3. CDC, Cyanide Information Page: **http://emergency.cdc.gov/agent/cyanide**
4. Baka A., Astriti M. et al. *Handbook of Clinical Management of Communicable Diseases and Agents of Deliberate Release*, Hellenic Centre for Infectious Diseases Control, Athens 2004.


# III.4 VESICANTS (Blister Agents)

## Agents

Mustards (nitrogen and sulphur), organic arsenicals (Lewisite, Phosgene Oxime)

### Why vesicants?

Vesicants were manufactured as chemical weapons in large quantities between WWI and II, and mustards were used in the Iran-Iraq war in the '80s. These agents are not used in industry, but quantities of them still exist in the arsenals of various countries and are under the process of destruction or have been dumped in the sea and frequently show up on the shores or in fishermen's nets in the Baltic Sea.

### Odor

- Lewisite: may smell of geraniums
- Mustards: may smell like garlic, fresh onion or mustard

### Latent Period

- Immediate for Lewisite
- 4-12 hrs for mustards

### Mechanism of Action

- Oily volatile liquids, pale yellow to amber that in gas form are heavier than air and accumulate in low-lying areas
- Vesicants cause tissue damage by alkylation, similarly to radiation, affecting all rapidly replicating cells

## Exposure

- Inhalation of gas
- Absorption through intact skin
- Absorption through eye contact with liquid or gas

## Effects and clinical syndrome

Damage depends on concentration and duration of exposure, humidity and environmental temperature

### Eyes:

- Eye irritation: tearing, redness, blepharospasm, photophobia
- Periorbital edema
- Corneal ulceration and clouding
- Temporary or permanent loss of vision
- Globe perforation may complicate severe eye exposure to liquid form

PHOTO: OPCW

**PH31**. Tearing, redness and periorbital edema in a patient exposed to mustard

### Respiratory System:

- Runny nose with burning pain, ulceration of nose and oropharynx
- Loss of voice
- Cough, mucosal sloughing, dyspnea, hemoptysis
- Fever
- Chemical pneumonitis and ARDS
- Chemical pneumonitis and ARDS are the most common cause of death

### Skin:

- Itching, erythema (4-12 hrs)
- Blistering and painful vesicles(within 2hrs for Lewisite, within 24-48 hrs for mustards), similar to partial thickness burns

***Note**: skin blisters do not contain mustard*

PHOTO: OPCW

PHOTO: OPCW

PHOTO: OPCW

**PH32**. Skin lesions in patients exposed to mustard

### Gastrointestinal tract:

- Nausea, vomiting, diarrhea

### Systemic Effects:

- Arsenic toxicity after exposure to Lewisite (liver failure, nephritis, neuropathy, hemolysis, encephalopathy)
- Bone marrow depression and pancytopenia, leading to secondary bacterial infections in the skin or respiratory tract
- CNS depression
- Cardiac arrhythmias

## Diagnosis of vesicant exposure

- ❑ The diagnosis is CLINICAL
  - ❑ Urine mustard metabolites (thiodiglycol) may be measured in specialised laboratories
  - ❑ Urine arsenic after suspected exposure to Lewisite

    ***Note**: laboratory tests can be used at a later stage to CONFIRM exposure and should not delay treatment or treatment decisions*

## Management

- ❖ **Decontamination** is CRITICAL:
  - ❑ Remove patient from the agent/area of exposure **and**
  - ❑ Remove agent from the patient
    - Remove clothes and dispose appropriately in double, sealed bags
    - Wash patient's skin with warm soap water or 0,1% hypochlorite solution
    - Remove contact lenses and irrigate eyes thoroughly with NaCl 0,9%, check for corneal injury
    - Do not cause emesis in cases of ingestion.

## Treatment

- ❍ There is NO antidote for mustards
- ❍ There is a specific antidote for Lewisite only, if there is clinical suspicion of exposure **and**
  - ❑ Pulmonary edema
  - ❑ Chemical burn with history of late decontamination (>15 min from exposure)
  - ❑ Skin damage >5% BSA :
    - Administer **Dimercaprol** or British Anti-Lewisite **(BAL)**: 3mg-5mg/kg by deep IM injection every 4 hours for 4 doses
    - Alternatives: **2, 3-DMSA** and **2, 3-DMPS**
- ❍ ABC and supportive care, intensive respiratory support
- ❍ Do not patch eyes: atropine eye drops for blepharospasm and ophthalmic ointment to prevent eyelids from sticking together
- ❍ Burn care for the skin damage: analgesia, debridement, dressings

## Upon serious clinical suspicion of exposure to VESICANTS:

✔ **Protect yourself and your colleagues:**
Make sure that patient is decontaminated **or**
Wear appropriate PPE

✔ **Inform senior clinician**
Do you need to activate emergency response plan in your hospital?

Poison centre
Critical Care Medicine (Burn Unit)
Plastic Surgery
Ophthalmology
consultations may be necessary

✔ **Report ASAP to PH, law enforcement or other services** (e.g. civil protection) according to the established procedure in your state




**References**

1. Heptonstall J, Gent N. CRBN incidents: clinical management & health protection. HPA, London, November 2006. **http://www.hpa.org.uk/web/HPAweb&Page&HPAwebAutoListName/Page/1158934607980**
2. Kales SN, Christiani DC. Acute Chemical Emergencies N Engl J Med 2004;350:800-8.
3. CDC, Blister Agents/Vesicants Information Page: **http://emergency.cdc.gov/agent/vesicants**
4. Baka A., Astriti M. et al. *Handbook of Clinical Management of Communicable Diseases and Agents of Deliberate Release*, Hellenic Centre for Infectious Diseases Control, Athens 2004.


# III.5 NERVE AGENTS (Cholinesterase Inhibitors)

## Agents

G-agents (tabun, sarin, soman, cyclosarin), V-agents (VX, Russian VX)

### Why nerve agents?

Nerve agents are extremely toxic chemical weapons and were manufactured as chemical weapons in large quantities between WWI and II. These agents were used in the Iran-Iraq war in the '80s, as well as in terrorist attacks in Matsumoto (1994) and Tokyo (1996) in Japan. These agents are not used in industry, but quantities of them still exist in the arsenals of various countries and are under the process of destruction. Organophosphate pesticides in general have been banned from use in the EU, but accidental or deliberate (e.g. suicide) exposures are not uncommon in almost all EU MS.

### Odor

- G-agents: clear, colorless liquids, odorless or may smell fruity
- V-agents: brown oily liquid at room temperature, odorless

### Latent Period

- Immediate

### Mechanism of Action

- Volatile liquids, colorless to brown at room temperature, vapors are heavier than air and accumulate in low lying areas
- Nerve agents act similarly to organophosphate pesticides by inhibiting acetylcholinesterase enzymes, causing extreme cholinergic stimulation of CNS, and peripheral muscarinic and nicotinic receptors by the accumulating acetylcholine.

