

Armed Conflict and Infectious Disease

Barry S. Levy, M.D., M.P.H.

December 16, 2008

Forum on Microbial Threats

Health Consequences of War

1. War-related injuries and diseases

Health Consequences of War

1. War-related injuries and diseases
2. Adverse effects on medical care and public health services

Health Consequences of War

1. War-related injuries and diseases
2. Adverse effects on medical care and public health services
3. Damage to health-supporting infrastructure and the environment

Health Consequences of War

1. War-related injuries and diseases
2. Adverse effects on medical care and public health services
3. Damage to health-supporting infrastructure and the environment
4. Forced migration

Health Consequences of War

1. War-related injuries and diseases
2. Adverse effects on medical care and public health services
3. Damage to health-supporting infrastructure and the environment
4. Forced migration
5. Violation of human rights

Health Consequences of War

1. War-related injuries and diseases
2. Adverse effects on medical care and public health services
3. Damage to health-supporting infrastructure and the environment
4. Forced migration
5. Violation of human rights
6. Diversion of resources

Health Consequences of War

1. War-related injuries and diseases
2. Adverse effects on medical care and public health services
3. Damage to health-supporting infrastructure and the environment
4. Forced migration
5. Violation of human rights
6. Diversion of resources
7. Promotion of violence

Infectious Diseases Increased in War and Other Complex Emergencies

- Diarrheal diseases

Infectious Diseases Increased in War and Other Complex Emergencies

- Diarrheal diseases
- Acute respiratory infections

Infectious Diseases Increased in War and Other Complex Emergencies

- Diarrheal diseases
- Acute respiratory infections
- Measles

Infectious Diseases Increased in War and Other Complex Emergencies

- Diarrheal diseases
- Acute respiratory infections
- Measles
- Malaria

Infectious Diseases Increased in War and Other Complex Emergencies

- Diarrheal diseases
- Acute respiratory infections
- Measles
- Malaria
- Meningococcal disease

Infectious Diseases Increased in War and Other Complex Emergencies

- Diarrheal diseases
- Acute respiratory infections
- Measles
- Malaria
- Meningococcal disease
- Tuberculosis

Infectious Diseases Increased in War and Other Complex Emergencies

- Diarrheal diseases
- Acute respiratory infections
- Measles
- Malaria
- Meningococcal disease
- Tuberculosis
- Other

Causes of Death During Civil War in the Democratic Republic of Congo

- Diarrhea
- Respiratory infections
- Suspected malaria
- Malnutrition

(Van Herp et al, 2003)

Causes of Death in Young Children, Eastern Democratic Republic of Congo

Fever/malaria.....	35%
Neonatal death.....	13%
Diarrhea.....	13%
Anemia.....	7%
Acute respiratory tract infections.....	7%
Measles.....	5%
Meningitis.....	5%
Malnutrition.....	5%

(Coghlan et al., 2007)

Causes of Infectious Diseases Due to War

1. Adverse effects on medical care and public health services

Causes of Infectious Diseases Due to War

1. Adverse effects on medical care and public health services
2. Damage to the health-supporting infrastructure and the environment

Causes of Infectious Diseases Due to War

1. Adverse effects on medical care and public health services
2. Damage to the health-supporting infrastructure and the environment
3. Forced migration

Causes of Infectious Diseases Due to War

1. Adverse effects on medical care and public health services
2. Damage to the health-supporting infrastructure and the environment
3. Forced migration
4. Diversion of resources

Causes of Infectious Diseases Due to War

1. Adverse effects on medical care and public health services
2. Damage to the health-supporting infrastructure and the environment
3. Forced migration
4. Diversion of resources
5. Biological weapons

1. Adverse Effects on Medical Care and Public Health Services

- Physicians, nurses, and other health workers are injured or killed or they flee

1. Adverse Effects on Medical Care and Public Health Services

- Physicians, nurses, and other health workers are injured or killed or they flee
- Damage to clinics and hospitals

1. Adverse Effects on Medical Care and Public Health Services

- Physicians, nurses, and other health workers are injured or killed or they flee
- Damage to clinics and hospitals
- Reduction of public health services

1. Adverse Effects on Medical Care and Public Health Services

- Physicians, nurses, and other health workers are injured or killed or they flee
- Damage to clinics and hospitals
- Reduction of public health services
- Reduced supplies of medications and vaccines

