DIAGNOSIS AND TREATMENT OF DISEASES OF TACTICAL IMPORTANCE TO U.S. CENTRAL COMMAND

USACHPPM TECHNICAL GUIDE 273

USACHPPM
Readiness thru Health

SOURCES

The U.S. Army Center for Health Promotion and Preventive Medicine (http://chppm-www.apgea.army.mil/) has produced this technical guide (TG) by integrating instructional material contributed by numerous military physicians and scientists. The TG is comprised of updated excerpts from existing U.S. Army publications, as well as new information that is directly relevant for current military operations.

Original text for a large portion of this TG was contributed by the U.S. Army Medical Research and Materiel Command (http://mrmc-www.army.mil/) through four of its laboratories:

- Walter Reed Army Institute of Research (http://wrair-www.army.mil/)
- U.S. Army Research Institute of Environmental Medicine (http://www.usariem.army.mil/)
- U.S. Army Medical Research Institute of Infectious Diseases (http://www.usamriid.army.mil/)
- U.S. Army Medical Research Institute of Chemical Defense (http://chemdef.apgea.army.mil)

Global epidemiologic information that served as a basis for selecting and appropriately outlining the diseases addressed herein was provided by the Armed Forces Medical Intelligence Center, which can provide additional tools to U.S. military personnel for estimating the risk of specific diseases in specific geographic areas.
(http://mic.afmic.detrick.army.mil/)

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AREA OF RESPONSIBILITY

Introduction

This TG is compiled and edited for military physicians and physician assistants operating OCONUS under USCENTCOM.

The geographic area of consideration includes parts of Central and Southwest Asia, and northeastern Africa. A reasonable degree of geographic specificity is provided for conditions that show significant variability in this regard. Certain tropical diseases (such as filariasis) will most likely not be encountered in Central Asia. However, this TG is not to be considered a definitive source of medical intelligence, and the reader is referred to the Armed Forces Medical Intelligence Center for the most current medical intelligence.

Diseases outlined herein are primarily within the scope of primary care internal medicine. The following caveats bear mentioning:

- Focus is on initial, not definitive, management outside of the hospital. Assumed level of care is I or II, with a worst-case evacuation policy of 7 days. The format and distribution of this TG is aimed at providers who would generally lack laboratory support, and whose local supply of drugs, sterile supplies, and medical equipment would be extraordinarily limited. However, for most conditions, components of definitive care are briefly mentioned to help guide the reader through triage and clinical decisions that depend on feasibility of evacuation and predictability of an acceptable prognosis.

- Determination of physical profiles and specific duty limitations are left primarily to the provider, though some of the information in this guide may be helpful in decision support.

- This is not a complete guide for preventive countermeasures. Therefore, this is not the source for patient or command education. Use alternative, easily available, military sources for prevention guidance at the individual, small-unit, and command level. (see USACHPPM Web Site).

- Several categories of disease are not addressed, even though they would include conditions of military relevance. These categories were excluded for one or more of the following reasons:

  - Alternative, field-expedient sources are available to military providers (examples: for traumatic injuries, military dermatology, neuropsychiatric conditions, and care of local populations with and without malnutrition during relief operations).

  - Management of diseases in the category is an integral part of daily practice in CONUS and would not be unique in the operational setting (example: sexually transmitted diseases).

  - Morbidity or epidemic potential of the diseases, at least in the acute phase, would typically not be great (examples: intestinal helminth infections and human immunodeficiency virus infection).

- Medical management of the conditions is typically conservative, with emphasis on self-care and unit-level prevention strategies (examples related to cold weather operations: cold urticaria, chilblains, solar keratitis, sunburn, and eczema).

- Immunity in U.S. military populations (including vaccine-induced) is reliably universal (examples: tetanus, diphtheria, measles, and poliomyelitis).

SUGGESTED REFERENCES & COMPANION MANUALS

Control of Communicable Diseases Manual (Army FM 8-33, NAVMED P-5038), American Public Health Association, 2000

Emergency War Surgery, Second United States Revision, NATO Handbook, 1988

Field Operations Guide for Disaster Assessment & Response, Office of Foreign Disaster Assistance, U.S. Agency for International Development, 1998

Special Operations Medical Handbook, U.S. Special Operations Command & Center for Total Access, Teton NewMedia & The Geneva Foundation, 2001

Medical Management of Chemical Casualties Handbook, U.S. Army Medical Research Institute of Chemical Defense, Aberdeen Proving Ground, Maryland, July 2000

Medical Management of Biological Casualties Handbook, U.S. Army Medical Research Institute of Infectious Diseases, Fort Detrick, Maryland, February 2001

PART ONE: ENDEMIC INFECTIOUS DISEASES

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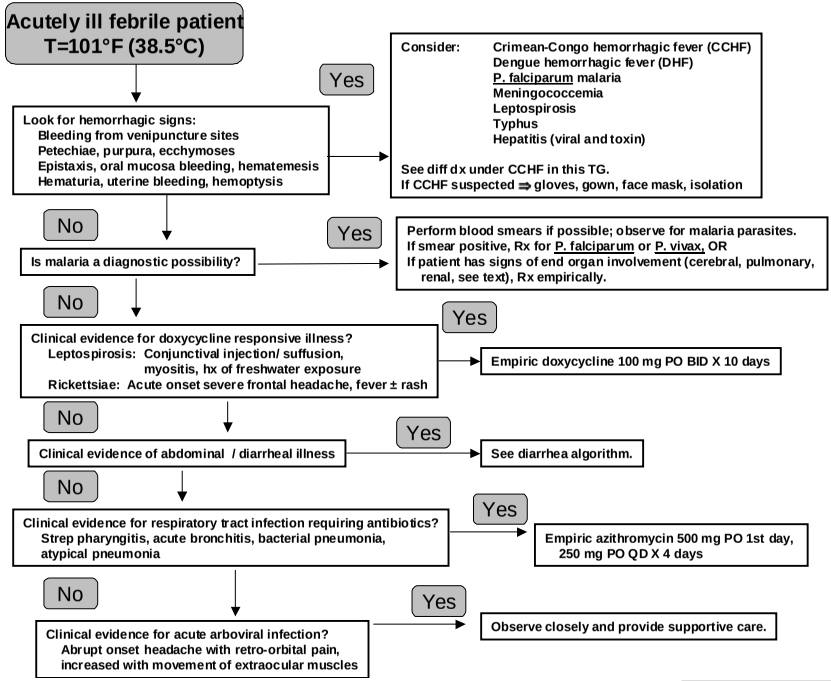
APPROACH TO THE ACUTELY ILL FEBRILE PATIENT

When evaluating a patient with fever, consider first the possibility of highly transmissible infections that can pose a threat to the community, and second the need to identify diseases that may progress rapidly to death if not promptly treated. Keep your index of suspicion high for both malaria and viral hemorrhagic fevers. Remember, malaria MUST be considered immediately in all febrile patients who are, or were recently, in a malarious region; and that hemorrhagic manifestations of viral hemorrhagic fevers such as Crimean-Congo hemorrhagic fever (CCHF) and dengue hemorrhagic fever (DHF) may not appear until at or near the time of defervescence.

APPROACH TO THE ACUTELY ILL FEBRILE PATIENT



ENDEMIC DISEASES

APPROACH TO THE PATIENT WITH DIARRHEA

Communicability of Pathogens Causing Acute Gastroenteritis:

- Route: oral ingestion of infectious organisms in contaminated food/water, particularly if inadequately cooked/purified. Inadequate personal hygiene, inadequate sanitary measures, and flies are the most likely contributory factors.
- Isolation: normal sanitary and stool precautions only; hand washing is essential.
- Prophylaxis: Not recommended, except for short duration during high-risk missions, such as aircraft pilots who must eat on the local economy. Efficacy is of brief duration; inadequate for sustained operations. After initial 1- 2 weeks of protection, prophylaxis with antibiotics has been associated with increased incidence of diarrhea due to disruption of protective normal bowel flora and with emergence of drug-resistant pathogens. Furthermore, it is prudent to reserve the best prophylactic drug (ciprofloxacin) for treatment to ensure its effectiveness when needed.

Public Health Measures - Command emphasis is essential:

- Adequate sanitary facilities.
- Personal hygiene, especially hand washing.
- Water purification and individual water discipline.
- Use of food obtained only from medically approved sources.

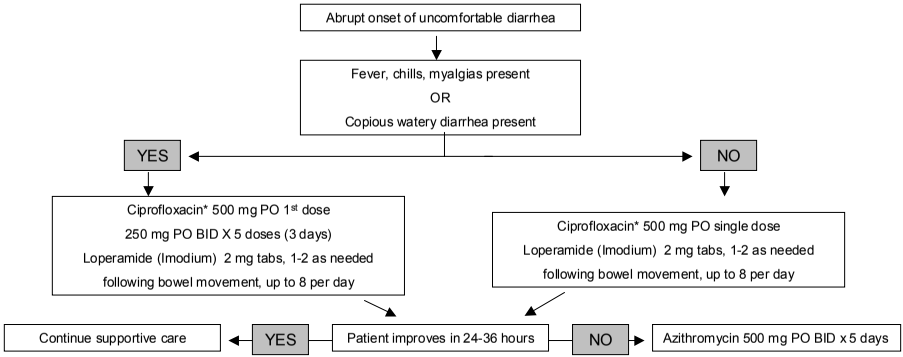
Incubation:

- Varies with specific pathogen. Ranges from hours (staphylococcal enterotoxins) to several weeks (giardiasis or amebiasis).

Diagnosis:

- Specific pathogen identification is not usually required for effective management of individual patients.
- The following algorithm provides an effective, efficient approach.

APPROACH TO THE PATIENT WITH DIARRHEA



Definition/Note:

1) Uncomfortable diarrhea = loose stools, abdominal cramps, urgency.
2) Antibiotic Rx is most effective when given ASAP after onset of symptoms.
3) Self Rx encouraged for mission essential personnel.
4) Significant nausea and vomiting at onset likely to be viral or exotoxin induced. Antibiotic Rx not useful.
5) More gradual onset and prolonged symptoms of greater than 1 week: empiric metronidazole (Flagyl) 250 mg PO TID x 7 days.
6) Consider malaria if systemic symptoms and signs are present and failure to improve quickly with antimicrobial.
7) Campylobacter may have high resistance rates to Ciprofloxacin; if a campylobacter is known to be the causative agent (e.g., identified outbreak), then azithromycin is preferred.
8) For continued bloody diarrhea, consider E. histolytica.

* If quinolones such as Ciprofloxacin are not available, use azithromycin.

- Oral rehydration: 3.3 gm NaCl, 2.5 gm $NaHCO_3$, 1.5 gm KCl, 20 gm glucose (or 40 gm sucrose) in 1 liter H_2O. Intake should be sufficient to maintain 60 to 100 mL urine output per hour. Pre-mixed salts/glucose are available. (See end of Heat Illness section, Part Five, for simple measure and field expedient equivalents.)
- Antimotility agents:
  - Use loperamide (Imodium) 2 mg tablet, 2 tablets loading dose, followed by 1 tablet after each stool, not to exceed 8 tablets per day.
  - Kaopectate is ineffective.
  - Diphenoxylate with atropine (Lomotil) is less desirable than loperamide due to a higher incidence of side effects.
- Alternate fluoroquinolone choices, in order of preference, include:
  - Ciprofloxacin 500 mg PO BID for 3-5 days.
  - Levofloxacin 500 mg PO QD for 3-5 days.
  - Norfloxacin 400 mg PO BID for 3-5 days.
  - In event of fluoroquinolone clinical failure, consider azithromycin 500 mg PO BID for 5 days.

BRUCELLOSIS

(see also Brucellosis, Part Two, BIOWEAPONS)

Communicability:

- Route:
  - Ingestion of contaminated meat or dairy products.
  - Inhalation of infectious aerosols, including laboratory-specimens.
  - Direct contact of abraded skin or mucous membranes with infected tissues, blood or lymph.
- Isolation: body fluid precautions.
- Prophylaxis: none required, no evidence of communicability from person to person.

Incubation: 2-3 weeks (1 week to several months).

Diagnosis: systemic infection with many different manifestations; no diagnostic clinical findings. Exposure history is critical. Screen for:

- ingestion of unpasteurized milk products or consumption of cheese, and
- exposure to animals, livestock, meats.

Classic presentation of the patients with no history of prior brucellosis infection could be presentation of fever associated with peripheral arthritis, prominent sacroileitis or spondylitis.

- Symptoms/Signs:
  - Systemic (almost 100%):
    - Fever as high as 104°F.
    - Weakness.
    - Night sweats.
    - Weight loss.
    - Malaise.
    - Lymphadenopathy (20%).

- Gastrointestinal:
  - Nausea and vomiting.
  - Splenomegaly (50-70% in acute disease).
  - Constipation or diarrhea.
  - Abdominal pain.
  - Liver and spleen.
  - Hepatomegaly (up to 65% in acute disease).
  - Abscesses.
  - Anorexia.
- Osteoarticular (20-85%):
  - Arthralgias.
  - Tenosynovitis.
  - Myalgia.
  - Bursitis.
  - Arthritis.
  - Sacroileitis.
  - Spondylitis.
  - Paravertebral abscess.
  - Osteomyelitis.
- Genitourinary (2-40%):
  - Unilateral epididymo-orchitis.
  - Pyelonephritis.
  - Acute interstitial nephritis.
  - Prostatitis (very uncommon).
- Pulmonary: cough (15-25%)
- Neurological (2-5%):
  - Meningitis, encephalitis.
  - Psychosis.
  - Meningoencephalitis.
  - Depression.
  - Myelitis.
  - Headaches.
  - Paresis.

- ♦ Cardiovascular:
  - Endocarditis - 2% (most common cause of death)
- ♦ Cutaneous (5%) - many nonspecific findings such as:
  - Erythema nodosum.
  - Eczematous rashes.
  - Vasculitis.
  - Maculopapular rashes.
  - Petechiae.
- ♦ Ocular:
  - Keratitis.
  - Uveitis.
  - Papilledema.
  - Optic neuritis.

- Laboratory findings:
  - ♦ Hematology: anemia, leukopenia, thrombocytopenia; lymphopenia worse in more severe cases.
  - ♦ Chemistry: elevated alkaline phosphatase; mildly elevated transaminases.
  - ♦ Microbiology: culture of pathogen from blood, bone marrow, fluids or tissue; blood cultures 70% sensitive, bone marrow-cultures 92% sensitive. Cultures must be held 45 days. Special media and conditions helpful. Strict precautions to avoid aerosol exposure necessary.
  - ♦ Serology: very helpful; IgM elevated in first 3 weeks, followed by IgG elevation after 3 weeks; titer > 1:160 indicates past exposure.
- Radiology:
  - ♦ CXR abnormal in patients who acquired infection by aerosol: hilar adenopathy, perihilar infiltrates, nodular lesions, lung abscess, pleural effusions, and/or pneumothorax.

  - Spondylitis with disk-space narrowing and epiphysitis; erosion and rounding of anterior superior edge of vertebral body with syndesmophyte formation; lumbar involvement much greater than thoracic or cervical involvement.
- Invasive procedures: not required for diagnosis; only required in therapy for focal suppurative complications.
- "Gold Standard" for Diagnosis:
  - Isolation of pathogen, or
  - Titer > 1:160 with compatible epidemiologic and clinical findings.

Duration:

- Treated: week to months.
- Untreated: months, with up to 30% complications.

Complications: see Symptoms/Signs.

Treatment:

- Uncomplicated: doxycycline 100 mg PO BID plus rifampin 600 mg/day x 6 weeks.
- Complications: seek specialist consultation.
- Alternative treatment regimens: not well defined; obtain specialist consultation.
- Treatment failure and relapses occur in 5%; most not due to drug resistance; re-treat with initial regimen and obtain specialist consultation.

Disposition:

- Uncomplicated: limited duty (consider evacuation).
- Complications: hospitalization and evacuation.

Prognosis:

- Treated: excellent.
- Untreated: 30% complications, prolonged hospitalization and convalescence with occasional deaths due to endocarditis.

Prevention and Public Health Measures:

- Locate contaminated products, if implicated, and destroy.
- Educate commanders and troops not to drink or eat unpasteurized dairy products.
- Report case as a reportable event using theater medical surveillance reporting channels.

CRIMEAN-CONGO HEMORRHAGIC FEVER (CCHF)

Communicability:

- Route:
  - Ixodid tick (Hyalomma species) bite.
  - Exposure to blood, secretions, or excrement of infected patients. Aerosol transmission may occur, as transmission to hospital staff has been documented in the absence of direct patient contact.
  - Exposure to tissue or blood or infected animals. (Source animals do not appear to be sick.)
  - Onset of illness more than 3 weeks after last possible exposure rules out CCHF.
- Isolation: Strict isolation mandatory, to include contact, blood, body fluids, and respiratory. This must include strict precautions in handling of clinical laboratory specimens. Barrier protection including mask and gloves required for all health care workers taking care of the patient, all laboratory personnel handling blood and other clinical specimens, and all immediate air/evac and transportation personnel.
- Prophylaxis:
  - No prophylaxis of proven efficacy available.
  - The antiviral drug Ribavirin may be effective as immediate, post-exposure prophylaxis; and, if available, it should be strongly considered for health care workers and transportation personnel involved in caring for patients with CCHF (400 mg PO Q6H for 24 hours, then 400 mg PO TID for 6 days).

Incubation: 1-3 days (range: 1-12 days).

Diagnosis:

- Symptoms:
  - Sudden onset of fever, chills, headache, myalgias (especially lower back).
  - Marked anorexia and irritability.
  - Flushing of face and chest with fine petechial rash.
  - Pharyngeal hyperemia, petechiae, and hemorrhage on soft palate.
  - Conjunctival injection.
  - Signs of hemorrhage on 4^{th} or 5^{th} day.
  - Ecchymoses or bleeding from mucous membranes (gums, nose, mouth, lungs, intestines, uterus).
  - Abdominal pain (90%)
  - Backache (90%)
  - Arthralgia/myalgia (70%)
  - Diarrhea (40-50%)
  - Photophobia (50%)
  - Cough (nonproductive) (16-40%)
  - Chest pain (20%)
  - Sore throat (16%)
- Signs:
  - Fever: to 104^0F (40^0C) (100%).
  - Skin hemorrhages (petechiae, purpura) (100%).
  - Jaundice (25-100%).
  - Hematuria (90%).
  - Tachycardia (70-90%).
  - Hypotension (70-90%).
  - Oliguria (80%).
  - Hepatomegaly (80-100%).
  - Disturbed consciousness (80%).
  - GI bleeding (hematemesis or melena) (70%).
  - Epistaxis (50%).
  - Vaginal bleeding (>50% of women).

- Edema (50%).
- Meningeal irritation (40%).
- Blooding gums (40%).
- Relative bradycardia (20%).
- Conjunctival injection (20%).
- Palmar erythema (20%).
- Gingival ulcers (16%).

■ Laboratory findings:

- Hematologic:
  - Anemia (as condition deteriorates).
  - Leukopenia (60%).
  - Thrombocytopenia (100%).
  - Atypical lymphocytes (60%).
- Chemistry:
  - Hyperbilirubinemia.
  - Elevated transaminases.
- Urinalysis:
  - Hematuria (90%).
  - Proteinuria (90%).
- Microbiologic:
  - Unavailable in most clinical laboratories.
  - Viral isolation possible by specialized laboratories with sophisticated containment and viral culture capabilities.
  - Exposure of laboratory personnel to aerosolized specimens is highly dangerous.
- Serology: Acute and convalescent paired sera can demonstrate virus-specific antibodies by 20-21 days using ELISA or IFA tests, but are of no immediate clinical diagnostic value.
- Coagulation studies:
  - Prolonged bleeding time (100%).
  - Prolonged PT (75%).

- Prolonged PTT (67%).
- Fibrinogen - decreased.
- Fibrin split products (increased in 60%).

- Invasive procedures: not applicable.
- X-rays: nonspecific.
- Diagnostic confirmation: serologic or viral isolation.

Duration:

- Treated: undefined, but presumably shorter acute illness and markedly abbreviated convalescence.
- Untreated: 10-14 days with subsequent convalescence requiring several weeks.

Complications:

- Sepsis, shock, renal failure, death (20-40% mortality).
- Relapse does not occur.

Treatment:

- Treatment regimens of proven efficacy do not exist.
- Ribavirin may be beneficial for CCHF treatment if given intravenously over a 10-day course, and IF available as part of an investigational new drug (IND) protocol (Landstuhl Regional Medical Center, Germany). Ribavirin to be administered in a volume of 50-100 mL and infused over 30 to 40 minutes with the following dosing schedule:

  Loading dose: 33 mg/kg (maximum dose: 2.64 g),
  Days 1-4: 16 mg/kg (maximum dose: 1.28 g) IV Q6H,
  Days 5-10: 8 mg/kg (maximum dose 0.64 g) IV Q8H.

  Oral Ribavirin is NOT recommended for acute CCHF, and if used, would be considered off-label use (prompting informed consent): 400 mg PO Q4H for 24 hours, then 400 mg PO Q8H for 7-14 days.

- Human immune convalescent serum: isolated clinical reports suggest possible benefit, but efficacy has not been proven.
- No alternatives exist for treatment failure.
- Relapses are not known to occur.
- Aggressive supportive care and fluid management, emphasizing replacement of intravascular volume and blood products, is essential.
- Summary of immediate objectives:
  - Prevent secondary cases (institute barrier precautions against blood and secretions ASAP)
  - Initiate evacuation procedures
  - Consider treatable diseases in differential diagnosis:

Falciparum malaria	Mefloquine 1250 mg (5 tabs) given in a divided PO dosing schedule with 3 tabs initially followed by 2 tabs 8-24 hours later OR Malarone 4 adult tabs PO QD for 4 days
Meningococcemia	Ceftriaxone 50 mg/Kg per day (2 gm max) IM for 14 days
Leptospirosis	Doxycycline 100 mg PO BID for 10 days
Typhus	Doxycycline 200 mg PO single dose
Septicemia	Ceftriaxone 50 mg /kg per day (2 gm max) IM for 14 days
Plague	Doxycycline 100 mg PO BID for 10 days

- Clinical clues to differentiate from CCHF:

CCHF	Pharyngeal hyperemia, petechiae, and hemorrhage on soft palate
Falciparum malaria	DIC and/or bleeding as a preterminal event occurring more than 7 days following onset of fever
Meningococcemia	Purpura occurring very soon (within hours) after onset of illness
Leptospirosis	Hemorrhage, especially pulmonary, with jaundice
Typhus	Maculopapular rash development on days 4-7 with progression to purpura
Septicemia	DIC and/or bleeding less prominent than organ failure
Plague	Acral gangrene with septicemic plague, no adenopathy

Disposition:

- Local hospitalization is favored during acute illness if possible. If evacuation to larger facilities is unavoidable, strict isolation must be observed.
- Depending on clinical response, evacuation for extended convalescence after acute illness may be required.
- Rapidly recovered cases may return to duty.

Prognosis:

- Treated: unknown.
- Untreated: 10-70% mortality; nosocomial cases may be associated with higher mortality than sporadic cases.
- Survivors generally suffer no major sequelae.

Prevention and Public Health Measures:

- Investigate possible infection sources.
- Identify and clinically assess close contacts.
- Report case as a reportable event using theater medical surveillance reporting channels.

DENGUE FEVER AND DENGUE-LIKE DISEASES

Communicability:

- Route: Dengue is transmitted by the daytime biting *Aedes* mosquito.
- Isolation: not directly transmitted from patient to patient. Patients must be protected from exposure to day-biting mosquitoes until afebrile. Insect repellent and permethrin-impregnated bed netting should be used.
- Prophylaxis: none.

Incubation period: 3-14 days, commonly 4-7 days.

Diagnosis:

Primary infection of adults with dengue virus or similar viruses results in an undifferentiated febrile syndrome known as dengue fever (DF). A positive tourniquet test or spontaneous epistaxis may occur in DF. Very rarely, primary dengue infection results in a significant hemorrhagic diathesis or capillary leakage and shock. Therefore, extensive petechiae, ecchymoses or significant bleeding should prompt immediate consideration of more serious diseases, such as CCHF or even dengue hemorrhagic fever (DHF); see Fever Algorithm. Secondary dengue cases in persons who may have previously had a dengue infection can also manifest with critical hemorrhagic manifestations that require aggressive clinical management.

- Symptoms (abrupt onset):
  - Fever, may be biphasic (saddleback).
  - Chills.
  - Headache, diffuse.
  - Eye pain.
  - Intense long bone and joint pain.
  - Myalgias.
  - Anorexia.

- Nausea.
- Vomiting.
- Lassitude.
- Cutaneous hyperesthesia.

- Signs:
  - Initially, a transient, generalized, flushing rash.
  - Bradycardia.
  - Rash, morbilliform or macular, erythematous and blanching on day 3, 4 or 5.
  - Petechiae, epistaxis or positive tourniquet test .
  - Generalized lymphadenopathy.
  - Significant bleeding and shock suggest alternate diagnoses (CCHF or complicated Rift Valley Fever. Also see Fever Algorithm).
- Laboratory findings:
  - Hematologic:
    - Hb/Hct: normal.
    - WBC: leukopenia (< 1,500 WBC/mm^3).
    - Platelets: normal or low.
  - Chemistry, Urinalysis, Microbiology, Coagulation: not applicable.
  - Serology: Diagnosis by single acute IgM serum ELISA OR paired acute and convalescent sera 10-14 days apart using ELISA.
- Diagnostic confirmation: Numerous arthropod-borne viruses endemic in the region cause dengue-like illnesses which are indistinguishable solely on clinical grounds. These can be definitively distinguished only by paired serology or demonstration of specific viral antigen. With two exceptions, exact diagnosis has no specific vector control, treatment or prophylaxis consequences. Rift

Valley Fever is transmitted by contact with infected animals or mosquitoes and there is a vaccine available. CCHF is a severe, tick-borne viral hemorrhagic fever, which poses the threat of nosocomial spread, and for which specific treatment and chemoprophylaxis exists.

Duration: Usually 5-7, but up to 10 days.

Complications: Psychiatric depression may be severe.

Treatment:

- No specific therapy exists.
- Therapy is supportive; hydrate to maintain intravascular volume and correct electrolyte abnormalities, and administer analgesics and antipyretics (NSAIDs are not recommended for DHF). DO NOT OVERHYDRATE. Appropriate fluid hydration decreases DHF mortality; consider blood transfusion if Hct falls below 30%. Although platelet transfusions are generally not effective in reducing bleeding complications, consider if platelet count is less than 10,000.

Disposition: May be hospitalized in theater; most will be able to return to duty in 1 week. Development of severe systemic symptoms may require evacuation.

Prognosis:

- Mortality:
  - DF is a nonfatal disease; complete recovery is expected.
  - DHF is associated with a 0.5 to 15% mortality rate.
- Subsequent dengue virus infection is more likely to be complicated by hemorrhage and shock.
- Patients may experience fatigue, weakness, and depression for several weeks.

Prevention and Public Health Measures:

- Command emphasis on use of personal protective measures (use of insect repellents and impregnated mosquito netting, application of permethrin to clothes and netting if not previously treated).
- Insecticide applications to mosquito habitats.
- Eliminate mosquito breeding sites (standing water).
- Protection of patients from mosquito bites.
- Report case as a reportable event using theater medical surveillance reporting channels.

FILARIASIS

Filiarial parasites are long thread-like roundworms that dwell in tissue and produce microfilariae. The microfilariae are immature larval forms found in blood and skin and are the infective forms for the insect vector. Bancroftian filariasis is caused by the mosquito-borne nematode Wuchereria bancrofti. Not seen in Central Asia.

Communicability:

- Route: Infective larvae transmitted by mosquito bite.
- Isolation: not required.

Incubation period: 3-12 months.

Diagnosis: Symptoms and signs can be grouped as inflammatory, chronic obstructive or atypically hypersensitive.

- Symptoms/Signs (acute inflammatory, most likely to be seen in our nonimmune troops):
  - An acute attack of localized pain, tenderness, swelling, and erythema is the hallmark of lymphatic filariasis. Genitalia (42%), arms (25%), legs (11%).
  - Fever, sweats, chills, headache, lethargy, weakness, myalgias, and arthralgias after the lymphadenitis.
  - A retrograde lymphangitis follows within hours and is strongly diagnostic for filariasis.
  - Painful, swollen, tender testicle and/or epididymis.
- Symptoms/Signs (chronic obstructive, requires prolonged exposure over years following multiple acute attacks; may be seen in endemic populations):
  - Chronic lymphedema.
  - Hydrocele/chylocele.
  - Lymph varices.

- Lymph scrotum.
- Elephantiasis.
- Chyluria.

- Laboratory findings:
  - Routine labs are not necessary. Eosinophilia frequently accompanies the acute phase symptoms.
  - Diagnosis established by identifying the microfilaria in peripheral blood.
    - Giemsa stain thick film of peripheral blood collected between 2000 and 0200 as this is a nocturnally periodic parasite.
    - Concentration of peripheral blood:
      - Collect 5 mL of heparinized peripheral blood (nighttime collection will increase sensitivity).
      - Pass it through a 3-5 mm Nucleopore® filter.
      - Pass 10 mL distilled water through the filter to remove debris.
      - Place membrane on slide and stain with Giemsa.
  - Serology: only available in research labs.

Duration:

- Treated: Curative.
- Untreated: variable, recurrent attacks of acute lymphadenitis/lymphangitis frequently occur.

Complications: chronic obstructive phenomena if unrecognized and untreated.

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Treatment: diethylcarbamazine (DEC) and ivermectin (Mectizan®) - not available in a field situation. Doxycycline may be beneficial in the absence of these antihelminthics.

Prognosis: Excellent.

Disposition: Evacuate all nonmission-essential individuals with suspected or confirmed filarial infection to a CONUS facility such as Walter Reed Army Medical Center (WRAMC) or National Naval Medical Center (NNMC) where tropical medicine expertise is available.

