



# WEAPONS OF MASS DESTRUCTION



## BIOLOGICAL WEAPONS

Kolářová Marie, EPI Autumn 2019

# Biological agent



A **biological agent** (also called **bio-agent**, **biological threat agent**, **biological warfare agent**, **biological weapon**, or **bioweapon**) is a [bacterium](#), [virus](#), [protozoan](#), [parasite](#), or [fungus](#) that can be used purposefully as a weapon in [bioterrorism](#) or [biological warfare](#) (BW).

In addition to these living or replicating [pathogens](#), [toxins](#) and [biotoxins](#) are also included among the bio-agents.

More than 1,200 different kinds of potentially weaponizable bio-agents have been described and studied to date.



# Bioterrorism

is the deliberate release of viruses, bacteria, toxins or other harmful agents to cause illness or death in people, animals, or plants.

These agents are typically found in nature, but could be mutated or altered to increase their ability to cause disease, make them resistant to current medicines, or to increase their ability to be spread into the environment.

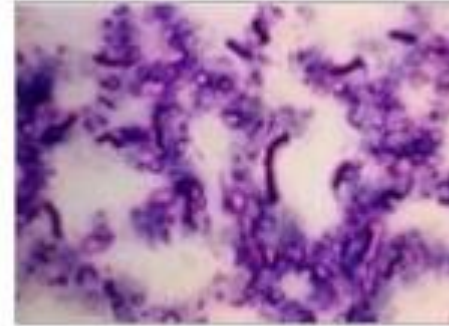
Biological agents can be spread through the air, water, or in food. Biological agents are attractive to [terrorists](#) because they are extremely difficult to detect and do not cause illness for several hours to several days.

Some bioterrorism agents, like the [smallpox virus](#), can be spread from person to person and some, like [anthrax](#), cannot.

# Types of Biowarfare Agents



- Bacteria
  - Cause disease by reproducing
  - Single cell organism
  - Typhus, anthrax
- Viruses
  - Multiply only inside host cells
  - Sub-microscopic organisms
  - Ebola, Chikungunya



Anthrax



Ebola



- Rickettsia
  - Larger than viruses
  - Smaller than bacteria
  - From fleas, lice and ticks
  - Q-fever
- Toxins
  - Poisons from living things
  - Botulinum most lethal known :  $<10^{-6}$  g
  - But some beneficial uses

# CDC - Category A Bacteria



Bacterial Agent	Disease
<i>Bacillus anthracis</i>	Anthrax
<i>Francisella tularensis</i>	Tularemia
<i>Yersinia pestis</i>	Plague

# CDC - Category A Viruses



Viral Agents	Disease
<i>Arenaviruses - Lassa, Junin, Machupo</i>	Viral Hemorrhagic Fevers
<i>Filoviruses – Ebola, Marburg</i>	Viral Hemorrhagic Fevers
<i>Variola major</i>	Smallpox

# [ CDC - Category A Toxins ]



Toxin Name	Disease
<i>Clostridium botulinum</i> toxin	Botulism



# CDC – Category B



Agents	Disease
<i>Coxiella burnetti</i>	Q fever
<i>Brucella</i> species	Brucellosis
<i>Burkholderia mallei</i>	Glanders
<i>Ricinus communis</i> (castor beans)	Ricin Toxin
<i>Clostridium perfringens</i>	Epsilon toxin
<i>Staphylococcus</i>	Enterotoxin B

# CDC – Category B



Agents	Disease
<i>Coxiella burnetti</i>	Q fever
<i>Brucella</i> species	Brucellosis
<i>Burkholderia mallei</i>	Glanders
<i>Ricinus communis</i> (castor beans)	Ricin Toxin
<i>Clostridium perfringens</i>	Epsilon toxin
<i>Staphylococcus</i>	Enterotoxin B

# CDC - Category C



Agents	Disease
Nipah virus	Viral Hemorrhagic Fevers
Hanta viruses	Viral Hemorrhagic Fevers
Tick-borne hemorrhagic fever	Viral Hemorrhagic Fevers