## Exposure

- Inhalation of gas or aerosol
- Absorption through intact skin
- Absorption through eye contact with liquid or gas

## Effects and clinical syndrome

Damage depends on route, dose and duration of exposure

Severe Exposure:

- Pinpoint pupils
- Confusion, agitation
- Convulsions
- Increased respiratory secretions
- Cardiac arrhythmias
- Respiratory arrest and coma
- Death

Mild to Moderate Exposure:

- Pinpoint pupils, red eyes, lachrymation (tearing), blurred vision
- Dizziness, confusion, headache
- Sneezing, coughing, bronchorrhea, wheezing, dyspnea
- Drooling, abdominal cramping, vomiting, diarrhea, urination
- Muscle twitching/tremors, muscle weakness and eventually paralysis
- Tachycardia and hypertension

***Note**: progression of symptoms should alert you for continued exposure, inadequate decontamination or inadequate treatment*

## Diagnosis of nerve agent exposure

- ❑ The diagnosis is CLINICAL
  - ❑ Red cell (RBC) cholinesterase activity
  - ❑ Plasma cholinesterase

***Note**: laboratory tests can be used at a later stage to CONFIRM exposure and should not delay treatment or treatment decisions*

## Management

- ❖ **Decontamination is CRITICAL:**
  - ❑ Remove patient from the agent/area of exposure **and**
  - ❑ Remove agent from the patient
    - Remove clothes and dispose appropriately in double, sealed bags
    - Wash patient's skin with warm soap water or 0,1% hypochlorite solution
    - Remove contact lenses and irrigate eyes thoroughly with NaCl 0,9%
    - Do not induce emesis in cases of ingestion.

***Note**: inadequate decontamination may cause continuing exposure and **progression** of symptoms for the patient, as well as **secondary cases** in the emergency response and medical personnel*

## Treatment

- There is specific antidote for nerve agents, which is lifesaving if administered
  - **Atropine**: (2 mg for adults or 0.05 to 0.1 mg/kg for children, IM/IV every 5-10 min, titrating with respiratory secretions and dyspnea)
  - **Pralidoxime**: 600-1800mg IM or 1g infusion over 30 min
  - **Benzodiazepines**: Diazepam (5 to 10 mg in adults and 0.2 to 0.5 mg/kg in children), for seizures as needed

***Note 1**: treating physicians should be able to recognize and treat possible atropinization*

***Note 2**: organophosphate poisoning may demand large amounts of atropine*

***Note 3**: pralidoxime should be administered ASAP, esp. if nerve agent is suspected, to avoid the "aging" of the agent*

- ABC and supportive care, intensive respiratory support

***Nerve Agent Checklist for Front-line Health Professionals***

**Upon serious clinical suspicion of exposure to NERVE AGENTS or ORGANOPHOSPHATES:**

✔ **Protect yourself and your colleagues:**
Make sure that patient is decontaminated **or**
Wear appropriate PPE

✔ **Inform senior clinician**

Poison centre
Critical Care Medicine consultations may be necessary
Ophthalmology

✔ **Report ASAP to PH, law enforcement or other services (e.g. civil protection) according to the established procedure in your state**

## References


1. Heptonstall J, Gent N. CRBN incidents: clinical management & health protection. HPA, London, November 2006. **http://www.hpa.org.uk/web/HPAweb&Page&HPAwebAutoListName/Page/1158934607980**
2. Kales SN, Christiani DC. Acute Chemical Emergencies N Engl J Med 2004;350:800-8.
3. CDC, Nerve Agents Information Page: **http://emergency.cdc.gov/agent/nerve**
4. Baka A., Astriti M. et al. *Handbook of Clinical Management of Communicable Diseases and Agents of Deliberate Release*, Hellenic Centre for Infectious Diseases Control, Athens 2004.


PHOTO: Tokyo Sarin Incident, 1995

PHOTO: Tokyo Sarin Incident, 1995

# III.6 RIOT CONTROL AGENTS (incapacitating agents, tear gas)

## Agents

BZ, hallucinogens (LSD), lachrymators (CS, CN, Chloropicrin, pepper spray, mace), vomiting agents (adamsite)

### Why riot control agents?

Riot control agents are frequently used by law enforcement around the world for crowd control in demonstrations or for capturing missions. Although not lethal, except in specific circumstances such as confined spaces and for patients with pre-existing morbidity, they can be adequately incapacitating and cause significant mass morbidity.

### Odor

Usually white odorless agents, tear gases may smell like pepper or apples

### Latent Period

- Immediate (secs to min)

### Mechanism of Action

- **BZ**: anticholinergic agent, antagonist of muscarinic receptors
- **Hallucinogens**: 5-HT serotonin receptor agonist, action o sympathetic system
- **Opioids**: liquid, synthetic opioids
- **Lachrymators**: irritants to mucosa and skin
- **Vomiting agents**: action on CNS centre for vomiting

## Exposure

- Inhalation of spray/dust/aerosolized agent
- Ingestion (rare)

## Effects and clinical syndromes

Damage depends on concentration and duration of exposure

- **BZ**: latent period 30min-24hrs, mydriasis and blurred vision, agitation, disorientation and hallucinations, initially tachy- then bradycardia, flushing, hyperthermia, dry skin and mucous membranes, ataxia
- **Hallucinogens**: latent period min-12hrs, visual, acoustic and tactile hallucinations, confusion, hyperthermia, vertigo, ataxia, vomiting, tachycardia, hypertension
- **Opioids**: miosis, seizures and chest rigidity, respiratory depression/arrest, loss of consciousness, coma
- **Lachrymators**: latent period few min, eye and mucous membrane burning, excessive tearing, blepharospasm, corneal ulceration, skin irritation, blistering in prolonged exposure, painful runny nose, loss of voice, salivation, chest tightness, ARDS in severe exposure
- **Vomiting agents**: latent period few min, eye and mucous membrane irritation, burning and tearing, vomiting and malaise for hours

## Diagnosis of incapacitating agent exposure

- ❑ The diagnosis is CLINICAL
- ❑ Opioids and BZ can be detected in the urine

## Management

- ❖ Decontamination:
  - ❑ Remove patient from the agent/area of exposure **and**
  - ❑ Remove agent from the patient
    - Remove clothes and dispose appropriately
    - Wash patient's skin with warm soap water

      ***Note**: hypochlorite solution exacerbates symptoms from lachrymators*
    - Remove contact lenses and irrigate eyes thoroughly with NaCl 0,9%, check for corneal injury

## Treatment

- **BZ**: physostigmine 30-45mg/kg IM/IV, repeat as needed depending on mental status, every 60 min-

  ***Note**: test dose 1mg IM/IV if diagnosis doubtful, IV administration may cause significant bradycardia*

- **Hallucinogens**: benzodiazepines (e.g. diazepam, lorazepam) IV as needed
- **Opioids**: naloxone 0,2-0,4 mg IM/IV and repeat as needed
- **Lachrymators** and **Vomiting agents**: there is NO antidote for these agents. Topical hydrocortisone for skin irritation and antihistamines or burn care if blistering. Respiratory support. Symptoms last for a few hours at the most.
- ABC and supportive care

***Incapacitating Agent Checklist for Front-line Health Professionals***

### Upon serious clinical suspicion of exposure to INCAPACITATING AGENTS:

✔ **Protect yourself and your colleagues:**

Make sure that patient is decontaminated **or**
Wear appropriate PPE

✔ **Inform senior clinician**

Poison centre
Ophthalmology consultations may be necessary

✔ **Report ASAP to PH, law enforcement or other services (e.g. civil protection) according to the established procedure in your state**

## References


1. Heptonstall J, Gent N. CRBN incidents: clinical management & health protection. HPA, London, November 2006. **http://www.hpa.org.uk/**
2. CDC, Riot Control Agents Information Page: **http://emergency.cdc.gov/agent/riotcontrol/**
3. Baka A., Astriti M. et al. *Handbook of Clinical Management of Communicable Diseases and Agents of Deliberate Release*, Hellenic Centre for Infectious Diseases Control, Athens 2004.