2. Damage to the Health-Supporting Infrastructure and the Environment

- Food safety and supply

2. Damage to the Health-Supporting Infrastructure and the Environment

- Food safety and supply
- Sewage treatment

2. Damage to the Health-Supporting Infrastructure and the Environment

- Food safety and supply
- Sewage treatment
- Water safety and supply

2. Damage to the Health-Supporting Infrastructure and the Environment

- Food safety and supply
- Sewage treatment
- Water safety and supply
- Electrical power

2. Damage to the Health-Supporting Infrastructure and the Environment

- Food safety and supply
- Sewage treatment
- Water safety and supply
- Electrical power
- Transportation

2. Damage to the Health-Supporting Infrastructure and the Environment

- Food safety and supply
- Sewage treatment
- Water safety and supply
- Electrical power
- Transportation
- Communications

2. Damage to the Health-Supporting Infrastructure and the Environment

- Food safety and supply
- Sewage treatment
- Water safety and supply
- Electrical power
- Transportation
- Communications
- Environmental damage

Factors Promoting Diarrheal Disease

- Contamination of food supply
- Inadequate sewage treatment and disposal
- Contamination of water supplies
- Malnutrition
- Inadequate handwashing and inadequate availability of soap

Factors Promoting Acute Respiratory Infections

- Overcrowding
- Air contamination from indoor fires
- Inadequate shelter
- Malnutrition

TB and the Role of War: Study of 36 Conflicts

TB notification rates:

- Before conflicts = 81.9/100,000
- After start of conflicts = 105.1/100,000

Risk of presenting with TB:

- 2.5 years after the outbreak of conflict same as that 2.5 years before conflict

(Drobniewski and Verlander, 2000)

TB in Afghanistan

During and After War

- Situation worsened due to cessation of TB control activities during the 1980s
- In early 1990s, anti-TB efforts increased
- Yet in 1999, incidence of active cases was 278 per 100,000, and only 10% of TB patients had DOTS coverage

(Kahn and Laaser, 2002)

TB Mortality During Civil War in Guinea-Bissau in 1998

Increased mortality rates:

- Among those who received irregular or no treatment: 3-fold increase
- HIV-positive patients: 8-fold increase

(Gustafson et al., 2001)

Successful Restoration of TB Services During 5 Years After End of Conflict in East Timor

Factors contributing to success:

- Structure and experience of local NGO
- Commitment and flexibility of local personnel and international advisors

(Martins et al., 2006)

Conditions That Increase HIV Transmission

- Risk-taking behavior
- Sexual violence
- Inadequate access to condoms
- Untreated STIs
- Commercial sex
- HIV-contaminated blood
- Inadequate use of universal precautions

War and HIV in Sub-Saharan Africa: Study of 7 Countries with Long-Term Civil Disorders or Wars

- Sierra Leone and Somalia: Adult HIV prevalence was < 1%
- Democratic Republic of Congo: Prevalence stabilized during civil disorder and war after 1991
- Angola and Liberia: Apparently low HIV prevalence
- Mozambique: HIV prevalence was ~ 1% after civil war, but dramatic increase since

(Gisselquist, 2004)

Examples of HIV/AIDS Prevention and Treatment During Armed Conflict

- Côte d'Ivoire – Importance of NGOs working with regional and international organizations and UN agencies (Betsi et al., 2006)
- DR Congo – Major factors in success: Adequate human resources, secure drug storage, decentralization of care, and integration of services (Culbert et al, 2007)

Vulnerability to HIV Infection in Northern Uganda

Mass abduction of children into the resistance army:

- Boy child soldiers coerced to use rape as a weapon
- Girls forced to become sexual slaves

In camps for internally displaced persons:

- Woman raped and driven to provide sex for money

(Westerhaus et al., 2007)

3. Forced Migration

Refugees – 12 million

Internally displaced persons – 22-25 million

- Loss of socio-cultural support systems
- Reduced access to:
 - Safe food and water
 - Medical care and public health services
 - Adequate clothing and shelter



Leading Diagnoses, Emergency Ward, Khao-I-Dang Camp for Cambodians, Thailand, 1980

URI and pneumonia.....	25%
Gastroenteritis/diarrhea...	13%
Measles.....	8%
Otitis media.....	5%
Trauma.....	5%
Fever of unknown origin...	4%
Meningitis.....	4%
Malaria.....	2%







Rwandan Refugees in Zaire, 1994

- Almost 1,000,000 refugees
- Many died from cholera or dysentery during first month after arrival