Prevention and Public Health Measures:

- Command emphasis on use of personal protection measures (use of insect repellents and impregnated netting, application of permethrin to clothes and netting if not previously treated).
- Insecticide applications to mosquito habitats.
- Eliminate mosquito breeding sites (standing water).
- Protection of patients from mosquito bites.
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HEPATITIS (VIRAL)

Communicability:

- Route:
  - Hepatitis A and hepatitis E (epidemic non-A, non-B hepatitis):
    - Usually are contracted by oral ingestion of the viruses, typically via infected food or water, or after physical contact with an infected individual (e.g., hand-to-hand-to-mouth, basically fecal-oral).
    - Hepatitis A is rarely spread by male homosexual activity, among IV drug abusers or by blood transfusions.
  - Hepatitis B, hepatitis delta, and hepatitis C are contracted by exposure to infected blood, blood products, other infected bodily fluids, or by sexual activity. Hepatitis delta occurs as co-infection with acute hepatitis B or as superinfection with chronic hepatitis B.
- Isolation:
  - Hepatitis A, E: stool precautions, hand washing.
  - Hepatitis B, delta, C: needle, blood, and body fluid precautions.
  - In case of clinical uncertainty as to specific viral etiology, implement both types of precautions.
  - Infectiousness is generally greatest during incubation period and early icteric phase of illness, but may persist with hepatitis B or C for much longer periods.
- Prophylaxis:
  - Hepatitis A: Vaccinate with Hepatitis A vaccine.
  - Hepatitis B: Vaccinate with Hepatitis B vaccine.
  - Hepatitis C: No prophylaxis available.
  - Hepatitis E: No prophylaxis available.

Incubation:

- Hepatitis A: 30 days (range: 15-45).
- Hepatitis B: 70 days (range: 30-180).
- Hepatitis C: 50 days (range: 15-150).
- Hepatitis D: less well defined; probably similar to hepatitis B.
- Hepatitis E: 40 days (range 15-60).

Diagnosis: the clinical manifestations of acute hepatitis caused by the various viral agents overlap. Specific diagnosis must usually be based on serology. For any type of viral hepatitis, the spectrum of disease may range from inapparent to fulminant.

- Symptoms:
  - Malaise.
  - Anorexia, including loss of taste for tobacco smoking.
  - Nausea and/or vomiting.
  - Right upper quadrant pain/discomfort.
  - Pruritus.
  - Arthritis/arthralgia.
  - Headaches.
  - Fever (low grade).
- Signs:
  - Icterus/jaundice.
  - Tender hepatomegaly (mild-moderate).
  - Splenomegaly (uncommon).
  - Palmar erythema.
  - Spider angiomata.
  - Jaundice.
  - Dark urine.
  - Light color (acholic) stools.
  - Low-grade fever (although fever is usually absent).

- Laboratory findings:
  - Hematologic:
    - Hgb/Hct: usually normal; hemolysis occurs uncommonly.
    - WBC:
      - normal or mild leukopenia.
      - mild lymphocytosis with or without atypical lymphocytes may occur.
    - Platelets: normal.
  - Chemistry:
    - Transaminases:
      - rise 5-100 times normal.
      - ALT (SGPT) > AST (SGOT).
    - Bilirubin: rises 1-20 times normal.
    - Alkaline phosphatase: rises mildly, 1-4x normal.
    - Albumin/globulin: remains normal or near normal in uncomplicated acute hepatitis.
  - Urinalysis:
    - Positive for bile.
    - Occasional microhematuria.
    - Occasional mild proteinuria.
  - Microbiologic: not applicable.
  - Serology:
    - Anti-hepatitis A IgM suggests acute hepatitis A.
    - Anti-hepatitis A IgG indicates prior infection with hepatitis A.
    - Hepatitis B surface antigen (HBsAg) indicates active infection with hepatitis B or chronic carrier.
    - Hepatitis B “e” antigen indicates greater infectiousness.
    - Anti-hepatitis B surface antibody appears during convalescence (except in chronic carriers); it indicates either prior infection or vaccination.

- Anti-hepatitis B core IgM antibody indicates acute infection with hepatitis B. (IgG: past infection).
- Anti-hepatitis C antibody indicates prior or ongoing infection with hepatitis C.
- Anti-hepatitis E IgM suggests acute hepatitis E, (IgG past or current infection). PCR useful during the acute phase of illness.

♦ Coagulation:
- Generally normal in uncomplicated acute viral hepatitis.
- Prothrombin time (PT) rises in fulminant hepatitis.

■ X-rays: nonspecific.
■ Invasive procedures: not indicated.
■ Diagnostic confirmation: serologic.

Duration:
■ Icteric phase: 1-3 weeks.
■ Convalescent phase: may require up to several months.

Complications:
■ Fulminant hepatitis:
♦ Presentation: hepatic encephalopathy, asterixis, coma, coagulopathy, death.
♦ Treatment:
- Supportive to include bed rest, protein restriction.
- Lactulose in sorbitol orally, if tolerated; by enema otherwise; or oral neomycin.
- Pregnant women with hepatitis E are at particular risk for fulminant hepatitis associated with a 15-40% mortality.

- Progression to chronic hepatitis:
  - Hepatitis A or E: none.
  - Hepatitis B: 5-10%.
  - Hepatitis C: up to 50-70%.
- Pancreatitis.

Treatment:

- No specific treatment is available for acute viral hepatitis.
- Rest is important.
- Discontinue any nonessential medications.

Disposition:

- Mild cases may be hospitalized in theater, as some will be able to return to duty in 2-3 weeks.
- Evacuate moderate or severe cases.

Prognosis:

- Mortality: less than 1%, (except hepatitis E, up to 5% in normal hosts, greater in pregnancy).
- Chronic disease: see complications above.

Prevention and Public Health Measures:

- Hepatitis A:
  - Hepatitis A vaccine, if available.
  - Command emphasis on proper sanitation.
  - Proper food preparation/water purification.
  - Personal hygiene.
- Hepatitis B, delta, and C:
  - Vaccinate high-risk populations with hepatitis B vaccine. Vaccination series requires 3 injections at 0, 1, and 6 months.

- Sexual abstinence or use of barrier (condom) protection.
- Screening of blood products for hepatitis B and C.
- Use of barrier precautions by health workers when dealing with blood or other body fluids.

- Report case as a reportable event using theater medical surveillance reporting channels.

LEISHMANIASIS, CUTANEOUS (OLD WORLD)

Communicability:

- Route: parasite inoculated into skin by the bite of an infected sand fly.
- Isolation: not required.
- Prophylaxis: simple wound care with covering of open lesions.
- Highly endemic in Afghanistan, epidemic proportions in Kabul.

Incubation period: usually 2-8 weeks, but may be years depending on initial inoculum size.

Diagnosis:

- Symptoms/signs: inflammatory papule/nodule that slowly increases in size and ulcerates. Base will crust over but the ulcer spreads under the edge of a firm and raised border. Lesions are usually on exposed skin (genital lesions have been confirmed in a Desert Storm soldier, so consider latrines and similar areas as potential sites of infective sand flies) and are rarely seen in the scalp or on the palms and soles.
- Laboratory confirmation: requires parasite demonstration. Place scrapings of the cleaned ulcer base onto a glass slide and stain with Giemsa or Diff-Quick. Prepare Giemsa stained touch preps using a small full thickness skin biopsy from the lesion's edge. Divide the biopsy specimen longitudinally into halves for culture and histology. **Note:** the parasite must be demonstrated for accurate diagnosis; diagnosis based on clinical presentation or serology can be incorrect.

Treatment: ulcers do not necessarily require treatment, but consider treating if the lesions are large, multiple, threaten structures like the eye, or limit function. The diagnosis must be confirmed parasitologically before treatment is offered (see above).

- Patients requiring treatment must be evacuated to a CONUS facility such as WRAMC or NNMC where sodium stibogluconate (Pentostam ®) can be given. The regimen is 20 mg/kg/day (in 2 divided doses) IM or IV for 28 days.

Disposition:

- Evacuate all patients to CONUS if sodium stibogluconate therapy is required.

Prognosis: Mucosal or mucocutaneous disease is rarely reported from the Old World. Chronic cutaneous lesions (leishmaniasis recidivans) are usually associated with Leishmania tropica infections.

Prevention and Public Health Measures:

- Command emphasis on use of personal protective measures (use of insect repellents, application of permethrin insecticides to clothes if not previously treated). Mosquito netting such as bednets are not effective controls against sand flies *unless mesh hole density is not longer than 10-12 mesh holes/cm*.
- Insecticide applications to sand fly habitats.
- Reservoir host (domestic canines) control.
- Protection of patients from sand-fly bites.
- Report case as a reportable event using theater medical surveillance reporting channels.

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LEISHMANIASIS, VISCERAL

Communicability:

- Route:
  - Sand fly (Phlebotomus species) bites.
  - Other transmission routes have been reported.
    - Sexual intercourse (two reports).
    - Infected blood transfusion (several reports).
    - Accidental inoculation in a laboratory.
    - Vertical transmission from mother to fetus.
- Isolation: generally not required. In forward areas or under field conditions where continued exposure to sand flies may occur, personal measures to protect the patient from sand fly bites, including insect repellents and permethrin-impregnated netting, should be used.
- Prophylaxis: no immunoprophylaxis, chemoprophylaxis or vaccine available.
- Has been described in Afghanistan, and is quite common in India.

Incubation: normally 3-8 months (range: from 10 days to more than 10 years).

Diagnosis:

Acute visceral leishmaniasis in an immunologically naive adult will frequently present as an acute febrile illness that is often confused with malaria. There are no pathognomonic signs or symptoms that will distinguish this febrile illness from many other causes. Patients are often described as not toxic even with fever > 40^0C. The acute presentation can resolve, progress to kala-azar or evolve to a chronic syndrome of abdominal complaints, diarrhea, night sweats, weight loss, and fatigue.

Consider visceral leishmaniasis in the differential diagnosis of all acutely febrile patients.

- Symptoms:
  - Onset may be insidious or abrupt.
  - Fever: high intermittent or remittent, can be associated with chills or prostration.
  - Sweats.
  - Nonproductive cough.
  - Epistaxis.
  - Abdominal discomfort and/or swelling.
  - Weight loss.
  - Diarrhea.
  - Peripheral edema (late).
  - Bleeding diathesis (late).
  - Generalized weakness (as emaciation progresses).
  - Headaches ± nuchal rigidity.
- Signs:
  - Weight loss/emaciation.
  - Splenomegaly (presents early, progressively worsens).
  - Hepatomegaly (less pronounced than splenomegaly).
  - Lymphadenopathy (solitary, regional or generalized).
  - Fever (39 to 40^0C).
  - Skin:
    - trophic changes (due to malnutrition): thinning, dryness, hair loss, hypopigmentation.
    - polymorphic lesions: papules, wart-like nodules, ulcers (rare).
    - petechiae, purpura, bruises.
  - Eye: retinal hemorrhage, papilledema, eyelid nodules, anterior uveitis (rare and occur late).
  - Jaundice (in advanced disease).
  - Nodules or ulcers of oral and/or nasopharyngeal mucosa (rare).

- Edema (associated with hypoalbuminemia with proteinuria).
- Bleeding: epistaxis, gingival, vaginal, other sites.
- Ascites (advanced disease).

■ Laboratory findings:

Note: In early illness there may only be mild anemia and transaminase elevation. Leukopenia and thrombocytopenia seen in advanced disease with hepatosplenomegaly.

- Hematologic:
  - anemia (normochromic, normocytic).
  - leukopenia.
  - thrombocytopenia.
  - Coombs test usually positive.
  - marked decrease or absence of eosinophils.
  - parasitemia may be occasionally detected on peripheral blood smear.
  - buffy coat smears may be diagnostic.
- Chemistry:
  - polyclonal hypergammaglobulinemia.
  - positive rheumatoid factor.
  - hypoalbuminemia.
  - elevated transaminases.
  - hyperbilirubinemia (advanced disease).
- Urinalysis:
  - proteinuria (occasional).
  - hematuria (occasional).
- Microbiologic: standard microbiologic techniques are not applicable.
- Serologic: Serologic diagnosis available.
- Coagulation:
  - bleeding and clotting times are generally normal.
  - prothrombin time (PT) may be mildly prolonged (2-4 seconds more than control).

- X-ray:
  - Standard examinations are nonspecific.
  - Hepatomegaly and splenomegaly can be detected by appropriate imaging modalities (sonogram, CT, etc.).
- Invasive procedures:
  - Aspiration/biopsy of bone narrow, spleen, liver, or lymph nodes.
  - Attempt to visualize amastigotes on Wright or Giemsa stained smears of tissue and /or (+) culture.
- Skin testing: Leishmanin skin test will be negative in active disease and is not useful for diagnosis.
- Diagnostic confirmation:
  - Diagnosis must be confirmed by the demonstration of parasites in a tissue aspirate or biopsy.
  - Culture of organism from tissue aspirate specimens is possible with specialized technique (NNN or Schneider's media), but this should only be attempted in facilities with experience in culturing leishmania.

Duration:

- Treated: varies with therapeutic regimen; generally about 1 month with sodium stibogluconate (Pentostam) therapy; however, fever will respond within 48-72 hours of starting therapy, and patient will feel improved within first week.
- Untreated: indefinite.

Complications:

- Renal:
  - Renal amyloidosis with nephrotic syndrome.
  - Immune-complex mediated glomerulonephritis.

- Hepatic:
  - Acute liver failure may rarely occur.
  - Cirrhosis (rare).
- Disseminated intravascular coagulation (DIC).
- Hemorrhage.
- Secondary infections usually seen only in advanced cases with accompanying malnutrition.
  - Tuberculosis.
  - Pneumonia.
  - Dysentery.
  - Measles, in previously unvaccinated individuals.
  - Herpes Zoster.
- Persistent post-disease splenomegaly.

Treatment: visceral leishmaniasis is not a life threatening disease acutely. However, all patients with suspected or confirmed visceral leishmaniasis must be evacuated to CONUS facilities (WRAMC). These patients should not be treated in theater or in Europe.

- Standard therapy:
  - Liposomal amphotericin (AmBisome®) 3 mg/kg, days 1-5, day 14 and day 21.
  - Alternatives:
    - Sodium stibogluconate (Pentostam), 20 mg/kg IV QD, for 30 days.
    - Sodium stibogluconate is not a licensed product in the United States, and must only be given under a treatment IND protocol. Patients requiring stibogluconate treatment must be evacuated to a CONUS facility such as WRAMC or NNMC.

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Prognosis: generally good; mortality usually occurs only in advanced disease, but even advanced disease may be successfully cured.

Disposition: evacuate all patients with suspected or confirmed visceral leishmaniasis. This disease is slowly progressive and should not be so far advanced in U.S. military personnel that emergency treatment is required.

Prevention and Public Health Measures:

- Command emphasis on use of personal protection (repellent, impregnated netting, application of permethrin to clothes and netting if not previously treated).
- Insecticide applications to sand fly habitats located near troop areas.
- Control of wild canids and feral dogs (foxes, jackals, dogs may be natural reservoirs of infection; probably includes domestic dogs as well).
- Protection of patients from further sand fly bites, thus aborting possibility of epidemics based on human reservoirs.
- Report all cases through preventive medicine channels.

LEPTOSPIROSIS

Communicability:

- Route:
  - Transmitted by contact of mucous membranes or skin with water or soil contaminated by urine from leptospiuric animals.
  - Transmitted by ingestion of food contaminated by leptospiuric animals.
- Isolation: Blood and body fluid precautions.
- Prophylaxis: None: person-to-person. transmission is rare.
- Chemoprophylaxis: Doxycycline 200 mg weekly is effective during times of high exposure.

Incubation: 10 days, (range 2-26 days).

Diagnosis: Asymptomatic infection may occur. Leptospirosis usually presents as an anicteric, often biphasic illness; but severe, icteric disease with renal failure and hemorrhage does occur (See Leptospirosis "Complications"). There may be a history of exposure to contaminated water (swimming, wading or drinking), or soil (digging, farming or construction).

- Symptoms (abrupt onset):
  - Fever (100% -may be biphasic).
  - Myalgia (97% -especially calves and thighs).
  - Headache (95%).
  - Chills (85%).
  - Sore throat (72%).
  - Nausea (70%).
  - Vomiting (65%).
  - Eye pain (50%).
  - Diarrhea (23%).

- Signs:
  - Conjunctival injection (100%).
  - Muscle tenderness (70%).
  - Hepatosplenomegaly (60%).
  - Lymphadenopathy (35%).
  - Pulmonary findings (11%).
  - Petechiae or ecchymoses (4%).
  - Pulmonary hemorrhage (variable %).
- Laboratory findings:
  - Hematologic:
    - WBC variable, but neutrophilia common.
    - ESR increased.
  - Chemistry:
    - aldolase increased.
    - CPK increased.
  - Urinalysis:
    - proteinuria.
    - pyuria.
    - microscopic hematuria.
  - Microbiologic: Leptospires can be cultured from blood (day 0-7) or spinal fluid (day 4-10), and intermittently from urine during second week of illness. If special culture media not available, leptospires remain viable in blood anticoagulated with sodium oxalate for 21 days.
  - Serology: 4-fold antibody rise with acute and convalescent sera 14-21 days apart. Microscopic hemagglutination assay is confirmatory. Rapid diagnostic tests are available (Lepto dipsticks).
- X-ray: variable in those with symptomatic pulmonary disease, most often small patchy, peripheral infiltrates.
- Diagnostic confirmation: In the absence of rapid diagnostic tests (Lepto dipsticks), serology and culture results are too slow to benefit acutely ill patients.

Duration: 3 days to 3 weeks.

Complications:

- Anicteric leptospirosis: Aseptic meningitis, meningoencephalitis, uveitis, and iridocyclitis.
- Icteric leptospirosis (Weil's disease): Jaundice, renal failure, hemorrhage, and death.

Treatment:

- All cases should receive either doxycycline 100 mg PO BID for 7 d; or if severely ill, high dose parenteral aqueous penicillin G 110,000 U/kg per day (6-8 million U/day) IV as four divided doses every 6 hours. Initiation of therapy may be accompanied by high fever and hypotension within 12 hours after starting therapy (Jarisch-Herxheimer reaction, see Relapsing Fever complications section for characteristics and treatment suggestions).
- In icteric leptospirosis (Weil's Disease), careful maintenance of intravascular volume will reduce the incidence of renal failure requiring dialysis.

Disposition:

- For mild cases, hospitalization in theater.
- For complicated cases with hemorrhage or jaundice or renal insufficiency, evacuation to third or fourth echelon medical facilities.

Prognosis:

- Anicteric leptospirosis: if treated, complete recovery.
- Icteric leptospirosis: untreated, 5-30% mortality rate, mostly due to renal failure, but survivors recover completely.

Prevention and Public Health Measures:

- Command emphasis on educating troops to avoid swimming, wading, and exposure to contaminated soil.
- Control local rodent populations.
- Report case as a reportable event using theater medical surveillance reporting channels.
- Consider troop prophylaxis in endemic areas with confirmed cases: doxycycline 200 mg PO once weekly during periods of high exposure.

MALARIA: GEOGRAPHICAL RISK

Country	Transmission Period	Distribution	Potential Rate per Month Without Countermeasures	Type
Afghanistan	May - November	Countrywide	Up to 11 - 50%	80 to 90% *P. vivax* 10 to 20% *P. falciparum*
Bahrain			Risk does not currently exist	
Djibouti	November - March	Countrywide	Up to 11 - 50%	98% *P. falciparum* 2% *P. vivax*
Egypt	June - October	Variable - Risk only occurs in focal rural areas of Al Fayyum Governorate	Infrequent cases	99% *P. vivax* 1% *P. falciparum*
Eritrea	Year-round	Variable	Up to 11 - 50%	85% *P. falciparum* *P. vivax* & *P. malariae* also occur
Ethiopia	Year-round	Variable	Up to 11 - 50%	85% *P. falciparum* *P. vivax*, *P. malariae, & P. ovale* also occur
Iran	March - November	Variable	Up to 1%	*P. falciparum, P. vivax*, & *P. malariae* all occur at varying levels
Iraq	May - November	Variable	Up to 2 - 10%	99% *P. vivax* 1% *P. falciparum*
Jordan			Risk does not currently exist	
Kazakhstan	May - September	Variable	Infrequent cases	Primarily *P. vivax*, but *P. falciparum* and *P. malariae* also occur
Kenya	Year-round	Countrywide	11 to 50%	*90 % P. falciparum* *P. malariae*, *P. ovale*, & *P. vivax* also occur
Kyrgyzstan	June - September	Variable	Infrequent cases	Primarily *P. vivax* but *P. falciparum* & *P. malariae* also occur

MALARIA: GEOGRAPHICAL RISK

Country	Transmission Period	Distribution	Potential Rate per Month Without Countermeasures	Type
Kuwait			Risk does not currently exist	
Lebanon			Risk does not currently exist	
Oman	Year-round	Variable	Infrequent cases	90% *P. falciparum* 10% *P. vivax*
Pakistan	Year-round	Countrywide	Up to 2 to 10%	90% *P. falciparum* 10% *P. vivax*
Qatar			Risk does not currently exist	
Saudi Arabia	Year-round	Variable - Risk occurs in the southern and western provinces	Up to 1%	88% *P. falciparum* 12% *P. vivax*
Somalia	Year-round	Countrywide	Up to 11 to 50%	95% *P. falciparum* *P. vivax,* *P. malariae* & *P. ovale* also occur
Sudan	Year-round	Countrywide	Up to 11 to 50%	90% *P. falciparum* *P. vivax,* *P. malariae* & *P. ovale* also occur
Tajikistan	April - October	Variable	Up to 2 to 10%	84% *P. vivax* 16% *P. falciparum*
Turkmenistan	April - September	Variable	Infrequent cases	Primarily *P. vivax*
United Arab Emirates		Variable	Up to 1%	77% *P. vivax* 23% *P. falciparum*
Uzbekistan	June - September	Variable	Up to 1%	Primarily *P. vivax*
Yemen	Year-round	Countrywide	Up to 11 to 50%	95% *P. falciparum* *P. vivax* *P. malariae*

MALARIA

Communicability:

- Route:
  - Disease is transmitted by bites of infected anopheline mosquitoes.
  - Transfusion of malaria-infected blood will transmit infection.
  - IV drug abusers sharing contaminated needles have become infected.
- Isolation: Malarious patients must be protected from exposure to additional mosquito bites. Insect repellent and permethrin-impregnated bed netting should be used. No other isolation is required.
- Prophylaxis: Individuals who have had contact with malaria patients do not require prophylaxis per se.
- Chemoprophylaxis:
  - Chemoprophylaxis of all individuals should be instituted for specific destinations where malaria is endemic. In Central Asia, Plasmodium falciparum accounts for less than 5% of cases and P. vivax predominates. Chloroquine-resistant P. falciparum is described in the area.
  - Recommended regimen: Follow CINC surgeon advice for theater of operations. Possible regimens include:
    - Mefloquine 250 mg PO weekly, preferably beginning 2 weeks before arrival in country and continuing for 4 weeks (4 doses) after departure,
      OR
    - Doxycycline 100 mg PO QD, preferably beginning 1-2 days before arrival in country and continuing for 4 weeks after departure,
      OR

  - Malarone 1 adult tablet PO QD starting 1-2 days before arrival in theater and continuing 7 days after departure from theater.

- "Radical cure" to eradicate persistent hepatic parasites should be given to individuals with documented P. vivax malaria. Primaquine must not be given to pregnant or G6PD deficient individuals. Different strains of vivax parasites have varying tolerances to primaquine, therefore dosage recommendations vary by geographical region. Studies of Afghan refugees indicate that 30 mg daily for 14 days is needed to reduce relapse rates for vivax infections from that region. When used, give primaquine phosphate (30 mg primaquine base) by mouth daily for 14 days. Individuals unable to take primaquine should take a total of 12 weeks of chemoprophylaxis after return from endemic area, with either mefloquine or doxycycline.
- Specific malaria chemoprophylaxis dosage recommendations from the CINC surgeon, although frequently identical to those used to treat a P. vivax malaria infection, will depend on the geographic area and season of exposure.
  - In areas where there is seasonal transmission of P. vivax malaria, chemoprophylactic medications should either be continued through the non-transmission season (winter), OR post-exposure chemoprophylactic medications such as primaquine should be considered for the appropriate duration after the last possible period of malaria transmission has occurred.

- After leaving a malarious area, "terminal prophylaxis" using primaquine may also be given to individuals without documented P. vivax malaria to prevent relapses.

Incubation: Malaria can present as soon as 5 days after arrival in an endemic area, and anytime thereafter, under conditions of continuous exposure. Usual incubation periods are:

- P. falciparum: 12 days (range 9-30 days).
- P. vivax: 14 days (range 12 days - 10 months).
- P. malariae: 28 days (range 18-40 days).

Diagnosis: Malaria MUST be considered in all febrile patients. If not diagnosed and treated promptly, P. falciparum is often fatal. Disease can occur before parasites are detectable by blood smear, but patients critically ill due to malaria will have a detectable parasitemia at some time in their illness. Patients with suspected malaria should have blood smear exams every 8-12 hours for 48 hours to exclude malaria. Persons on effective chemoprophylaxis may have very low parasitemias and atypical presentations.

- Symptoms:
  - Prodrome of malaise, fatigue, and myalgia may precede febrile paroxysm by several days.
  - Paroxysm characterized by abrupt onset of fever, chills, rigors, profuse sweats, headache, backache, myalgia, abdominal pain, nausea, vomiting, and diarrhea (may be watery and profuse in P. falciparum.
- Signs: Intermittent fever to >40^{0}C (105^{0}F). Fever may be almost continuous In P. falciparum malaria; classic "periodicity" is usually absent. Profuse sweating between febrile paroxysms. Tachycardia, orthostatic hypotension, tender hepatomegaly, moderate splenomegaly, and delirium (during fever; see "Cerebral malaria").

- Laboratory findings:
  - Hematologic:
    - Intra-erythrocytic parasites on smears of peripheral blood.
      - thin smear: prepare film as for normal CBC, fix in methanol, use Giemsa stain.
      - thick smear: place one drop of blood on a slide; with the corner of another glass slide, spread drop until it is about dime size, and newsprint below slide can barely be read; wait until thoroughly dry. DO NOT METHANOL FIX; stain with Giemsa stain.
      - thick smears are more sensitive (about 20X) for finding parasites; thin smears are more accurate for identifying parasite species.
      - SMEAR MUST BE PREPARED AND EXAMINED 2-3 TIMES DAILY FOR 48 HOURS TO RULE OUT MALARIA.
    - Anemia (normochromic, normocytic, hemolytic)
    - Leukopenia.
    - Monocytosis (>10%).
    - Eosinophilia not seen.
    - Thrombocytopenia (to less than < 150,000/mm^3).
  - Chemistry:
    - Hypoglycemia (may be severe, especially with quinine therapy, and may be recurrent).
    - Electrolyte abnormalities, including hyperkalemia (from RBC lysis), and hyponatremia (from reduced free water clearance).
    - Elevated transaminases (alkaline phosphatase normal).
    - Azotemia (pre-renal).
    - Hyperbilirubinemia.

- Urinalysis: may be normal; but increased protein, urobilinogen, and conjugated bilirubin may occur.
- Microbiologic: standard techniques are not applicable.
- Serology:
  - Biologic false positive VDRL may occur.
  - Specific malarial serologic tests exist, but are of epidemiologic, not clinical, value.
- Coagulation:
  - Generally normal, but prolonged prothrombin time (PT) and partial thromboplastin time (PTT) may be seen.
  - Disseminated intravascular coagulation (DIC) occurs, but uncommonly.

- X-ray: nonspecific.
- Invasive procedures:
  - Not specifically indicated.
  - Lumbar puncture to assess mental status or neurologic changes may show elevated opening pressure but will otherwise be normal in the absence of cerebral malaria.
  - Lumbar puncture in cerebral malaria may show increased opening pressure, increased protein and pleocytosis, but glucose is usually normal.
- Diagnostic confirmation: Identification of parasite on blood smears.

Duration:

- Treated: 3 days in uncomplicated cases. May recrudesce within 4 weeks if parasite is drug resistant.
- Untreated:
  - P. falciparum rapidly fatal in untreated nonimmune patients; in survivors may recrudesce up to 2 - 4 years later.

- P. vivax rarely fatal but may relapse up to 8 years later if persistent liver forms are not eliminated with primaquine (See Terminal prophylaxis).
- P. malariae is rarely fatal but may relapse up to 50 years later if not treated.

Complications: The following complications strongly indicate infection with P. falciparum:

- Hyperparasitemia: > 5% of RBC's on thin smear parasitized; correlates with other complications, though complications can be seen with lower degrees of parasitemia.
- Cerebral malaria:
  - Altered mental status, personality changes, lethargy, stupor, coma or delirium.
  - Neurologic impairment: hyperpyrexia, monoplegia, hemiplegia, cerebellar signs, seizures (assess for hypoglycemia).
  - Treatment is with appropriate antimalarials, although exchange transfusion may be of value.
  - Mortality is high (20-50%), but survivors rarely show neurologic sequelae.
- Algid malaria:
  - Clinically resembles septic shock; patient is cold, pale, and clammy.
  - Treat with appropriate antimalarials. Intravascular volume replacement, vasopressors, and antibiotics should be added to the antimalarial regimen, as needed.
- Renal failure:
  - May be prerenal or intrarenal (ATN-like) in origin.
  - Treatment:
    - Assure adequate intravascular volume replacement.
    - Supportive care to include dialysis if needed.

- Adult respiratory distress syndrome (ARDS, noncardiogenic pulmonary edema):
  - Pathogenesis: due to increased capillary permeability and fluid extravasation. Avoiding excessive intravascular fluid administration may reduce incidence.
  - Treatment is supportive, to include mechanical ventilation.
- Splenic rupture/hemorrhage:
  - Spontaneous or from palpation of the spleen, especially with VIVAX malaria.
  - Treatment is emergent blood replacement and surgical control of hemorrhage.