# Biological Terrorism



- Use of biological agents to intentionally produce disease or intoxication in susceptible populations
    - humans, animals, or plants
- ‘to meet terrorist aims’**
- Biological agents are much deadlier than chemical agents
    - Estimated 10 grams of anthrax could kill as many people as a ton of the nerve agent Sarin

# Features of Bioterrorism



- Weapon: Microbe or toxin
- Strike: Premeditated
- Goals: Political, religious, ideological
- Motivation: Fear, disruption, instability
- Molecular Biology and Genetic Engineering have enabled scientists to increase the virulence, develop antibiotic resistant strains, and create novel strains for which population lacks immunity

# Biological Terrorism? Epidemiologic Clues



- Tight cluster of cases
- High infection rate
- Unusual or localized geography
- Unusual clinical presentation
- Unusual time of year
- Dead animals



# [ The Potential of Bioterrorism ]



## Agent

## Lethal infective doses in 5mls

Cyanide	50
Mustard gas	100
Sarin	5,000
Botulinum toxin	1,000,000
Anthrax	50,000,000,
Tularemia	50,000 x 10 <sup>6</sup>





# Emperer Barbarossa - Tortona

1155

Used infected dead bodies to poison the enemy's water supply



Fortificazioni di Tortona (AL).  
BSA, sez.24, n. d'ord.161, arm.1, cass.7, inv.10371, (1745).  
Fotografia Salvatore Rosato 1999.





The Tatars threw plague infected cadavers by hurling machines into the city of Caffa- Ukraine

1347–1353





## Siemenowics- a Polish artillery general

1650

He put saliva from rabid dogs into hollow spheres for firing





# Gen Sir Jeffery Amherst

1754-1767

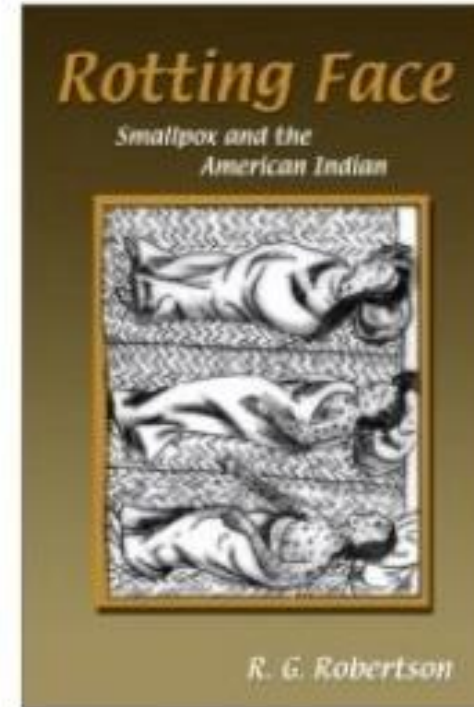
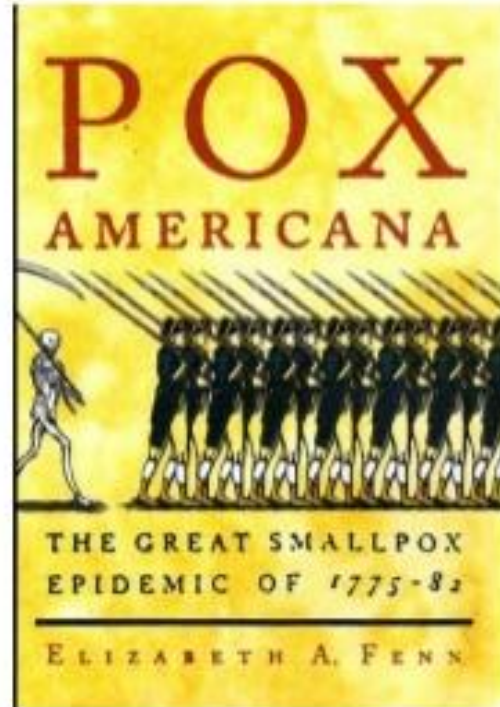
Offered infiltrated smallpox infested blankets to un  
suspected American Indians during French-Indian war