Mortality Among Internally Displaced Persons and Others, Darfur, 2005

Diarrhea.....	25%
Injuries.....	14%
Acute respiratory infections.....	7%
Malnutrition.....	5%
Tetanus.....	5%
Malaria.....	5%
Meningitis.....	2%
Measles.....	2%

(WHO and Federal Ministry of Health, Sudan, 2005)

4. Diversion of Resources

- Human resources
- Financial resources
 - Example: Public expenditures per capita, 1990

	<u>Military</u>	<u>Health</u>
Ethiopia	\$ 16	\$ 1
Sudan	\$ 25	\$ 1
Angola	\$114	\$ 8

Diversion of Resources

\$107 million spent in the District of Columbia for proposed nuclear weapons for FY 2009 could fund one of the following:

- 370 affordable housing units
- Health care for 34,000 children for 1 year
- 1,800 elementary school teachers for 1 year

(National Priorities Project, 2008)

5. Biological Weapons

- Contaminating drinking water

5. Biological Weapons

- Contaminating drinking water
- Hurling of plague victims

5. Biological Weapons

- Contaminating drinking water
- Hurling of plague victims
- Infecting blankets with smallpox

5. Biological Weapons

- Contaminating drinking water
- Hurling of plague victims
- Infecting blankets with smallpox
- Placing dead animals in water sources

5. Biological Weapons

- Contaminating drinking water
- Hurling of plague victims
- Infecting blankets with smallpox
- Placing dead animals in water sources
- Infecting horses with glanders bacteria

5. Biological Weapons

- Contaminating drinking water
- Hurling of plague victims
- Infecting blankets with smallpox
- Placing dead animals in water sources
- Infecting horses with glanders bacteria
- Testing anthrax bombs on a deserted island

Biological Weapons Convention (1972)

- Bans development, production, stockpiling, or acquisition of biological weapons and their means of delivery, except for peaceful purposes
- No formal verification regime
- 162 nations have signed or ratified

CDC Categories of Diseases Caused by Biological Agents

Category A:

- Anthrax
- Botulism
- Plague
- Smallpox
- Tularemia
- Viral hemorrhagic fevers

CDC Categories of Diseases Caused by Biological Agents

Category B:

- Brucellosis
 - Epsilon toxin of *Clostridium perfringens*
 - Food safety threats
 - Glanders
 - Melioidosis
 - Psittacosis
- (continued)