# III.7 TOXINS

## Agents

Toxins are proteins or peptides produced by various organisms as part of their defense mechanisms or other physiologic process:

- **Botulinum toxin** from bacterium Clostridium botulinum (see I.2 p24-27)
- **Staphylococcal Enterotoxin B (SEB)** from bacterium Staphylococcus aureus
- **Ricin** and **abrin** from castor oil (Ricinus communis) and rosary pea (Abrus precatorius) plants respectively
- **Terodotoxin, saxitoxin and conotoxin** from marine organisms (puffer fish and marine snails)
- **Mycotoxins** produced from various fungus species such as Fusarium sp, Aspergillus or Penicillium

### Why toxins?

Toxins are in general proteinic substances, which are lethal to humans in very small quantities. They are considered as very high threat agents, although they are found in nature in minute quantities and they are in general hard to produce. Toxins produce nonspecific clinical syndromes which are hard to diagnose, with significant morbidity and mortality and have no known (or hard to obtain) antidotes. Their victims require high quality critical care support which is extremely costly. Finally toxins pose a serious diagnostic challenge, as they are difficult to diagnose either clinically or in a laboratory. Little expertise is available at European or international level.

### Odor

Odorless and tasteless substances

### Latent Period

- Immediate to delayed in hrs (see below)

### Mechanism of Action

- **SEB**: latent period 1-6hrs, exotoxin, super-antigen, activation of cytokine reaction, shock
- **Ricin** and **Abrin**: latent period depends on the route of exposure, for ingestion ranges typically between 6-12hrs, may be less for inhalation (4-6hrs). Both are water soluble, tasteless glycoproteins, cell poisons inhibiting ribosome or mitochondrial function and protein synthesis
- **Tetrodotoxin** and **Saxitoxin**: latent period minutes to a few hours, neurotoxins, inhibit Na+ influx intracellularly and disrupt nerve conduction
- **Mycotoxins**: latent period minutes from skin exposure or 3-12 hrs from ingestion, inhibit protein synthesis, which is followed by a secondary disruption of DNA and RNA synthesis and skin irritant

### Epidemiology

- **SEB**: commonly associated with food poisoning from *S. aureus* but due to its stability, was studied as an incapacitating bioweapon
- **Ricin** and **Abrin**: while the castor oil plant has a worldwide distribution, the rosary plant is native to Indonesia and grows in tropical and subtropical areas of the world, and sporadic cases of poisoning are reported from consumption of its fruit
- **Tetrodotoxin** and **Saxitoxin**: the toxin is produced by bacteria contaminating the intestines of the puffer fish, which live in the Atlantic and Pacific tropical and temperate waters. Sporadic cases of tetrodotoxin food-borne poisoning are reported annually in the Far East, where these fish are considered particular delicacies
- **Mycotoxins**: Trichothecenes may be contaminants of grain crops such as wheat or corn, and are detected in environmental samples in buildings affected by mould, but are also considered incapacitating chemical weapons



## Exposure

- Consumption of contaminated food (e.g. fish) or plant fruit/seeds (e.g. castor beans or rosary peas)
- Skin contamination for mycotoxins or contact with the toxin producing organism
- Injection of the toxin in an attempt for assassination
- Inhalation of aerosolized toxins as a laboratory accident or an act of deliberate release

## Transmission

- No person to person transmission

## Signs and Symptoms

### SEB Toxin Syndrome:

- Non-specific flu like illness,
- Headache, myalgias
- High fever with chills
- Dyspnea, chest pain, cough, may progress to respiratory failure and ARDS (especially if inhaled)
- Multiple organ failure and septic shock in high level exposure

### Ricin & Abrin Toxic Syndrome:

- Fever
- Cough, dyspnea, chest tightness
- Myalgia, arthralgia
- Non cardiogenic pulmonary edema, respiratory failure and ARDS
- Abdominal pain, cramps
- Nausea, vomiting and bloody diarrhea related to ingestion
- Hematuria, liver failure
- Hypovolemia, DIC, multiple organ failure
- Death in 36-72 hrs

### Tetrodotoxin & Saxitoxin:

- ❑ Oral paresthesias progressing to arms and legs
- ❑ Repsiratory failure due to
- ❑ Cranial nerve dysfunction
- ❑ Weakness progressing to paralysis, causing respiratory failure and death

### Trichothecene Mycotoxins:

- Skin and mucous membrane burning pain
- Skin vesicles progressing to necrosis
- Nausea, vomiting, diarrhea,
- Cough, dyspnea progressing to respiratory insufficiency and ARDS
- Bleeding diathesis
- Convulsions and coma

## Diagnosis of Toxins

❑ The diagnosis of most toxin related syndromes is clinical.

❑ Ricin: antibody fluorescent immunoassay and PCR in environmental samples, measurement of ricinine in urine by Mass Spectrometry.

❑ Detection of SEB, Mycotoxins or Tetrodotoxin in food sample/serum/urine in specialized laboratories

## Management of Toxin-related Syndromes

❖ Standard precautions during hospitalisation

❖ Decontamination if a deliberate release incident is suspected involving aerosolized toxin:

- Remove clothes and dispose appropriately in double, sealed bags
- Wash patient's skin with warm soap water or 0,1% hypochlorite solution
- Remove contact lenses and irrigate eyes thoroughly with NaCl 0,9%,
- Contaminated objects or surfaces can be cleaned with 0,1% hypochlorite solution

❖ No vaccines available

❖ No post-exposure prophylaxis available

## Treatment

❍ ABCs

❍ Critical care support

❍ Collect relevant specimens for testing, which need to reach a reference laboratory for toxin detection



## Upon serious clinical suspicion of any clinical TOXIN syndrome:

✔ **Protect yourself and your colleagues:**
standard precautions for infection control

✔ **Inform senior clinician**
If you suspect food borne toxin syndrome, try to collect the suspected foodstuff for testing

ID specialist
critical care — consultations may be needed for your patient
Poison centre/toxicology

✔ **Report ASAP to PH services, according to the established procedure in your region/state**
A single case of toxin poisoning in any EU MS is considered a PH emergency and should be investigated fully regardless of the suspicion of deliberate release

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Tetrodotoxin Information Page: **http://emergency.cdc.gov/agent/tetrodotoxin**
Mycotoxin Information Page: **http://emergency.cdc.gov/agent/trichothecene/casedef.asp**
3. Baka A., Astriti M. et al. *Handbook of Clinical Management of Communicable Diseases and Agents of Deliberate Release*, Hellenic Centre for Infectious Diseases Control, Athens 2004.

Puffer fish producing tetrodotoxin

Ricinus communis

Aspergillus niger, a fungus that produces trichothece mycotoxins

# IV RADIOLOGICAL EMERGENCIES

## Basic Information and Terms

Radiation is a type of ionizing energy, emitted by certain materials which cannot be detected by human senses. It is important to differentiate between a nuclear and a radiological event:

- A nuclear event results from the fusion or fission of atoms, which produces a significant and highly destructive wave of heat, light and radiation.
- A radiological event may involve an explosion and release of generally smaller amounts of radiation compared to a nuclear event.

The radiation injury suffered by persons involved in a radiological incident depends on:

- The dose of radiation received
- The type of radiation (alpha, beta or gamma)
- Whether the exposure involves internal or external contamination

Cells that multiply regularly are in general more sensitive to radiation, which in turn means that some body organs, like the bone marrow, are more radiosensitive compared to others.