# Smallpox Pandemic



1775-1782





## Dr. Luke Blackburn, future governor of Kentucky - War between the States

1879-83

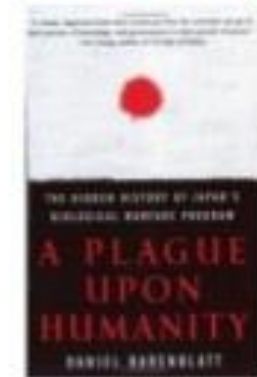
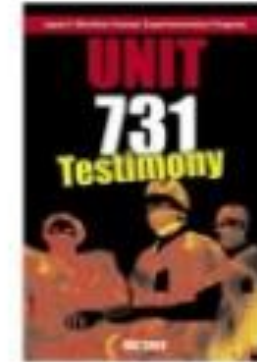
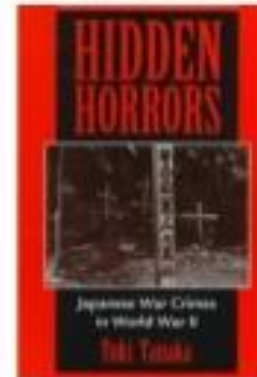
He attempted to infect clothing with smallpox and yellow fever and then sell it to unsuspecting Union troops.



## Japanese Tests with BW agents

1932-1945

More than 1,000 of Chinese, Koreans, Mongolian, Soviet, American, British, and Australian prisoners were estimated to have died in experiments by the Japanese with agents causing anthrax, botulism, brucellosis, cholera, dysentery, gas gangrene, and plague - Unit 731



British trials with *B. anthracis*  
were held on Gruinard Island, Scotland

1941-42





## US Army established BW research station - Camp Detrick

1943-1969

- Operationalized 7 months later
- By Jan 1944, field station for Horu Island was functional
- By 1969, US Dept of Defense completed study on fol BW agents
  - **Incapacitating agents**
    - Rickettsia, RVFV and VEE virus
  - **Lethal agents**
    - Yellow fever virus, *Bacillus anthracis*, *Rickettsia rickettsiae*, *Yersinia pestis*





# Umbrella gun to assassinate Bulgarian exile Georgi Markov - London

1978



A pellet was designed to contain Ricin toxin.





## The Rajneeshee cult

1984

*Salmonella* in Oregon restaurants - 751 cases





## Aum Shinrikyo cult- Tokyo Subway

1995

Sarin Gas Attack, Tokyo Subway- 12 killed; 5,000 injured



## Iraqi Biological Warfare Program

1995

- 166 bombs
  - 100 botulinum toxin, 50 anthrax, 16 aflatoxin
- 25 Scud missile warheads
  - 13 botulinum toxin, 10 anthrax, 2 aflatoxin
- 122-mm rockets filled with
  - Anthrax, botulinum toxin, and aflatoxin
- Spray tanks capable of being fitted to a fighter aircraft or remotely piloted aircraft, and spraying 2,000 L





# Anthrax Bioterrorism

1998

## Anthrax hoax at federal building delays 91 in LA.

**Los Angeles** — Nineteen people were told the anthrax risk from a bomb planted at the Los Angeles Federal Courthouse on Monday, but the anthrax was never released into the air from a hidden building.

The people were given instructions and special masks to wear once their clothes had been put in plastic bags, officials said. Those who had been subjected to the anthrax were quickly decontaminated.

Authorities told the people that their U.S. Bankruptcy Court staff members, as well as FBI investigators and several FBI dogs, had anthrax spores on the building.

They also mentioned the new plan for people to be decontaminated.

"Don't panic, the FBI and health department are on top of this," said Bob Miller, Los Angeles Fire Department spokesman.

An anonymous source advised workers had been alerted to the anthrax risk.

Tests on clothing and bedding from the courthouse and from the FBI building, a spokesman for the Los Angeles County Health Department (LACPH) said, were negative Tuesday.

"I think the chances are very high that this is not a problem," the spokeswoman said. "We have not seen any anthrax spores."

Who is working for the courthouse?

The FBI people were instructed to take down all signs, as well as the FBI dogs. They were given special instructions on how to decontaminate their clothes.

