SAINT BARNABAS HEALTH CARE SYSTEM
New Jersey's Health Care Leader

Introduction to Weapons of Mass Destruction

Course Outline

New Jersey Preparedness Training Consortium

■An association of public health agencies tasked by the federal government with providing Weapons of Mass Destruction and Terrorism education to health care providers

■Traditional WMD education targets have been physicians, nurses and EMS workers

New Jersey Preparedness Training Consortium

■Consortium Members

■Saint Barnabas Health Care System

■University of Medicine and Dentistry of New Jersey

■Rutgers, the State University

■New Jersey Primary Care Association

■New Jersey Hospital Association

■Liberty Health

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The Center for Health Care Preparedness

Established as a *center of excellence*, furthering education and research in the field of health care disaster readiness

Why you need to be prepared:

■**Catastrophic Natural Disasters**

■Weather related

■floods, hurricanes, electrical storms

■Geophysical events

■earthquakes, volcanoes, tsunamis

■**Emerging/Re-emerging Infections**

■SARS, Avian Influenza

■West Nile virus, Monkeypox, Lassa fever

Why you need to be prepared:

■**Technological Disasters**

■Chernobyl, Bhopal, Three Mile Island

■**Terrorism**

■Conventional

■explosives, incendiaries

■Non-conventional

■nuclear, biological, chemical attacks

Role of Health Care Providers

■Awareness
■maintain a high index of suspicion… be on the alert
■Recognition
■know the common signs and symptoms
■Response
■Personal protection and infection control
■Meet patient's acute care needs
■Implement facility response protocol
■Notifications:
▪Clinical / Psychosocial referral
▪Law enforcement
▪Public health
■Participation
■Drills and exercises

Weapons of Mass Destruction

■Terrorism involving weapons of mass destruction is an ever-present threat in today's world
■As a hospital care provider, you may be called on to deal with patients involved in an incident involving WMDs

■Weapons of Mass Destruction:
■are chiefly designed to incite terror, not to kill
■consist of a variety of different agents
■can be delivered through a variety of different means
■can be extremely difficult to control
■are designed to cause *widespread* and *indiscriminate* death and destruction

Useful mnemonics to categorize WMDs:

B NICE	**CBRNE**
B Biological	**C** Chemical
N Nuclear	**B** Biological
I Incendiary	**R** Radiological
C Chemical	**N** Nuclear
E Explosive	**E** Explosive

Chemical
Weapons of Mass Destruction
Why CW are attractive to terrorists:
■They are inexpensive to manufacture to obtain
■Simple technology is needed to produce them
■They are difficult to detect
■They are highly efficient (little quantity is needed)
Nerve Agent Lethality

An amount of VX equal in size to one column of the Lincoln Memorial on the back of a penny would be *lethal* to you

Sources of CW Agents

■Foreign governments
■Internet recipes
■"Black Market" of the former Soviet Union
■U.S. chemical plants (Chlorine, Phosgene, etc.)
■U.S. Military Stockpile
■30,600 tons of nerve agents and vesicants at 8 sites across U.S.
■1985 law directed DoD destroy stockpile by 2004
■Outdated and recovered CW are buried at 215 sites across U.S.

Items that don't mix…

Risks from Chemical Agents

■Detonation of CWA-containing munitions
■Atmospheric Dispersal
■Contamination of Food or Water Supplies
■Product Tampering

Recent Chemical Terrorism Events

■1995: Aum Shinrikyo cult releases Sarin vapor into Tokyo subway
■12 deaths and 5,500 casualties
■*4,000 w/o clinical manifestation of injury*

■1993: World Trade Center Bombing
■Explosive contained sufficient cyanide to contaminate entire building
■Cyanide destroyed in blast

Classification of Chemical Weapons

■Chemical agents are classified by the toxic effects they have on the body
■**Chief Categories of Agents:**
■Nerve Agents
■Vesicants or Blistering Agents
■Choking or Pulmonary Agents
■Blood Agents
■Incapacitating or Riot-Control Agents

Nerve Agents

■Action: Irreversibly bind to acetylcholinesterase (AChE), the enzyme that terminates the action of the neurotransmitter acetylcholine (ACh)
■Leads to accumulation of acetylcholine, resulting in:
■*Muscarinic Effects: small pupils, dim vision, smooth muscle contraction, copious hypersecretion (sweat, tears, runny nose)
■Nicotinic Effects: skeletal muscle weakness, paralysis
■CNS Effects: changes in mood, decreased mental status, seizures, coma... respiratory failure and terminal arrhythmia
■Ex: Sarin (GB), Soman (GD), Tabun (GA), VX Gas

S.L.U.D.G.E.