Treatment:

- Treatment of choice:
  - Avoid chloroquine wherever P. falciparum is endemic.
  - Initial treatment for patients not already on mefloquine prophylaxis who are able to tolerate oral medication should be mefloquine 1250 mg PO (5 tablets). The dose may be split and given 4-6 hours apart to reduce toxicity.
  - Alternatives:
    - Malarone 4 tablets PO QD for 3 days.
    - Quinine 650 mg PO TID for 3 days PLUS Fansidar® 3 tablets PO one time.
  - Depending on response, prophylaxis can than be resumed, or patient can be evacuated and terminal prophylaxis given if needed.

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- Critically ill patients who require IV medication can receive one the following regimens:
  - Quinidine gluconate in normal saline, 10 mg/kg (max 600 mg) IV loading dose over 1 to 2 hours, followed by 0.2 mg/kg/minute constant IV infusion for a maximum of 72 hours. Monitor EKG and switch to oral agents when mental status clears and parasitemia < 1%. Suitable oral agents to complete 7 days of therapy include: doxycycline 100 mg PO Q12H, or tetracycline 250 mg PO Q6H.
  - Quinidine gluconate, 15 mg/kg (max 650 mg) IV loading dose over 4 hours, followed by 7.5 mg/kg over 4 hours Q8H for 7 days. Monitor EKG and switch to oral agents as above.
  - Quinine dihydrochloride, 650 mg IV over 4 hours, Q8H for 7 days. Monitor EKG and switch to oral agents as listed above (if IV quinine is not available, use IV quinidine as listed above).
- Specific Precautions for IV Quinidine and IV Quinine:
  - Monitor patient with EKG. Either IV quinidine or IV quinine should be slowed or temporarily stopped if the QRS complex widens by > 50% of baseline, or if the QT interval exceeds 0.6 seconds, or if hypotension develops which is unresponsive to fluid challenge.
  - Monitor patient for hypoglycemia and treat it immediately if it is noted during either IV quinidine or IV quinine therapy. Failure to monitor and treat promptly can result in potentially lethal or severe complications.

- For treatment failures or early recrudescence:
  - IV regimen of either quinidine or quinine as above
    OR
  - Quinine sulfate, 650 mg PO TID for 3 days, PLUS Pyrimethamine-sulfadoxine (Fansidar) 3 tablets PO in one dose,
    OR
  - Tetracycline, 250 mg PO QID for 7 days,
    OR
  - Doxycycline 100 mg PO BID for 7 days
    OR
  - Mefloquine, 1000-1250 mg (4-5 tablets) PO as a single dose or as divided dose 4-6 hours apart.
    - Toxicities of mefloquine: CNS effects (psychosis, confusion, and seizures) may be seen.
    - Use with caution (with EKG monitoring) if concurrently used with either IV quinine or quinidine, or in patients with known conduction disturbances.

Disposition for uncomplicated cases: local hospitalization for up to 48 hours, with limited duty for several days (until drug therapy is completed).

MENINGOCOCCAL DISEASE

Communicability:

- Route: person to person by respiratory droplets.
- Isolation: respiratory isolation for first 24 hours of antibiotic therapy; disinfect nasal and pharyngeal secretions and material contaminated with them.
- Prophylaxis:
  - Intimate and household contacts, including barracks and tent-mates should receive:
    - rifampin 600 mg PO Q12H for 4 doses, OR ceftriaxone 250 mg IM one dose, OR ciprofloxacin 500 mg PO Q12H for 5 days,

    PLUS
    - meningococcal vaccine, unless this has been received within 2 years prior to the incident exposure.
  - Casual contacts need not receive prophylaxis.
  - Prophylaxis in not uniformly effective. Even after receiving prophylaxis, close contacts of cases who develop symptoms suggestive of meningococcal disease should be rapidly evaluated.

Incubation: 3-4 days (range 1-10 days).

Diagnosis: meningococcal infection may be asymptomatic, or may present either as a self-limited flu-like illness (without sequelae), as meningitis, as fulminant septicemia (meningococcemia), or as combined meningitis-septicemia. Clinical signs and symptoms will vary with the type of presentation. Serogroup B meningococcus is prevalent in Asia, therefore, vaccination history should not preclude a possible diagnosis of acute meningitis.

- Symptoms:
  - Meningococcemia (very abrupt onset with fulminant course):
    - Fever.
    - Headache.
    - Malaise.
    - Diarrhea (occasionally may be severe).
  - Meningitis [onset may be abrupt or subacute (several days)]:
    - Headache.
    - Fever.
    - Malaise.
    - Photophobia.
    - Nausea/vomiting.
    - Backache.
- Signs:
  - Meningococcemia:
    - Fever.
    - Tachycardia.
    - General muscular tenderness.
    - Altered mental status.
    - Petechiae/purpura/ecchymoses (skin & mucosal). Development of purpura or ecchymoses within a few hours of onset of illness is pathognomonic for meningococcemia.
  - Meningitis:
    - Headache.
    - Fever.
    - Meningismus/stiff neck.
    - Cranial nerve palsies (most commonly III, VI and VIII).
    - Altered mental status.
    - Seizures.
    - Positive Kernig's sign.

- Laboratory findings:
  - Hematologic:
    - Meningococcemia:
      - HGB/HCT: nonspecific.
      - WBC: leukocytosis or leukopenia (leukopenia implies more fulminant illness).
      - thrombocytopenia: common.
    - Meningitis:
      - Hgb/Hct: nonspecific.
      - WBC: leukocytosis more typical, leukopenia suggests sepsis/meningococcemia.
      - platelets: usually normal: thrombocytopenia suggests sepsis/meningococcemia.
      - CSF: see below.
  - Chemistry: nonspecific; serum glucose and protein should be obtained for comparison against CSF values.
  - Urinalysis: nonspecific.
  - Microbiologic:
    - CSF Gram stain: positive in 50-90%, including meningococcemia without clinical meningitis. Organisms my be present prior to WBCs.
    - CSF culture: positive in 50-90%, including meningococcemia without clinical meningitis.
    - Blood culture: positive in 50-60%.
    - Organisms are fragile: smear and cultures should be prepared as soon as CSF is obtained from patient.
  - Serology: not applicable.
  - Coagulation: prothrombin time (PT) and partial thromboplastin (PTT) time may be prolonged in meningococcemia. Evidence of DIC, including decreased fibrinogen levels, and elevated levels of fibrin degradation products may be seen.

- X-ray: nonspecific.
- Invasive procedure:
  - In presence of meningitis or suspected meningococcemia, lumbar puncture for CSF should be performed immediately, unless papilledema or other focal neurologic signs suggestive of either intracranial mass or increased intracranial pressure are present.
  - CSF should be tested for glucose, cell count, gram stain and culture. Abnormal CSF results include but are not limited to:
    - glucose < 40 mg/dl (in 75% of cases).
    - protein > 150 mg/dl (range 25-800).
    - WBC > 1000 cells/mm, neutrophils predominant (range 10- 65,000; lymphocyte predominance is seen in <10%; poor prognosis associated with absence of WBCs in CSF, as may be caused by WBC lysis from large amounts of meningococcus).
- Diagnostic confirmation: culture of organism from clinical specimen (from CSF, or petechial aspirate). Chocolate agar plates required.

Duration:

- Treated: clinical response should occur within 48 hours. Duration of convalescence depends on severity of illness and its complications.
- Untreated: death may occur within minutes to hours. Mortality is 5-15%, even with the best of care.

Complications: shock, DIC, adult respiratory distress (ARDS), pericarditis including tamponade, pneumonia, diabetes insipidus, cranial nerve palsies, prolonged mental status changes.

Treatment:

- Treatment must be initiated immediately upon suspicion of meningococcal disease, with continued diagnostic evaluation to proceed simultaneously with initiated treatment regimen.
  - Obtain rapid history and physical exam, identifying contraindications to lumbar puncture.
  - While establishing IV line access, obtain blood for hemoglobin, chemistry, coagulation and culture studies.
  - Perform LP if not contraindicated.
  - Administer antibiotics:
    - penicillin G 300,000 U/kg/day IV Q2-4 hours (divided in 8 to 12 doses) to a maximum of 2 million units IV Q2H.
    - Alternate therapy or if penicillin allergic: ceftriaxone 2 gms IV Q12H for 10-14 days.
  - Provide hemodynamic and respiratory support as needed.
  - Proceed with more detailed history and examination, and evaluate results of laboratory tests.
- If pneumococci are identified in CSF, add vancomycin 1 gm IV Q6H* to ceftriaxone 2 gm IV Q12H. (**Note: This dose is double a usual Vancomycin dose for other indications, but is NOT a typographical error for meningitis.)*
- If H. influenzae are identified in CSF, treat with ceftriaxone 2 gms IV Q12H.

Disposition:

- Milder cases or cases that recover rapidly may be treated at hospitals in theater in anticipation of return to duty.
- Cases that initially appear more severe, become complicated, or convalesce more slowly should be evacuated after initial stabilization.

Prognosis:

- Treated: In properly treated cases, residual morbidity is not unusual, hearing loss may persist, and mortality may be as high as 5-10%.
- Untreated: Mortality may range from 50-85%.

Prevention and Public Health Measures:

- Vaccination of susceptible populations. An effective quadrivalent vaccine (affording protection against serotypes A, C, Y, and W-135) is available. Vaccination within the past 3 years is regarded as protective. An approved vaccine for serogroup B meningococci is not available.
- Antibiotic prophylaxis of close contacts, as above.
- Prevent overcrowding in troop shelters, and provide them with adequate ventilation.

Q FEVER

(see also Q Fever, Part Two: BIOWEAPONS)

Communicability:

- Route:
  - Inhalation of contaminated aerosols or handling of infected material—organisms found in urine, feces, milk, birth products of infected cattle, goats, sheep. Rare—ingestion of contaminated milk.
  - Person-to-person transmission has rarely occurred.

Incubation: 20 days (range 14-39 days).

Diagnosis:

- Symptoms (gradual or abrupt onset):
  - Fever to 40°C (100%).
  - Headache, severe (75%).
  - Fatigue (98%).
  - Chills (88%).
  - Myalgia (68%).
  - Nausea, emesis (25-50%).
  - Pleuritic chest pain (28%).
  - Diarrhea (21%).
  - Retroorbital pain.
  - Nonproductive cough.
- Signs:
  - Inspiratory crackles.
  - Hepatomegaly, splenomegaly, or both (~50%).
  - Mental status changes (2-5%).
  - Relative bradycardia.
  - Hypoxemia, in cases with rapidly progressive pneumonia rash is rare, except in cases of endocarditis with palpable purpura.

- Laboratory findings:
  - Hematology: Leukocytosis in 30%.
  - Chemistry: hepatic transaminases elevated 2-3 times normal.
  - Microbiology: not available under field conditions, requires specialized facility with high level containment.
  - CXR: rounded opacities, pleural effusions (35%), patchy interstitial disease.
  - Serology: fourfold rise in antibody titer between acute and convalescent samples usually measured by complement fixation or IFA.
  - Invasive procedures: LP to rule out pyogenic meningitis if symptoms warrant.
  - Diagnostic confirmation: serology (see above).

Duration: clinical manifestations usually resolve within 2-4 weeks in absence of specific treatment. However, therapy is indicated to prevent development of complications (i.e., chronic infection).

Complications: endocarditis (chronic Q fever), granulomatous hepatitis, and rarely, osteomyelitis, aseptic meningitis/encephalitis, hemolytic anemia, pericarditis.

Treatment:

- Doxycycline 200 mg PO BID for 2 weeks.
- Tetracycline 250 mg PO QID for 10 days.
- Ciprofloxacin 500 mg PO TID for 10 days.

Disposition: local hospitalization, anticipate return to duty after 4-6 weeks. Complicated cases should be evacuated.

Prognosis: most recover uneventfully and without relapse. Fatalities rare in acute disease.

Prevention and Public Health Measures:

- Avoidance of slaughterhouses and birth products of animals.
- Ingestion of only pasteurized dairy products.
- Report case as a reportable event using theater medical surveillance reporting channels.

RABIES

Communicability:

- Route: virus laden saliva of an infected animal introduced by a bite.
- Isolation: contact isolation for saliva and respiratory secretions. Transmission to attending personnel has not been documented.
- Prophylaxis: contacts with an open wound or mucous membrane that has been exposed to patient's saliva should receive post-exposure prophylaxis.

Incubation period: 14-60 days (range: 10 days to 1 year); 95% are within 1 year.

Diagnosis:

- Symptoms/Signs: nonspecific syndrome of malaise, fatigue, headache, and fever lasting 2-10 days with pain and paresthesia at the bite site in over 50%. Syndrome merges to an acute encephalomyelitis with apprehension and hyperactivity progressing to spasm of the swallowing muscles and hydrophobia.
- Laboratory: diagnosis confirmed by specific fluorescent antibody staining of brain tissues. No useful antemortem diagnostic findings that would change management, although corneal impression smears or a skin biopsy of the neck above the hair line, stained with immunofluorescent antibody, can confirm the diagnosis.

Duration:

- Treated: death in weeks to months.
- Untreated: death in days to weeks of clinical symptoms.

Complications: usual multiple complications of comatose ICU patient.

Treatment:

- No specific antirabies chemotherapy available; treatment is directed solely at supportive care.
- Pre-exposure prophylaxis to be determined by CINC surgeon.
- Local treatment of wound:
  - IMMEDIATE and THOROUGH washing of all bite wounds and scratches with SOAP and WATER.
  - Debridement as indicated, under medical supervision, leaving wound open if possible.
  - Tetanus prophylaxis and measures to control bacterial infection should be given as indicated.
- Post-exposure prophylaxis (Both HRIG *and* HDCV):
  - Indicated for anyone who is bitten by a dog, cat, fox or jackal, and should be considered in nonbite exposures (though risk is much lower).
  - Single dose of Human Rabies Immune Globulin (HRIG), 20 IU/kg or 9 IU/lb body weight; all of the dose should be infiltrated into the bite site if anatomically possible. Any residual dose can be given intramuscularly in the gluteal area. (HRIG should NEVER be given in the same syringe or into the same site as the vaccine.) AND

- Give Human Diploid Cell Vaccine (HDCV) in five 1.0 mL doses, IM (deltoid area), on days 0, 3, 7, 14, and 28. *HDCV administration concurrent with malaria chemoprophylaxis with chloroquine may result in decreased HDCV vaccine efficacy.*
- Other approved rabies vaccines may be available.

Disposition:

- Exposure: full duty with supervised HRIG and HDCV.
- Clinical illness: EVAC.
- Nonavailability of HRIG and HDCV: EVAC.

Prognosis:

- Treated potential exposure: excellent.
- Treated or untreated clinical illness: uniformly fatal.

Prevention and Public Health Measures:

- Safely capture and sacrifice implicated animal; submit intact head packed in ice (not frozen) to laboratory.
- Command emphasis and education of troops to avoid stray or feral dogs, cats, and wild fox.
- Report case as a reportable event using theater medical surveillance reporting channels.

RELAPSING FEVER

Communicability:

- Route:
  - Louse-borne relapsing fever (due to Borrelia recurrentis) is acquired when infected lice are crushed or injured and the spirochetes thus released are able to enter abrasions, scratches, or other skin wounds. Not transmitted by louse bites or louse feces. Lice become infective 4-5 days after ingesting an infected blood meal.
  - Tick-borne relapsing fever (due to Borrelia duttonii and the Borrelia spp.) is transmitted by the bite of infected nymph or adult soft ticks of the genus Ornithodoros. Transmission of infection may occur within minutes of tick attachment.
  - Transfusion of infected blood transmits disease.
  - Transplacental infection occurs.
- Isolation:
  - Delouse patients with insecticide, taking care to avoid crushing lice or abrading skin.
  - Direct person-to-person transmission does not occur; isolation other than measures to avoid transfer of lice is not needed.
  - Ticks should be identified and carefully removed.
  - Blood and body fluid precautions.
- Prophylaxis: Following tick or louse bites in a high-risk setting, a single dose of tetracycline 500 mg PO may be administered.

Incubation:

- Louse-borne relapsing fever: 4-8 days (range 2-10 days).
- Tick-borne relapsing fever: 2-14 days.

Diagnosis:

- Symptoms: The characteristic feature of relapsing fever is abrupt severe fever lasting several days, terminating in a crisis by rapid defervescence, severe sweating and weakness ; then, after an interval of days (rarely weeks), recurring one or more times.
  - Louse-borne relapsing fever:
    - Fever (98%): > 39°C in over 70% of cases. Initial episode of fever usually lasts 5-7 days, then ends abruptly. Death may occur suddenly and unexpectedly during febrile crisis. Approximately 65% of patients will have a relapse after 5-9 days, similar to but less severe than the first. A third relapse is seen in about 25% of patients; more than three relapses are uncommon.
    - Body pain (80-90%): severe and generalized, especially back, chest, abdominal, legs (especially calves), joints.
    - Chills/rigors (90%).
    - Severe headache (87%).
    - Dizziness (74%).
    - Nausea (65%).
    - Vomiting (30-35%).
    - Cough (50%).
    - Prostration dysphagia (45-50%).
    - Severe dyspnea (15-20%).
    - Anorexia.

- ♦ Tick-borne relapsing fever:
  Initial episode of fever averages 3.5 days, but may persist up to 17 days. Relapses are more common and more frequent than in louse-borne disease, with at least one relapse in almost all, 8 relapses about average, and up to 17 relapses being reported. Relapses average about 2 days each. Neurologic symptoms more common than in louse-borne disease. Other symptoms similar to, but less severe than, those in louse-borne disease.

■ Signs:
- ♦ Louse-borne relapsing fever:
  - Petechiae, ecchymoses (up to 54%), more pronounced on trunk than extremities.
  - Jaundice.
  - Fine erythematous rash early in illness.
  - Liver tenderness (60%).
  - Spleen tenderness (55%).
  - Iritis.
  - Meningismus.
  - Delirium.
  - No local skin lesion or eschar at site of entry of infection.
- ♦ Tick-borne relapsing fever: Signs are similar to those of louse-borne disease, but less severe. Neurologic signs common, including encephalitis, subarachnoid hemorrhage, aseptic meningitis, aphasia, hemiplegia, sciatica, iritis, iridocyclitis, optic atrophy, and palsies of cranial nerves III, IV, V, VI, VIII, and especially VII (Bell's Palsy). No local skin lesion or eschar at site of entry of infection.

- Laboratory findings:
  - Hematologic:
    - Wright or Giemsa-stained blood smears should be carefully examined for extracellular spirochetes. In louse-borne disease, spirochetes should be visible on smears, but they may too low in concentration to detect by this method in tick-borne disease. Thick and thin malaria smears are satisfactory for examination. Spirochetes are not detectable during intervals between fevers.
    - Anemia.
    - Thrombocytopenia, often < 50,000.
    - WBC: usually WNL, but may rise to 15,000-30,000.
  - Chemistry: elevated transaminases; elevated bilirubin, both conjugated and unconjugated
  - Urinalysis: albuminuria, microhematuria, pyuria
  - Microbiologic:
    - Dilute one drop of blood with one drop of normal saline, cover with cover slip, and examine by darkfield or phase contrast microscopy. Typical corkscrew rotation of spirochetes can be seen.
    - Specialized culture techniques or animal inoculation are required for isolation.
  - Serologic: not clinically available.
  - Coagulation: PT and PTT may be prolonged
- Radiology: nonspecific.
- Invasive Procedures: lumbar punctures show elevated opening pressure; pleocytosis, and elevated CSF protein are typical. Both polys and mononuclear cells may be seen.
- Diagnostic confirmation:
  - Demonstration of spirochetes in blood smear.

Duration:

- Treated: immediate cure, with residual exhaustion lasting several days.
- Untreated: see above for discussion of duration of febrile episodes, afebrile intervals, and number of relapses.

Complications:

- Jarisch-Herxheimer reactions (see leptospirosis as well):
  - Characteristics: within 1-3 hours of administration of antibiotics, a severe rigor and transient blood pressure elevation occur. These are followed by a sharp rise in fever and marked hypotension. Severe headaches and myalgias occur. Vomiting and urinary incontinence may develop. Abrupt hypoglycemia, leukopenia and thrombocytopenia occur. The severity of Jarisch-Herxheimer reactions is greater if antibiotics are given IV.
  - Treatment of Jarisch-Herxheimer reactions:
    - Meptazinol (an opioid agonist-antagonist) 100 mg IV given with antibiotic dose, repeated 30 minutes after antibiotic dose, repeated again at onset of febrile reaction, and again if systolic BP drops below 70 mm Hg; has been shown to ameliorate the Jarisch-Herxheimer reaction in relapsing fever. This drug is not available in the U.S.
    - Pretreatment with steroids or antipyretic agents is of questionable value.
    - Naloxone is ineffective. Hemodynamic support with isotonic IV fluid administration (e.g., normal saline) is essential. Vasopressors may be necessary, but should be reserved for hypotension refractory to adequate volume replacement.

- Myocarditis with prolonged QT interval, T wave changes, and congestive heart failure.
- Coincident typhus may occur simultaneously with louse-borne relapsing fever.

Treatment:

Lethal Jarisch-Herxheimer reactions may rapidly follow administrations of appropriate antibiotics and must be anticipated, particularly in louse-borne disease. Frequency and severity of these reactions is higher when IV antibiotics are given. See above.

Antibiotics (in order of preference):

- Louse-borne:
  - Oral regimens:
    - tetracycline 500 mg PO, single dose *(avoid in pregnant women or children < 8 years old)*.
    - doxycycline 200 mg PO, single dose.
    - erythromycin 500 mg PO, single dose.
  - Parenteral regimens:
    - tetracycline 250 mg IV, single dose
    - erythromycin, 250 mg IV, single dose
- Tick-borne:
  - Oral regimens:
    - tetracycline 500 mg PO Q6H for 6 days *(avoid in pregnant women or children < 8 years old)*.
    - doxycycline 100 mg PO BID for 10 days
    - erythromycin 500 mg Q6H for 10 days
  - Parenteral regimens:
    - penicillin G 3 million units IV Q4H FOR 10 days
    - ceftriaxone 2 gms IV Q6H for 10 days

Disposition: Local hospitalization, with subsequent return to duty. Consider restricted duty with no hard physical activity for 30 days to allow associated splenomegaly to resolve. Evacuation may be needed for cases with complications.

Prognosis:

- Louse-borne:
  - Treated: complete recovery in > 95% of cases.
  - Untreated: mortality variable; usually 2-10%, but may reach 70% in epidemic conditions.
- Tick-borne:
  - Treated: complete recovery in > 95% of cases.
  - Untreated: mortality low, less than 10%.

Prevention and Public Health Measures:

- Vector control:
  - Delousing, personal hygiene. Use permethrin impregnated clothing and bedding.
  - Tick control/avoidance:
    - Avoidance of tick-infested locales: old housing, old campsites.
    - Insect repellents and other personal protection measures including permethrin-impregnated clothing and bedding; avoid sleeping on ground.
    - Insecticide application to tick-infested sites.
- Reservoir eradication:
  - Louse-borne disease: human reservoir; identify and treat.
  - Tick-borne disease: human and animal reservoirs; treat and control rodents.
- Report case as reportable event using theater medical surveillance reporting channels.

SAND FLY FEVER

Communicability:

- Route:
  - Sand fly (Phlebotomus papatasii) bites.
  - No direct human-to-human transmission.
- Isolation: not required. Protection of patients from further sand fly bites will interrupt transmission. Human viremia is present from about 24 hours prior to onset of fever until about 24 hours after fever resolves. Very fine mesh for screens or bed net (10-12 mesh/cm) required. Permethrin treatment of larger mesh mosquito nets will also make effective barriers for sand flies.
- Prophylaxis: none required.

Incubation: 3-6 days.

Diagnosis: Widespread outbreaks have occurred in military campaigns when nonimmune soldiers entered endemic areas.

- Symptoms:
  - Fever to 40^{0}C.
  - Headache.
  - Myalgia.
  - Supraorbital pain (intense) or retrobulbar pain with eye movement.
  - Limb stiffness.
  - Malaise.
  - Gastrointestinal symptoms (nausea, vomiting).
  - Facial congestion.
  - Neck stiffness.

- Signs:
  - Fever.
  - Conjunctival injection.
  - Papilledema (occasional).
  - **No adenopathy**.
  - Erythematous flush but **no rash**.
- Laboratory findings:
  - Hematologic: leukopenia on day 4 - 5 of fever.
  - Chemistry, urinalysis, microbiology, and coagulation: not applicable.
  - Serology: paired sera for hemagglutination-inhibition (HI) and neutralizing antibodies (retrospective only).
- Invasive procedures: lumbar puncture shows increased opening pressure and CSF pleocytosis.
- X-ray: not applicable.
- Diagnostic confirmation: serologic.

Duration: 2-4 days, convalescence may be a week or longer.

Complications: none; though patients may have lethargy, depression, and easy fatigability for weeks after recovery.

Treatment:

- No specific treatment available yet.
- Provide supportive care.

Disposition: limited duty or local hospitalization until fever resolves, then full duty; occasionally, convalescence may be prolonged and some patients may require EVAC.

Prognosis: full recovery. Single infection confers lasting immunity against same serotype.

Prevention and Public Health Measures:

- Insecticide spraying of troop quarters, emplacements and entrenchments.
- Troop education.
- Command emphasis on use of personal protective measures (use of insect repellents, application of permethrin insecticides to clothes if not previously treated). Mosquito netting such as bednets are not effective controls against sand flies *unless mesh hole density is no larger than 10-12 mesh holes/cm.*
- Report outbreaks to higher echelon medical authorities.

SCHISTOSOMIASIS, ACUTE (KATAYAMA FEVER)

Communicability:

- Route: human-to-human spread not seen. Disease acquired by contact with infected fresh water (swimming, wading, washing, etc.). Not seen in Central Asia.
- Isolation: not required.
- Prophylaxis: not required.

Incubation: schistosomiasis dermatitis (swimmer's itch) occurs within 24 hours of penetration of skin by the infective, forked-tailed cercariae. Clinical syndrome of acute schistosomiasis occurs after 2 weeks to 3 months.

Diagnosis:

- Characteristically associated with S. japonicum and sometimes with S. mansoni. S. haematobium is rarely associated with an acute syndrome.
- While schistosomiasis is not a threat in most of Central Asia, it does occur in the Arabian Peninsula and parts of Southwest Asia. Outbreaks of swimmer's itch that have occurred in Central Asia are attributable to animal-dependent schistosomes for which humans are not primary hosts.
- Symptoms:
  - Fever (all).
  - Chills.
  - Sweating.
  - Headache.
  - Cough (most).
  - Diarrhea (50%).
  - Weight loss.

- Signs:
  - Lymphadenopathy.
  - Hepatomegaly (50%).
  - Splenomegaly (10%).
- Laboratory findings:
  - Hematology: eosinophilia very common.
  - Microbiology: stool or urine exam may but usually does not show schistosoma eggs in patients with acute schistosomiasis.
  - Serology: not useful in acute cases.
- Radiology: not useful acutely.
- NOTE: exposure history is essential to consider the diagnosis. Absence of eosinophilia (>500 cell/mm^3) does not usually support the diagnosis.

Duration:

- Treated: aborts chronic sequelae but may not limit acute disease.
- Untreated: 2-4 weeks for resolution of acute symptoms.

Complications:

- Rare reports of death in nonimmune with a heavy primary infection.
- If not recognized or treated, could present later as chronic manifestations of schistosomiasis; so all infections must be treated, whether asymptomatic or not.

Treatment:

- Praziquantel (Biltricide®): single oral dose of 40 mg/kg following a meal; may also be given in two divided doses on the same day.

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- Praziquantel may cause malaise, headache or dizziness; side effects fewer if given as two divided doses.
- Treatment of acute schistosomiasis with schistosomicidal drugs may result in acute, severe, possibly life-threatening clinical deterioration. This transient complication may be prevented by the co-administration of prednisone 40 mg PO QD for 5 days, or by an equivalent course of another corticosteroid.
- Swimmer's itch can be treated with a topical steroid and an antipruritic.

Disposition: limited duty or hospitalization depending on illness severity; evacuation may be indicated with severe disease.

Prognosis: excellent if diagnosed and treated early.

Prevention and Public Health Measures:

- Command emphasis and education of soldiers to avoid exposure (swimming or wading with bare skin contacting fresh water -- especially lakes, marshes and slow-moving waters). Vigorous towel-drying or application of rubbing alcohol can prevent penetration of parasites after water contact.
- Report case as a reportable event using theater medical surveillance reporting channels.

STREPTOCOCCAL INFECTIONS

Communicability:

- Route:
  - Person to person, via respiratory or salivary droplets; crowded living arrangements enhance transmission.
  - Food and waterborne outbreaks have occurred.
- Isolation: not warranted.
- Prophylaxis: generally not warranted. In an outbreak of streptococcal disease associated with rheumatic fever or glomerulonephritis, culture and treatment of culture-positive household contacts (barracks or tent mates) can be considered. Alternatively, prophylactic benzathine penicillin can be employed to interrupt an outbreak.

Incubation: 2-4 days for pharyngitis.

Diagnosis: clinical streptococcal disease may present as pharyngitis, scarlet fever, erysipelas (superficial cellulitis), or pyoderma (impetigo). A streptococcal toxic shock-like syndrome occurs, but is uncommon.

- Pharyngitis:
  - Symptoms: sore throat, headache, fever, malaise.
  - Signs: pharyngeal redness, edema, and lymphoid hyperplasia; enlarged reddened tonsils with exudate (in 50%), tender submandibular lymphadenopathy; favor > 101^0F (38.3^0C).
  - Laboratory: mild leukocytosis, positive pharyngeal cultures. Antigen detection tests are very specific, but somewhat insensitive. They may be helpful if laboratory support is minimal.
- Scarlet fever:
  - Usually occurs with pharyngitis, but may be seen with streptococcal skin infections.

- Symptoms: those of primary infected site, plus fever, rash, and occasionally marked systemic toxicity or a toxic shock-like syndrome.
- Signs: diffuse blanching red rash, darker at skin creases, normally sparing face, palms, and soles. "Sandpaper" texture of skin is due to sweat gland occlusion. Palatal petechiae. Yellowish-white coating of tongue followed by beefy red appearance of tongue.