Health officials told there is no anthrax in the building and to return to work as usual.

"They are going to be wearing the decontaminated clothes," the spokeswoman said.

The FBI would not release details of how the threat was contained.

The building houses a bankruptcy court and police officers. Federal officials said they are trying to find out how the anthrax was spread.

Authorities said a number of FBI agents were in the building on Monday, as they investigated the threat.

The FBI would not release details of how the threat was contained.

Officials said the anthrax risk was not a hoax, but that the anthrax was never released into the air from a hidden building.

Officials said the anthrax was never released into the air from a hidden building.

Officials said the anthrax was never released into the air from a hidden building.

San Francisco Chronicle, 20 December 1998



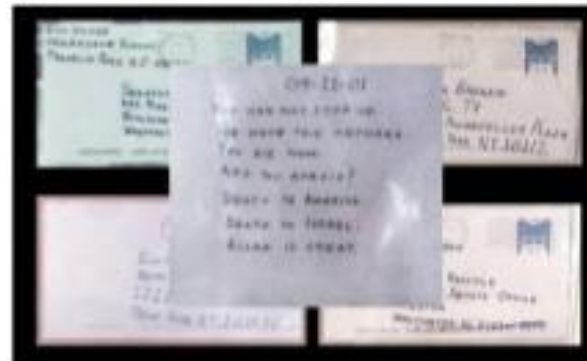
# Anthrax through post - US

2001

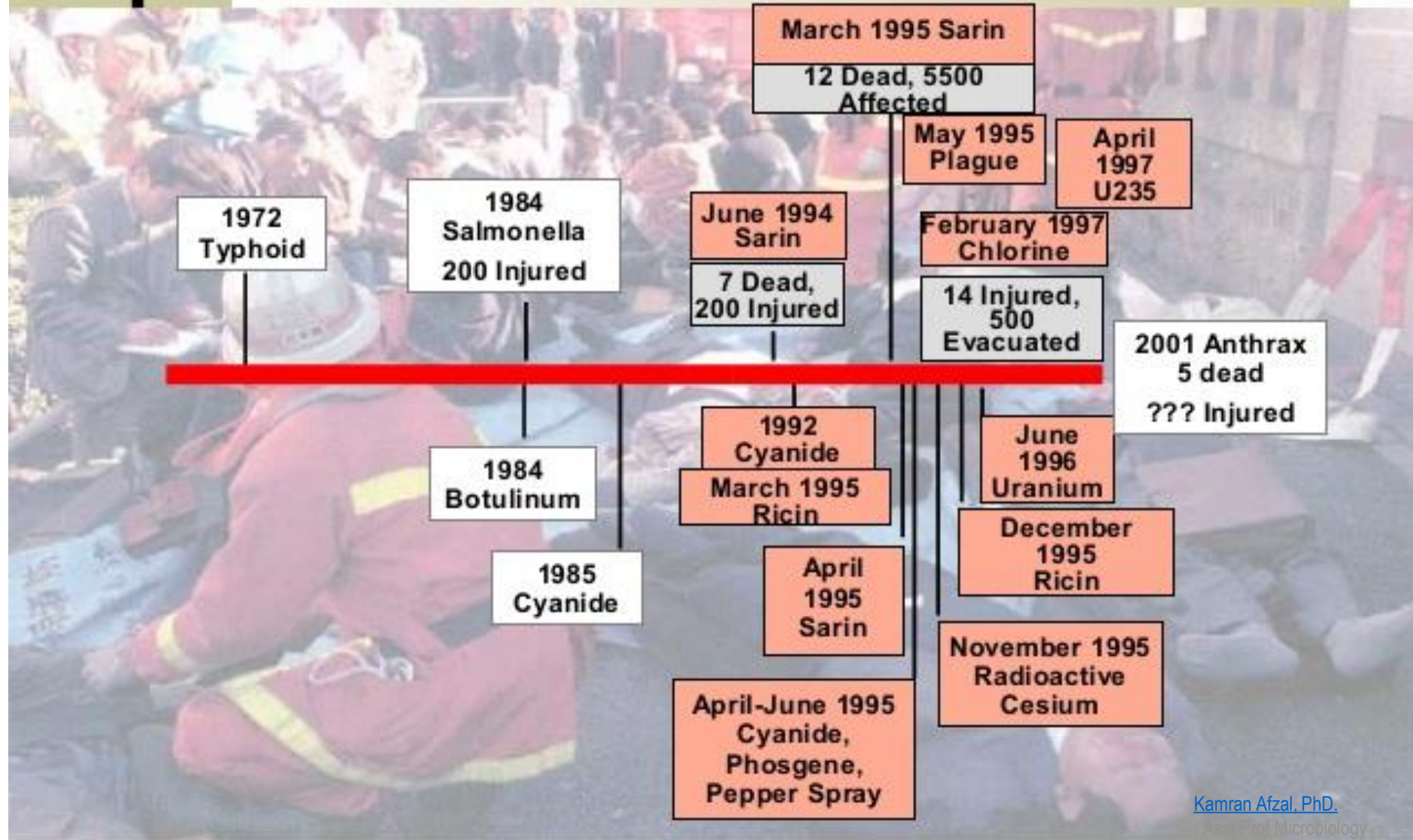
22 Cases: 5 deaths, 11 inhalational, 11 cutaneous