### Why radiological threats?

All types of radioactive sources or material used for industrial or medical purposes pose radiological threat and may cause a radiological emergency. Such events may involve the misuse of abandoned sources, transport emergencies, accidental leaks or spills of radioactive material or intentional use of radioactive material in conjunction with explosives (Radiation Dispersion Device (RDD) or "dirty bomb").

### Latent Period

Minutes to days after the exposure, depending on the dose of radiation absorbed.

## Mechanism of Action

- Direct: radiation acts directly on tissues and causes biological changes
- Indirect: radiation acts on tissue water which becomes ionized and by creating free radicals it binds to proteins, enzymes and other molecules and causes biological changes

The effects of radiation on live cells are

- Stochastic: where the dose is related to the increasing possibility of occurrence of an effect (carcinogenesis, genetic effects).
- Non-stochastic: which are directly dose dependant and outlined in Table IV.1.

## Exposure

- Radiation exposure occurs when this particular type of energy penetrates the human body to cause its effects.
- Factors determining the exposure to radiation are mainly:
  - **Time**: shorter time means shorter exposure
  - **Distance**: the longer the distance from the source means less exposure
  - **Shielding**: barrier between the body and the source means less exposure.
- *Internal contamination* signifies inhalation, ingestion or contamination of open wounds with radioactive dust or other material.
- *External contamination* implies the existence of radioactive dust or other material on the skin, hair or clothing of the exposed person.

## Acute radiation syndrome (ARS)

- Acute radiation exposure in high dose, usually in short time, on large body surface area, to penetrating radiation results in acute radiation syndrome.
- Symptoms occur in 4 phases: prodromal, latent, illness, recovery/death and depend on the amount of the absorbed radiation dose.

The following tables IV.1 and IV.2. present an overview of the symptoms per radiation dose and a clinical scoring system for the prediction of clinical outcome of radiation exposed patients.



**PH33**. Photo of a vary dangerous ionizing source from a radiography machine

*Table IV.1: Effects and Symptoms according to the dose of exposure*

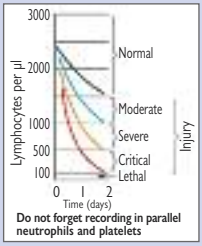
| Dose in Sv[1] | Effects and Symptoms |
|---|---|
| 0.005 (5mSv) | Asymptomatic |
| 0.1 (100 mSv) | Asymptomatic, minimum dose detected by chromosome analysis |
| 0.5 (500 mSv) | Asymptomatic, recurrent nausea and vomiting in <10% exposed, transient lymphocyte and platelet depression |
| 1.0 | 15% presents recurrent nausea and vomiting within 2d after exposure |
| 2.0 | Nausea and vomiting in the majority of exposed, anorexia, skin damage (itching, erythema), hair loss |
| 4.0 | Nausea, vomiting and diarrhea within 48hrs, skin damage (burns), hair loss, serious bone marrow depression (hematopoietic syndrome), 50% mortality without treatment |
| 6.0 | Severe hematopoietic syndrome, 100% mortality within 30d without treatment, 50% mortality with treatment |
| 7.0 | Gastrointestinal syndrome: early nausea, vomiting, fatigue, severe bone marrow depression, death in 2-3 weeks |
| >20.0 | CNS syndrome: immediate explosive vomiting and diarrhea, headache, altered consciousness, coma, convulsions, shock, death in 24-72 hrs |

[1] **Equivalent dose** measured in Sievert (Sv), to account for the different effects of the different types of radiation (equivalent dose = absorbed dose x radiation weighting factor), where 1 Sv = 1 Gy for gamma rays.

## *Table IV.2: Clinical Score for patient management in the first 48hrs after exposure*

**Primary scoring**
**Record all clinical symptoms on a date and hour-stamped chart**

| | Score I | Score II | Score III |
|---|---|---|---|
| Average delay before symptoms appear | Less than 12 hrs | Less than 5 hrs | Less than 30 minutes |
| Cutaneous erythema | 0 | +/- | +++; before 3rd hour |
| Asthenia | + | ++ | +++ |
| Nausea | + | +++ | (-) |
| Vomiting per 24 hrs | Maximum 1 | 1 to 10 | Above 10; intractable |
| Diarrhea / Number of stools per 24 hrs | Maximun 2-3; bulky | 2-9; soft | Above 10; watery |
| Abdominal pain | Minimal | intense | Excruciating |
| Headaches | 0 | ++ | Excruciating; Signs of intra-cranial HT |
| Temperature | Below 38°C | 38-40°C | Above 40°C |
| Blood pressure | Normal | Normal - Possible temporary decrease | Systolic below 80 |
| Temporary loss of consciousness | 0 | 0 | + / Coma |



**Do not forget recording in parallel neutrophils and platelets**

| Depletion of blood lymphocytes | | | |
|---|---|---|---|
| At 24 hrs | Above 1.500 / µl | Below 1.500 / µl | Below 500 / µl |
| At 48 hrs | Above 1.500 / µl | Below 1.500 / µl | Below 100 / µl |
| | **Outpatient monitoring** | **Hospitalisation for curative treatment** | **Hospitalisation (MOF predicted)** |

The score assumes whole body or large parts of the body external exposure. Source: European Consensus Conference (EBMT, European group for Bone Marrow Transplantation, Ulm University-Germany and IRS, Institut de Radioprotection et de Sûreté Nucléaire-France).



## Diagnosis of radiation exposure

- Radiation can be detected only by specific equipment, e.g. Geiger counter
- Radiation detected on nasal or oral swabs indicate internal contamination by inhalation or ingestion.
- Complete Blood Count (CBC) with white cell differential (immediately as baseline and then every 4hrs for 12hrs followed by every 6hrs for 48hrs) to monitor absolute lymphocyte count (Andrews Lymphocyte Normogram, to predict severity of radiation injury).


Geiger counter

## Management

- Decontamination:
  - Remove patient from the agent/area of exposure **and**
  - Remove agent from the patient
    - Survey patient with appropriate radiation detection equipment, document result
      - Carefully remove clothes and dispose appropriately in double, sealed bags
    - Repeat patient survey with radiation detection equipment, document result
      - Wash patient's skin carefully with warm soap water or 0,1% hypochlorite solution
      - Remove contact lenses and irrigate eyes thoroughly with NaCl 0,9% solution, check for corneal injury
    - Repeat patient survey with radiation detection equipment, document result

      ***Note 1**: may need to repeat washing until radiation level is twice the background or remains unchanged.*

      ***Note 2**: decontamination of contaminated victims should be done as soon as possible **BUT it should not delay/interfere with life threatening interventions. (Fig. IV.1).***