- Erysipelas:
  - Symptoms: chills, fever, systemic toxicity.
  - Signs: red, edematous, sharply demarcated, advancing skin lesion.
- Impetigo:
  - Signs: pustules that rupture easily and enlarge into shallow skin ulcers or erosions, typically with honey-colored crusts. Usually occur on exposed skin areas, such as the mid-face or beard area or at sites of insect bites or other preexisting rashes.
- Streptococcal toxic shock:
  - Signs: sepsis syndrome, shock, acute renal failure, ARDS.

Duration:

- Pharyngitis: treated 1-4 days; untreated 3-5 days.
- Scarlet fever: rash persists 4-5 days; subsequent desquamation persists 2-4 weeks.
- Erysipelas/cellulitis:
  - Treated: improvement in 24-48 hours.
  - Untreated: may proceed to fatality.
- Impetigo:
  - Treated: improvement within 2-3 days.
  - Untreated: may persist several weeks.
- Streptococcal toxic shock: 30% mortality rate even with intensive care and antibiotics.

Complications:

- Immunologic:
  - Rheumatic fever (from pharyngeal disease).
  - Acute glomerulonephritis (most commonly from skin infections).
- Infection: septicemia, otitis media, sinusitis, mastoiditis, meningitis, brain abscess, toxic shock syndrome, necrotizing fascitis (all uncommon).

Treatment:

- Pharyngitis:
  - Benzathine Penicillin G 1.2 million units IM one dose; preferred; OR
  - Penicillin V 250 mg PO TID for 10 days (avoid due to compliance problem); OR
  - Erythromycin 250 mg PO QID for 10 days (for penicillin allergic patients).
- Scarlet fever:
  - Treat primary source of infection (e.g. pharyngitis, skin) as appropriate.
  - Supportive care.
- Erysipelas/cellulitis:
  - Penicillinase-resistant penicillin (to cross cover possible staphylococcal etiology) IV or PO depending on severity of infection. May switch to oral agent 1-2 days after initiating therapy if response is good. Minimum 10-day course; OR
  - Erythromycin 0.5 to 1 gm IV Q6H; when response occurs, transition to PO dosing with 500 mg PO Q6H to complete full 10-day course of Erythromycin; OR
  - Vancomycin 1 gm IV Q12H; when response occurs, transition to PO dosing with 500 mg PO Q6H to complete 10-day antibiotic course.

- Impetigo - must cover for both Staphylococcal aureus and Streptococcal pyogenes organisms:
  - Dicloxacillin.
  - Cephalexin (Keflex®).
  - Trimethoprim-Sulfamethoxazole (Septra®).
  - Doxycycline.
  - Topical Mupirocin (Bactroban®).
- Streptococcal toxic shock, or necrotizing fascitis:
  - Penicillin G 3 million U IV Q4H for 10-14 days PLUS Clindamycin 900 mg IV Q8H.
  - Surgical debridement and compartment pressure monitoring required for necrotizing fascitis.
  - Intensive supportive care.
- For penicillinase producing streptococcal organisms that are resistant to penicillin, alternate therapies include macrolides such as clarithromycin or the second generation quinolones such as lofloxacin.

Disposition:

- Local hospitalization required for scarlet fever, erysipelas, or severe pharyngitis.
- Mild pharyngitis or impetigo may be returned to duty.
- Evacuation required for rheumatic fever, glomerulonephritis, toxic shock, necrotizing fascitis or other advanced infectious complications.

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Bactroban® is a registered trademark of GlaxoSmithKline.

Prognosis:

- Treated: excellent prognosis.
- Untreated: complication will be associated with serious sequelae in some cases.
  - Scarlet fever and erysipelas: may be fatal if not properly treated.
  - Toxic shock-like syndrome: 30% mortality and may be associated with lasting sequelae in survivors.
  - Necrotizing fascitis: any therapy delay associated with markedly increased mortality.

Prevention and Public Health Measures:

- No specific measures warranted under most circumstances. Investigation of outbreaks is mandatory; intervention with prophylactic antibiotics may be required. Occurrence of any cases of streptococcal toxic shock-like syndrome indicates presence of toxin-producing strain with potential for additional cases.
- Food handler precautions and good hygiene by all personnel will minimize incidence of streptococcal skin infections.

TUBERCULOSIS

Communicability:

- Route:
  - Inhalation of airborne droplet nuclei from productive cough of tuberculous patients.
  - Ingestion of infected unpasteurized dairy products.
- Isolation: respiratory isolation and early evacuation for suspected cases.

Incubation:

- For development of primary lesion: 4-12 weeks.
- For progressive, reactivation or extrapulmonary disease: 4 weeks to lifetime risk of active disease is greatest during the first 6-24 months after infection, or with development of other systemic illnesses which weaken host defenses.

Diagnosis:

- Symptoms:
  - Initial infection is usually asymptomatic.
  - Fever (may be intermittent) night sweats, anorexia, weight loss, fatigue, cough (productive or nonproductive), hemoptysis, chest pain (pleuritic), dyspnea.
  - Symptoms produced by extrapulmonary tuberculosis depend on the organ system involved. Extrapulmonary sites, listed here in order of decreasing frequency, include lymphatics, pleura, genitourinary tract, bone/joint, meninges, peritoneum, liver, pericardium, middle ear, and brain.
- Signs:
  - Signs may be absent, especially in early disease. In general, they are nonspecific and less significant than would be expected from extent of disease.

- Rales, especially post-tussive: dullness to percussion; and diminished breath sounds.
- Other signs depend on the site(s) of extrapulmonary involvement.

■ Laboratory findings:
- Hematologic:
  - May be normal.
  - Anemia, mild leukocytosis or monocytosis (> 10%).
- Chemistry:
  - Usually normal.
  - Hypercalcemia.
  - Hyponatremia.
  - Other abnormalities may represent specific effects of extrapulmonary involvement.
- Urinalysis:
  - Usually normal.
  - In presence of genitourinary tuberculosis may see sterile pyuria, proteinuria and/or hematuria.
- Microbiologic:
  - Examination of smear (sputum, gastric aspirate) with acid-fast staining may show organism. A single organism on a slide may be significant, though usually 3 to 5 organisms per slide is considered a true positive.
    - Fluorochrome staining is most efficient.
    - Alternatives include Ziehl-Neelsen, Kinyoun, or blue-light fluorescent stains.
  - Radiometric culture system (i.e., BACTEC®) will reveal presence of organisms in 2-6 days.
  - Standard mycobacterial cultures may take up to 12 weeks to define organism.

BACTEC® is a registered trademark of Becton, Dickinson and Company.

- Drug sensitivity results are generally unavailable before 4-6 weeks.
- In presence of urinary sediment abnormalities, obtain AFB smears and cultures on centrifuged urine.

♦ Serology: not in general use.
♦ Coagulation: generally normal.

■ X-ray: findings depend on the character and extent of disease.
♦ Early or primary TB may present in any lobe (more typically lower) as pneumonic infiltrate, atelectasis or mass, with or without ipsilateral hilar adenopathy.
♦ Later, chronic, or reactivation TB typically shows patchy or nodular infiltrates in the apices or superior segments of lower lobes; cavitation may or may not be present.
♦ Pleural effusions may be seen.

■ Invasive procedures:
♦ Gastric aspirate for smear and culture may be useful if no sputum can be produced.
♦ Bronchoscopy, with washings for cultures, may be diagnostic when TB is a consideration but organisms cannot be recovered by less invasive means.
♦ The choice of other specific invasive procedures, including thoracentesis, lumbar puncture, or biopsies, is guided by clinical evidence of extrapulmonary TB.

■ Skin testing: In previous nonreactors PPD may convert to positive by 4 weeks. PPD may be negative in early or primary disease, in overwhelming disease, or in patients with immunosuppression from other disease. Up to 25% of patients with pulmonary TB my have negative skin tests; 5% of patients may have a selective anergy

(negative PPD and positive anergy panel). In an area of high prevalence, PPD skin tests of >10 mm induration are considered positive. Positive multiple puncture tests (Tine, Monovac) need to be confirmed with an PPD, unless there is vesiculation.

- Diagnostic confirmation: successful culture of mycobacteria from clinical specimens.

Duration:

- Treated: variable, depending on extent of disease. Treatment regimens range from 9-18 months, but clinical response occurs much sooner.
- Untreated: indefinite; 50% die, 25% develop chronic TB which can remain active for years, and 25% spontaneously heal.

Complications:

- Pulmonary: hemoptysis, massive hemorrhage, and major parenchymal lung damage with permanent impairment of respiratory function.
- Extrapulmonary: ranges from minor damage to destruction of the involved organ.
- Recurrence, possibly with resistant organisms, may occur in inadequately treated patients. Recurrence in adequately treated patients is very uncommon, but may occur.

Treatment:

- Treatment should not be started in theater, unless patient shows evidence of disseminated disease, meningitis, or is otherwise acutely unstable. Microbiological isolation and determination of resistance patterns is important for correct clinical management and will not be available in theater.

- When required, given high rates of resistance to INH and streptomycin among M. tuberculosis acquired in Central and Southwest Asia, treatment of TB cases in that setting should include rifampin plus at least one other drug in addition to INH, all to be given as directly observed therapy (DOT). Optimal choices for the third drug include pyrazinamide 25-35 mg/kg (maximum 2.5 gm) PO QD, or ethambutol 15-25 mg/kg PO QD. A four-drug regimen containing INH, rifampin, ethambutol, and pyrazinamide is optimal pending mycobacterial sensitivity results. If initiation of treatment is necessary in theater, and no antituberculosis drugs are available, levofloxacin may be used as presumptive therapy.

Disposition: EVAC.

Prognosis: excellent in properly treated cases.

Prevention and Public Health Measures:

- Isolation and treatment of infectious patients.
- Prophylaxis of contacts per policy of CINC surgeon.
- Avoid use of local (unpasteurized) dairy products.
- Report case as a reportable event using theater medical surveillance reporting channels.

TYPHOID & PARATYPHOID ENTERIC FEVER

Communicability:

- Route: oral ingestion of organisms, typically in contaminated food or water.
  - Patients excrete organisms in stool, urine, pus and/or emesis. Asymptomatic carriage and excretion of organisms in stool is common.
  - Viable organisms can contaminate food and water via spread by hands, flies, fomites, or direct contamination.
- Isolation:
  - Enteric precautions while ill and convalescing.
  - Disinfection of contaminated articles.
  - Since excretion of organisms typically persists for several weeks after resolution of illness, and persists more than 1 year in up to 3% of patients, convalescing patients should be evacuated rather than returned to field setting.
- Prophylaxis:
  - For household (barracks or tent mate) contact, administer vaccine if this has not been received within 3 years.
  - Household contact should not be used as food handlers unless both stool and urine are each negative for salmonella on two occasions at least 24 hours apart.

Incubation:

- Average: 1 week.
- Range: 3 days to 8 weeks.
- Larger inoculum is associated with briefer incubations.

Diagnosis:

- Symptoms: insidious onset (note that brucellosis may present with similar symptoms; see Brucellosis section for considerations):
  - Fever (75-100%).
  - Headache* (59-90%).
  - Anorexia (39-91%).
  - Cough (28-86%).
  - Myalgia (12-91%).
  - Constipation (10-79%).
  - Weakness (10-87%).
  - Diarrhea (37-57%) *may NOT be present.*
  - Vomiting (24-54%).
  - Nausea (23-54%).
  - Sore throat (6-84%).
  - Chills (16-37%).
  - Abdominal pain (19-39%).
  - Sweats (33%).

  **Headache associated with enteric fever is frequently intense, frontal, and not bitemporal.*
- Signs:
  - Fever: remittent, 104°F (40°C); (75-100%); less likely in early phase.
  - Pulse slow relative to fever.
  - Rose spots: 2-4 mm blanching, erythematous, maculopapular lesions; occur in crops of about 10 located on upper abdomen; persist several hours to several days; appear 7-10 days into illness, (13-46%).
  - Hepatomegaly: (15-50%).
  - Splenomegaly: often tender; (40-64%).
  - Neurological/mental status changes: lethargy, stupor, coma seizures, delirium, and meningismus; (10%).

- Laboratory findings:
  - Hematologic:
    - Hgb/Hct: anemia common**,** worsens progressively over first 3 weeks.
    - WBC: normal in 75% (range 1,200-20,000).
    - Platelets: usually normal, occasionally low.
    - ESR: typically elevated.
  - Chemistry:
    - SGOT, LDH: mild/moderate elevation in about 33%.
    - Alkaline phosphatase: mild elevation common.
    - Bilirubin: mild elevation (twofold) common; sufficient to cause jaundice, uncommon.
    - CPK: occasionally elevated.
  - Urinalysis: nonspecific.
  - Microbiologic: causative organisms include Salmonella typhi (typhoid), other salmonella species (paratyphoid) and other bacteria including Yersinia enterocolitica, Yersinia pseudotuberculosis and Campylobacter fetus.
    - Blood cultures: first week 80% positive; by third week 20-30% positive. Obtain 2 to 3 sets for optimal yield.
    - Bone marrow aspirate cultures: 90-95% positive.
    - Stool cultures: occasionally positive during incubation; 33-67% positive during weeks 2-4 of illness.
    - Urine culture: intermittently positive after second week of illness in 25%. Multiple specimens should be sent.
    - Skin snips of rose spots may be positive when cultures of other sites fail to isolate organism.
  - Serologic: limited value; insensitive and nonspecific.

- Coagulation: usually normal. Occasionally coagulopathy, with prolonged PT and PTT may be seen.

- X-Ray: chest x-ray normal (infiltrates in <10%).
- Invasive procedures:
  - Bone marrow aspiration, for culture, as above.
  - Skin snip or biopsy of rose spot, for culture, as above.
- Diagnostic confirmation: isolation of organism from blood, marrow, or skin. Isolation from stool of a typical case is presumptive evidence, but is not definitive.

Duration:

- Treated: 3-10 days, until fever resolves.
- Untreated: 4-week acute illness, if not complicated.

Complications:

- Intestinal perforation:
  - Incidence: 1-10%, typically during second or third week of illness.
  - Mortality: 25%.
  - Signs:
    - Classic peritoneal signs often absent.
    - Abdominal x-ray shows air below diaphragm.
    - Absent bowel sounds and vomiting, suggesting ileus, may be most prominent clinical features.
  - Perforations may be single or multiple.
  - Ileum is most common location.
  - Treatment is surgical.
- GI hemorrhage:
  - Incidence: 1-20% depending on initiation of antibiotics.
  - Mortality: low if recognized and treated.

- Typically occurs during second or third week of illness.
- Treatment is supportive, including transfusion. Surgical intervention should be reserved for massive or persistent bleeding.

- Local abscess/infection:
  - Incidence: < 1%.
  - May occur in any tissue, notably bone, soft tissue, meninges, heart, pericardium, lungs, liver, spleen, kidneys, thyroid, or breast.
- Other complications:
  - Hemolytic anemia (2%).
  - Typhoid pneumonia (8-10%).
  - Peripheral neuropathy.
  - Relapse (5-20%).

Treatment:

- Preferred regimens:
  - Ciprofloxacin 500 mg PO BID for 10-14 days (if disease detected early); OR
  - Ceftriaxone (Rocephin®) 2 gm IV Q12H for 7 days.
- Supportive fluid and nutritional therapy is essential.
- Avoid heparin and antipyretics.
- In critically ill patients (i.e., shock, delirium, stupor, or coma), IV dexamethasone improves survival from 45-90%: dexamethasone, loading dose 3 mg/kg IV, then 1 mg/kg IV Q8H for 48 hours.

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Disposition: evacuation, once stabilized.

Prognosis:

- Treated: < 1 mortality.
- Untreated: 10% mortality.

Prevention and Public Health Measures:

- Vaccinate all military personnel.
- Command emphasis:
  - Strict sanitation.
  - Hand washing/personal hygiene.
  - Strict water purification/food preparation.
  - Fly control:
    - Insecticide spraying.
    - Screening.
    - Proper garbage disposal.
- Epidemiologic investigation of each case is required.
- Report case as a reportable event using theater medical surveillance reporting channels.

TYPHUS, ENDEMIC (MURINE, FLEA-BORNE)

Communicability:

- Route:
  - Bite of infected rat flea (Xenopsylla cheopis).
  - No evidence of person-to-person transmission.
- Isolation: not required.
- Prophylaxis: not required.

Incubation: 12 days (range 4-15 days).

Diagnosis: overall similar to epidemic typhus but milder, briefer.

- Symptoms: onset variable, but more commonly sudden.
  - Fever (90-100%).
  - Chills.
  - Headache (severe) (85% or more).
  - Myalgia (85%).
  - Nonproductive cough (50-60%).
  - Nausea.
  - Vomiting.
  - Marked weakness/prostration.
  - Sore throat.
  - Chest pain.
- Signs:
  - Fever (100%) up to 105^0F (40^0C) for 12-16 days duration.
  - Rash (60-80%).
    - Initial: upper thorax and abdomen, macular, appears on day 3-5 of illness.
    - Later: remains central, becomes maculopapular, duration 4-8 days, rarely involves face or palms.
  - Conjunctival injection (50%).
  - Splenomegaly (30%).

- Mental status changes (20%).
- Photophobia (10-20%).
- No eschar present.

- Laboratory findings:
  - Hematology: WBC usually normal.
  - Chemistry: nonspecific.
  - Microbiology: not available, except in special facilities with containment capability.
  - Urinalysis: proteinuria (15-20%).
  - Serology: available but cross-reacts with other rickettsial organisms.
  - Coagulation: nonspecific.
- Invasive procedures: not indicated.
- X-ray: findings nonspecific.
- Diagnostic confirmation: clinical diagnosis generally is sufficient for patient care. If specific confirmation is required for epidemiologic purposes, either culture or specialized application of indirect immunofluorescent antibody (after cross-absorption of patient's serum with specially prepared antigen from other Rickettsial species) may be done.

Duration:

- Treated: 2-3 days, until defervescence.
- Untreated: up to 16 days until defervescence.

Complications: very uncommon.

Treatment:

- Standard: Doxycycline 100 mg PO BID until 3 days after defervescence.
- Alternatives: Tetracycline 250 mg PO QID until 3 days after defervescence.

- Relapse: rare in murine typhus; retreat with original regimen.

Disposition: local hospitalization, anticipate return to duty in 1-2 weeks.

Prognosis: excellent; even untreated cases should recover without sequelae.

Prevention and Public Health Measures:

- Insecticide application to rat runs and rat-infested areas to kill fleas.
- After effective insecticide applications, rat elimination measures including poisoning and trapping are indicated.
- Rat-proofing human quarters.

TYPHUS, EPIDEMIC (LOUSE-BORNE)

Communicability:

- Route:
  - Body louse (Pediculus humanis) infestation; inoculation with louse feces through skin abrasions or excoriations.
  - No evidence of person-to-person transmission.
- Isolation: contact isolation required until after delousing (by insecticide) of patients clothing, bedding, quarters, and household contacts. Options: lindane, malathion, carbaryl, DDT.
- Prophylaxis: Doxycycline, single dose, 200 mg.

Incubation: 12 days (range 5-23 days).

Diagnosis:

- Symptoms (abrupt onset):
  - Sustained fever > 40^0C.
  - Severe headache.
  - Prostration.
  - Back pain.
  - Limb pain.
  - Nonproductive cough.
  - Photophobia.
  - Anorexia.
  - Constipation.
  - Nausea (uncommon).
  - Vomiting (uncommon).
  - Diarrhea (uncommon).

- Signs:
  - Rash (90%); onset on 5th or 6th day of illness. Initially in axillary folds, on abdomen and chest. Centrifugal spread later. Initially roseolar, macular; becomes petechial. Rarely involves palms, soles or face. No eschar is seen. Also:
  - Profound lethargy/stupor.
  - Delirium.
  - Facial congestion.
  - Conjunctival injection.
  - Splenomegaly.
  - Hypotension.
  - Tachycardia.
  - Jaundice (uncommon).
  - Oliguria.
  - Meningismus.
  - Cranial nerve palsies, including deafness/tinnitus.
- Laboratory findings:
  - Hematologic: leukopenia early; no eosinophilia; anemia and thrombocytopenia seen as disease advances.
  - Chemistry: azotemia, hypoalbuminemia, hyponatremia.
  - Urinalysis: proteinuria.
  - Microbiology: culture may be possible in large centers but not under field conditions or in small hospitals.
  - Serology available.
  - Coagulation: **prolonged prothrombin time** (PT).
- Invasive procedures: CSF may show pleocytosis.
- X-ray: CXR may show pulmonary infiltrate.

Complications: sepsis, parotitis, and pneumonia; rarely myocarditis, CHF, venous thromboses.

Treatment:

- Doxycycline, 200 mg PO, single dose.
- Tetracycline, 250 mg PO QID, until 3 days post defervescence (avoid if renal failure is present).
- Relapse: repeating initial treatment is effective.

Disposition:

- Initial: hospitalization.
- Post treatment:
  - prompt responders: return to duty.
  - complicated cases, or those with inadequate response to treatment: evacuate.

Prognosis:

- Mortality:
  - Treated: very little, if any, mortality.
  - Untreated: 10-40% depending on clinical situation.
- Prompt recovery with therapy: usually better in 24-48 hours.
- Untreated: rapid fever defervescence after about 2 weeks, mentation rapidly returns to normal; 2-3 months may be required for return of strength.
- Relapses rarely occur, but are more likely if tetracycline or chloramphenicol is prematurely stopped.

Prevention and Public Health Measures:

- Insecticides:
  - Application of insecticide to clothing of all personnel at risk of exposure.
  - Use of persistent insecticide for application to clothing of individuals at particular risk.
- Hygiene: command emphasis on personal hygiene and cleanliness of clothing.
- Disease reporting to higher echelon medical authorities.
- Report case as a reportable event using theater medical surveillance reporting channels.

TICK TYPHUS

Communicability:

- Route:
  - Bite of infected tick (Ixodid).
  - No evidence of person-to-person transmission.
- Isolation: not required.
- Prophylaxis: not required.

Incubation: 7 days.

Clinical manifestations and diagnosis: usually abrupt onset.

- Symptoms:
  - Fever (100%).
  - Headache, severe (60%).
  - Myalgia (35%).
  - Dyspnea.
  - Weakness, fatigue.
  - Cough.
- Signs:
  - Fever (100%) up to 39 °C for 7-14 days if untreated.
  - Rash (>95%).
    - Initial: painless eschar (tache noire) in 70% at site of infected tick bite (lower limbs, groin, abdomen) with tender regional lymphadenopathy followed by systemic symptoms.
    - Later: maculopapular rash on 3rd-5th day of fever, located on extremities (including palms/soles) then trunk. Eruption lasts 7-14 days if untreated. May develop petechial appearance in severe cases.
  - Conjunctival injection, chemosis (10%).
  - Hepatomegaly (13%).
- Laboratory findings:
  - Hematology: thrombocytopenia (35%).
  - Chemistry: hyponatremia, azotemia, elevated SGOT.

- Microbiology: not available under field conditions.
- Urinalysis: proteinuria.
- Serology: available.
- Coagulation: prolonged prothrombin time and bleeding time in severe cases.

- Invasive procedures: not indicated.
- Diagnostic confirmation: clinical diagnosis sufficient for patient care. Diagnosis may be confirmed by demonstrating rickettsiae in skin biopsy of macules using immunofluorescent techniques.

Duration: 7-14 days if untreated. Treatment leads to clinical improvement after 48 hours, with rapid resolution of symptoms and rash.

Complications: deep venous thrombosis, digital gangrene, myocarditis, renal failure, hemorrhage.

Treatment: Doxycycline 100 mg PO BID or Tetracycline 250 mg PO Q6H until 1 day after defervescence.

Disposition: local hospitalization, anticipate return to duty in 1-2 weeks. Evacuate cases with complications.

Prognosis: excellent, most show rapid clinical improvement after 46 hours of therapy.

Prevention and Public Health Measures:

- Avoid contact with ticks or tick-infested animals if possible.
- Use of DEET repellent and permethrin impregnated clothing by all personnel will reduce risk of exposure.
- Report case as a reportable event using theater medical surveillance reporting channels.

PART TWO: EXPOSURE TO BIOLOGICAL WARFARE AGENTS

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ANTHRAX

Symptoms/Signs: Incubation period is generally 1-6 days, although longer periods have been noted. Fever, malaise, fatigue, cough and mild chest discomfort progress to severe respiratory distress with dyspnea, diaphoresis, stridor, cyanosis, and shock. Death typically occurs within 24-36 hours after onset of severe symptoms.

Diagnosis: Physical findings are nonspecific. A widened mediastinum may be seen on CXR in later stages of illness. The organism is detectable by Gram stain of the blood and by blood culture late in the course of illness.

Prophylaxis: Oral ciprofloxacin or doxycycline for known or imminent exposure. An FDA-licensed vaccine is available. Vaccine schedule is 0.5 mL SC at 0, 2, 4 weeks, then 6, 12, and 18 months (primary series), followed by annual boosters.

Isolation and Decontamination: Standard precautions for healthcare workers. After an invasive procedure or autopsy is performed, the instruments and area used should be thoroughly disinfected with a sporicidal agent (hypochlorite).

Treatment: Although effectiveness may be limited after symptoms are present, high dose antibiotic treatment with penicillin, ciprofloxacin, or doxycycline should be undertaken. Supportive therapy may be necessary.

- Almost all inhalational anthrax cases in which treatment was begun after patients were significantly symptomatic have been fatal, regardless of treatment. Penicillin has been regarded as the treatment of choice, with 2 million units given intravenously every 2 hours. Tetracyclines and erythromycin have been recommended in penicillin allergic patients. The vast majority of naturally occurring anthrax strains are sensitive *in vitro* to penicillin. However, penicillin-resistant strains exist naturally, and one has been recovered from a fatal human case. Moreover, it might not be difficult for an adversary to induce resistance to penicillin, tetracyclines, erythromycin, and many other antibiotics through laboratory manipulation of organisms. All naturally occurring strains tested to date have been sensitive to erythromycin, chloramphenicol, gentamicin, and ciprofloxacin. In the absence of antibiotic sensitivity data, empiric IV antibiotic treatment should be instituted at the earliest signs of disease. Military policy (FM 8-284) currently recommends ciprofloxacin (400 mg IV Q12H) or doxycycline (200 mg IV load, followed by 100 mg IV Q12H) as initial therapy, with penicillin (4 million U IV Q4H) as an alternative once sensitivity data is available. Published recommendations from a public health consensus panel recommends ciprofloxacin as initial therapy. Therapy may then be tailored once antibiotic sensitivity is available to penicillin G or doxycycline. Recommended treatment duration is 60 days, and should be changed to oral therapy as clinical condition improves. Supportive therapy for shock, fluid volume deficit, and adequacy of airway may all be needed.

BOTULINUM

Symptoms/Signs: Usually begins with cranial nerve palsies, including ptosis, blurred vision, diplopia, dry mouth and throat, dysphagia, and dysphonia. This is followed by symmetrical descending flaccid paralysis, with generalized weakness and progression to respiratory failure. Symptoms begin as early as 12-36 hours after inhalation, but may take several days after exposure to low doses of toxin.

Diagnosis: Diagnosis is primarily a clinical one. Biowarfare attack should be suspected if multiple casualties simultaneously present with progressive descending flaccid paralysis. Lab confirmation can be obtained by bioassay (mouse neutralization) of the patient's serum. Other helpful labs include: ELISA for antigen in environmental samples, PCR for bacterial DNA in environmental samples, or nerve conduction studies and electromyography.

Prophylaxis: Pentavalent toxoid vaccine (types A, B, C, D, and E) is available as an IND product for those at high risk of exposure.

Isolation and Decontamination: Standard precautions for healthcare workers. Toxin is not dermally active and secondary aerosols are not a hazard from patients. Decontaminate with soap and water. Botulinum toxin is inactivated by sunlight within 1-3 hours. Heat (80^{O}C for 30 minutes, 100^{O}C for several minutes) and chlorine (>99.7% inactivation by 3 mg/L free available chlorine (FAC) in 20 minutes); also destroy the toxin.

Treatment: Early administration of trivalent licensed antitoxin or heptavalent antitoxin (types A, B, C, D, E, F and G), available only as an IND product, may prevent or decrease progression to respiratory failure and hasten recovery. Intubation and ventilatory assistance for respiratory failure. Tracheostomy may be required.

- Supportive care, including prompt respiratory support, can be lifesaving. Respiratory failure due to paralysis of respiratory muscles is the most serious effect and, generally, the cause of death. Reported cases of botulism prior to 1950 had a mortality rate of 60%. With tracheotomy or endotracheal intubation and ventilatory assistance, fatalities are less than 5% today. Prevention of nosocomial infections is a primary concern, along with hydration, nasogastric suctioning for ileus, bowel and bladder care, and prevention of decubitus ulcers and deep venous thromboses. Intensive and prolonged nursing care may be required for recovery, which may take up to 3 months for initial signs of improvement, and up to 1 year for complete resolution of symptoms.

Antitoxin: Early administration of botulinum antitoxin is critical, since the antitoxin can only neutralize the circulating toxin in patients with symptoms that continue to progress. When symptom progression ceases, no circulating toxin remains, and the antitoxin has no effect. Antitoxin may be particularly effective in food-borne cases, where presumably toxin continues to be absorbed through the gut wall. Animal experiments show that after aerosol exposure, botulinum antitoxin is very effective if given before the onset of clinical signs. If the antitoxin is delayed until after the onset of symptoms, it does not protect against respiratory failure.