Anthrax check (gov)



# NBC Events since 1970



## Pakistan's Stance On Biowarfare



- Pakistan is a signatory nation of “The Biological Toxin Weapons (BTW) Convention of 1972”
  - Signed by 158 nations
  - US has rejected enforcement
- Convention abstract:
  - The prohibition of the development, production, stockpiling, and destruction of bacteriologic and toxin weapons
  - Required to submit information annually to the United Nations concerning facilities where biological defense research is being conducted





## Pakistan's Experience of Bioterrorism

- A total of **230** suspected samples of Anthrax from **194** sources were analyzed for anthrax spores at NIH from Nov 2001 to March 2002
  - 71 samples were from clinical specimens (anterior nares, skin, blood)
  - 159 were from non-clinical environmental samples (powders, swabs from inanimate objects, papers, envelopes, packages, plastics etc)
- The samples were received from Foreign mission, media organizations, banks, government institutions, universities, hospitals and individuals



Out of these, 141 samples yielded growth suggestive of *Bacillus* species

- On the basis of colony morphology, Gram's stain and other preliminary laboratory tests 62 isolates were found suspicious for *B. anthracis*, however all the samples were negative by animal inoculation
- The suspected anthrax parcel/letter bombs in Pakistan during the investigation period were hoaxes

## Challenges in Pakistan

- Smart detection, field preparedness
  - Would require quick military intervention
- Vaccination drives—cheaper to prevent
- Limited funding: un-smart intelligence
- Collaborative programs—funds not available
- Need dynamic consolidated vision
- Don't know where to look for



# Conclusions



- For continuous surveillance and monitoring of important strategic, tactical and containment areas, and with the rapid advancement in the field of genetic engineering and biotechnology and possibility of use of genetically modified BW agents, it is essential to acquire/ use advanced early detection devices at national level - in addition to gold standard conventional microbiological methods for rapid and quick response
- Plan ahead smartly, and be prepared to move quickly and decisively
- Communication, data integration and timely delivery of data analysis to decision-makers is crucial



# Bacterial bio-agents (Military Symbol)

<a href="#">Tularemia</a>	<a href="#">Francisella tularensis</a> (SR or JT)
<a href="#">Plague</a>	<a href="#">Yersinia pestis</a> (LE)
<a href="#">Meliodosis</a>	<a href="#">Burkholderia pseudomallei</a> (HI)
<a href="#">Listeriosis</a>	<a href="#">Listeria monocytogenes</a> (TQ)
<a href="#">Glanders</a>	<a href="#">Burkholderia mallei</a> (LA)
<a href="#">Dysentery (bacterial)</a>	<a href="#">Shigella dysenteriae</a> , some species of <a href="#">Escherichia coli</a> (Y)
<a href="#">Diphtheria</a>	<a href="#">Corynebacterium diphtheriae</a> (DK)
<a href="#">Cholera</a>	<a href="#">Vibrio cholerae</a> (HO)
<a href="#">Brucellosis (porcine)</a>	<a href="#">Brucella suis</a> (US, AB or NX)
<a href="#">Brucellosis (caprine)</a>	<a href="#">Brucella melitensis</a> (AM or BX)
<a href="#">Brucellosis (bovine)</a>	<a href="#">Brucella abortus</a>
<a href="#">Anthrax</a>	<a href="#">Bacillus anthracis</a> (N or TR)