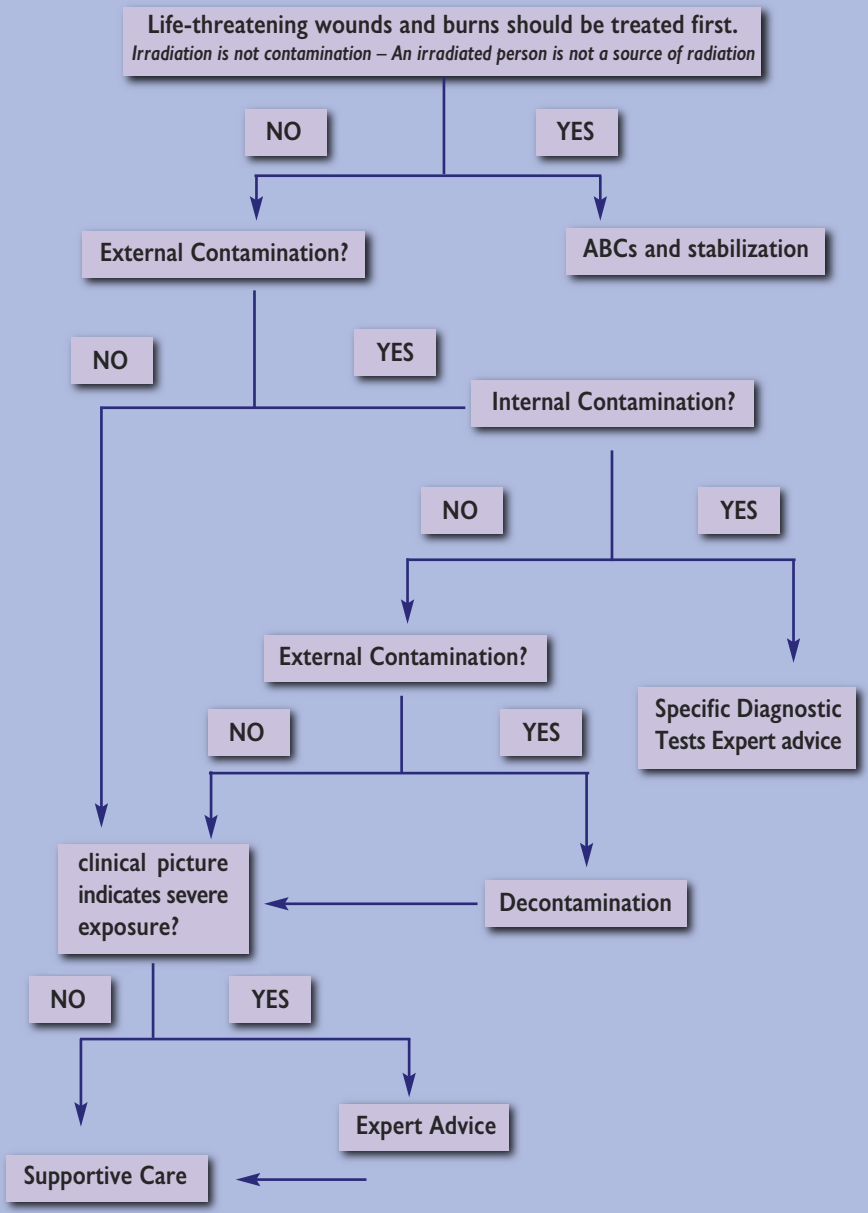
      ***Note 3**: persons who have been exposed to radiation but are NOT externally contaminated do not require decontamination.*

## Treatment

- ABCs
- In the event of internal contamination
  - Specific agents may be available to dilute or compete with their radioactive counterpart or help eliminate specific radionuclides (e.g. potassium iodide for radioactive iodine (I-131) to protect the thyroid gland, Prussian Blue for radioactive thallium or cesium (Cs-137), DTPA for plutonium and americium, deferoxamine for plutonium and iron, stable strontium, calcium, zinc and iron to compete with the respective radioactive elements
  - Diuresis helps with the removal of tritium, as well as radioactive sodium and potassium
  - Gastric lavage and cathartics may also be needed for the excretion of the radioactive agent
- Frequent reassessment and monitoring blood tests, as per experts
- Supportive care:
  - Analgesia,
  - Symptomatic treatment for nausea, vomiting and diarrhea,
  - Aggressive prevention/treatment of infections,
  - Use of hematopoietic growth factors.
- In whole body exposure, surgeries need to be performed within 48hrs or after recovery of the bone marrow



*Fig. IV.1: Algorithm for the management of persons involved in a radiological emergency*



## Upon serious clinical suspicion of exposure to RADIATION:

✔ **Protect yourself and your colleagues:**

Make sure that patient is decontaminated BUT do not delay ABCs
Need for radiation detection equipment
Standard precautions are usually enough
FFP3 masks are preferred

✔ **Inform senior clinician**

Hospital Radiation Safety
Haematology consultations may be necessary

✔ **Report ASAP to PH services and Radiation Protection Authority** according to the established procedure in your state



### References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# V TRIAGE

As mentioned at the beginning of this handbook, disasters either natural or man-made are usually connected with health crises involving multiple casualties. Mass casualty situations create a discrepancy between the medical resources available for treatment and the number of casualties. A mass casualty incident (MCI) is usually defined as one involving >5 victims, which strains the medical resources available but does not overwhelm them. A mass casualty event (MCIE) is a situation involving usually >20 patients that completely overwhelms the health system of the area.[1]

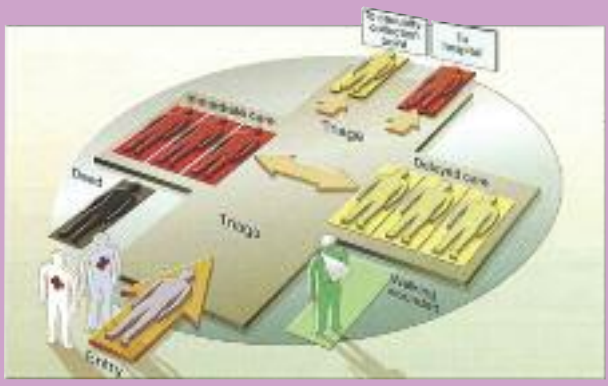
A frequent assumption by the planners and the authorities in general, is that in a mass casualty situation:

- there is prompt formation of a unified command for the on-scene management of the incident
- there is coordinated transport of patients from the site to the receiving health care facilities
- first aid is given by medical and paramedical personnel.

But in **reality**, according to reviews of disasters the situation usually develops as follows:

- the on-scene unified command forms late or not at all
- first aid is given by survivors of the incident and bystanders
- patients are transported with any available means to the closest health care facility.[2]

Depending on the capacity of each healthcare facility the threshold number of casualties, which will prove critical for providing the standard of care varies widely. Understanding this discrepancy between the needs created in the community and the medical resources available is critical in the response phase to such an incident as the medical personnel will need to make life and death decisions: severely ill or injured patients may need to wait until others with greater likelihood of survival are treated first in a process called triage.[1] Severe resource constraints mandate a change in the standard of care that can be delivered.




Triage is the procedure applied to resolve the discrepancy between the number of casualties and the capacity for care by applying a simple rule in order to "do good for the largest possible number of

persons". The aim is to prioritize

- according to severity of injuries and
- according to the availability of medical care,

in order to facilitate the management of the largest number of casualties (e.g. priority for evacuation, for transportation to health care facilities, for surgical or other specific treatment).

Triage should be performed repeatedly during the development of an MCE. It can be used at the scene in the prehospital setting to determine rescue priority or treatment, transportation and evacuation priorities, but also at the receiving end of the health care facility for similar reasons (i.e. treatment, surgical management priority etc). Triage priorities should be re-evaluated frequently especially in mass casualty situations, as patients tend to change priority category.

Triage can be performed by experienced medical, nursing or paramedical personnel. Staff needs to be rotated frequently as triage exacts a high physical and psychological toll on personnel. Casualty priorities are usually color coded or are referred to as Class I-IV.

Special considerations during triage decisions should be given to:

- children
- elderly
- patients exposed to RBC agents, as appropriate and speedy decontamination may factor in the decision.