Muscarinic Effects of Nerve Agents

Salivation
Lacrimation
Urination
Diaphoresis
GI distress (diarrhea, vomiting)
Emesis

Nerve Agent Antidote: MARK I Kit

■Self-injectable needle
■Pralidoxime Chloride (600 mg)
■Atropine (2 mg)

Vesicants / Blister Agents

■Produce severe blisters and chemical burns, effecting epithelium of the skin and respiratory tract
■Slow acting: causes death in 48-72 hours
■Fatality due to:
■Impaired gas exchange (hypoxia)
■Loss of body fluids
■Secondary infection
■Skin and eyes affected first, then lungs and bone marrow
■Once symptoms have begun, decontamination is no longer effective
■Ex: Mustard Gas, Lewisite

Pulmonary Damaging Agents

■Immediately irritating to the bronchial tree
■Early effects:
■rhinitis/pharyngitis
■tearing
■eyelid spasm
■upper respiratory tract irritation
■Later effects:
■severe pulmonary toxicity
■respiratory failure
■Ex: Phosgene, Chlorine

Blood Agents or Cyanides

■Combines with a cellular enzyme inhibiting the body's ability to transport oxygen to vital organs
■Quick acting: causes death in minutes
■Relatively large dose needed to be effective
■Initial effects: rapid/deep breathing, anxiety, agitation, dizziness, weakness, nausea, muscle trembling
■Later effects: loss of consciousness, decreased respirations, seizures, arrhythmias
■Ex: Hydrogen cyanide

Riot Control Agents

■Potent lacrimators and irritants
■Effects are believed to be transient, not meant to be lethal (though some deaths in asthmatics and the elderly have been documented)

■Considered more humane than the alternative
(80 countries voted to ban RCA by the Geneva Convention)
■Ex: CN gas, CS gas

Case Study: Russia

■October 26, 2002
■50 heavily armed Chechen insurgents hold hundreds of civilians hostage in a Moscow theater
■Russian Special Forces use fentanyl derivative to incapacitate the terrorists
■Over 100 hostages die from the gas

General Treatment Guidelines for all classes of Chemical Weapons

■Move to fresh air
■Supplemental oxygen
■Remove clothing
■Decontaminate skin
■Restrict physical activity
■Hospitalization/medical attention

Biological Weapons of Mass Destruction

What is Bioterrorism?

"Intentional or threatened use of viruses, bacteria, fungi or toxins from living organisms to produce death or disease in humans, animals or plants"

Why Biologics are attractive to terrorists:

■**Some can be obtained from nature**
■**Potential dissemination over large geographic area**
■**Creates panic and chaos**
■**Can overwhelm medical services**
■**Civilian populations may be highly susceptible**
■**High morbidity and mortality**
■**Difficult to diagnose and/or treat**
■**Some are transmitted person-to-person via aerosol**

Characteristics of Biological Attacks

■Incident may not be recognized for weeks
■Responders and health workers are at risk of becoming casualties themselves
■Continuing effect with re-infection
■Require special training and equipment to handle
■Large numbers of "worried well" (30:1 ratio)
■Fear of the unknown

Genealogical Classification of Bioterrorism Agents

■Bacterial Agents
▪**Anthrax**
▪**Brucellosis**
▪**Cholera**
▪**Plague, Pneumonic**

■**Tularemia**
■**Q Fever**

Source: U.S. A.M.R.I.I.D.

CDC: Critical Biological Agents

■**Category A**
■The 9 highest priority agents; highest risk to national security
■Frequency is low; impact is high (speedy spread)
■Easily disseminated or spread person-to-person
■High mortality
■Greatest potential for widespread panic and social disruption

CDC: Critical Biological Agents

■**Category B**
■Second highest priority agents
■Moderately easy to disseminate
■Moderate morbidity and low mortality (compared to Cat. A)
■**Category C**
■Emerging pathogens that could be engineered for mass dissemination
■Readily available; easy to produce and disperse
■Potentially high morbidity and mortality

Category A Bioterrorism Agents

■*Variola major*
(Smallpox)
■*Bacillus anthracis*
(Anthrax)
■*Yersinia pestis*
(Plague)
■*Clostridium botulinum*
(Botulism)
■*Francisella tularensis*
(Tularemia)
■Ebola hemorrhagic fever
■Marburg hemorrhagic fever
■Lassa fever
■Argentine hemorrhagic fever