## Chlamydial bio-agents

<a href="#">Psittacosis</a>	<a href="#">Chlamydophila psittaci</a> (SI)
-----------------------------	---



# Rickettsial bio-agents

<a href="#">Q Fever</a>	<a href="#">Coxiella burnetii</a> (OU)
<a href="#">Rocky Mountain spotted fever</a>	<a href="#">Rickettsia rickettsii</a> (RI or UY)
<a href="#">Typhus (human)</a>	<a href="#">Rickettsia prowazekii</a> (YE)
<a href="#">Typhus (murine)</a>	<a href="#">Rickettsia typhi</a> (AV)

# Viral bio-agents

<a href="#">Equine Encephalitis (Eastern)</a>	<a href="#">Eastern equine encephalitis virus</a> (ZX)
<a href="#">Equine Encephalitis (Venezuelan)</a>	<a href="#">Venezuelan Equine Encephalomyelitis virus</a> (FX)
<a href="#">Equine Encephalitis (Western)</a>	<a href="#">Western equine encephalitis virus</a> (EV)
<a href="#">Japanese B encephalitis</a>	<a href="#">Japanese encephalitis virus</a> (AN)
<a href="#">Rift Valley fever</a>	<a href="#">Rift Valley fever virus</a> (FA)
<a href="#">Smallpox</a>	<a href="#">Variola virus</a> (ZL)
<a href="#">Yellow fever</a>	<a href="#">Yellow fever virus</a> (OJ or LU)

# Mycotic bio-agents

<a href="#">Coccidiomycosis</a>	<a href="#">Coccidioides immitis</a> (OC)
---------------------------------	---



## Biological toxins

Toxin	Source of Toxin ( <a href="#">Military Symbol</a> )
<a href="#">Abrin</a>	<a href="#">Rosary pea</a> ( <i>Abrus precatorius</i> )
<a href="#">Botulinum toxins (A through G)</a>	<i>Clostridium botulinum</i> bacteria or spores, and several other Clostridial species. (X or XR)
<a href="#">Ricin</a>	<a href="#">Castor bean</a> ( <i>Ricinus communis</i> ) (W or WA)
<a href="#">Saxitoxin</a>	Various marine and brackish cyanobacteria, such as <a href="#">Anabaena</a> , <a href="#">Aphanizomenon</a> , <a href="#">Lyngbya</a> , and <a href="#">Cylindrospermopsis</a> (TZ)
<a href="#">Staphylococcal enterotoxin B</a>	<a href="#">Staphylococcus aureus</a> (UC or PG)
<a href="#">Tetrodotoxin</a>	Various marine bacteria, including <a href="#">Vibrio alginolyticus</a> , <a href="#">Pseudoalteromonas tetraodonis</a> (PP)
<a href="#">Trichothecene mycotoxins</a>	Various species of fungi, including <a href="#">Fusarium</a> , <a href="#">Trichoderma</a> , and <a href="#">Stachybotrys</a>

# Biological vectors



Vector ( <a href="#">Military Symbol</a> )	Disease
<a href="#">Mosquito</a> ( <a href="#">Aedes aegypti</a> ) (AP)	<a href="#">Malaria</a> , <a href="#">Dengue fever</a> , <a href="#">Chikungunya</a> , <a href="#">Yellow fever</a> , other <a href="#">Arboviruses</a>
<a href="#">Oriental rat flea</a> ( <a href="#">Xenopsylla cheopis</a> )	<a href="#">Plague</a> , <a href="#">Murine typhus</a>