- Three different antitoxin preparations are available in the United States. A licensed trivalent (types A, B, E) equine antitoxin is available from the Centers for Disease Control and Prevention for cases of food-borne botulism. This product has all the disadvantages of a horse serum product, including the risks of anaphylaxis and serum sickness. A monovalent human antiserum (type A) is available from the California Department of Health Services for infant botulism. A "despeciated" equine heptavalent antitoxin against all 7 serotypes has been prepared by cleaving the Fc fragments from horse IgG molecules, leaving $F(ab)_2$ fragments. This product was developed by USAMRIID, and is currently available under IND status. It has been effective in animal studies. However, 4% of horse antigens remain, so there is still a risk of hypersensitivity reactions.
- Use of the equine antitoxin requires skin testing for horse serum sensitivity prior to administration. Skin testing is performed by injecting 0.1 mL of a 1:10 dilution (in sterile physiological saline) of antitoxin intradermally in the patient's forearm with a 26 or 27 gauge needle. Monitor the injection site and observe the patient for allergic reaction for 20 minutes. The skin test is positive if any of these allergic reactions occur: hyperemic areola (colored ring) at the site of the injection > 0.5 cm; fever or chills; hypotension with decrease of blood pressure > 20 mm Hg for systolic and diastolic pressures; skin rash; respiratory difficulty; nausea or vomiting; generalized itching. DO NOT administer equine-derived Botulinum $F(ab)_2$ antitoxin if the skin test is positive. If no allergic symptoms are observed, the antitoxin is administered as a single dose intravenously in normal saline solution, 10 mL over 20 minutes.

- With a positive skin test, desensitization can be attempted by administering 0.01 - 0.1 mL of antitoxin subcutaneously, doubling the previous dose every 20 minutes until 1.0 - 2.0 mL can be sustained without any marked reaction. Preferably, desensitization should be performed by an experienced allergist. Medical personnel administering the antitoxin should be prepared to treat anaphylaxis with epinephrine, intubation equipment, and IV access.

BRUCELLOSIS

(see also Brucellosis, Part One, ENDEMIC DISEASES)

Symptoms/Signs: Illness, when manifest, typically presents with fever, headache, myalgias, arthralgias, back pain, sweats, chills, and generalized malaise. Other manifestations include depression, mental status changes, and osteoarticular findings (i.e., Sacroiliitis, vertebral osteomyelitis). Fatalities are uncommon.

Diagnosis: Diagnosis requires a high index of suspicion, since many infections present as nonspecific febrile illnesses or are asymptomatic. Laboratory diagnosis can be made by blood culture with prolonged incubation. Bone marrow cultures produce a higher yield. Confirmation requires phage-typing, oxidative metabolism, or genotyping procedures. ELISA, followed by Western blot are available.

Prophylaxis: There is no human vaccine available against brucellosis, although animal vaccines exist. Chemoprophylaxis is not recommended after possible exposure to endemic disease. Treatment should be considered for high-risk exposure to the veterinary vaccine, inadvertent laboratory exposure, or confirmed biological warfare exposure.

Isolation and Decontamination: Standard precautions are appropriate for healthcare workers. Person-to-person transmission has been reported via tissue transplantation and sexual contact. Environmental decontamination can be accomplished with a 0.5% hypochlorite solution.

Treatment: Antibiotic therapy with doxycycline + rifampin or doxycycline in combination with other medications for 6 weeks is usually sufficient in most cases. More prolonged regimens may be required for patients with complications of meningoencephalitis, endocarditis, or osteomyelitis.

- Oral antibiotic therapy alone is sufficient in most cases of brucellosis. Exceptions involve uncommon cases of localized disease, where surgical intervention may be required (e.g., valve replacement for endocarditis). A combination of Doxycycline 200 mg/d PO + Rifampin 600 mg/d PO is generally recommended. Both drugs should be administered for 6 weeks. Doxycycline 200 mg/d PO for 6 weeks in combination with two weeks of Streptomycin (1 g/d IM) is an acceptable alternative. Regimens involving Doxycycline + Gentamicin, TMP/SMX + Gentamicin, and Ofloxacin + Rifampin have also been studied and shown effective. Long-term triple-drug therapy with rifampin, a tetracycline, and an aminoglycoside is recommended by some experts for patients with meningoencephalitis or endocarditis.

GLANDERS AND MELIOIDOSIS

Symptoms/Signs: Incubation period ranges from 10-14 days after inhalation. Onset of symptoms may be abrupt or gradual. Inhalational exposure produces fever (common in excess of 102 F.), rigors, sweats, myalgias, headache, pleuritic chest pain, cervical adenopathy, hepatosplenomegaly, and generalized papular / pustular eruptions. Acute pulmonary disease can progress and result in bacteremia and acute septicemic disease. Both diseases are almost always fatal without treatment.

Diagnosis: Methylene blue or Wright stain of exudates may reveal scant small bacilli with a safety-pin bipolar appearance. Standard cultures can be used to identify both B. mallei and B. pseudomallei. CXR may show military lesions, small multiple lung abscesses, or infiltrates involving upper lungs, with consolidation and cavitation. Leukocyte counts may be normal or elevated. Serologic tests can help confirm diagnosis, but low titers or negative serology does not exclude the diagnosis.

Prophylaxis: Currently, no pre-exposure or post-exposure prophylaxis is available.

Isolation and Decontamination: Standard precautions for healthcare person-to-person airborne transmission is unlikely, although secondary cases may occur through improper handling of infected secretions. Contact precautions are indicated while caring for patients with skin involvement. Environmental decontamination using a 0.5% hypochlorite solution is effective.

Treatment: Therapy will vary with the type and severity of the clinical presentation. Patients with localized disease may be managed with oral antibiotics for a duration of 60-150 days.

More severe illness may require parenteral therapy and more prolonged treatment.

- The recommended therapy will vary with the type and severity of the clinical presentation. The following oral regimens have been suggested for localized disease: Amoxicillin / clavulanate 60 mg/kg/day in three divided doses; Tetracycline 40 mg/kg/day in three divided doses; or Trimethoprim / sulfa (TMP 4 mg/kg/day-sulfa 20 mg/kg/day) in two divided doses. The duration of treatment should be for 60-150 days.
  - If the patient has localized disease with signs of mild toxicity, then a combination of two of the oral regimens is recommended for a duration of 30 days, followed by monotherapy with either amoxicillin / clavulanate or TMP / sulfa for 60-150 days. If extrapulmonary suppurative disease is present, then therapy should continue for 6-12 months. Surgical drainage of abscesses may be required.
- For severe disease, parental therapy with Ceftazidime 120 mg/kg/day in three divided doses combined with TMP/sulfa (TMP 8 mg/kg/day – sulfa 40 mg/kg/day) in four divided doses for 2 weeks, followed by oral therapy for 6 months.
- Other antibiotics that have been effective in experimental infection in hamsters include doxycycline, rifampin, and ciprofloxacin. The limited number of infections in humans has precluded therapeutic evaluation of most of the antibiotic agents; therefore, most antibiotic sensitivities are based on animal and *in vitro* studies. Various isolates have markedly different antibiotic sensitivities; therefore, each isolate should be tested for its own resistance pattern.

PLAGUE

Symptoms/Signs: Pneumonic plague begins after an incubation period of 1-6 days, with high fever, chills, headache, malaise, followed by cough (often with hemoptysis), progressing rapidly to dyspnea, stridor, cyanosis, and death. Gastrointestinal symptoms are often present. Death results from respiratory failure, circulatory collapse, and a bleeding diathesis. Bubonic plague, featuring high fever, malaise, and painful lymph nodes (buboes) may progress spontaneously to the septicemic form (septic shock, thrombosis, DIC) or to the pneumonic form.

Diagnosis: Suspect plague if large numbers of previously healthy individuals develop fulminant Gram negative pneumonia, especially if hemoptysis is present. Presumptive diagnosis can be made by Gram, Wright, Giemsa or Wayson stain of blood, sputum, CSF, or lymph node aspirates. Definitive diagnosis requires culture of the organism from those sites. Immunodiagnosis is also helpful.

Prophylaxis: For asymptomatic persons exposed to a plague aerosol or to a patient with suspected pneumonic plague, give doxycycline 100 mg orally twice daily for 7 days or the duration of risk of exposure plus 1 week. Alternative antibiotics include ciprofloxacin, tetracycline, or chloramphenicol. No vaccine is currently available for plague prophylaxis. The previously available licensed, killed vaccine was effective against bubonic plague, but not against aerosol exposure.

Isolation and Decontamination: Use standard precautions for bubonic plague, and respiratory droplet precautions for suspected pneumonic plague. *Y. pestis* can survive in the environment for varying periods, but is susceptible to heat, disinfectants, and exposure to sunlight. Soap and water is effective if decon is needed. Take measures to prevent local disease cycles if vectors (fleas) and reservoirs (rodents) are present.

Treatment: Early administration of antibiotics is critical, as pneumonic plague is invariably fatal if antibiotic therapy is delayed more than 1 day after the onset of symptoms. Choose one of the following: streptomycin, gentamicin, ciprofloxacin, or doxycycline for 10-14 days. Chloramphenicol is the drug of choice for plague meningitis.

- Streptomycin, gentamicin, doxycycline, and chloramphenicol are highly effective, if begun early. Plague pneumonia is almost always fatal if treatment is not initiated within 24 hours of the onset of symptoms. Dosage regimens are as follows: streptomycin, 30 mg/kg/day IM in two divided doses; gentamicin, 5 mg/kg IM or IV once daily, or 2 mg/kg loading dose followed by 1.75 mg/kg IM or IV every 8 hours; doxycycline 200 mg initially, followed by 100 mg every 12 hours. Duration of therapy is 10-14 days. While the patient is typically afebrile after 3 days, the extra week of therapy prevents relapses. Results obtained from laboratory animal, but not human, experience, indicate that quinolone antibiotics, such as ciprofloxacin and ofloxacin, may also be effective. Recommended dosage of ciprofloxacin is 400 mg IV twice daily. Chloramphenicol, 25 mg/kg IV loading dose followed by 15 mg/kg IV four times daily for 10-14 days, is required for the treatment of plague meningitis.

- Usual supportive therapy includes IV crystalloids and hemodynamic monitoring. Although low-grade DIC may occur, clinically significant hemorrhage is uncommon, as is the need to treat with heparin. Endotoxic shock is common, but pressor agents are rarely needed. Finally, buboes rarely require any form of local care or surgical drainage, but instead recede with systemic antibiotic therapy. In fact, incision and drainage poses a risk to others in contact with the patient; aspiration is recommended for diagnostic purposes and may provide symptomatic relief.

Q FEVER

(see also Q Fever, Part One, ENDEMIC DISEASES)

Symptoms/Signs: Fever, cough, and pleuritic chest pain may occur as early as 10 days after exposure. Patients are not generally critically ill, and the illness lasts from 2 days to 2 weeks.

Diagnosis: Q fever is not a clinically distinct illness and may resemble a viral illness or other types of atypical pneumonia. The diagnosis is confirmed serologically.

Prophylaxis: Chemoprophylaxis begun too early during the incubation period may delay but not prevent the onset of symptoms. Therefore, tetracycline or doxycycline should be started 8-12 days post exposure and continued for 5 days. This regimen has been shown to prevent clinical disease. An inactivated whole cell IND vaccine is effective in eliciting protection against exposure, but severe local reactions to this vaccine may be seen in those who already possess immunity. Therefore, an intradermal skin test is recommended to detect presensitized or immune individuals.

Isolation and Decontamination: Standard precautions are recommended for healthcare workers. Person-to-person transmission is rare. Patients exposed to Q fever by aerosol do not present a risk for secondary contamination or re-aerosolization of the organism. Decontamination is accomplished with soap and water or a 0.5% chlorine solution on personnel. The M291 skin decontamination kit will not neutralize the organism.

Treatment: Q fever is generally a self-limited illness even without treatment, but tetracycline or doxycycline should be given orally for 5-7 days to prevent complications of the disease. Q fever endocarditis (rare) is much more difficult to treat.

- Standard precautions are recommended for healthcare workers. Most cases of acute Q fever will eventually resolve without antibiotic treatment, but all suspected cases of Q fever should be treated to reduce the risk of complications. Tetracycline 500 mg every 6 hours or doxycycline 100 mg every 12 hours for 5-7 days will shorten the duration of illness, and fever usually disappears within 1-2 days after treatment is begun. Ciprofloxacin and other quinolones are active *in vitro* and should be considered in patients unable to take tetracycline or doxycycline. Successful treatment of Q fever endocarditis is much more difficult. Tetracycline or doxycycline given in combination with trimethoprim-sulfamethoxazole (TMP-SMX) or rifampin for 12 months or longer has been successful in some cases. However, valve replacement is often required to achieve a cure.

RICIN

Symptoms/Signs: Acute onset of fever, chest tightness, cough, dyspnea, nausea, and arthralgias occurs 4-8 hours after inhalational exposure. Airway necrosis and pulmonary capillary leak resulting in pulmonary edema would likely occur within 18-24 hours, followed by severe respiratory distress and death from hypoxemia in 36-72 hours.

Diagnosis: Acute lung injury in large numbers of geographically clustered patients suggests exposure to aerosolized ricin. The rapid time course to severe symptoms and death would be unusual for infectious agents. Serum and respiratory secretions should be submitted for antigen detection (ELISA). Acute and convalescent sera provide retrospective diagnosis. Nonspecific laboratory and radiographic findings include leukocytosis and bilateral interstitial infiltrates.

Prophylaxis: There is currently no vaccine or prophylactic antitoxin available for human use, although immunization appears promising in animal models. Use of the military chemical protective mask is currently the best protection against inhalation.

Isolation and Decontamination: Standard precautions for healthcare workers. Ricin is nonvolatile, and secondary aerosols are not expected to be a danger to healthcare providers. Decontaminate with soap and water. Hypochlorite solutions (0.1% sodium hypochlorite) can inactivate ricin.

Treatment: Management is supportive and should include treatment for pulmonary edema. Gastric lavage and cathartics are indicated for ingestion, but charcoal is of little value for large molecules such as ricin.

- Management of ricin-intoxicated patients depends on the route of exposure. Patients with pulmonary intoxication are managed by appropriate respiratory support (oxygen, intubation, ventilation, PEEP, and hemodynamic monitoring) and treatment for pulmonary edema, as indicated. Gastrointestinal intoxication is best managed by vigorous gastric lavage, followed by use of cathartics such as magnesium citrate. Superactivated charcoal is of little value for large molecules such as ricin. Volume replacement of GI fluid losses is important. In percutaneous exposures, treatment would be primarily supportive.

SMALLPOX

Symptoms/Signs: Clinical manifestations begin acutely with malaise, fever, rigors, vomiting, headache. Two to three days later, lesions appear which quickly progress from macules to papules, and eventually to pustular vesicles. They are more abundant on the extremities and face, and develop synchronously.

Diagnosis: Neither electron nor light microscopy are capable of discriminating variola from vaccinia, monkeypox or cowpox. The new PCR diagnostic techniques may be more accurate in discriminating between variola and other *Orthopoxviruses*.

Prophylaxis: Immediate vaccination or revaccination should be undertaken for all personnel exposed.

Isolation and Decontamination: Droplet and airborne precautions for a minimum of 17 days following exposure for all contacts. Patients should be considered infectious until all scabs separate and quarantined during this period. In the civilian setting, strict quarantine of asymptomatic contacts may prove to be impractical and impossible to enforce. A reasonable alternative would be to require contacts to check their temperatures daily. Any fever above 101°F (38°C) during the 17-day period following exposure to a confirmed case would suggest the development of smallpox. The contact should then be isolated immediately, preferably at home, until smallpox is either confirmed or ruled out, and remain in isolation until all scabs separate.

Treatment: At present, there is no effective chemotherapy, and treatment of a clinical case remains supportive.

- Antivirals for use against smallpox are under investigation. Cidofovir has been shown to have significant *in vitro* and *in vivo* activity in experimental animals. Whether it would offer benefit superior to immediate post-exposure vaccination in humans has not been determined.

STAPHYLOCOCCAL ENTEROTOXIN B

Symptoms/Signs: Latent period of 3-12 hours after aerosol exposure is followed by sudden onset of fever, chills, headache, myalgia, and nonproductive cough. Some patients may develop shortness of breath and retrosternal chest pain. Patients tend to plateau rapidly to a fairly stable clinical state. Fever may last 2-5 days, and cough may persist for up to 4 weeks. Patients may also present with nausea, vomiting, and diarrhea if they swallow the toxin. Presumably, higher exposure can lead to septic shock and death.

Diagnosis: Diagnosis is clinical. Patients present with a febrile respiratory syndrome without CXR abnormalities. Large numbers of patients presenting in a short period of time with typical symptoms and signs of SEB pulmonary exposure would suggest an intentional attack with this toxin.

Prophylaxis: Use of military chemical protective mask. There is currently no human vaccine available to prevent SEB intoxication.

Isolation and Decontamination: Standard precautions for healthcare workers. SEB is not dermally active and secondary aerosols are not a hazard from patients. Decontaminate with soap and water. Destroy any food that may have been contaminated.

Treatment: Treatment is limited to supportive care. Artificial ventilation might be needed for very severe cases, and attention to fluid management is important.

- Currently, therapy is limited to supportive care. Close attention to oxygenation and hydration is important, and in severe cases with pulmonary edema, ventilation with positive end expiratory pressure, vasopressors and diuretics might be necessary. Acetaminophen for fever, and cough suppressants may make the patient more comfortable. The value of steroids is unknown. Most patients would be expected to do quite well after the initial acute phase of their illness, but generally would be unfit for duty for 1-2 weeks. Severe cases risk death from pulmonary edema and respiratory failure.

T-2 MYCOTOXINS

Symptoms/Signs: Exposure causes skin pain, pruritus, redness, vesicles, necrosis, and sloughing of the epidermis. Effects on the airway include nose and throat pain, nasal discharge, itching and sneezing, cough, dyspnea, wheezing, chest pain, and hemoptysis. Toxin also produces effects after ingestion or eye contact. Severe intoxication results in prostration, weakness, ataxia, collapse, shock, and death.

Diagnosis: Should be suspected if an aerosol attack occurs in the form of "yellow rain" with droplets of variously pigmented oily fluids contaminating clothes and the environment. Confirmation requires testing of blood, tissue, and environmental samples.

Prophylaxis: The only defense is to prevent exposure by wearing a military chemical protective mask and clothing (or topical skin protectant) during an attack. No specific immunotherapy or chemotherapy is available for use in the field.

Isolation and Decontamination: Outer clothing should be removed and exposed skin decontaminated with soap and water. Eye exposure should be treated with copious saline irrigation. Secondary aerosols are not a hazard; however, contact with contaminated skin and clothing can produce secondary dermal exposures. Contact precautions are warranted until decontamination is accomplished. Then, standard precautions are recommended for healthcare workers. Environmental decontamination requires the use of a hypochlorite solution under alkaline conditions such as 1% sodium hypochlorite and 0.1M NaOH with 1 hour contact time.

Treatment: There is no specific antidote. Treatment is supportive. Soap and water washing, even 4-6 hours after exposure can significantly reduce dermal toxicity; washing within 1 hour may prevent toxicity entirely. Superactivated charcoal should be given orally if the toxin is swallowed.

- No specific antidote or therapeutic regimen is currently available. All therapy is supportive. If a soldier is unprotected during an attack, the outer uniform should be removed within 4 hours and decontaminated by exposure to 5% hypochlorite for 6-10 hours. The skin should be thoroughly washed with soap and uncontaminated water if available. This can reduce dermal toxicity, even if delayed 4-6 hours after exposure. The M291 skin decontamination kit can also be used to remove skin-adherent T-2. Standard burn care is indicated for cutaneous involvement. Standard therapy for poison ingestion, including the use of superactivated charcoal to absorb swallowed T-2, should be administered to victims of an unprotected aerosol attack. Respiratory support may be necessary. The eyes should be irrigated with normal saline or water to remove toxin.

TULAREMIA

Symptoms/Signs: Ulceroglandular tularemia presents with a local ulcer and regional lymphadenopathy, fever, chills, headache and malaise. Typhoidal tularemia presents with fever, headache, malaise, substernal discomfort, prostration, weight loss, and a nonproductive cough.

Diagnosis: Clinical diagnosis. Physical findings are usually nonspecific. Chest x-ray may reveal a pneumonic process, mediastinal lymphadenopathy or pleural effusion. Routine culture is possible but difficult. The diagnosis can be established retrospectively by serology.

Prophylaxis: A live, attenuated vaccine is available as an investigational new drug. It is administered once by scarification. Tetracycline given as a 2-week course is effective as prophylaxis when given after exposure.

Isolation and Decontamination: Standard precautions for healthcare workers. Organisms are relatively easy to render harmless by mild heat (55° C for 10 minutes) and standard disinfectants.

Treatment: Administration of antibiotics (streptomycin or gentamicin) with early treatment is very effective.

- Appropriate therapy includes one of the following antibiotics:
  - Gentamicin 3 - 5 mg/kg IV daily for 10-14 days.
  - Ciprofloxacin 400 mg IV every 12 hours, switch to oral ciprofloxacin (500 mg every 12 hours) after the patient is clinically improved; continue for completion of a 10- to 14-day course of therapy.
  - Ciprofloxacin 750 mg orally every 12 hours for 10-14 days.
  - Streptomycin 7.5 - 10 mg/kg IM every 12 hours for 10-14 days.

- Streptomycin has historically been the drug of choice for tularemia; however, since it may not be readily available immediately after a large-scale BW attack, gentamicin and other alternative drugs should be considered first. Requests for streptomycin should be directed to the Roerig Streptomycin Program at Pfizer Pharmaceuticals in New York (800-254-4445)*. Another concern is that a fully virulent streptomycin-resistant strain of *F. tularensis* was developed during the 1950s and it is presumed that other countries have obtained it. The strain was sensitive to gentamicin. Gentamicin offers the advantage of providing broader coverage for gram-negative bacteria and may be useful when the diagnosis of tularemia is considered but in doubt. Tetracycline and chloramphenicol are also effective antibiotics; however, they are associated with significant relapse rates.

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* This number may only be answered during regular office hours: Monday-Friday, 8:30 AM to 5:30 PM, EST.

VENEZUELAN EQUINE ENCEPHALITIS

Symptoms/Signs: Incubation period 1-6 days. Acute systemic febrile illness with encephalitis developing in a small percentage (4% children; < 1% adults). Generalized malaise, spiking fevers, rigors, severe headache, photophobia, and myalgias for 24-72 hours. Nausea, vomiting, cough, sore throat, and diarrhea may follow. Full recovery from malaise and fatigue takes 1-2 weeks. The incidence of CNS disease and associated morbidity and mortality would be much higher after a BW attack.

Diagnosis: Clinical and epidemiological diagnosis. Physical findings nonspecific. The white blood cell count may show a striking leukopenia and lymphopenia. Virus isolation may be made from serum, and in some cases throat swab specimens. Both neutralizing or IgG antibody in paired sera or VEE-specific IgM present in a single serum sample indicate recent infection.

Prophylaxis: A live, attenuated vaccine is available as an investigational new drug. A second, formalin-inactivated, killed vaccine is available for boosting antibody titers in those initially receiving the first vaccine. No post-exposure immunoprophylaxis. In experimental animals, alpha-interferon and the interferon-inducer poly-ICLC have proven highly effective as post-exposure prophylaxis. There are no human clinical data.

Isolation and Decontamination: Patient isolation and quarantine is not required. Standard precautions augmented with vector control while the patient is febrile. There is no evidence of direct human-to-human or horse-to-human transmission. The virus can be destroyed by heat (80°C for 30 minutes) and standard disinfectants.

Therapy: Treatment is supportive only. Treat uncomplicated VEE infections with analgesics to relieve headache and myalgia. Patients who develop encephalitis may require anticonvulsants and intensive supportive care to maintain fluid and electrolyte balance, ensure adequate ventilation, and avoid complicating secondary bacterial infections. Patients should be treated in a screened room or in quarters treated with a residual insecticide for at least 5 days after onset, or until afebrile, as human cases may be infectious to mosquitoes for at least 72 hours.

VIRAL HEMORRHAGIC FEVERS

Viral hemorrhagic fevers are a diverse group of illnesses caused by RNA viruses from four viral families. The *Arenaviridae* include the etiologic agents of Argentine, Bolivian, and Venezuelan hemorrhagic fevers, and Lassa fever. The *Bunyaviridae* include the members of the *Hantavirus* genus, the CCHF virus from the *Nairovirus* genus, and the Rift Valley fever virus from the *Phlebovirus* genus; the *Filoviridae* include Ebola and Marburg viruses; and the *Flaviviridae* include dengue and yellow fever viruses. These viruses are spread in a variety of ways; some may be transmitted to humans through a respiratory portal of entry. Although evidence for weaponization does not exist for many of these viruses, they are included in this TG because of their *potential* for aerosol dissemination or weaponization, or likelihood for confusion with similar agents that might be weaponized.

Symptoms/Signs: VHFs are febrile illnesses which can feature flushing of the face and chest, petechiae, bleeding, edema, hypotension, and shock. Malaise, myalgias, headache, vomiting, and diarrhea may occur in any of the hemorrhagic fevers.

Diagnosis: Definitive diagnosis rests on specific virologic techniques. Significant numbers of military personnel with a hemorrhagic fever syndrome should suggest the diagnosis of a viral hemorrhagic fever.

Prophylaxis: The only licensed VHF vaccine is yellow fever vaccine. Prophylactic ribavirin (available only as IND under protocol) may be effective for Lassa fever, Rift Valley fever, CCHF, and possibly hemorrhagic fever with renal syndrome (HFRS).

Isolation and Decontamination: Contact isolation, with the addition of a surgical mask and eye protection for those coming within 3 feet of the patient, is indicated for suspected or proven Lassa fever, CCHF, or filovirus infections. Respiratory protection should be upgraded to airborne isolation, including the use of a fit-tested HEPA filtered respirator, a battery-powered air purifying respirator, or a positive pressure-supplied air respirator, if patients with the above conditions have prominent cough, vomiting, diarrhea, or hemorrhage. Decontamination is accomplished with hypochlorite or phenolic disinfectants.

Treatment: Intensive supportive care may be required. Antiviral therapy with ribavirin may be useful in several of these infections (available only as IND under protocol). Convalescent plasma may be effective in Argentine hemorrhagic fever (available only as IND under protocol).

- General principles of supportive care apply to hemodynamic, hematologic, pulmonary, and neurologic manifestations of VHF, regardless of the specific etiologic agent. Only intensive care will save the most severely ill patients. Healthcare providers employing vigorous fluid resuscitation of hypotensive patients must be mindful of the propensity of some VHFs (e.g., HFRS) for pulmonary capillary leak. Pressor agents are frequently required. The use of intravascular devices and invasive hemodynamic monitoring must be carefully considered in the context of potential benefit versus the risk of hemorrhage. Restlessness, confusion, myalgia, and hyperesthesia should be managed by conservative measures, and the judicious use of sedatives and analgesics. Secondary infections may occur as with any patient undergoing intensive care utilizing invasive procedures and devices, such as IV lines and indwelling catheters.

- The management of clinical bleeding should follow the same principles as for any patient with a systemic coagulopathy, assisted by coagulation studies. Intramuscular injections, aspirin, and other anticoagulant drugs should be avoided.
- The investigational antiviral drug ribavirin is available via compassionate use protocols for therapy of Lassa fever, HFRS, CCHF, and Rift Valley fever. Separate Phase III efficacy trials have indicated that parenteral ribavirin reduces morbidity in HFRS, and lowers both the morbidity and mortality of Lassa fever. In the HFRS field trial, treatment was effective if begun within the first 4 days of fever, and continued for a 7-day course. A compassionate use protocol, utilizing IV ribavirin as a treatment for Lassa fever, is sponsored by the CDC. Doses are slightly different, and continued for a 10-day course; treatment is most effective if begun within 7 days of onset. The only significant side effect of ribavirin is a modest anemia due to a reversible inhibition of erythropoiesis, and mild hemolysis. Although ribavirin is teratogenic in laboratory animals, the potential benefits must be weighed against the potential risks to pregnant women with grave illness due to one of these VHFs. Safety in infants and children has not been established. Ribavirin has poor *in vitro* and *in vivo* activity against the filoviruses (Ebola and Marburg) and the flaviviruses (dengue, yellow fever, Omsk HF and Kyanasur Forest disease).
- Argentine HF responds to therapy with 2 or more units of convalescent plasma containing adequate amounts of neutralizing antibody and given within 8 days of onset. This therapy is investigational, and available only under protocol.

DECONTAMINATION

Contamination is the introduction of an infectious agent on a body surface, food or water, or other inanimate objects. Decontamination involves either disinfection or sterilization to reduce microorganisms to an acceptable level on contaminated articles, thus rendering them suitable for use. Disinfection is the selective reduction of undesirable microbes to a level below that required for transmission. Sterilization is the killing of all organisms.

Decontamination methods have always played an important role in the control of infectious diseases. However, we are often unable to use the most efficient means of rendering microbes harmless (e.g., toxic chemical sterilization), as these methods may injure people and damage materials which are to be decontaminated. BW agents can be decontaminated by mechanical, chemical, and physical methods:

- Mechanical decontamination involves measures to remove but not necessarily neutralize an agent. An example is the filtering of drinking water to remove certain water-borne pathogens (e.g., *Dracunculus medinensis*), or in a BW context, the use of an air filter to remove aerosolized anthrax spores, or water to wash agent from the skin.
- Chemical decontamination renders BW agents harmless by the use of disinfectants that are usually in the form of a liquid, gas or aerosol. Some disinfectants are harmful to humans, animals, the environment, and materials.
- Physical means (heat, radiation) are other methods that can be employed for decontamination of objects.

Dermal exposure to a suspected BW aerosol should be immediately treated by soap and water decontamination. Careful washing with soap and water removes nearly all of the agent from the skin surface. Hypochlorite solution or other disinfectants are reserved for gross contamination (i.e., following the spill of solid or liquid agent from a munition directly onto the skin). In the absence of chemical or gross biological contamination, these will confer no additional benefit, may be caustic, and may predispose to colonization and resistant superinfection by reducing the normal skin flora. Grossly contaminated skin surfaces should be washed with a 0.5% sodium hypochlorite solution, if available, with a contact time of 10-15 minutes.

Ampules of calcium hypochlorite high test hyprochlorite (HTH) are currently fielded in the Chemical Agent Decon Set for mixing hypochlorite solutions. The 0.5% solution can be made by adding one 6-ounce container of calcium hypochlorite to five gallons of water. The 5% solution can be made by adding eight 6-ounce ampules of calcium hypochlorite to five gallons of water. These solutions evaporate quickly at high temperatures, so if they are made in advance, they should be stored in closed containers. Also, the chlorine solutions should be placed in distinctly marked containers because it is very difficult to tell the difference between the 5% chlorine solution and the 0.5% solution.