Category B Bioterrorism Agents

■*Coxiella burnetti*
(Q fever)
■*Brucella species*
(brucellosis)
■*Burkholderia mallei*
(glanders)
■Venezuelan encephalomyelitis
■Eastern and Western equine encephalomyelitis
■Ricin toxin from Ricinus communis (castor beans)

■*epsilon toxin* of Clostridium perfringens
■*Staphylococcus enterotoxin B*

Food/Water Borne Agents
■*Salmonella species*
■*Shigella dysenteriae*
■*Escherichia coli* O157:H7
■*Vibrio cholerae*
■*Cryptosporidum parvum*

Category C Bioterrorism Agents
■Nipah virus
■Hantavirus
■Tickborne hemorrhagic fever viruses
■Tickborne encephalitis viruses
■Yellow fever
■Multi-drug resistant tuberculosis (MDRTB)

Smallpox

History of Smallpox
■Most deadly germ in all of human history
■First recorded case of biowarfare
■Last natural case in U.S.: 1947
■U.S. phased out vaccination from 1968-1972
■Last natural case in world: 1977
■"Eradicated" from the globe in 1980
■Two live cultures kept for research
■Only 10% of Soviet stockpile accounted for

Smallpox

***Variola major* (Smallpox)**
■Highly contagious virus (Attack rate: 90%)
■Person-to-person spread (by inhalation)
■Mortality rate: 35%
■Vaccine ~95% effective, can be administered up to 4 days after exposure
■No effective anti-viral agents

Smallpox: Clinical Features
■Prodrome
■Acute onset fever, malaise, headache, backache, vomiting
■Exanthem (Rash)
■Begins on face, hands, forearms spreads to lower extremities then trunk over ~ 7 days
■Synchronous progression:
macules → vesicles → pustules → scabs
■Lesions on palms /soles

Smallpox vs. Chickenpox

Incubation	7-17 days	14-21 days
Prodrome	2-4 days	minimal/none

Distribution	centrifugal	centripetal
Scab formation	10-14 days	4-7 days
Scab separation	14-28 days	<14 days

Smallpox Vaccine

■Made from live Vaccinia virus
■Intradermal inoculation with bifurcated needle
■Scar (permanent) demonstrates successful vaccination
■Immunity not life-long
■Adequate vaccine for all of U.S. population

Anthrax: Overview

■Primarily disease of herbivores
■Natural transmission to humans by contact with infected animals or contaminated animal products
■Three clinical forms
■Cutaneous (least lethal)
■Gastrointestinal
■Inhalational (most lethal)
aka "Woolsorter's Disease"

Anthrax: Overview

■Soil reservoir
■Forms highly stable spores
■No person-to-person transmission
■Easy to manufacture, difficult to aerosolize
■History:
■1979: Accidental release of spores from a USSR Bioweapons factory, at least 66 dead
■2001: Anthrax attacks in the United States, 11 contract inhalational anthrax, 5 died

Anthrax: Cutaneous

■Most common form (95%)
■Inoculation of spores under skin
■Small papule → ulcer surrounded by vesicles (24-28h)
■Painless eschar with edema
■Death rate: 20% if untreated

Anthrax:
Cutaneous Vesicle Development

Anthrax: Gastrointestinal

Anthrax: Inhalational

■Requires inhalation of 8,000 – 15,000 spores
■Initial symptoms "Flu-Like Illness" (2-5 days)
▪fever, cough, myalgia, malaise
■Terminal symptoms (1-2 days)
▪High fever, dyspnea, cyanosis
▪hemorrhagic mediastinitis/pleural effusion
▪Rapid progression to shock/death

■Mediastinal widening on CXR
■Mortality rate: ~75% with antibiotic TX
~97% without antibiotic TX

Anthrax: Vaccine
■Current U.S. vaccine
■For persons 18 - 65 years of age
■Protective against cutaneous anthrax and possibly inhalational anthrax (animal data)
■6 dose regimen over 18 months
■Limited availability
■Not currently administered to the civilian population
Anthrax
Plague: Overview
■Caused by bacterium *Yersinia pestis*
■Naturally occurring disease of rodents, rabbits, squirrels
■3 Forms:
■Pneumonic (P2P spread)
■Bubonic (no P2P spread)
■Septicemic (no P2P spread)

Plague: Overview
■Famous for causing the "Bubonic Plague"
■a.k.a. the "Black Death"
■Infected rodent fleas bite a human victim
■Leads to characteristic swollen, tender lymph nodes
■Endemic to parts of the United States
■About 10-15 total cases/year, mainly in SW states
■Mostly Bubonic (1-2 cases Pneumonic)
■Difficult to acquire; difficult to weaponize
■Treated with antibiotics
Plague: Bubonic
■Inguinal, axillary or cervical lymph nodes most commonly affected
■Sudden-onset headache, malaise, myalgia, fever, tender lymph nodes
■Regional lymphadenitis (Buboes)
■Possible papule, vesicle, or pustule at inoculation site
■60% mortality if untreated
Plague: Bubonic