Triage tools are frequently accompanied by specifically developed cards to accompany each patient; some examples are shown in the next page. In mass casualty situations simple solutions such as relevant colour bracelets or plain coloured tape can be used to expedite the procedure, as well as help indicate the decontamination status of the patient (i.e. one colour for triage priority and one for decon status).

START (Simple Triage And Rapid Treatment) triage system is one of the many available triage systems used in mass casualty incidents aiming to ensure care for as many casualties possible, according to the available resources. START triage was developed jointly by the staff of the Hoag Hospital Newport Beach and the Fire and Marine Department in California, USA[3].

Due to significant differences in physiology and injury patterns of children, JumpSTART was developed in order to provide an objective framework for the triage of injured children.[4] JumpSTART's objectives are:

- to optimize the primary triage of injured children in the MCI setting
- to enhance the effectiveness of resource allocation for all MCI victims
- to reduce the emotional burden on triage personnel who may have to make rapid life-or-death decisions about injured children in chaotic circumstances.

It is important to note that because of the infrequent use of disaster triage and the difficulty of collecting accurate data in disasters, none of the existing triage tools have been clinically validated in the disaster setting.

START triage is a simple algorithm based on the ABCs of Basic Life Support for the decision making. The priority categories for casualties are:

| | |
|---|---|
| **immediate** | Casualties that need immediate attention for life saving procedures (e.g. intubation, pneumothorax management etc) |
| **urgent** | Casualties that need urgent attention to prevent loss of limb or life (e.g. head injuries, limb fractures, vascular or ocular injury) |
| **minimal** | Casualties with simple injuries or psychological effects only (e.g. cuts and abrasions) |
| **expectant** | Casualties that are dead or dying, cannot be cared for in the current situation and with the available resources |

## References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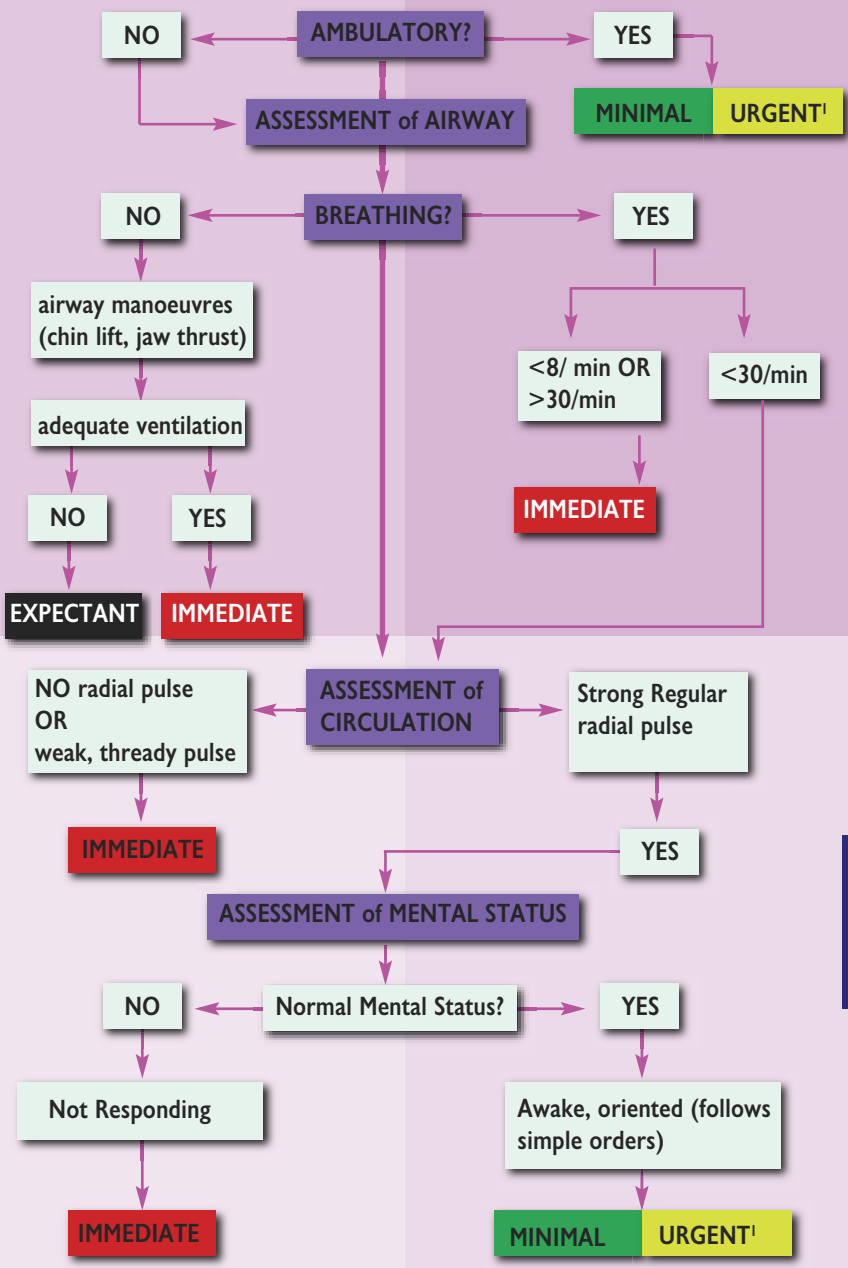
2. Disaster Response: Principles of Preparation and Coordination. Erik Auf der Heide, **http://orgmail2.coe-dmha.org/dr/flash.htm**
3. **www.start-triage.com**
4. **www.jumpstarttriage.com**, developed by Lou Romig MD, Miami Children's Hospital, Florida, USA


*Fig.V.I: START Triage algorithm*




[1] the assignment of a patient in Green or Yellow priority category will then depend on other concomitant injuries, e.g. limp fractures etc

# VI MANAGEMENT OF CONTAMINATED PATIENTS

## VI.I Basics of on-scene management and response

PHOTO: courtesy Tim Brooks, HPA.

**Fig V.I.:** *This figure outlines the factors that most influence the dissemination of an agent in the environment and therefore the establishment of hot, warm and cold zones.*

In the case of an overt incident involving a chemical or radiological threat a command and control structure will need to be rapidly established, usually near the scene of the incident. Standardized patterns for the organization of the response to an incident, so that everyone understand their role and are able to collaborate with each other, are needed. Such an example is shown in Table VI.I.

| *Table VI.I.* | *The D I S A S T E R Paradigm*[1] |
|---|---|
| D | Detection / Declaration |
| I | Incident Command |
| S | Safety / Security |
| A | Assess Hazards |
| S | Support Services |
| T | Triage / Treatment |
| E | Evacuation |
| R | Recovery |

The first act of the incident commander would be to establish control of the site for the protection of attending emergency services, casualties and the wider public. This involves the establishment of an exclusion zone ("the hot zone"), where there is a risk of direct contamination from chemical exposure. It is therefore accessed only by specifically trained rescue personnel wearing gas tight (also referred as Type A) PPE and self- contained breathing apparatus (SCBA).

Casualties are brought by the rescue team to the contamination reduction zone ("warm zone") where decontamination takes place. The risk in this zone is from indirect exposure to chemicals

from contaminated casualties and equipment. Therefore, workers in this zone (ambulance, paramedical and medical staff) require liquid tight PPE. Following decontamination, casualties enter the support zone ("cold" zone) before transportation to hospital, if required. The command post, as well as any medical aid and decontamination stations, is always established upwind, uphill and up water of the incident, to prevent further contamination or exposure of the operating personnel. Fig. VI.1 presents some of the most important factors that play a significant role in the dispersion of an agent and should factor in the decisions to establish zones, command post, medical aid and decontamination stations.