CDC Categories of Diseases Caused by Biological Agents

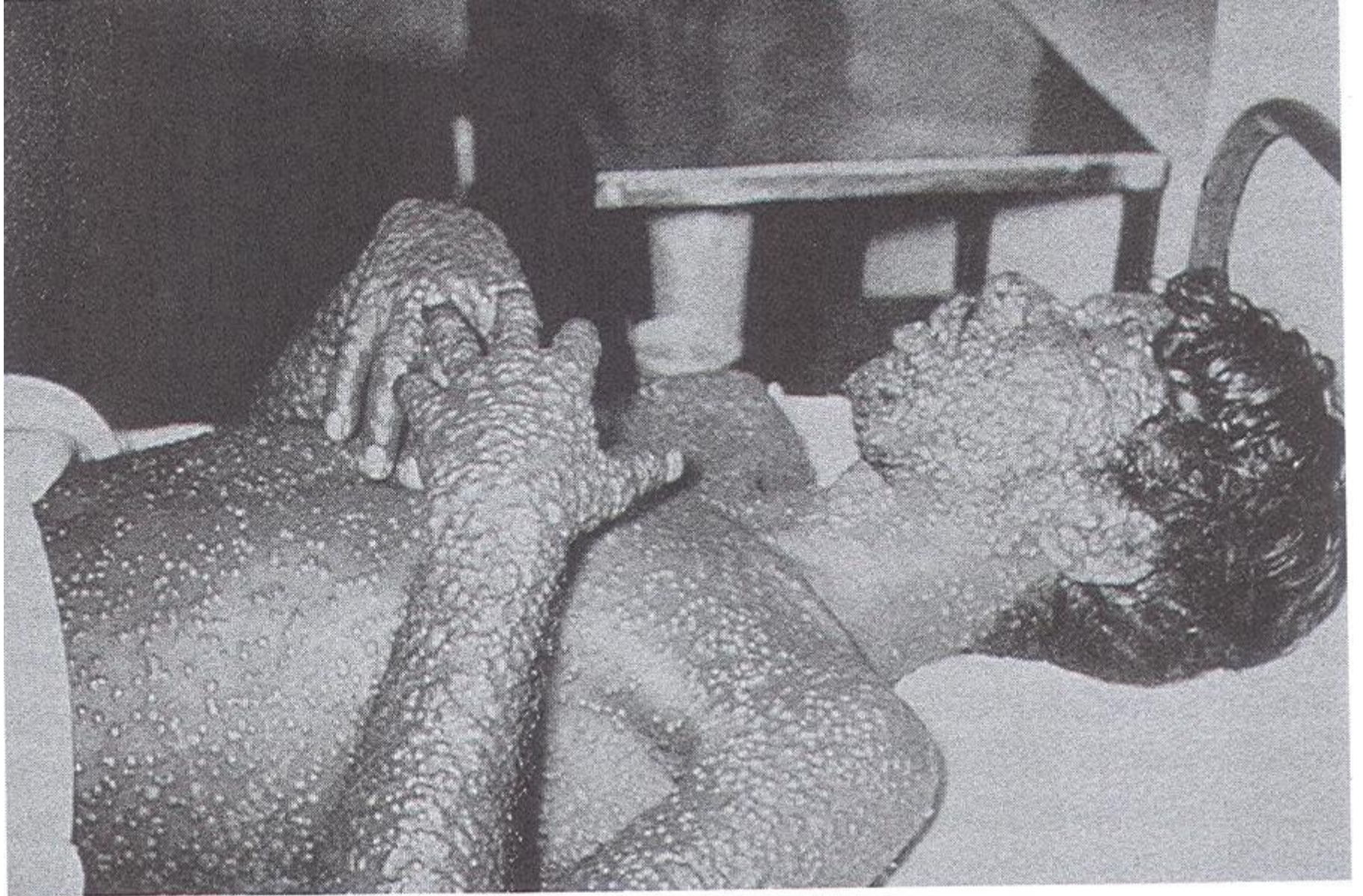
Category B (continued):

- Q fever
- Ricin toxin
- Staphylococcal enterotoxin B
- Typhus fever
- Viral encephalitis
- Water safety threats

CDC Categories of Diseases Caused by Biological Agents

Category C:

- Emerging infectious diseases, such as:
 - Nipah virus
 - Hantavirus



Smallpox

- Very stable
- Moderate to high lethality

Smallpox

- Very stable
- Moderate to high lethality
- Difficult to obtain stock and to process
- Questionable likelihood of use because limited availability (only confirmed sources are in U.S. and Russia)

(New York Times, 2001)

Anthrax

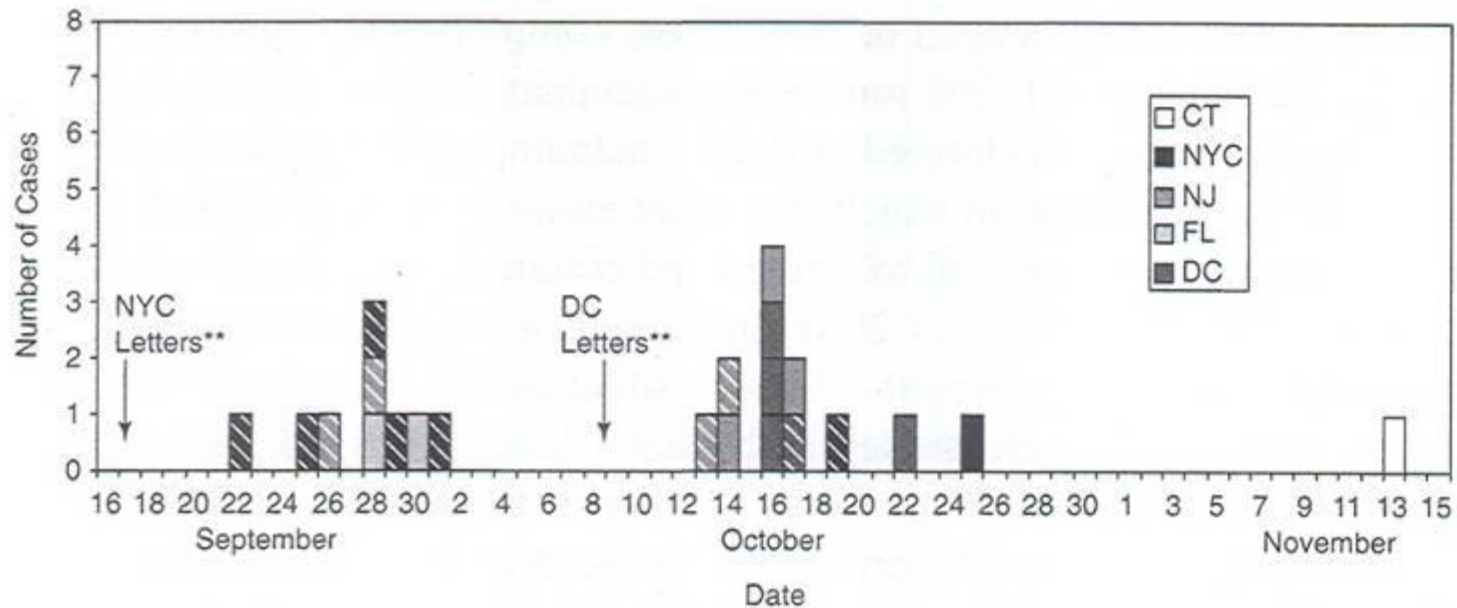
- Spores very stable and resistant to sunlight, heat, and some disinfectants
- Lethality high for pulmonary anthrax