Plague: Pneumonic
■Person-to-person transmission by respiratory droplet
■Sudden onset headache, malaise, fever, cough
■Pneumonia progresses rapidly to dyspnea, cyanosis, hemoptysis
■Death from respiratory collapse/sepsis
■100% mortality if untreated
Plague: Septicemic

■Secondary from bubonic or pneumonic forms
■Bacteria multiplies in the blood
■Septic shock develops
■100% mortality if untreated

Plague

Break Time!

Radioactive and Nuclear
Weapons of Mass Destruction

Radiation vs. Radioactive Material

■Radiation: energy transported in the form of particles or waves (alpha, beta, gamma)
■Radioactive Material: material that contains atoms that spontaneously emit radiation
■Light, radio waves and microwaves are types of radiation *(Ionizing radiation is what we are concerned about)*
■Radiation comes in four forms:
■Alpha particles
■Beta particles
■Gamma rays

Penetration Abilities of Different Types of Radiation

Exposure vs. Contamination

Exposure: irradiation of the body
Contamination: radioactive material on patient (external) or within patient (internal)

Internal Contamination

The biological pathways that can introduce radioactive contamination internally include:

Injuries Associated with
Radiation Exposure

■Acute Radiation Syndrome (ARS)
■Cutaneous Radiation Syndrome
■Chronic radiation exposure
■Teratogenic effects

Acute Radiation Syndrome

■Also known as radiation toxicity or sickness
■Requirements:
■Large, acute dose
■Penetrating
■Majority of the body is exposed

■Three classic ARS syndromes:
■Bone Marrow Syndrome
■Gastrointestinal Syndrome
■Cardiovascular / Central Nervous System Syndrome

Acute Radiation Syndrome
(A Spectrum of Disease)

Cutaneous Radiation Syndrome

■Acute radiation exposure of the skin
■Signs/Symptoms:
▪Itching

■Tingling
■Erythema
■Edema
■Epilation
■Lesions may be life threatening
■Lesions do not appear for days to weeks
■Surgical treatments must be performed within 48 hrs to be effective

Detecting Radiation:
Survey Meters

■Ionizing radiation interacts with detector material
■Produces a meter reading and/or audible clicks
■Typically read in counts per minute (CPM)
■Not designed for measuring radiation *exposure*

Detecting Radiation:
Dosimetry Devices

■Self-Reading Dosimeter (SRD)
■Measures accumulated dose in real time
■Hold up to light and look through the eyepiece to read
■Should be checked frequently

Methods of protection

■Time

■Distance

■Shielding

Potassium Iodide (KI) Tablets

■Only helpful in certain cases
■Only protects the thyroid from radioactive iodine
■KI saturates the thyroid gland with stable iodine
■KI must used prior to exposure to radioactive iodine

Radioactive/Nuclear WMDs:
Possible Scenarios

■Nuclear power plant incident
■Nuclear weapon
■Improvised Nuclear Device (IND)
■"Dirty bomb"

Nuclear Power Plant Incident

■Attack by air fairly easy for terrorist
■Would result in little release of radioactive material, if any
■Redundant safety systems make catastrophic radiation leak highly unlikely

Nuclear Weapon

■Manufacture requires extraordinary degree of scientific expertise
■Requires constant maintenance

■Unlikely that a terrorist organization has the resources to effectively accomplish a NW attack

Hypothetical Scenario
Scientific American, Nov 2002: A simulated detonation of radioactive cesium-137 (3500 curies) dirty bomb at the lower tip of Manhattan Island

Improvised Nuclear Device

■Weapons made from small devices that trigger uncontrolled nuclear reactions
■Difficult to manufacture
■Require frequent maintenance

"Dirty Bomb"

■Radioactive/Nuclear weapon of greatest concern
■Relatively easy to manufacture
■Consists of radioactive material coupled with a conventional explosive
■Immediate effect: Blast injuries
■Long term effect: chronic radiation exposure
■Would require massive decon effort (of people, buildings, environment)

Explosive/Incendiary
Weapons of Mass Destruction

■Conventional weapons: Bombs
■Incendiary devices: Fire-Causing Devices
■**The Most Widely Used WMDs!**