To mix a 0.5% sodium hypochlorite solution, take one part Clorox and nine parts water (1:9), since standard stock Clorox is a 5.25% sodium hypochlorite solution. The solution is then applied with a cloth or swab. The solution should be made fresh daily with the pH in the alkaline range.

Chlorine solution must NOT be used in (1) open body cavity wounds, as it may lead to the formation of adhesions, or (2) brain and spinal cord injuries. However, this solution may be instilled into

noncavity wounds and then removed by suction to an appropriate disposal container. Within about 5 minutes, this contaminated solution will be neutralized and nonhazardous. Subsequent irrigation with saline or other surgical solutions should be performed. Prevent the chlorine solution from being sprayed into the eyes, as corneal opacities may result.

For decontamination of fabric clothing or equipment, a 5% hypochlorite solution should be used. For decontamination of equipment, a contact time of 30 minutes prior to normal cleaning is required. This is corrosive to most metals and injurious to most fabrics, so rinse thoroughly and apply oil to metal surfaces after completion.

BW agents can be rendered harmless through such physical means as heat and radiation. To render agents completely harmless, sterilize with dry heat for 2 hours at 160°C. If autoclaving with steam at 121°C and 1 atmosphere of overpressure (15 pounds per square inch), the time may be reduced to 20 minutes, depending on volume. Solar ultraviolet (UV) radiation has a disinfectant effect, often in combination with drying. This is effective in certain environmental conditions , but hard to standardize for practical usage for decontamination purposes.

The health hazards posed by environmental contamination with biological agents differ from those posed by persistent or volatile chemical agents. Aerosolized particles in the 1-5 μm size range will remain suspended due to Brownian motion; suspended BW agents would be eventually inactivated by solar UV light, desiccation, and oxidation. Little, if any, environmental residues would occur. Possible exceptions include residua near the dissemination line, or in the immediate area surrounding a point-source munition. BW agents deposited on the soil would be subject to degradation by environmental stressors and competing

soil microflora. Simulant studies at Dugway Proving Ground suggest that secondary reaerosolization would be difficult, and would probably not pose a human health hazard. Environmental decontamination of terrain is costly and difficult and should be avoided, if possible. If grossly contaminated terrain, streets, or roads must be passed, the use of dust-binding spray to minimize reaerosolization may be considered. If it is necessary to decontaminate these surfaces, chlorine-calcium or lye may be used. Otherwise, rely on the natural processes which, especially outdoors, leads to the decontamination of agent by drying and solar UV radiation. Rooms in fixed spaces are best decontaminated with gases or liquids in aerosol form (e.g., formaldehyde). This is usually combined with surface disinfectants to ensure complete decontamination.

BW Agent Characteristics

Disease	Transmit Man to Man	Infective Dose (Aerosol)	Incubation Period	Duration of Illness	Lethality (approx. case fatality rates)
Inhalation anthrax	No	8,000-50,000 spores	1-6 days	3-5 days (usually fatal if untreated)	High
Brucellosis	No	10 -100 organisms	5-60 days (usually 1-2 months)	Weeks to months	<5% untreated
Cholera	Rare	10-500 organisms	4 hours - 5 days (usually 2-3 days)	$\geq$ 1 week	Low with treatment, high without
Glanders	Low	Assumed low	10-14 days via aerosol	Death in 7-10 days in septicemic form	> 50%
Pneumonic Plague	High	100-500 organisms	2-3 days	1-6 days (usually fatal)	High unless treated within 12-24 hours
Tularemia	No	10-50 organisms	2-10 days (average 3-5)	$\geq$ 2 weeks	Moderate if untreated
Q Fever	Rare	1-10 organisms	10-40 days	2-14 days	Very low
Smallpox	High	Assumed low (10-100 organisms)	7-17 days (average 12)	4 weeks	High to moderate
Venezuelan Equine Encephalitis	Low	10-100 organisms	2-6 days	Days to weeks	Low
Viral Hemorrhagic Fevers	Moderate	1-10 organisms	4-21 days	Death between 7-16 days	High for Zaire strain, moderate with Sudan
Botulism	No	0.001 μg/kg is LD_{50} for type A	1-5 days	Death in 24-72 hours; lasts months if not lethal	High without respiratory support
Staph Enterotoxin B	No	0.03 μg/ person incapacitation	3-12 hours after inhalation	Hours	< 1%
Ricin	No	3-5 μg/kg is LD_{50} in mice	18-24 hours	Days - death within 10-12 days for ingestion	High
T-2 Mycotoxins	No	Moderate	2-4 hours	Days to months	Moderate

BW AGENTS – DRUG THERAPY AND PROPHYLAXIS

DISEASE	CHEMOTHERAPY (Rx)	CHEMOPROPHYLAXIS (Px)	COMMENTS
Anthrax	Ciprofloxacin 400 mg IV Q12H or Doxycycline 200 mg IV, then 100 mg IV Q12H	Ciprofloxacin 500 mg PO BID x 4 wk. If unvaccinated, begin initial doses of vaccine.	Potential alternates for Rx: gentamicin, erythromycin, and chloramphenicol
	Penicillin 4 million units IV Q4H	Doxycycline 100 mg PO BOD x 4 wk plus vaccination	PCN for sensitive organisms only
Cholera	Oral rehydration therapy during period of high fluid loss	NA	Vaccine not recommended for routine protection in endemic areas (50% efficacy, short term)
	Tetracycline 500 mg Q6H x 3 d		Alternates for Rx: erythromycin, trimethoprim and sulfamethoxazole, and furazolidone
	Doxycycline 300 mg once, or 100 mg Q12H x 3 d		
	Ciprofloxacin 500 mg Q12H x 3 d		Quinolones for tetra/doxy resistant strains
	Norfloxacin 400 mg Q12H x 3 d		
Q Fever	Tetracycline 500 mg PO Q6H x 5-7 d continued at least 2 d after afebrile	Tetracycline 500 mg PO QID x 5 d (start 8-12 d post-exposure)	Currently testing vaccine to determine the necessity of skin testing prior to use.
	Doxycycline 100 mg PO Q12H x 5-7 d continued at least 2 d after afebrile	Doxycycline 100 mg PO BID x 5 d (start 8-12 d post-exposure)	
Glanders	Antibiotic regimens vary depending on localization and severity of disease - refer to text	Post-exposure prophylaxis may be tried with TMP-SMX	No large therapeutic human trials have been conducted owing to the rarity of naturally occurring disease.
Plague	Streptomycin 30 mg/kg/d IM in 2 divided doses x 10–14 d or Gentamicin 5mg/kg IM or IV once daily x 10-14 d or Ciprofloxacin 400mg IV Q12H until clinically improved then 750 mg PO BID for total of 10–14 d	Doxycycline 100 mg PO BID x 7 d or duration of exposure Ciprofloxacin 500 mg PO BID x 7 d	Chloramphenicol for plague meningitis is required 25 mg/kg IV, then 15 mg/kg QID x 14d
	Doxycycline 200 mg IV then 100 mg IV BID, until clinically improved then 100mg PO BID for total of 10-14 d	Tetracycline 500 mg PO QID x 7 d	Alternate Rx: trimethoprim-sulfamethoxazole

DISEASE	CHEMOTHERAPY (Rx)	CHEMOPROPHYLAXIS (Px)	COMMENTS
Brucellosis	Doxycycline 200 mg/d PO plus rifampin 600 mg/d PO x 6 wks	Doxycycline 200 mg/d PO plus rifampin 600 mg/d PO x 6 wks	Trimethoprim-sulfamethoxazole may be substituted for rifampin; however, relapse may reach 30%
	Ofloxacin 400/rifampin 600 mg/d PO x 6 wks		
Tularemia	Streptomycin 7.5-10 mg/kg IM BID x 10-14 d	Doxycycline 100 mg PO BID x 14 d	
	Gentamicin 3-5 mg/kg/d IV x 10-14 d	Tetracycline 500 mg PO QID x 14 d	
	Ciprofloxacin 400 mg IV Q12H until improved, then 500 mg PO Q12H for total of 10 - 14 d	Ciprofloxacin 500 mg PO Q12H x 14 d	
	Ciprofloxacin 750 mg PO Q12H for 10 - 14 d		
Viral encephalitides	Supportive therapy: analgesics and anticonvulsants prn	NA	
Viral Hemorrhagic Fevers	Ribavirin (CCHF/Lassa) (IND) 30 mg/kg IV initial dose; then 16 mg/kg IV Q6 H x 4 d; then 8 mg/kg IV Q8H x 6 d	NA	Aggressive supportive care and management of hypotension very important
	Passive antibody for AHF, BHF, Lassa fever, and CCHF		
Smallpox	No current Rx other than supportive; Cidofovir (effective in vitro); animal studies ongoing	Vaccinia immune globulin 0.6 mL/kg IM (within 3 d of exposure, best within 24 h)	Pre and post exposure vaccination recommended if > 3 years since last vaccine
Botulism	DOD heptavalent equine despeciated antitoxin for serotypes A-G (IND): 1 vial (10 mL) IV	NA	Skin test for hypersensitivity before equine antitoxin administration
	CDC trivalent equine antitoxin for serotypes A, B, E (licensed)	NA	
Staphylococcus Enterotoxin B	Ventilatory support for inhalation exposure	NA	
Ricin	Inhalation: supportive therapy G-I : gastric lavage, superactivated charcoal, cathartics	NA	
T-2 Mycotoxins		Decontamination of clothing and skin	

PART THREE: EXPOSURE TO CHEMICAL WARFARE AGENTS

CHLORINE

General: Chlorine is found as a greenish-yellow gas. There is a pungent, acrid, characteristic odor. Sensitivity to the odor is below toxic levels; however, since some sensory adaptation occurs, repeat exposures are more likely to produce toxic effects. Chlorine affects both the central (conducting) and distal (respiratory) surfaces. Exposures irritate eyes and central (upper) airways within minutes. Low doses produce some cough and choking sensation. Moderate doses also produce a sense of suffocation, hoarseness, and substernal pain. High doses also produce a severe dyspnea, with pulmonary edema, nausea, vomiting, headache, syncope also seen. Very high doses may produce sudden death without obvious pulmonary lesions—possibly via laryngospasm. All recognized exposures should be referred for direct observation/care.

Patient evaluation:

- Victim should be immediately removed from the toxic environment by fully masked personnel. The M40 mask is insufficient respiratory protection at the point of release where chlorine concentrations may be very high. Chemically protective clothing is required for liquid/solution exposures.
- Liquid contamination causes eye and skin burns on contact. Contaminated clothing should be removed/disposed of.

Treatment:

- General: Persons with inhalational exposures must be put at immediate rest. Exertion increases the extent of injury and hastens the onset of pulmonary edema. Symptoms of

trouble breathing are experienced before signs manifest. Casualties must be observed for 6 hours after exposure before they can be cleared for discharge.

- Eyes: Liquid exposures should be flushed with copious quantities of water; medical attention should be sought. Vapor exposures, if symptomatic, should be flushed with water. Medical attention should be sought if symptomatic.
- Skin: Liquid exposures should be flushed with copious quantities of water. Contaminated clothing should be removed/disposed of. Vapor exposures require no specific therapy unless symptomatic. Intense exposure produces burns; wash with water.
- Breathing: Symptoms of noncardiogenic pulmonary edema precede signs. Patients must be put at rest in order to minimize the degree of injury. Patients who demonstrate trouble breathing at rest, particularly with audible crackles or diminished breath sounds, in 4 hours or less after exposure are severely injured and must be evacuated for hospital level respiratory care. Evaluate respiration, cyanosis, and bronchospasm. Bronchospasm should be treated as asthma with B-agonists and bronchodilators.

  If apnea: CPR with intubation. Be aware that laryngospasm may be present with intense exposures, hence intubation may be very difficult and tracheostomy could be required. Medical attention should be sought.

  If stridorous/hoarse: Consider intubation under direct vision since laryngospasm may be imminent (see above). Medical attention should be sought.

If dyspnea/cough/chest tightness: Consider intubation for impending pulmonary edema. Also consider possible bronchospasm sufficiently severe to have so little air exchange that wheezes are absent. Medical attention should be sought. Codeine-containing demulcents may help. Be wary of sedation. Oxygen therapy with positive pressure ventilation and PEEP are appropriate for severe pulmonary edema.

Fluid management: Patients may become hypotensive due to fluid shifts from the vasculature to the lungs. Rehydration using appropriate solutions is advisable should hypotension develop.

If bronchospasm: Provide aggressive bronchodilation:

Adult:
Inhaled albuterol: unit dose Q2H.
Steroids: methylprednisolone, load 120 mg, then 60 mg Q6H.
Theophylline: load 150 mg, then 30 mg/hr.

If asymptomatic: Maintain direct observation for at least 1 hour.

If becomes symptomatic, treat as above.

If still asymptomatic, lesser observation for additional 6 hours, since some bronchospasm may appear late.

If hypoxic from bronchospasm: bronchodilators and supplemental oxygen (oxygen may be utilized with positive pressure; e.g., PEEP 5-7 cm or intubation).

If pulmonary edema (occurs with moderate to severe exposures): Treat as noncardiac pulmonary edema (ARDS) with PEEP 5-7 cm and/or intubation. Control hypotension with fluids, not vasoactive drugs. Diuretic therapy risks severe hypotension if intubation is required.

If infection: Inhalational exposures may produce pulmonary infiltrates, fever, and white blood cell elevations leading to an erroneous diagnosis of (presumed bacterial) pneumonia. Prophylactic antibiotics are not indicated. Surveillance bacteriologic cultures are obtained anticipating an approximate 50% risk of nosocomial pneumonia at days 3-6.

If pain: Airway discomfort may benefit from codeine. Be wary of sedation.

HYDROGEN CYANIDE AND CYANOGEN CHLORIDE

General:

- Rescuers must don protective mask and clothing prior to rescuing the casualty. Cyanides are dermally active.
- Patient should be removed from the toxic environment immediately. Their clothing (underwear included) should be removed (vapor or liquid exposure).
- Clothing should be removed. If liquid cyanide is the contaminant, wash the patient with water while instituting medical measures.
- The effects of severe vapor exposure from either form of cyanide appear within seconds to a minute. If vapor exposed person has no or only mild effects when seen 5-30 minutes after exposure, he/she will need no treatment. Liquid exposed persons may take 30-60 minutes to manifest even a severe poisoning, longer for a milder poisoning.
- Clues to cyanide intoxication include: respiratory depression (cyanide stops the central respiratory center and apnea ensues rapidly), unconsciousness, convulsions, pink color, almond smell on the breath, and history of exposure. Cyanide intoxications can be difficult to distinguish from nerve agent intoxications. Hydrogen sulfide (rotten egg smell) is clinically and therapeutically identical.
- Severe cyanide poisoning produces metabolic acidosis. If cyanide poisoning is suspected in a patient who does not have moderate or severe acidosis, treatment for cyanide poisoning should not be delayed, but the diagnosis should be reconsidered.

Patient evaluation: level of consciousness, respiratory rate, heart rate, convulsive activity.

- Exposure to a high concentration: transient hyperpnea, followed by convulsions (30 seconds after exposure), gradual decrease in respiratory rate and depth to apnea (3-5 minutes) and cessation of cardiac activity (5-8 minutes).
- Exposure to lower concentration: flushing, headache, anxiety, agitation, vertigo, feeling of weakness, nausea, muscular trembling (cyanogen chloride may cause irritation of eyes, nose, and airways). Prolonged exposure may lead to effects listed above.
- Odor of bitter almonds may be detected (half of the population cannot smell this); normal pupils (may be dilated in terminal stage); "cherry-red" skin (may not be present); diaphoresis; venules in fundus are same color as arterioles; cyanosis occurs only after circulatory collapse and apnea.

Treatment:

- For a mild exposure (conscious and breathing): observe; no antidotes; oxygen maybe given to young or old or in presence of heart disease in a patient with mild symptoms.
- Severe exposure (unconscious, not breathing): should immediately receive 100% oxygen and CPR as needed. Cardiac monitoring and evaluation of oxygen saturation should be done when possible. (Saturation will be normal even in severe casualty until terminal stage; however, additional oxygen may assist in therapy.)

Antidotes should be administered as soon as possible (see below). It is important to note that pulse oximeter results are completely unreliable in the setting of methemoglobinemia, which is induced by amyl nitrite or sodium nitrite therapy.

- Administer 300 mg (10 mL) of sodium nitrite IV over 5 minutes. Flush line. Be aware: Nitrites produce orthostatic hypertension, but a patient who can stand does not need them. *If there is a chance of serious methaemoglobinaemia on initial presentation, as may be the case after a chemical fire with multiple agents present, some of which can function as methaemoglobin formers, skip the nitrite administration and go directly to IV thiosulphate administration.*
- Follow with 12.5 grams (50 mL) of sodium thiosulfate IV over 20 minutes. Too rapid infusion causes vomiting. Use care giving nitrite in a patient with hypertension or heart disease. [Amyl nitrite*, sodium nitrite, and sodium thiosulfate are in the Pasadena (formerly Lilly) Cyanide Antidote Kit, the latter two in ampules of 300 mg/10 mL and 12.5 grams/50 mL]. Use one-half dose in 20 minutes if no improvement. See instructions on top of Antidote Kit box. See instructions on top of Antidote Kit box. Clinical response to antidote therapy is usually rapid (under 5 minutes). Seizing patients may also require anticonvulsant therapy with benzodiazapines.

* For all ages, crush amyl nitrite ampule and allow it to be inhaled for up to 3 minutes. If patient is endotracheally intubated, place ampule or some of its contents in the large end of the ET tube where it connects to the Ambu bag or the ventilator. If amyl nitrite use is to continue beyond 3 minutes, use a new vial approximately every 3 minutes until patient recovers or until sodium nitrite can be administered. Once venous access is established and sodium nitrite is available, administer sodium nitrite and discontinue use of amyl nitrite as soon as possible.

- If patient continues to remain apneic, intubate and continue oxygen through tube with assisted ventilation.
- Transfer apneic or unconscious patients to medical facility.
- Patients often recover rapidly unless CNS hypoxia has occurred.

Laboratory issues:

- Metabolic acidosis is common; should be treated with bicarbonate.
- Monitor arterial pO_2; should be normal until near-terminal stage.

MUSTARD (SULFUR MUSTARD)

General:

- The initial clinical effects of mustard (which usually involve the eyes, the skin, and the airways) appear 2-24 hours (usually 4-8 hours) after exposure to liquid mustard or to mustard vapor. However, liquid or vapor mustard penetrates the skin and mucous membranes and damages cells within minutes of exposure, so decontamination must be done immediately after exposure.
- The patient should be immediately removed from the toxic environment.
- *Physical removal by the fastest available method, even with just copious amounts of water, is far better than wasting time to prepare a dilute bleach solution.* If liquid contact, clothing should be removed and skin decontaminated with whatever is immediately available that is clean. Use friction plus a liquid. The M291 kit followed by a wet wipe is good for gross decontamination. Warm soapy water followed by warm water rinse is excellent. 0.5% hypochlorite (1 part household bleach mixed with 9 parts water), soap and cool water, or thoroughly flushed with water alone are acceptable alternatives. Full strength bleach must not be used for it will enhance mustard penetration and further injure the skin. Eyes should be flushed with large amounts of saline. If exposure is to vapor alone, remove clothing and thoroughly wash as above.
- If there is a history of definite exposure and, either the patient becomes symptomatic OR later evacuation might become impossible, consider evacuation to a medical facility for observation and indicated treatment.

Patient evaluation: Initial effects (usually 2-24 hours after exposure):

- Eyes: irritation, feeling of grit in eye, redness. First affected organ. Severe conjunctivitis with massive lid swelling may ensue. Duration: often 2 weeks or longer. Severe eye injury may result in globe perforation or corneal destruction resulting in permanent blindness.
- GI: expect patients to vomit. The vomiting is not stopped with anti-emetics. It will stop in time.
- Skin: erythema (will progress to blisters 1-4 hours later if exposure was large enough).
- Airways: irritation of nose, voice change, sinus pain, hacking cough. (Very rarely a patient might inhale an extremely large amount and start to have these effects plus dyspnea within 2 hours. This patient should be intubated, and assisted ventilation with oxygen should be started. This patient should be evacuated to an intensive care unit as quickly as possible.)

Treatment:

- There is nothing to do for these patients until effects appear except to decontaminate. Tissue is damaged within minutes, so decontamination must be done immediately.
- Eyes: Acute mustard (both vapor and liquid) casualties should ALWAYS have their eyes copiously irrigated with a sterile solution PRIOR to administration of any additional ophthalmic solutions or medications. *If copious irrigation is not done initially, it may well not be possible later if the eyelids have swollen shut over the eye.* Any commercial eye solution may relieve the irritation from a mild exposure. More severe effects: A mydriatic BID or QID (depending on the length of action of the drug); a topical antibiotic BID;

vaseline on lid edges BID; sunglasses if photophobia is present. Topical steroids within the first 24 hours only may reduce inflammation. Control pain with systemic, not topical, analgesics. Visual loss is usually due to lid edema and blepharospasm, not eye damage.

- Skin: A soothing lotion (e.g., calamine) for erythema. Leave small blisters intact. Unroof large blisters and irrigate denuded area at least TID followed by liberal application of topical antibiotic. Watch for infection. Fluid requirements are much less than those for thermal burns; do not overhydrate.
- Airways: Steam inhalation and cough suppressants will generally relieve mild symptoms. A chemical pneumonitis (increased temperature, white blood count; chest x-ray findings) may develop after large exposure: intubation, assisted ventilation with oxygen (and possibly with PEEP or CPAP); bronchodilators; watch sputum at least daily for organisms (no antibiotics until organism is identified).
- Systemic absorption of a large amount of mustard may cause bone marrow and gastrointestinal tract damage. Monitor lymphocyte (not total WBC) counts of moderately to severely intoxicated patients every 12-24 hours starting as soon as possible. Lymphocyte drops of 50% within the first 24-36 hours predict bone marrow failure and those patients should be evacuated for definitive management. Within about 5 days they may become granulocytopenic and septic, and within 7 days they may bleed from low platelet counts. Mustard induced bone marrow suppression can be treated with marrow transplant and GCSF as an investigational treatment; these treatments will require evacuation to a high echelon of care. Granulocyte counts initially rise rendering the total WBC count less valuable.

NERVE AGENTS (GA, GB, GD, GF, VX)

General: Nerve agents are extremely toxic chemicals that cause effects by inhibiting the enzyme acetylcholinesterase, allowing excess acetylcholine to accumulate. This excess neurotransmitter then produces overstimulation and causes hyperactivity in muscles, glands, and nerves. The nerve agents are GA (tabun), GB (sarin), GD (soman), GF, and VX. Their routes of exposures are skin, respiratory system, and GI.

Protect yourself. Remove patient from contaminated atmosphere. *Physical removal by the fastest available method, even with just copious amounts of water, is far better than wasting time to prepare a dilute bleach solution.* If liquid contact, clothing should be removed and skin decontaminated with whatever is immediately available that is clean. Use friction plus a liquid. The M291 kit followed by a wet wipe is good for gross decontamination. Warm soapy water followed by warm water rinse is excellent. 0.5% hypochlorite (1 part household bleach mixed with 9 parts water), soap and cool water, or thoroughly flushed with water alone are acceptable alternatives. Full strength bleach must not be used for it will enhance mustard penetration and further injure the skin. Eyes should be flushed with large amounts of saline. If exposure is to vapor alone, remove clothing and thoroughly wash as above. All casualties require complete nakedness and full washing to protect the treating personnel.

Patient evaluation: If conscious, note ventilatory status and ask about nausea. If unconscious, note ventilatory status and heart rate (heart rate may be high, low, or normal in a nerve agent casualty).

Initial effects differ depending on whether exposure was to vapor or to liquid.

- Vapor: Effects start within seconds to a minute or two.
  - Mild to moderate: Miosis (possible redness in eye, eye pain, and complaints of dim or blurred vision, nausea), rhinorrhea, excess secretions, dyspnea (mild to severe). Nerve agents cause severe bronchospasm and bronchorrhea, the worst conceivable asthma attack.
  - Severe: Include all the effects from mild exposure PLUS loss of consciousness, seizures, apnea, flaccid paralysis; systemic distribution is indicated by affect on two or more body systems.
- Liquid: Effects start in minutes (large exposure) to 18 hours (small exposure) after an asymptomatic interval. Miosis may be absent.
  - Mild to moderate: Sweating and fasciculations at site of exposure; nausea, vomiting, diarrhea; weakness.
  - Severe: Same as for vapor, but after a 1- to 30-minute asymptomatic interval.

Treatment:

- Initial management.
  - Mild to moderate: Dyspnea should be treated with one or two doses of atropine IM or IV and 1 dose of pralidoxime (IV drip) initially, depending on severity of the dyspnea. See “Recommended adult doses” below for size of dose. This should be supplemented with oxygen, if available. Atropine dose should be repeated at 5- to 10-minute intervals until improvement is noted.

Failure to respond (i.e., no dry mouth, no decrease in secretions) confirms the need to administer additional doses of atropine. Gastrointestinal effects after liquid exposure are treated in the same manner. Do not treat for miosis (unless eye pain is severe) or rhinorrhea (unless severe). FOR SELF-CARE OR BUDDY CARE:

- Mild exposure: no treatment required.
- Moderate exposure with moderate respiratory symptoms: one to two MARK 1 kits. Repeat atropine alone every 3-5 minutes until respiratory symptoms are relieved.
- Severe exposure or severe symptoms: three MARK 1 kits and one CANA (diazepam). If already seizing, will need three to four CANA. Repeat atropine alone every 3-5 minutes until respiratory symptoms are relieved. Repeat three MARK 1's in 1 hour if needed. Titrate atropine to respiratory effect. Do not give more than three 2-PAM per hour and do not give more than six unless BP can be monitored. It can cause hypertension. Treat convulsions with benzodiazapines. Other anticonvulsants do not work.
- *NOTE: Military doctrine advises diazepam (CANA) administration for any nonseizing patient with severe nerve agent poisoning. In both field and remote-site clinical settings, it is difficult to differentiate between grossly visible convulsions and electrical seizing which can appear either as flaccid paralysis (due to nonavailability of ATP) or as a post-ictal state; therefore, diazepam (CANA) must be administered in ALL of these situations.*

- Severe: Administer 3 doses of atropine IM (not IV in hypoxic patient) and start 1 dose of pralidoxime by slow IV drip over 20 minutes. (More rapid administration will cause hypertension.) See "Recommended adult doses" below for size of dose. Intubate and ventilate with oxygen. Initial ventilation will be difficult because of airway resistance; atropine will relieve this. Administer diazepam if convulsing. Suction for secretions. Repeat 1 dose of atropine (IM until hypoxia is improved, then IV) every 5 minutes until:
  - secretions diminish or
  - airway resistance is less or is normal.

  Failure to respond (i.e., no dry mouth, no decrease in secretions) confirms the need to administer additional doses of atropine. Monitor via pulse oximeter; cardiac monitoring should also be done. Cardiac arrhythmias are uncommon after atropine is given. Acidosis may develop after seizures or after period of hypoxia and will require therapy. Patient should be medically evacuated to a hospital after stabilization (adequate drug therapy and initiation of ventilation).
- Eyes: Do not treat miosis unless eye/head pain is severe. Use topical, not systemic, anticholinergic to relieve pain. Papillary constriction may persist for up to 2 months.

- Recommended adult doses:
  Atropine: 2 mg
  Pralidoxime: 1 gram

  Pralidoxime can cause hypertension when given rapidly IV. Slow administration over 20 minutes will minimize the hypertension effect. After rapid administration, hypertension can be rapidly but transiently reversed by phentolamine (adult: 5 mg IV). Pralidoxime is also available for IM administration as an autoinjector formulation (600 mg autoinjector) to be repeated twice at 15-minute intervals.
- Further care.
  - Give atropine repetitively until the patient is breathing comfortably on his/her own and respiratory secretions are no longer excessive. In a liquid exposure, this may require treatment for hours or even days.
  - Mild to moderate: After vapor exposure, a patient who is breathing normally does not need to be hospitalized as he will not worsen. However, miosis should be followed until eyes are normal (4-6 weeks). After liquid exposure, a patient should be observed in hospital for 18 hours until all agent is absorbed from skin.
  - Severe: Continue to ventilate and to administer atropine following guidelines above. Treat acidosis if present. If patient has not had prolonged hypoxia, recovery of an unconscious patient will be gradual over 1-3 hours.

PHOSGENE - CARBONYL CHLORIDE

General: Will only be encountered on the battlefield in the gaseous state. Even a terrorist release will produce a gas. Phosgene is a colorless-to-white gas and has an odor of newly-mown or moldy hay. Sensitivity to the odor may degrade, making individuals unaware of toxic inhalation. Lethal inhalations may be asymptomatic at the time of exposure, although very high-intensity exposure irritates eyes and upper airways within minutes. Symptoms of severe intoxication appear in 2–4 hours. Less severe injury may take more than 4 hours to manifest. Phosgene is a peripheral acting pulmonary intoxicant and causes non-cardiogenic pulmonary edema. Development of pulmonary edema within 4 hours of exposure is a very poor prognostic sign.

Patient evaluation:

- Victim should be immediately removed from the toxic environment by fully masked personnel (full-face positive pressure apparatus).

Treatment: Maintain at rest at least 6 hours.

- Eyes: Gas exposures, if symptomatic, should be flushed with water.
- Skin: Gas exposures require no specific therapy unless symptomatic.
- Breathing: symptoms precede signs. Casualties may first complain of dyspnea on exertion. Evaluate respiration, cyanosis. Oxygen always used –

  If apneic: CPR with intubation. Be aware that laryngospasm may be present with intense exposures; hence, intubation may be very difficult and tracheostomy required.

If stridorous/hoarse: Consider intubation under direct vision since laryngospasm maybe imminent (see above).

If dyspnea/cough/chest tightness: Consider intubation for impending pulmonary edema.