It needs to be noted that ambulatory patients from any incident (accidental or terrorist) may present to the closest medical facility and therefore they always present a challenge for the control of the incident and the proper response of the health sector in the area.

## VI.2 Basic Decontamination Process

This chapter aims to give a brief overview of the process and the issues involved in the decontamination of persons exposed to biological or chemical agents or radioactive dust for the Front Line Health Professional (FLHP). Decontamination of exposed persons follows the same basic principles for all types of agents in accidental or deliberate exposures. Exposure to biological agents is usually not perceived by humans and it remains to be

detected by the clinical syndrome developed after the incubation period of the particular agent. In this case the patients presenting in the health care facilities do not need to undergo decontamination. In particular cases though, where there is a believable threat (e.g. powder sent by mail) there may be need to also decontaminate persons exposed to biological agents.

In short, based on the history of the particular incident and the relevant risk assessment the medical personnel involved need to decide first on the need and then on the best approach for effective decontamination with the least possible delay.

Casualties are brought by the rescue team to the contamination *reduction zone* ("warm zone") where decontamination takes place. The risk in this zone is from indirect exposure to chemicals from contaminated casualties and equipment. Therefore, workers in this zone (ambulance, paramedical and medical staff) require *liquid* tight PPE. Following decontamination, casualties enter the *support zone* ("cold" zone) before transportation to hospital, if required.

All patients exposed to RBC agents through accidental or intentional release should be decontaminated **before entering** any facility (the Emergency Department or other treatment area) in order to protect

- the health care staff,
- the hospital environment, avoiding its contamination
- the other patients in the hospital and
- as part of the clinical management of their exposure.

The decontamination area should be prepared in advance or created ad hoc, but it needs to provide on one hand some privacy and on the other full access to running water. Various solutions are available for portable or permanent structures for the health care facilities.

The **single most important step for the decontamination** of patients exposed to biological, chemical or radioactive material is the prompt and complete **removal of the patient's clothing**. In order to achieve this promptly and smoothly FLHPs should consider the need for triage of the exposed persons before decontamination primarily in ambulatory and non-ambulatory patients and secondly in the groups according to the triage system used in the particular health care facility, as presented in the previous chapter.

## Non-ambulatory patients

Health care professionals need to assist or perform the decontamination of these patients in a different line from the ambulatory patients, following basically the same procedure as described below with the patient lying on the stretcher. Special consideration should be given to open wounds, which need to be irrigated copiously with Normal Saline (0,9% NaCl).

## Ambulatory patients

Some considerations for ambulatory patients include:

- Provide clear instructions and a number of health professionals to oversee the process, especially if you are dealing with multiple patients
- Provide privacy in order to unclothe
  - ❏ Separation of sexes may be needed, especially if people with different religious beliefs are involved in the incident
  - ❏ Avoid separation of family members to minimize their anxiety
- The process of applying soap and rinsing should each last at least 5-10 minutes
- Provide clothing for the decontaminated, "clean" victims
- Need for a means to indicate "clean" status (e.g. coloured wrist band, triage card, labet etc.)

## VI.3 Basic Principles for human decontamination

- Remove clothes carefully

  ***Attention***: you may need to cut the clothes off in non-ambulatory victims

- Double-bag clothes and seal them. They need to be disposed appropriately, according to agreed procedure or expert advice.
- Remove jewelry, eye glasses and contact lenses. Jewelry and eye glasses need to be double-bagged and sealed and decontaminated in a second phase. If eye glasses are absolutely necessary they need to be decontaminated carefully. Contact lenses need to be discarded.
- Skin should be washed carefully and thoroughly. In most cases using soap and copious amount of warm water is more than enough.
- The water temperature should be close to the one in the human body, to avoid hypothermia or excessive skin circulation, which in certain cases could result in increased absorption of the agent sitting on the skin.
- Instead of soap and water some experts suggest the use of hypochlorite solution of various densities, but 0,1% is preferred to avoid excessive skin and mucous membrane irritation.

  ***Attention***: skin folds (e.g. axilla, under breasts etc) should be thoroughly washed and rinsed

  ***Attention***: irrigate eyes with normal saline (0,9% NaCl) solution to avoid irritation and check for corneal abrasions

  ***Attention***: irrigate open wounds with normal saline (0,9% NaCl) solution to avoid irritation

## VI.4 Special Considerations for the Decontamination Process

- Removal of clothes is usually adequate decontamination of patients exposed to gases, with the exception of patients exposed to nerve agents
- Remove first any solid particles (dust or larger particles) from naked skin by sweeping, **before** rinsing with water
- In case of decontamination of persons exposed to a biological agent, the removal of clothing should be careful so as not to create aerosol or alternatively it should be done under running water.
- Decontamination of patients exposed to mercury
  - ❑ Mercury is highly toxic and volatile, even a household or laboratory thermometer contains dangerous quantities of mercury

- ❑ Removal of contaminated clothing needs to be very careful to avoid inhalation by the patient and the assisting team

- Decontamination of radioactive material (dust or particles)
  - ❑ Need for Geiger counter to assess complete decontamination
- Some emergency response services or emergency departments may have available chemical detection equipment to assess complete decontamination for certain chemical agents
- Waste water after the decontamination process maybe considered hazardous in some MS, which implies strict regulation of its containment and disposal. In other MS there maybe little or no legislation available on this issue. Many experts argue that, especially in the case of mass decontamination of numerous exposed victims, this cannot be achieved and the dilution of waste water in the sewer system would be more than enough.
- Waste water after the decontamination process may be considered hazardous material in some MS, which implies strict regulation of its containment and disposal. In other MS, little or no legislation may be available on this issue. Many experts argue that, especially in the case of mass decontamination of numerous exposed victims, this cannot be achieved and the dilution of waste water in the sewer system would be more than enough to ensure that the environment is not polluted.

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# VII PSYCHOLOGICAL EFFECTS OF HEALTH CRISES AND TERRORISM

As mentioned at the beginning of this handbook, oftentimes a disaster is interconnected or leads to a health crisis with multiple people being displaced, injured or loosing their lives and in general it affects a community in multiple ways. The psychological effects of a health crisis have been recognized as one of the most significant on the exposed population, and in need of specific management that involves increased awareness of the problem in the first responders and the medical personnel involved, appropriate risk and crisis communication during the event and mental health follow up after the event.

FLHPs may not only be the first responders who have the opportunity to identify psychological distress but may in fact be the only health care professionals to identify, triage and begin interventions to promote adjustment and coping for the people involved . It is important to acknowledge and understand the effect of stress on patients as:

- Psychological stress may present with symptoms mimicking serious conditions (tachypnea, tachycardia, confusion, pain etc)
- Even in the case of actual injury or disease being the reason for a patient's symptoms, coexisting psychological stress may worsen and complicate medical management.
- Distressed patients cannot provide accurate history in order to facilitate prompt triage and management, especially in an MCE.
- Distressed or agitated patients are less likely to cooperate and follow instructions, or behave in a predictable manner, in order to facilitate the emergency management of the event.

Terrorism has been defined as "the illegal use or threatened use of force or violence; an intent to coerce societies or governments by inducing fear in their populations". The key word in this definition is the word "fear", which reveals that apart from causing mass casualties, terrorism aims at causing widespread confusion, fear and psychological stress.