Anthrax

- Spores very stable and resistant to sunlight, heat, and some disinfectants
- Lethality high for pulmonary anthrax
- Virulent stock hard to obtain and process
- Use possible, but requires sophistication to manufacture and disseminate

(New York Times, 2001)

Anthrax Outbreak



Solid bar = inhalation anthrax
Striped bar = cutaneous anthrax

*Modified from MMWR. November 2, 2001, Vol. 50, No. 43, pp 941-948

**Postmarked date of known contaminated letters.

Incidence and Mortality for Selected Causes, United States, 2001-2004

	<u>Incident Cases</u>	<u>Deaths</u>
Bioterrorism	23	5

Incidence and Mortality for Selected Causes, United States, 2001-2004

	<u>Incident Cases</u>	<u>Deaths</u>
Bioterrorism	23	5
AIDS	164,000	69,000

Incidence and Mortality for Selected Causes, United States, 2001-2004

	<u>Incident Cases</u>	<u>Deaths</u>
Bioterrorism	23	5
AIDS	164,000	69,000
Hepatitis C	107,000	36,000

Incidence and Mortality for Selected Causes, United States, 2001-2004

	<u>Incident Cases</u>	<u>Deaths</u>
Bioterrorism	23	5
AIDS	164,000	69,000
Hepatitis C	107,000	36,000
Hospital-associated infections	~8,000,000	~360,000

U.S. National Counterterrorism Center Report for 2007

- ~ 14,000 terrorist attacks worldwide
- ~ 22,000 deaths (~ 14,000 in Near East)
- ~ 44,000 wounded (~31,000 in Near East)
- Armed attacks and bombings accounted for the vast majority of fatalities
- Apparently no attacks with biological agents

Causes of Infectious Diseases Due to War

1. Adverse effects on medical care and public health services
2. Damage to the health-supporting infrastructure and the environment
3. Forced migration
4. Diversion of resources
5. Biological weapons

What Needs To Be Done?

- Surveillance of infectious diseases

What Needs To Be Done?

1. Surveillance of infectious diseases
2. Evaluating prevention and control measures

What Needs To Be Done?

1. Surveillance of infectious diseases
2. Evaluating prevention and control measures
3. Protecting medical care and public health services and maintaining their neutrality

(continued)

What Needs To Be Done?

4. Vector control

What Needs To Be Done?

4. Vector control
5. Epidemic preparedness and response to outbreaks

What Needs To Be Done?

4. Vector control
5. Epidemic preparedness and response to outbreaks
6. Research
 - Improved vaccines
 - Better diagnostic tests
 - Improved treatment

(continued)

What Needs To Be Done?

7. Protecting health-supporting infrastructure and the environment

What Needs To Be Done?

7. Protecting health-supporting infrastructure and the environment
8. Preventing forced migration

What Needs To Be Done?

7. Protecting health-supporting infrastructure and the environment
8. Preventing forced migration
9. Controlling biological agents and strengthening the Biological Weapons Convention

What Needs To Be Done?

7. Protecting health-supporting infrastructure and the environment
8. Preventing forced migration
9. Controlling biological agents and strengthening the Biological Weapons Convention
10. Creating a world without war