Also consider possible bronchospasm sufficiently severe to have so little air exchange that wheezes are absent. Codeine-containing demulcents may help. Be wary of sedation. Note: cough may presage pulmonary edema.

If bronchospasm: Individuals with underlying asthma may suffer bronchospasm. Treat as any asthmatic: Inhaled albuterol, parenteral steroids, theophylline. Watch for hypoxia.

Adult:
Inhaled albuterol-: unit dose Q2H.
Steroids: methylprednisolone, load 120 mg, then 60 mg Q6H.
Theophylline: load 150 mg, then 30 mg/hr.

If asymptomatic: Maintain direct observation for at least 6 hours;
If becomes symptomatic, treat as above.
If still asymptomatic, lesser observation for additional 36 hours.

If hypotensive (will occur rapidly with pulmonary edema): Immediate volume replacement should be undertaken. Colloid or crystalloid may be used to maintain adequate tissue perfusion.

If infection: Inhalational exposures may produce pulmonary infiltrates, fever and white blood cell elevations—leading to an erroneous diagnosis of (presumed bacterial) pneumonia. Prophylactic antibiotics are not indicated. Surveillance bacteriologic cultures are obtained anticipating an approximate 50% risk of nosocomial pneumonia at days 3-6.

If hypoxia: Commonly from pulmonary edema, treat as above; occasionally from bronchospasm, treat as above.

If pain: Airway discomfort may benefit from codeine. Be wary of sedation.

DOSAGES FOR CHEMICAL AGENT TREATMENTS

Drug	Adult Dose [> 50 kg (110 lb)]
ATROPINE at 0.1 mg/mL drug concentration (0.02 mg/kg Pediatric, 2 mg adult)	20 mL
ATROPINE at 0.4 mg/mL drug concentration (0.02 mg/kg Pediatric, 2 mg adult)	5 mL
ATROPINE at 1 mg/ml drug concentration (0.02 mg/kg Pediatric, 2 mg adult)	2 mL
ATROPINE at 2 mg/mL drug concentration (0.02 mg/kg Pediatric, 2 mg adult)	1 mL
PRALIDOXIME (2-PAM, Protopam®) at 50 mg/mL (for IV use) (50 mg/kg Pediatric, 1000 mg adult)	20 mL
PRALIDOXIME (2-PAM, Protopam) at 300 mg/mL (for IM use) (40 mg/kg Pediatric, 600 mg adult) (Reconstitute by adding 3 mL sterile water to a 1 g vial of pralidoxime)	20 mL
SODIUM NITRITE at 3% (300 mg/ 10 mL) (Pediatric 0.3 mL/kg for Hgb 11 g/dL, adult 10 mL)	10 mL
SODIUM THIOSULFATE at 25% concentration (Pediatric 1.65 mL/kg, adult 50 mL)	

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PART FOUR: TOXIC INDUSTRIAL CHEMICAL EXPOSURES

BASIC PRINCIPLES

- Multiple chemicals of various classes may be encountered during incidents not predicted by intelligence or direct observation. Industrial facilities may release substances normally used or produced therein. Products of combustion are added to these in the case of an explosion or fire.
- During casualty management it is not practical to consider every specific chemical that may have been present. One can, however, consider major classes of chemicals that were likely and how they are expected to affect the exposed population, thus guiding general treatment measures. This part of the TG is organized around classes of chemicals and their toxic syndromes ("toxidromes").
  - Toxidrome classes include irritant gases, corrosives, asphyxiants, organic vapors (hydrocarbons and chlorinated hydrocarbons), and cholinergics.
  - Inhalation and skin exposures are emphasized, as most chemical "accidents" would not involve ingestion.
  - The Table (Toxic Industrial Chemicals) summarizes essential information on specific agents. This table is located at the end of Part Four.
- Exposure incidents are often complicated by concurrent injuries such as thermal burns of the skin, mucous membranes and lungs, and trauma from projectiles and the force of explosions.

- Acute and chronic effects will vary among different subpopulations (e.g., occupational groups, including military personnel, are typically healthier than many of the local residents who have preexisting sensitivities).
- Other basic principles to bear in mind:
  - Characterize what happened and types of exposure.
  - Organize at the scene (e.g., control zones, decontamination, triage).
  - Do primary survey and resuscitate (A, B, C, D, E's, etc.).
  - Firefighters and other rescuers should wear protective equipment to avoid becoming casualties themselves.
- "The Chemical Exposure Questionnaire located at the end of Part Four should be used as a screening tool for patients whose complaints or clinical signs are possibly related to an occupational or environmental exposure during deployment. The practitioner should try to relate positive answers to the questions with signs and symptoms found during the clinical encounter, thus prompting any intervention that may be indicated."

IRRITANT GASES

- Highly water soluble irritant gases include ammonia, sulfur dioxide, hydrogen chloride, and formaldehyde. Intermediate water soluble irritant gases include chlorine, hydrogen sulfide and acrolein. Lower water soluble irritant gases include oxides of nitrogen, phosgene, and ozone.

Toxidrome: irritation, inflammation, edema, and possibly chemical burns of the exposed mucous membranes, airways, and lungs.

- It is difficult to determine if a substance is a corrosive or irritant in a particular concentration or circumstance.
- Irritants are substances that cause inflammation and swelling, but not cellular death and tissue damage. A corrosive would cause cellular damage and death.

Acute Effects:

- Throat, eye, nose or skin irritation, choking feeling, burning feeling, coughing, tachypnea, and wheezing.
- Headache, and nasal dryness and hemorrhage.
- Skin: Redness, swelling, and pain may occur.
- Highly water soluble irritant gases cause immediate irritation of the upper respiratory mucosa. Most people will find this unpleasant enough to get away before great damage is done. However, if they are trapped and must breathe or be in contact with high concentrations for long enough periods, damage will occur. Eyes and skin can burn and necrose. Upper airway will be affected most, but prolonged high concentration will affect lower

airways as well. Patient may have trouble with breathing and oxygen absorption, hyperreactive airways (asthma), glottic and esophageal edema, hoarseness, stridor and laryngospasm (danger of airway obstruction). Development of pulmonary edema may be delayed by 1-3 days. Pulmonary edema may be delayed by 1-3 days. Circulatory failure can occur in severe cases.

- Gases with lower water solubility can injure the lower airways and alveoli, with pulmonary edema that may be delayed. May not manifest immediately with symptomatic upper respiratory tract irritation, so the recipient may not try to escape—thus increasing exposure.
- Gases with intermediate water solubility cause damage throughout the respiratory tract and have intermediate tendency to irritate the upper airway.
- Most irritant gases will exert their effects at the point of contact and not systemically, unless very severe. However, one must be alert to possible systemic effects.

Chronic Effects:

- Reactive airways dysfunction syndrome (RADS) is persistent asthma after irritant exposure:
  - onset within 24 hours of high-level irritant exposure;
  - positive methacholine challenge test;
  - persistence of respiratory symptoms and airway hyperreactivity for at least 3 months;
  - symptoms simulating asthma, with cough, wheezing, and dyspnea; and
  - airflow obstruction as measured by pulmonary function tests.
- Skin: Allergic contact dermatitis may arise after repeated exposure to irritants.

Treatment:

- Using wide-range pH paper test for pH of irritant substance if possible, and pH of ocular cul de sac.
- Move patient to fresh air. Monitor for respiratory distress. If symptoms not relieved by exposure to fresh air, administer oxygen until blood gases can be measured. Use 100% humidified supplemental oxygen with assisted ventilation as needed if symptoms are severe or prolonged.
- Decontamination by diluting and irrigating is critical.
  - Copiously flush exposed skin with water, and wash with soap and water.
  - Irrigate exposed eyes with copious amounts of tepid water or sterile saline, initially for at least 15 minutes at the scene, and then in the MTF until the lower lid cul de sac is returned to neutrality.
  - Some alkali exposures may require prolonged irrigation.
  - Application of an ophthalmic local anesthetic will increase patient comfort.
  - If irritation, pain, swelling, lacrimation, or photophobia persist, an ophthalmologic examination should be performed including a slit lamp exam after thorough irrigation.
  - Administration of topical antibiotics, cycloplegics, mydriatics, and patching may be necessary in rare instances of abrasion.
- Support respiratory and cardiovascular function. If cough or difficulty in breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. Carefully observe patients with inhalation exposure for the development of any systemic signs or symptoms and administer symptomatic treatment as necessary.

- Evacuate patients with moderate symptoms, chest signs, or impaired oxygenation. Observe for at least 48 hours if exposure has been to substances known to cause delayed onset of pulmonary symptoms. Chest x-ray may be needed. Crystalloid solutions must be administered cautiously to avoid a net positive fluid balance.

CORROSIVES

- Examples of corrosives include acids, bases, oxidizers, and white phosphorus. Corrosives can exist either as dusts, mists, fumes, aerosols, vapors or liquids, and cause injury either by inhalation or direct contact with skin or mucous membranes. Irritant gases, which dissolve in water to produce an acid or a base, are also considered to be corrosives. (Note: Ingestion is not discussed here.)
  - It is difficult to determine if a substance is a corrosive or irritant at a particular concentration.
  - Irritants are substances that cause inflammation and swelling, but not cellular death and tissue damage. A corrosive would cause cellular damage and death.
  - Examples of acids are acetic, hydrochloric, nitric, phosphoric, and sulfuric.
  - Examples of bases are ammonium, potassium, and sodium hydroxide.
  - Examples of oxidizers include chloride dioxide, hydrogen peroxide, methyl ethyl ketone peroxide, and sodium chlorate.

Toxidrome: local chemical burns of the skin and mucous membranes that come into contact with the corrosive.

Acute Effects:

- Swelling, redness and pain at any site, especially at mucous membranes. Mouth, nose, and eyes are very susceptible.

- Headache, nasal dryness and hemorrhage, laryngospasm, bronchospasm, and edema of the upper and lower airway (glottic, esophageal, or pulmonary edema).
- Irritation symptoms include coughing, burning, and difficulty breathing.
- Upper airway signs and symptoms include dysphonia and throat tightness, which can be progressive to hoarseness, stridor, and aphonia (signals upper airway obstruction). Irritation of the oropharyx can reflexively cause gagging, nausea, and vomiting. The lower airway can manifest wheezing and crackles.
  - The more highly water soluble corrosives affect the upper airway more. Acids, bases, and oxidizers are generally water soluble.
  - Respiratory effects depend on the size of the particles and how deeply they penetrate the lung.
- Cardiovascular effects are usually due to hypovolemia from intravascular volume depletion and third-spacing. This can lead to hypoxemia and shock, and myocardial ischemia. Oxidizers can cause actual or functional anemia as described above. Tachycardia and other reflexive cardiovascular reactions would be expected.
  - Cardiac effects possible with white phosphorus (WP) and hydrogen fluoride (HF) due to hypocalcemia (both) or direct effect (WP).
- Nervous system effects can result from hypoxemia, hypovolemia or anemia (anxiety, confusion, agitation, seizures, decreased level of consciousness, coma, death) or hypocalcemia (tetany, seizures).

- Skin and eyes: Pain and irritation, or corrosion at the burn site.

Chronic Effects: Scarring; RADS (see irritant gases).

Treatment:

- Move patient to fresh air. Administer 100% humidified supplemental oxygen with assisted ventilation as required. Airway intubation if needed – sooner vs later if signs of impending airway obstruction are present (see above). Cardiac monitoring or support as indicated and available.
- Decontamination by diluting and irrigating is critical.
  - Remove clothing and promptly irrigate skin with copious amounts of water.
  - In contrast to thermal blisters, chemical burn blisters SHOULD be broken, as the offending chemical is usually inside.
  - Exposed eyes should be irrigated with copious amounts of tepid water for at least 15 minutes. If irritation, pain, swelling, lacrimation, or photophobia persist perform an ophthalmologic examination. If indicated, continue irrigation at the MTF.
  - If in a medical facility, sterile saline should be used to irrigate the eyes until the lower lid cul de sac is returned to neutrality. Some alkali exposures may require prolonged irrigation. Application of an ophthalmic local anesthetic will increase patient comfort.
- Monitor for respiratory distress. If cough or difficulty in breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. Consider systemic toxicity as noted above.

- Consider and treat systemic toxicity (see notes below).
- Labs as indicated and available – e.g., ABGs, CBC, electrolytes, liver or kidney function tests, calcium, or urinalysis.
- Evacuate patients with moderate symptoms, chest signs, or impaired oxygenation. Observe for at least 48 hours if exposure has been to substances known to cause delayed onset of pulmonary symptoms.
- Specific systemic toxicities and treatment:
  - Acids produce coagulative necrosis (thick and hardened surface that can somewhat limit deeper penetration). Systemic effects are possible with some acids as sometimes the anion is more toxic or injurious than the hydrogen ion. For example, hydrofluoric acid is a relatively weak acid but the fluoride ion is very toxic systemically (see below). Chromic acid is a strong acid and an oxidizer (and can cause hemolysis based on this), and can also cause chromium poisoning.
  - Bases produce liquefactive necrosis (liquefies and destroys tissue), so burns tend to penetrate deeper and be more severe; however, bases are less likely to produce systemic effects.
  - Oxidizers, on the skin or on mucous membranes, oxidize cellular components indiscriminately, producing a burn with rapid tissue destruction. Mostly local effects are expected, but some such as chromates and methemoglobin formers have systemic toxicity with hemolysis or methemoglobin formation.

- For significant and symptomatic methemoglobin formation, use methylene blue (see asphyxiants). For serious hemolysis, blood transfusion and/or hemodialysis may be needed if hemolysis leads to acute renal failure (secondary to pigment release).
- White phosphorus spontaneously combusts on contact with air. It produces both chemical and thermal burns. Immersion in water stops the burning. It is unlikely to be inhaled, but its reactive combustion products, such as phosphorus pentoxide and related oxyacids, could be inhaled.
  - On the skin, it causes serious burns and systemic toxicity. It can be absorbed through the burned skin to produce kidney and/or liver damage.
  - Liver damage and even failure, and renal insufficiency and even failure, can be delayed developments.
  - Before liver or kidney damage is apparent, there can be rapid cardiovascular collapse due to hypovolemia from the burns, and direct cardiotoxicity with pump failure (cardiogenic shock) and dysrhythmias.
  - It also combines with endogenous calcium to produce hypocalcemia (can lead to prolonged QT, torsade de pointes, and negative inotropy with decreased cardiac output).
  - It is damaging to eyes and mucous membranes and can cause blindness.
- White phosphorus is often embedded in skin and should be removed. To better visualize:
  - Use a black light in a dark room (phosphoresces).
  - Apply 1-3% copper sulfate solution (color change to bluish copper phosphide). Use sparingly as systemic absorption can cause hemolysis.

- Immerse removed WP in water to prevent spontaneous combustion.

- Hydrogen fluoride gas and hydrofluoric acid deserve special mention: the fluoride ion is very toxic systemically; it combines with endogenous calcium and magnesium to produce hypocalcemia, hypomagnesemia, and hyperkalemia (release of intracellular potassium). It is also a cytotoxicant (impairs oxidative phosphorylation and glycolysis). There can be severe burning neuropathic pain at the site of contact, twitching and tetany, nervous system irritability and seizures, and myocardial irritability with prolonged QT, decreased cardiac output, etc. Skin effects may be delayed up to 6-24 hours with more dilute solutions. Eye exposure is also very serious and could lead to blindness.
- Hydrogen fluoride and hydrofluoric acid exposure: administration of calcium may be required.
  - Inhalation exposures: 2.5 - 5 mL of a dilute (2.5%) solution of calcium gluconate through a hand-held nebulizer. (Dilute a 10% solution 3 to 1.)
  - Topical application: 2.5-10% calcium gluconate in gel form, or undiluted 10% in a glove if hand is involved.
  - Local subcutaneous injection: calcium gluconate titrated to relieve pain with 0.5 mL per square cm of skin surface area. (DO NOT inject calcium chloride subcutaneously – tissue necrosis.)
  - IV injection for systemic poisoning: calcium gluconate 10-30 mL adult dose, titrated for effect to control cardiac and electrolyte disturbances; or calcium chloride 5-10 mL IV slowly.

ASPHYXIANTS

- Simple asphyxiants displace oxygen from the ambient atmosphere so there is less oxygen available for respiration and examples include: acetylene, argon, butane, carbon dioxide, ethane, ethylene, helium, hydrogen, liquefied petroleum gas, methane, neon, nitrogen, propane, and propylene.
- Systemic (or tissue) asphyxiants act chemically in the body after absorption and include:
  - Methemoglobin-forming compounds which interfere with hemoglobin mediated oxygen transport: aryl amines, organic nitro compounds, or inorganic nitrite or nitrate salts such as amyl nitrite, aniline, isobutyl nitrite, nitrobenzene, nitroglycerine, and sodium nitrite.
  - Carbon monoxide interferes with hemoglobin medicated oxygen transport and oxygen utilization by mitochondrial cytochrome oxidase.
  - Cyanides, cyanogenic compounds, sulfides (such as hydrogen sulfide), and azides interfere with oxygen utilization by mitochondrial cytochrome oxidase.

Toxidrome: "choking hazard," inadequate oxygenation.

Acute Effects:

- The neurologic and cardiopulmonary systems will be the first to show effects as they are the most dependent on oxygen.
  - Dizziness, weakness, headache, belligerence, agitation, euphoria, numbness and tingling of the extremities, sleepiness, mental confusion, memory

loss, speech impairment, and decreased coordination and judgement. Severe cases: syncope, seizures, coma, and death.

- ♦ Tachycardia, tachypnea, air hunger, and hyperventilation. After initial agitation, respiratory depression and respiratory arrest may follow. There may be chest pain, palpitations, dysrhythmias, hypotension, myocardial ischemia, myocardial infarction, and eventual asystole.

- Cyanosis (not universal), signs of increased sympathetic activity (cool, pale, diaphoretic), and decreases in night vision, visual acuity, and visual fields (tunnel vision).
- Effects of lack of oxygen can be factors in impaired ability to escape from the toxic environment.
- Some agents causing asphyxia are stored and transported in compressed or liquid form and can cause frostbite on direct skin contact.
- Hydrogen sulfide can cause a characteristic and immediate loss of consciousness, called a "knock down." It is also an irritant gas (see irritant gases) and will inflame the eye, upper and possibly lower respiratory tract.
- Hydrogen azide will irritate the lower respiratory tract and lung, possibly delayed, without as much upper respiratory effect.

Chronic Effects:

- If hypoxia is severe and prolonged, potential exists for anoxic damage to various organ systems: CNS injury, eye/vision damage (mydriasis, proptosis, yellow vision, transient blindness, retinal cell damage); heart, and kidney (acute tubular necrosis, kidney failure).

Treatment:

- Removal from exposure and administration of 100% humidified oxygen is absolutely crucial, along with whatever other ventilatory or circulatory support is required. Arterial blood gases are useful to assess both the degree of hypoxemia, as well as the acid/base balance. With carbon monoxide poisoning, a pulse oximeter will give a falsely elevated oxygen reading.
- Exposed skin and eyes should be copiously flushed with water if indicated (or soap and water for skin, and normal saline for eyes).
- Monitor for respiratory distress. If cough or difficulty in breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. Carefully observe patients with inhalation exposure for the development of any systemic signs or symptoms and administer symptomatic treatment as necessary (e.g., seizures).
- Patients with severe or prolonged exposure should be carefully evaluated for neurologic and other sequelae.
- Freeze injury associated with dermal exposure to compressed or liquid forms (i.e., propane) is unlike frostbite in that the damage occurs within seconds and rewarming is not beneficial. Freeze injuries of this nature should be managed much like a thermal burn.
- If a patient appears with characteristic symptoms of a particular asphyxiant which has an antidote, administration of this in a timely manner can be lifesaving.
    - There are specific antidotes to some of the systemic asphyxiant exposures (e.g., a cyanide poisoning antidote kit, or hyperbaric oxygen for carbon monoxide), but it may be difficult in the field setting to make specific diagnoses regarding a mixed exposure.

- Specific antidotes (Note: This list is to remind you that these exist. There are specific instructions and caveats regarding how to administer these antidotes which should be obtained from your local consultants, packaging inserts, or medical texts):
  - Carbon monoxide: hyperbaric oxygen may be lifesaving.
  - Methemoglobin-forming compounds: methylene blue.
  - Cyanide and cyanogenic compounds usually found in an antidote kit: amyl nitrite and sodium nitrite (to form methemoglobin), followed by sodium thiosulfate (to form thiocyanate).
  - Sulfides: MAYBE amyl nitrite and sodium nitrite (to form methemoglobin), or hyperbaric oxygen.

■ Special notes:
- Cyanide compounds could form as products of combustion.
- Hydrogen sulfide and some other compounds, though they have a characteristic odor, cause "olfactory fatigue" where it is not perceived (smelled) after a short period of time, even though it is present.
- Some asphyxiant compounds, such as methane and hydrogen sulfide are heavier than air and will settle in low places.
- All the simple asphyxiant agents included are colorless gases. Argon, carbon dioxide, ethane, helium, hydrogen, methane, neon, and nitrogen are odorless. Acetylene has a faint garlic odor. Ethylene has a sweet odor and taste. Butane, liquefied petroleum gas, propane, and propylene have a faint

petroleum-like odor and may be stenched with mercaptans to increase casual observer nasal detection during transport and storage.

- ♦ Some of the simple asphyxiants are hydrocarbons (see "hydrocarbons" as well), and some have abuse potential (e.g., when supplied as propellants). Some hydrocarbons such as methane and propane are also dangerous because they are highly flammable and can form explosive mixtures with air.
- ♦ Nitrites and nitrates, and azides can also cause direct vasodilation and can produce a throbbing headache, hypotension, reflex tachycardia, syncope, and cerebral or myocardial ischemia or infarction due to hypoperfusion.
- ♦ Methemoglobinemia is characterized by a chocolate brown colored blood on contact with the air. The skin appears bluish (cyanotic) when there is about 7-10% methemoglobin in the blood.
- ♦ Skin appearance from carboxyhemoglobin (from CO exposure) does not appear cyanotic but possibly cherry red.
- ♦ The skin does not appear cyanotic in cyanide or azide poisoning because the oxygen is being transported by the blood, just can't be utilized.

■ Stages of exposure for simple asphyxiants:
Four stages are described, depending on the arterial oxygen saturation. All early effects may decrease ability for self-rescue from the toxic environment.

- ♦ INDIFFERENT STAGE:
  - • $\%O_2$ Saturation: 90%
  - • Night vision: decreased

- COMPENSATORY STAGE:
  - $\%O_2$ Saturation: 82 to 90%
  - Respiratory rate: compensatory increase
  - Pulse: compensatory increase
  - Night vision: decreased further
  - Performance ability: somewhat reduced
  - Alertness: somewhat reduced
  - Above symptoms may begin earlier in those with significant preexisting cardiac, pulmonary, or hematologic diseases.
- DISTURBANCE STAGE:
  - $\%O_2$ Saturation: 64 to 82%
  - Compensatory mechanisms become inadequate (air hunger; fatigue, tunnel vision, dizziness, headache, belligerence, euphoria, reduced visual acuity, numbness and tingling of extremities, hyperventilation, poor judgment, memory loss, cyanosis, decreased ability for escape from toxic environment).
- CRITICAL STAGE:
  - $\%O_2$ Saturation: 60 to 70% or less
  - Deterioration in judgment and coordination may occur in 3-5 minutes or less; total incapacitation and unconsciousness follow rapidly.

ORGANIC VAPORS [HYDROCARBONS (HC) AND HALOGENATED HYDROCARBONS (H-HC)]

Toxidrome: sleepiness, even to the point of narcosis (deep stupor or coma), and cardiac irritability with premature ventricular contractions (PVCs) and even ventricular tachycardia (VT) or ventricular fibrillation (VF).

- Gaseous HCs and H-HCs are also simple asphyxiants (see "asphyxiants").
- Examples of HCs include --
  - aliphatic: methane, ethane, propane, and butane.
  - aromatic: benzene, ethylbenzene, toluene, xylene, phenol, and aniline.
  - mixtures : gasoline, kerosene, naphtha, and mineral seal.
- Examples of H-HCs include --
  - methylene chloride
  - chloroform
  - carbon tetrachloride
  - trichloroethane (TCA)
  - trichloroethylene (TCE)
  - perchloroethylene (PCE)
  - vinyl chloride

Acute Effects:

- Exposures in confined spaces with poor ventilation can be deadly.
- Neurologic: CNS depression (headache, dizziness and a sense of intoxication, confusion, decreased levels of consciousness, sleepiness), general anesthesia and narcosis, possibly to respiratory depression and arrest, coma, and death. (Some H-HCs used to be used for general inhalational anesthesia.)

- Most likely from vapors of halogenated, aromatic, other higher molecular weight hydrocarbons, and volatile petroleum distillates.
- Halogenated and aromatic hydrocarbons can produce CNS depression following ingestion.

- Cardiac: Heart myocardium can be sensitized to endogenous catecholamines, epinephrine and norepinephrine, lowering the threshold for ventricular irritability – PVCs, tachycardia, fibrillation. The fatal ventricular arrhythmias, popularly labelled "sudden sniffing death" syndrome (with inhalant abuse) may be a result. Avoid sympathomimetics when treating these patients.
  - Most likely from volatile HCs and H-HCs. HCs vary in degree of sensitization. H-HCs are the greatest risk.
- Pulmonary: Prolonged exposure to inhaled fine HC mists and some longer chain HCs like gasoline (but not short chain molecules like methane, ethane, propane, and butane) can also result in chemical pneumonitis, with dyspnea, cough, sputum production, crackles, and hypoxemia.
- Skin:
  - Liquid HCs and H-HCs are excellent organic solvents and can dissolve skin and mucous membranes with acute but prolonged contact – irritation, defatting dermatitis, chemical burns.
  - With extensive or prolonged dermal exposure they can be absorbed through the skin and may contribute to systemic toxic effects.
  - Frostbite can result from contact with some liquefied gases (e.g., propane, methane, ethane).

- HC and H-HCs vary in their degree of irritation and drying to the mucous membranes of the respiratory tract.

- Eyes can be injured by direct contact: irritation, lacrimation, blurred vision, conjuctival injection, corneal ulceration. Mild to moderate eye irritation and reversible ocular injury may occur after contact with most hydrocarbons.
- Ingestion is not the usual route of exposure in chemical "accidents" but keep in mind that liquid HCs and H-HCs can have some stomach absorption, and also cause aspiration pneumonitis. The HC odor will likely be on the patient's exhaled breath. Patients with aspiration pneumonia may have fever, dyspnea, tachypnea, cough, sputum production, rales, rhonchi, and decreased breath sounds, hypoxemia, cyanosis.
  - Initial signs and symptoms of aspiration most frequently occur during the act of swallowing and may include coughing, choking, and gagging or persistent coughing occurring immediately following ingestion.
  - Hydrocarbons with low viscosity (less than 100 S.U.S), low surface tension, and high volatility (e.g., kerosene, mineral seal oil, gasoline, petroleum naphtha) are most likely to cause aspiration pneumonitis.
- Simple asphyxia (tachycardia or tachypnea) – see "asphyxiants." Lack of oxygen can cause headache, dizziness, weakness, confusion, agitation, seizures, coma, and even death.

- Liver or kidney toxicity : Many H-HCs are metabolized in the liver and kidney and can cause toxicity and failure. Kidney effects can also occur due to hypoxia.
  - Liver: elevated transaminases possible. Significantly hepatotoxic H-HCs: carbon tetrachloride, chloroform, 1,1,2-trichloroethane (vinyl trichloride). Less hepatotoxic: trichloroethylene, tetrachloroethylene and 1,1,1-trichloroethane. Carbon tetrachloride can cause fatty liver.
  - Renal effects (acute renal tubular necrosis, proteinuria, or hematuria) occur infrequently following acute exposure to petroleum distillates and other unsubstituted hydrocarbons. Many H-HCs are potentially nephrotoxic.
- Disseminated intravascular coagulation, hemolytic anemia, and pancytopenia have occasionally been reported following vapor inhalation, aspiration, or ingestion of HCs. Rhabdomyolysis has been reported.

Chronic Effects:

- Long-term or repeated exposure to certain aromatic and chlorinated HCs can result in hematologic (e.g., benzene), hepatotoxic (e.g., chlorinated HCs), renal (e.g., chlorinated HCs), neuropsychiatric (e.g., toluene), neurological (e.g., n-hexane) and carcinogenic (e.g., benzene, vinyl chloride) effects.
- Chronic exposure or abuse of some HCs can result in chronic encephalopathy and residual neurological impairment: cerebellar abnormalities including ataxia, nystagmus and dysarthria; incoordination, memory deficits poor concentration, poor abstract reasoning, and emotional lability.
- Biopsy confirmed glomerulonephritis and nephrotic syndrome has been reported following long-term inhalation or dermal exposure to various HCs.

Treatment:

- Treatment involves removal from the exposure, decontamination, oxygen, and ventilatory and circulatory support as needed.
- Move patient to fresh air. Administer 100% humidified supplemental oxygen with assisted ventilation as required. Monitor for respiratory distress. If cough or difficulty in breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. Respiratory tract irritation, if severe, can progress to pulmonary edema, which may be delayed in onset up to 24-72 hours after exposure.
- Support respiratory and cardiovascular function. Epinephrine and other sympathomimetics should be used with caution due to possible increased sensitivity of the myocardium to catecholamines.
- Decontaminate:
  - Remove all contaminated clothing to prevent further absorption.
  - Wash all exposed areas of the body thoroughly with soap and water.
  - Exposed eyes should be irrigated with copious amounts of tepid water for at least 15 minutes (to normal pH if the agent is acidic or basic – e.g., phenol or aniline). If eye irritation, pain, swelling, lacrimation, or photophobia persist, the patient should have an ophthalmologic exam.