These indirect effects have lasting consequences on people's mental health and may affect the social and economic life of a society for months or

years following a "traumatic" event , act of terrorism or not. The effects of any traumatic incident affect not only the immediate casualties, but also their families and colleagues, the first responders and health professionals who care for them.

On the other hand, all traumatic incidents (natural or man-made) that cause fear can be accompanied by physical symptoms of anxiety that may mimic exposure to an agent and require differentiating by the treating physicians.

In the following paragraphs, we aim to outline the key points with regards to:

- the characteristics of the vulnerable groups, which experience psychological trauma depending on whether they are directly or indirectly affected by the event
- the symptoms of Post Traumatic Stress Disorder (PTSD) that may follow a terrorist act or other traumatic incident and
- ways to prevent and cope with psychological effects and avoid massive panic.

## Vulnerable groups:

- **Individuals affected by and/or involved in the incident**
- **Families of individuals affected by and/or involved in the incident**
- **Children**
- **First responders:** usually referring to police, fire-fighters and emergency medical personnel
- **Health care professionals** (front line health professionals, usually in the Emergency Departments (ED)
- **Persons with pre-existing illnesses or psychological disorders**

## Remember that psychological effects on an individual depend on their:

- **Personality**
- **Age and personal experiences in life**
- **Cultural and religious or philosophical background**
- **Educational background**
- **Physical and mental health status** (history of trauma, unresolved anxieties, and pre-existing chronic illness)
- **Social support**
- **Whether affected by and/or involved**
- **Size and personal distance from the event**
- **Physical injuries**
- **Personal losses** (Relatives, friends, job loss, material loss, loss of trust and/or faith to civil structures, traumatic experiences)

## Symptoms after a traumatic incident:

**Emotions**

- Feeling nothing
- Sadness, grief, fear, anger, irritability, violate emotions
- Anxiety disorders
- Avoidance of thoughts, places, actions and people

**Cognition**

- Difficulty in concentrating
- Poor or loss of memory
- Disorientation
- Loss of or reduced interest
- Re-experiences: pictures, sounds, odors, motion experiences

**Physical Symptoms**

- Tiredness, exhaustion
- Dizziness, nausea
- Various aches and pains, mainly headaches
- Shaking or tremor
- Breathing difficulties
- Palpitations or other heart problems

**Other**

- Problems with substance use
- Refuse self-care: not eating, not washing/bathing, not changing clothes
- suicidal or homicidal thoughts, feelings or plans

**Wide Public Health Impact**

## Preventing / coping with psychological effects and PTSD:

### A. Education and Preparedness

- **Train mental health professionals in your hospital**, especially for assisting after acute traumatic incidents
- **Involve your mental health professionals in the preparedness** phase of an incident
- **Instruct, inform, train and sensitize all possible crisis helpers** (even informal care providers in your hospital) about the specific needs of acute traumatized people, as well as how to handle vulnerable groups such as children
- **Assist and participate in relevant training activities for the public** in your community to respond to a disaster

### B. During the Response to an acute incident

- **Involve your mental health professionals** right from the first hours of an incident
  - ❑ **Acute psychological counseling** for victims and individuals involved or directly affected
  - ❑ **Psychosocial support for victims' families**
  - ❑ **Activate a professional call center as early as possible**
- **Basic rules** to protect first responders and health care professionals in an emergency
  - ❑ **Ensure staff safety and security**
  - ❑ **Ensure rotating shifts** of maximum 12 hrs duration
  - ❑ **Provide frequent breaks** in quiet and private areas for resting
  - ❑ **Provide confidential psychological support for the staff**
- **Induce proper crisis communication at your level** in order to avoid mass panic reactions


**References**

1. Benedek DM, Holloway HC, Becker SM, *Emergency mental health management in bioterrorism events.* Emerg Med Clin North Am 2002, 20(2):393-407
2. Health Science Policy Program of the Institute of Medicine, Board on Environmental Studies and Toxicology of the National Research Council (1999) Prevention, Assessment, and Treatment of Psychological Effects In: *Chemical and Biological Terrorism: Research and Development to Improve Civilian Medical Response.* National Academy Press, Washington, D.C.
3. Heptonstall J, Gent N. *CRBN incidents: clinical management & health protection.* HPA, London, November 2006. **http://www.hpa.org.uk/web/HPAweb&Page&HPAwebAutoListName/Page/1158934607980**
4. Hyams KC, Murphy FM, Wessely S, *Responding to chemical, biological, or nuclear terrorism: the indirect and long-term health effects may present the greatest challenge.* J Health Polit Policy Law 2002, 27(2):273-291
5. Tanielian T, Stein B (2006) *Understanding and Preparing for the Psychological Consequences of Terrorism.* RAND
6. Foltin G, Tunik M, Treiber M, Cooper A. Pediatric Prehospital Disaster Preparedness Resource. New York, NY: *Center for Pediatric Emergency Medicine*; 2008. **http://cpem.med.nyu.edu/frontpage**

# VIII ADDITIONAL SOURCES OF INFORMATION

A large number of references are included in the CD-ROM that accompanies this handbook, but a short selection of trusted sources for biological, chemical and radiological agents, as well as other health threats is referenced here for more convenience.

1. European Centre for Disease Prevention and Control
   **www.ecdc.europa.eu**
2. European Commission
   **http://europa.eu/index_en.htm**
   a. DG SANCO:
      **http://ec.europa.eu/health/index_en.htm**
      i. Bioterrorism:
         **http://ec.europa.eu/health/ph_threats/Bioterrorisme/bioterrorisme_en.htm**
      ii. Generic Preparedness
         http://ec.europa.eu/health/ph_threats/com/preparedness/preparedness_pillars_en.htm#6
      iii. Communicable Diseases
         **http://ec.europa.eu/health/ph_threats/com/comm_diseases_en.htm**
3. Health Protection Agency, UK
   **www.hpa.org.uk**

   Deliberate and Accidental Releases:
   **www.hpa.org.uk/infections/topics_az/deliberate_release/menu.htm**
4. Robert Koch Institute, Berlin, Germany
   **http://www.rki.de/**
   a. Biologische Sicherheit
5. Centres for Disease Control and Prevention, Atlanta, USA
   **www.cdc.gov**
   a. Emergency and Response:
      **http://emergency.cdc.gov/**

i. Bioterrorism Emergencies:
**http://emergency.cdc.gov/bioterrorism/**

ii. Chemical Emergencies:
**http://emergency.cdc.gov/chemical/**

iii. Radiation Emergencies:
**http://emergency.cdc.gov/radiation/**

iv. Mass Casualty Event Preparedness and Response:
**http://emergency.cdc.gov/masscasualties/**

v. Infection Control in Healthcare Settings
**http://www.cdc.gov/ncidod/dhqp/index.html**

6. World Health Organisation
**www.who.int**

   a. Bioterrorism:
   **http://www.who.int/topics/bioterrorism/en/**

   b. Preparedness for Deliberate Epidemics:
   **http://www.who.int/csr/delibepidemics/en/**

   c. Disease Outbreak News:
   **http://www.who.int/csr/don/en/**

7. Organisation for the Prohibition of Chemical Weapons (OPCW)
**http://www.opcw.org/**

8. International Atomic Energy Agency
**www.iaea.org**

   a. Publications
   **http://www.iaea.org/Publications/index.html**

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