■Explosives
▪Ignite special fuels that burn extremely rapidly
▪Cause a shock wave or a blast
▪Cause injury by:
▪Pressure wave that damages air containing organs in the body
▪Throwing the body into the ground or other objects
▪Propelling debris that strikes a patient causing a traumatic injury
▪Causing building collapse

■Incendiary Devices
■Designed to burn at extremely high temperatures
▪napalm, thermite, white phosphorous
■Cause thermal burns
■Patients exposed to an incendiary device are treated as any other person suffering thermal burns

Personal Protection
Personal Protection

■ Proper PPE should be worn at all times
■Disposable, non-sterile gloves
■Gowns
■Eye shields

■N95 Respirator Face Masks
■ No eating, drinking, applying cosmetics or handling contact lenses in clinical areas
■Do not touch your eyes, nose or mouth

Infection Control: Gloves

■Discard gloves in biohazard bags after patient care is completed or when soiled or damaged
■Wash hands immediately after removal of gloves

Patient Respiratory Protection

■Patient may wear a paper surgical mask to reduce droplet production, if tolerated
■NRB masks offer some protection in reducing droplet spread
■CPR should never be performed using mouth-to-mouth or mouth-to-mask

The N95 Respirator

The N95 Respirator

■The most common disposable particulate respirator
■"N" = no oil is present in the contaminants
■"95" = filter efficiency level of 95% or greater against particulate aerosols

Why a Respirator Is Necessary

■You work in an environment where there is a high risk of disease transmission through infectious airborne infectious particulates

■Respirators, such as the N-95, provide protection from airborne infectious particulates when properly fitted and worn

Donning the N95 Respirator*

Step #1

Donning the N95 Respirator

Step #2

Donning the N95 Respirator

Step #3

Donning the N95 Respirator

Step #4

Donning the N95 Respirator

Step #5

Fit Check of the
N95 Respirator

■The respirator seal should be checked before each use
■Place both hands completely over the respirator and exhale
■If air leaks around your nose, readjust the nosepiece and recheck
■If air leaks at respirator edges, adjust the straps and recheck

N95 Respirators and Facial Hair

■Facial hair will prevent making a tight seal
■Just one or two days beard growth can effect the seal
■Males should be clean shaven
■Having no facial hair ensures that the N95 is fully protective

Removal of the N95 Respirator
Step #1

Removal of the N95 Respirator
Step #2

Removal of the N95 Respirator
Step #3

Limitations of the N95 Respirator
■If this respirator becomes wet, it is no longer effective and must be replaced
■The N-95 respirator filters particles 1 micrometer or larger with a filter efficiency of > 95%
■The N-95 is not intended for protection from organic vapors, toxic gases or toxic particulates

Strategic National Stockpile:
History
■Congress charged HHS and CDC to establish the National Pharmaceutical Stockpile (NPS) in 1999
■Mission: To provide essential medical materiel within 12 hours of the federal decision to deploy assets to a national emergency
■In March 2003, the NPS became the SNS managed jointly by the Departments of Homeland Security (DHS) and Health and Human Services
■Designed to supplement and resupply state and local public health agencies anytime, anywhere in the U.S.

Strategic National Stockpile:
Contents
■Oral Antibiotics
■Intravenous Supplies
■Nerve Agent Antidotes and Antitoxins
■Airway Maintenance Supplies
■Medical/surgical items

Strategic National Stockpile:
Strategy

<u>"Push Packages"</u>

■First line of support
■A broad spectrum of assets for an ill defined threat
■Strategically located in secured facilities around the United States and its territories
■Ready for immediate deployment
■Designed to arrive at a designated site within 12 hours of the federal decision to activate the SNS

Strategic National Stockpile:
Strategy

"Vendor Managed Inventory" (VMI)

■Additional pharmaceuticals and medical supplies designed to follow the Push Package if needed
■Designed to arrive within 24-36 hours
■Ideally, VMI is event specific, providing supplies tailored for the individual event

Strategic National Stockpile:
Transportation and Coordination
■Push Packages configured to fit in either trucks or commercial aircraft
■Technical Advisory Response Unit (TARU) is dispatched along with SNS assets in order to ensure efficient receipt and distribution upon arrival
■DHS transfers authority of SNS to state and local authorities upon receipt
Strategic National Stockpile:
Transportation and Coordination
The clock is ticking…
■ Governor and Commissioner of Health request the SNS from the CDC (zero hour)
■ Within 12 hours, SNS arrives in the state
■ In 12-24 hours, SNS is distributed to hospitals, counties, the military and prisons
■ In 24-36 hours, goal is to have "Pills in People"
Thank You!

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