- A physician may need to examine the affected skin areas if irritation or pain persists. Consultation with a clinician experienced in burn therapy or a burn unit should be obtained if larger area or more severe burns than the following are present:
  - minor chemical burns (first or second degree) less than 15% body surface area in adults or less than 10% body surface area in children; or
  - minor third degree: less than 2% body surface area.
  - Neutralizing agents should NOT be used.
- Some chemicals can produce systemic poisoning by absorption through intact skin. Carefully observe patients with dermal exposure for the development of any systemic signs or symptoms and administer symptomatic treatment as necessary.
- In cases of significant inhalational abuse, chlorinated HC exposure, prolonged unconsciousness and hypoxia, prolonged and extensive dermal exposure to liquid HC, or HC injection:
  - Monitor CBC, urinalysis, and liver and kidney function tests, and serum CPK in patients with significant exposure.
  - Monitor fluids and electrolytes.
  - Monitor arterial blood gases, pulmonary function, and chest x-ray for patients with significant exposure.
- Benzene may particularly produce abnormalities of the hematopoietic system. Monitor the complete blood count for patients with significant exposure.
- Monitor methemoglobin level in cyanotic patients who do not respond to oxygen and who may have been exposed to aniline or nitrobenzene.

- Special notes:
  - Natural gas and petroleum are the sources of most HCs, and they can be aliphatic (straight or branched chained), aromatic (with at least one benzene ring), or substituted with a chemical constituent in place of the hydrogen, such as hydroxyl or nitro or amine groups or halogenated (having a halide constituent – such as chlorine, fluorine, bromine or iodine). There are many HC, substituted HC, and H-HC compounds and besides having certain effects in common, many have their own unique toxicities.
  - HCs can be gaseous, liquid or solid (physical state is dependent upon chain length/molecular weight with shorter chains/lower MWs tending to exist as gases, and longer chains/higher MWs tending to exist as either liquids or solids). Their physical state will affect exposure and toxicity potentials. However, many HCs and H-HCs have a significant vapor pressure, and therefore, their potential for inhalation is substantial.
  - HCs also tend to be lipid soluble, so are able to locally affect the skin and permeate either intact or non-intact skin to exert systemic effects.
  - Flammability and significant vapor pressure create explosivity. HCs can form dangerous explosive mixtures in the air. HCs tend to be flammable, but H-HCs tend to be less or not flammable.

- Other specific characteristics and toxicities:
  - N-hexane: long-term exposure produces peripheral neuropathy, which would not otherwise be expected from a single exposure.
  - Phenol is rapidly and significantly absorbed through the skin leading to systemic toxicity. It is anesthetic on the skin but severe burns (depigmented) can result along with multi-organ injury, cardiac dysrhythmias and pump failure, hepatotoxicity, and death.
  - Aniline produces methemoglobinemia and direct hepatoxicity.
  - Pentachlorophenol and dinitrophenol uncouple oxidative phosphorylation to disallow ATP formation and allow subsequent development of hyperthermia, tachypnea, hypoxia, hypoglycemia, and initial CNS and cardiac irritability followed by CNS depression and cardiovascular collapse.
  - Benzene is a known human carcinogen. Long-term exposure also causes bone marrow toxicity with pancytopenia, aplastic anemia, and leukemia.
  - Methylene chloride is endogenously metabolized to carbon monoxide and can produce CO poisoning.

CHOLINERGIC TOXIDROME

Toxidrome: salivation, lacrimation, urination, defecation, gastroenteritis, and emesis (SLUDGE), and/or miosis, tachycardia, weakness, hypertension, and fasciculations (MTWTF).

- Cholinesterase inhibitors, such as the organophosphates (OPs) and the carbamates which are pesticides, cause the cholinergic toxidrome by causing excess acetylcholine at the cholinergic synapses and nerve endings.
  - Organophosphate examples include: acephate, azinphos-methyl, chlorpyrifos, demeton, diazinon, dichlorvos, EPN, ethion, malathion, parathion, ronnel, and tetraethyl pyrophosphate.
  - Carbamate examples include aldicarb, carbaryl, carbofuran, methomyl, and propoxur.
  - Chemical warfare nerve agents are also cholinesterase inhibitors.

Acute Effects:

- Cholinergic nerve endings or synapses (nicotinic and muscarinic) occur in the central nervous system (CNS); peripheral nervous system (PNS); autonomic ganglia – both sympathetic and parasympathetic, and neuromuscular junctions; and neuroeffector junctions (parasympathetic). Some of the effects can be contradictory and competing.
  - PNS muscarinic effects are also remembered as DUMBELS [diarrhea, urination, miosis, bradycardia, bronchorhea, bronchspasm (with wheezing), emesis, lacrimation, and salivation, secretion and sweating]. Also rhinorrhea and abdominal cramps. Lungs can be wet, crackling, from secretions.

- PNS nicotinic effects include MTWTF: mydriasis, tachycardia, weakness, hypertension, hyperglycemia, and fasciculations (of the muscles). Muscle weakness can progress to paralysis. Muscle fasciculations can be seen through the skin but are best seen on the face and tongue. Hyperglycemia is stimulated sympathetically (increased epinephrine and norepinephrine).
  - Initially there will be tachypnea, but slow respirations and respiratory arrest may follow, due to CNS effects or muscle weakness/paralysis.
  - Cardiovascular effects may waiver between sympathetic (tachycardia and hypertension) and parasympathetic (bradycardia and bradydysrhythmias). Usually sympathetic predominates at first, and parasympathetic later.
  - Other effects waiver similarly [e.g., miosis (pupillary constriction) and mydriasis (dilation), but usually miosis predominates].
- CNS effects include headache, anxiety, dizziness, confusion, agitation, convulsions, coma, and even death.
- Skin: most of these chemicals cause no or mild irritation, except Ronnel which is corrosive. Most OPs absorb well through the skin and mucous membranes (as well as GI and by inhalation of mists or dusts). Carbamates are usually less well absorbed.

Chronic Effects:

- Intermediate syndrome is characterized by paralysis of respiratory, cranial motor, neck flexor, and proximal limb muscles 12 hours to 7 days after exposure and following resolution of cholinergic symptoms. It occurs prior to development time of delayed peripheral neuropathy. Treatment is supportive (e.g., respiratory support). Atropine and pralidoxime are ineffective. Recovery begins 5-15 days after onset.
- Delayed polyneuropathy [from inhibition of neuropathic target esterase (NTE) by some OP]: Distal sensory-motor polyneuropathy may develop 6-21 days following exposure. It manifests as burning or tingling, then progressive distal weakness and ataxia in the lower limbs. Flaccid paralysis, spasticity, ataxia or quadriplegia may ensue. Recovery may be slow or incomplete.
- Sequelae may also include subtle neuropsychological deficits. Decreased vigilance, defects in expressive language and cognitive function, impaired memory, depression, anxiety or irritability and psychosis have been reported as delayed effects.
- The HC diluent may contribute to the overall toxicity. Refer to HCs management for further information.

Treatment:

- Remove to fresh air. Ensure adequate ventilation and oxygenation (100% oxygen as indicated). Airway suction and/or intubation may be needed. Cardiac monitoring and support as needed. Treat seizures with IV valium or lorazepam. Provide specific antidotes as needed, promptly.

- Decontaminate:
  - Remove all contaminated clothing to prevent further absorption.
  - Wash all exposed areas of the body thoroughly with soap and water.
  - Exposed eyes should be irrigated with copious amounts of tepid water for at least 15 minutes.
- RBC cholinesterase activity levels can be measured and serve as a reflection of nervous system acetylcholinesterase levels.
  - "Pseudocholinesterase" (plasma cholinesterase) can be measured but is not as reflective of the nervous system.
  - Depression in excess of 50% of baseline is generally associated with severe symptoms.
  - Correlation between cholinesterase levels and clinical effects in milder poisonings may be poor.
- Monitor electrolytes, ECG, and serum pancreatic isoamylase levels in patients with significant poisoning. Patients who have increased serum amylase levels and those who develop a prolonged QTc interval or PVCs are more likely to develop respiratory insufficiency and have a worse prognosis. Other lab/x-rays as indicated.
- Specific antidotes:
  - Atropine:
    - Symptomatic antidote for muscarinic effects only. It will not stop the nicotinic effects of fasciculations, weakness, flaccid paralysis, or respiratory arrest. It will not regenerate the acetylcholinesterase.

- Initial dose: 0.5 - 2.0 mg IV (adult). Repeat every 5 minutes until muscarinic effects (bronchorrhea, bronchspasm, bradycardia) resolve. Severely poisoned patients may require large doses – up to several grams over days to weeks.

♦ Pralidoxime (2-PAM):

- Reactivates acetylcholinesterase if given early enough and in enough dosage. Use for nicotinic and CNS effects. Not needed for carbamate poisoning, but use if not sure what the agent is.
- Infuse SLOWLY over 5-10 minutes. Initial dose: 1-2 grams IV (adult). Follow with continuous infusion of 500 mg/h for at least 24 hours. If RBC cholinesterase activity levels drop with discontinuation, then continue.

■ Special notes:

♦ Carbamates bind reversibly to cholinesterase. OPs will bind irreversibly unless pralidoxime (2-PAM) is provided before "aging occurs." Some OPs can take up to 2 days to age.

♦ Dichlorvos can vaporize sufficiently to be a danger in an enclosed space.

RESPIRATORY PROTECTION

- Respirators are of two main types: air-purifying and supplied-air. The latter are not logistically practical for most military units, especially in a tactical setting.
- Air-purifying respirators are masks that filter ambient air and use different cartridge types (with color coded canisters) to protect against specific exposures [e.g., acid gases, organic vapors, ammonia gas, pesticides, and particulates (HEPA)]. Limitations: not protective against some common toxic gases such as CO and NOx, nor against a lack of ambient oxygen.
- Soldiers are fit-tested and instructed in using the mask issued to them for protection against NBC (e.g., M-40 mask with the C2A1 canister, which has carbon with other reactive materials, and HEPA filters).
  - This mask is NOT meant for use with toxic industrial chemicals (TICs), except as emergency protection when evacuating a hazardous zone. However, testing has been done and the performance of this mask and canister with exposure to many TICs is known.
  - The table indicates relative effectiveness for each major TIC. Consult the USACHPPM for mask performance information related to specific agents.
- Commercial respirators for use against TICs are available, and each type has specific guidance on fit testing, proper use, and maintenance. A given type of mask could be issued to soldiers if intelligence indicated that a specific chemical release is likely to occur, but limited response time would make this logistically difficult in most cases.

DEPLOYMENT CHEMICAL EXPOSURE QUESTIONNAIRE

List medicines or immunizations taken for this deployment

Job-related factors:

- Where have you been located during this deployment? (Places, dates, jobs)
- Are you performing your usual job?
- Is your deployment job different? If *yes*, how?
  - Increased hours per day or days per week? How many?
  - Change of hours spent Indoors/Outdoors? What is the change?
  - New or different job duties/procedures?
  - New or different exposures? (chemical/biological/radiation/physical)

(Inquire from list below about all on-the-job exposures)

- Is ventilation adequate where you are working?
- Increased stress?
- Do you get the material(s) on your skin or clothing?
- Can you smell the chemical or material you are working with?
- Do you wash your hands with solvents?
- Do you use—or were you advised to use—protective equipment such as gloves, masks, respirator, or hearing protectors? (Specify the equipment.)
- Were you instructed in the use of protective equipment?

Environmmental factors at deployment site:

- Is your deployment location next to or near an industrial plant, commercial business, dump site, or other nonresidential property of concern?
- Is air pollution a problem?
- Are pesticides or herbicides used to control weeds and pests?
- What is your source of drinking water? (private well, city water, bottled water, other)
- Is the water purified prior to drinking? Tested for pollutants?
- Any unusual or irritating exposures in the living or work areas?

[If answered 'yes' to any question, please explain.]

Health Issues:

- Do you smoke? Do you smoke at the workplace?
- Have you or co-workers experienced any symptoms?
  If yes…..Aggravated by a specific activity?
  Get either worse or better at the workplace?
  Get either worse or better in your living area?
- Have you been off work more than 1 day due to a work-related illness during the deployment?
- Have you changed jobs or work assignments due to health problems or injuries during the deployment?

[Review of systems as appropriate.]

Exposures about which to inquire (and examples in parentheses):

During your deployment, have you been exposed to the following?

- Metals? (arsenic, beryllium, cadmium, chromates, lead, mercury, nickel)
- Dust or fibers? (asbestos, coal dust, fiberglass, rock dust, silica dust, talc)
- Fumes or mists? (welding fumes)
- Workplace chemicals? [gasoline, solvents, oils, acids, alkalis, industrial alcohols, ketones, pesticides – try to name specific chemicals (see list below)]
- Chemical warfare agents?
- Army-specific chemicals? [explosives, fogs (trinitrotoluene)]
- Radiation? (x-rays, lasers)
- Biologicals? (molds, viruses, insects, Anthrax, Smallpox, Bot tox, Ricin, tularemia)
- Loud noise, vibration, extreme heat or cold?

Specific chemicals for query: ammonia, benzene, carbon tetrachloride, chlorinated naphthalenes, chloroform, dichlorobenzene, ethylene dibromide, ethylene dichloride, halothane, isocyanates, ketones, methylene chloride, perchlorethylene, phenol, phosgene, styrene, toluene, TDI or MDI, trichloroethylene, vinyl chloride, PCBs, PBBs.

Toxic Industrial Chemicals

Chemical	Rate of Onset	Persistence in Environment	Toxicity Thresholds (ppm/hour) Impairment	fatality	BDO/ Mask Effective	Odor	Source/Use/other hazard	General Acute Signs, symptoms and treatment
Allyl alcohol (colorless liquid)	Immediate	Days-weeks, +	7.7	22	?	Mustard-like	Rapidly absorbed through skin highly flammable with caustic fumes; used as contact pesticide, plastic/perfume manufacture	See Toxidrome "irritant gas" and "corrosive"; hepatic and renal toxin, delayed skin effect - aching, vesiculation after hours
Acrolein (colorless-yellow liq)	Immediate	Minutes to hours	0.1	1.4	Poor	1 ppm - sharp, acrid, sweet	Herbicide; tox and corrosive fumes	See Toxidrome "irritant gas"
Acrylonitrile (clear/pale yellow liq)	Immediate	Minutes to hours	35	75	Poor	17 ppm - unpleasant, sweet (peach)	Plastics, coatings, adhesives industries; dyes; pharmaceuticals; flam gas	See toxidromes "irritant gases" or "corrosives" and "asphyxiants" dermal absoption and dermatitis (burn), CN poisoning, liver toxicity (use N-Acetyl Cysteine)

INDUSTRIAL CHEM

Toxic Industrial Chemicals (Cont.)

Chemical	Rate of Onset	Persistence in Environment	Toxicity Thresholds (ppm/hour) Impairment	fatality	BDO/ Mask Effective	Odor	Source/Use/other hazard	General Acute Signs, symptoms and treatment
Ammonia (colorless gas)	Immediate	Minutes	110	1100	Poor	17 ppm - sharp,suffo-cating,dry urine	Explosives manufacture; pesticides; detergents industry	See Toxidrome "irritant gas"
Arsine (colorless gas)	Immediate to 24 hours	Minutes to hours	0.2	0.5	Good	0.5 ppm - garlic-like	Used in electronics industry; reacts with H20 (don't use H2O in fire)	Hemolysis (can be delayed hours) (IV, transfusion), renal shutdown. Arsenic poisoning (chelation)
Chlorine (greenish-yellow gas)	Immediate to hours	Minutes to hours	3	22	Good	3.5 ppm-pungent (bleach), suffocating	Cleaner/disinfectant in many industries; water treatment; WWI war gas; irritating corr fumes heavier than air	See Toxidrome "irritant gas"
Diborane (colorless gas)	Immediate	Minutes to hours	>1	15	Good	2.5 ppm - sickly sweet	Intermediate chemical manufacturing; very flammable	See Toxidromes "irritant gas" and "corrosive". Possible neuro, liver and kidney systemic effects

Toxic Industrial Chemicals (Cont.)

Chemical	Rate of Onset	Persistence in Environment	Toxicity Thresholds (ppm/hour) Impairment	fatality	BDO/ Mask Effective	Odor	Source/Use/other hazard	General Acute Signs, symptoms and treatment
Ethylene oxide (colorless gas/liq)	Immediate	Minutes to hours	45	200	Poor	425 ppm - sweet, ether-like	Rocket propellant; fumigant; sterilization in health care industry; very flammable	See Toxidrome "irritant gas" and "corrosive". Alkylating agent. Also neuro effects. genotoxic, carcinogen
Flourine(pale ylw/green gas)	Immediate	Minutes to hours	5	25	Good	0.14 ppm choking	Flourochemical man; cleaning,water treatment	See Toxidromes "irritant gas" and "corrosive".
Formaldehyde (clear- white gas/liq)	Immediate	Hours	10	25	Poor	1 ppm - pungt suffocating	Disinfection/ germicide; fungicide; textile; health care (tissue fixing)	See Toxidrome "irritant gas"
Hydrogen bromide (pale yellow liq)	Immediate	Minutes to hours	3	30	Good	2 ppm - sharp stinging	Chemical manufacturing industry; very corrosive	See Toxidrome "irritant gas"

INDUSTRIAL CHEM

Toxic Industrial Chemicals (Cont.)

Chemical	Rate of Onset	Persistence in Environment	Toxicity Thresholds (ppm/hour) Impairment	fatality	BDO/ Mask Effective	Odor	Source/Use/other hazard	General Acute Signs, symptoms and treatment
Hydrogen chloride (hydrochloric acid) (pale yellow-colorless liq)	Immediate	Minutes to hours	22	104	Good	0.77 ppm - pungent, irritating	Ore, other metal refining/ cleaning; food/pickling; petroleum ; corrosive liq	See Toxidrome "irritant gas"
Hydrogen Cyanide(color less-white-pale blue gas; liquid <75F)	Immediate	Minutes	7.0	15-50	Good	1-5 ppm-bitter/sweet almond-like	War gas, pesticide,Herbicide; other industries; Weak acid except in water or mucous membranes - then corrosive/irritating	See Toxidrome "asphyxiant"
Hydrogen fluoride (colorless gas/fuming liq)	Immediate & Delayed	Minutes to hours	24	44	Good	0.4 ppm - strong irritating	Aluminum and other metal industries; insecticide manufacturing-corrosive liq	See Toxidromes "irritant gas" and"corrosive" (special note in "corrosive")
Hydrogen selenide (colorless gas)	Immediate	Minutes to hours	0.2	1.5+	Poor	0.3 ppm-decayed horseradish	Metals &semiconductor preparation; highly flammable/ explosive; can cause burns/frostbite; decomposes rapidly to form elemental selenium	See Toxidromes "irritant gas" and "corrosive" - systemic effects possible from selenium (cardiotoxicity, liver, kidney)
Hydrogen sulfide (colorless gas)	Immediate & Delayed	Minutes to hours	30	100	Good	0.1 ppm - rotten egg	Disinfectant lubricant/oils; interm for HC manufacture; deadens sense of smell	See Toxidrome "irritant gas"

Toxic Industrial Chemicals (Cont.)

Chemical	Rate of Onset	Persistence in Environment	Toxicity Thresholds (ppm/hour) Impairment	fatality	BDO/ Mask Effective	Odor	Source/Use/other hazard	General Acute Signs, symptoms and treatment
Lead (metal)	Delayed days to months	Days to months	0.5	100 mg/m^3	Good	Odorless	Industry/welding/ paint/leaded gasoline	Mulitple organ systems can be affected: neuro, heme, renal, GI, CV. Chelation for dangerous symptoms/signs with very high blood lead levels. Consider pregnant women to protect fetus
Mercury	Irritation immed.	Days to months	0.1mg/m^3	2 mg/m^3	Good	None if inorganic	Ore, electrical apparatus, insecticides/ fungicides	Comes in metallic, organic and inorganic forms, with differing effects. Consider respiratory, CNS, renal. Chelation if indicated.
Methyl hydrazine	Immediate	Hours - days	1.0	3.0	Poor?	1 -10 ppm- ammonia like	Solvent, rocket fuel; flammable; irritating to skin/eyes	See Toxidromes "corrosive" and "asphyxiant" (hemolytic, metHb former), CNS excitation and seizures, liver, kidney

INDUSTRIAL CHEM

INDUSTRIAL CHEM

Toxic Industrial Chemicals (Cont.)

Chemical	Rate of Onset	Persistence in Environment	Toxicity Thresholds (ppm/hour) Impairment	fatality	BDO/ Mask Effective	Odor	Source/Use/other hazard	General Acute Signs, symptoms and treatment
Hydrazine Colorless, oil (fuming) liquid/waxy solid or crystals	Immediate & Delayed (LUNGS)	Hours - days	13	35	Poor?	3-4 ppm- Ammonia - like	Flammable- Once ignited continues to burn; irritating vapors; Used as solvent, rocket fuel;	See Toxidromes "corrosive" and "asphyxiant" (hemolytic, metHb former), CNS excitation and seizures, liver, kidney, hyper/hypoglycemia; pyridoxine deficiency (give as anitidote)
Methyl mercaptan (colorless gas; liquid <43F)	Immediate	Minutes to hours	5.0	23	Poor	0.002 ppm- rotten cabbage (1 ppm odor fatigue)	From decayed organic matter - pulp mills, oil refineries; highly flammable; liquid burns/frostbite	See Toxidromes "irritant gas" and "asphyxiant" - similar to Hydrogen Sulfide - systemic asphyxiant; also possible MetHB former, hemolysis; CNS depression
Methyl isocyanate (colorless liquid)	Immediate	Minutes to hours	0.5	5	Poor	2.1 ppm - sharp pungent	Intermediate in manufacturing; reacts with H20 (don't use in fire)	See Toxidromes "irritant gas" and "corrosive"; Bhopal chemical, sensitizer/allergen; possibly CN forming ("asphyxiant")

Toxic Industrial Chemicals (Cont.)

Chemical	Rate of Onset	Persistence in Environment	Toxicity Thresholds (ppm/hour) Impairment	fatality	BDO/ Mask Effective	Odor	Source/Use/other hazard	General Acute Signs, symptoms and treatment
Nitrogen dioxide (colorless gas/pale liq)	Delayed (24-72 hrs)	Minutes to hours	12	20	Poor	1 ppm - ?	Intermediate for manuf of nitric acid & sulfuric acid; explosives/rocket propellant	See Toxidrome "irritant gas"
Nitric Acid(colorless, yellow, or red fuming liquid)	Immediate	Hours- days	4.0	22+	Poor	~1 ppm- Choking, sweet - acrid	Used in many industries; Very corrosive to skin/mucous membranes as well as metals & other materials;	See Toxidrome "corrosive"
Parathion(pale yellow to brown liquid)	Immediate but often Delayed (weeks)	Days to weeks	0.2	0.8	?	0.04 ppm	Organophosphate (insecticide); similar symptoms (and thus treatment) as nerve gases; can penetrate leather/canvas; attacks plastics/rubber coatings	See Toxidrome "cholinergic"

INDUSTRIAL CHEM

Toxic Industrial Chemicals (Cont.)

Chemical	Rate of Onset	Persistence in Environment	Toxicity Thresholds (ppm/hour) Impairment	fatality	BDO/ Mask Effective	Odor	Source/Use/other hazard	General Acute Signs, symptoms and treatment
Phosgene (colorless - light yellow gas)	Immediate & Delayed (LUNGS)	Minutes - hours	0.3	0.8-5	Good	0.5ppm- musty hay	Dye, pesticide, and other industries; history as war gas, corrosive/irritating	See Toxidrome "irritant gas"
Phosphine (colorless gas)	Immediate & Delayed (LUNGS)	Minutes- hours	2.5	7.5	Good?	0.9 ppm- rotten fish, garlic	Insecticide; used in manufacture of flame retardants and incendiaries;	See Toxidrome "irritant gas", possibly systemic "asphyxiant" - toxic to organs with high energy demand (brain, kidney, heart, liver; electrolyte imbalace
Sulfuric Acid(clear colorless- brown oily liquid)	Immediate	Hours-days	>3	15-100	Good	Odorless (acrid taste)	Battery/dyes/paper/-glue/metals industries; volcanic gas; toxic fumes when heated	See Toxidrome "corrosive"
Sulfur dioxide; sulfur trioxide; - form sulfuric acid (colorless gas)	Immediate & Delayed	Minutes to hours	0.08	0.51	Good (SO2); Marginal (SO3)	1 ppm; pungent; metallic taste	Disinfectant and preserving in breweries and food/canning; textile industry; batteries	See Toxidrome "irritant gas"
Toluene diisocyanate (2,4)(water-white to pale yellow liquid, or crystals)	Immediate	Hours - weeks	0.08	0.51	?	0.4-2 ppm- sharp pungent	Polyurethane (wood coatings , foam), nylon industries; skin irritant	See Toxidrome "corrosive"; CNS symptoms, lung and skin sensitizer, asthma

PART FIVE: ILLNESSES DUE TO ENVIRONMENTAL STRESSORS

High Altitude

ACUTE MOUNTAIN SICKNESS (AMS)

- Self-limited symptom complex.
- Universal susceptibility among the unacclimatized:
  - Apparently not influenced by physical fitness level.
  - Some soldiers inherently more susceptible than others.
  - Same symptoms can occur on repeated exposures (prior exposure not a predictor).
- Symptom onset 3-24 hours after rapid (<24 hours) ascent to above 6,000 ft (1,829 m):
  - Severity peaks at 24-72 hours.
  - Usually subsides over the course of 3-7 days.
  - Can reoccur after acclimatization with rapid ascent to higher altitude.
- Probable cause: hypoxia-induced subclinical cerebral edema.
- Often precedes both high altitude cerebral edema (HACE) and high altitude pulmonary edema (HAPE), but majority of cases do not progress to HACE or HAPE.
- Incidence and severity worsen with vigorous physical activity during ascent.

ALTITUDE	INCIDENCE (%)		
	MILD	MODERATE	SEVERE
~ 7,000 ft (2,130 m)	0-40	0-10	0
~10,000 ft (3,050 m)	60-70	0-40	0
~12,000 ft (3,660 m)	10-40	40-80	10-20
~14,000 ft (4,270 m)	20	60	20
~18,000 ft (5,500 m)	0	10	90

Symptoms/Signs (headache and nausea most common):

- Headache
  - Usually symmetric, nonfocal, throbbing.
  - Most intense at night and shortly after arising in the morning (increased hypoxemia caused by altitude-induced sleep apnea).
  - Worsened by strenuous exercise, changes in position, valsalva.
  - Sometimes helped by *mild* exercise (increased ventilation).
  - Anorexia, nausea, and vomiting.
  - Weakness, lassitude, general malaise.
  - Decreased coordination, dizziness or light-headedness.
  - Oliguria.
  - Sleep disturbances and periodic breathing with recurrent apneic periods (may persist for weeks even after other symptoms have resolved).

Diagnosis:

- Presumptive: headache and at least one other sign or symptom in an individual who ascended from low (<5,000 ft or 1,524 m) to high altitude or from high to higher altitude in the previous 24-48 hours.

- Differential:
  - Viral gastroenteritis.
  - Hangover.
  - Exhaustion.
  - Dehydration.
  - Carbon monoxide poisoning.
  - HACE.

Prevention and Public Health Measures:

- Staging and graded ascent [above 2,500 m sleeping altitude should not be increased more than 600 m/day (2,000 ft/day) with an extra day for increases of 2,000 - 4,000 ft (600-1,200 m)].
- Avoid over exertion.
- Acetazolamide 125-250 mg PO BID starting 24 hours pre-ascent, continue 48 hours post-ascent.
  - Prevents AMS in 50-75%; reduces symptoms in most of the other cases.
  - Side effects: peripheral paresthesias and polyuria.
  - Contraindications: sulfa sensitivity.
  - High dose dexamethasone *not* recommended. Prevents symptoms of AMS; symptoms may recur when the drug is stopped.

Treatment:

- Descent to lower elevation.
- Portable hyperbaric chamber.
- Continuous supplemental oxygen.
  - sufficient quantities not usually available for tactical situations. Low-flow oxygen especially effective during sleep.

- Acetazolamide, up 500 mg PO TID.
- Dexamethasone, 2 to 4 mg PO Q6H (can be combined with acetazolamide treatment).
- Palliative care:
  - Analgesics (aspirin 325 to 1000 mg PO Q4-6H, acetaminophen 325 mg PO Q4H to 1000 mg PO Q6H, ibuprofen 200 to 800 mg PO Q4-6H, or other NSAIDs).
  - Opioids may be more successful, but they should *not* be used because of respiratory depression and reduction of cognitive function.
  - Prochlorperazine 5 to 10 mg PO Q6-8H can be used to treat nausea and vomiting. Respiratory stimulation a potentially beneficial side effect.
  - Alcohol and other respiratory depressants should be avoided.

HIGH ALTITUDE PULMONARY EDEMA (HAPE)

- Noncardiogenic pulmonary edema occurring in unacclimatized individuals following a rapid ascent to high altitude (>8,000 ft, 2,400 m).
- Combination of hypoxia-induced pulmonary hypertension and an increase in permeability of the pulmonary capillary endothelium; elevated pulmonary artery pressure, normal left atrial filling pressure and normal ventricular function.
- Untreated, can be rapidly fatal and is the most common cause of death among the altitude illness syndromes. If recognized early and treated appropriately, it usually resolves rapidly and without permanent adverse consequences.
- Often preceded by AMS; frequently seen in individuals with HACE; most cases of HAPE occur without concomitant HACE.
- Incidence relatively low, but military impact, especially in small units, can be significant because of the serious prognosis and need for rapid evacuation.

Incidence:

- Varies widely with geography, population at risk and the specific circumstances of exposure. Incidence estimates: 1/10,000 at 6-10,000 ft (Colorado skiers), 1/50 at 20,320 ft (Mt. McKinley climbers), 15/100 at 11-18,000 ft (in Sino-Indian conflict).
- Increased risk in acclimatized individuals who reascend rapidly following several days to weeks at a lower altitude.
- Prior episodes may increase risk to as high as 60%.

- Subclinical form of HAPE occurs frequently:
  - Manifested primarily by rales in the right mid-lung field.
  - Rales found in 1/3 to 1/2 of persons exercising at altitudes higher than 11,500 ft.
  - Clinical significance unclear (most do not progress to frank pulmonary edema).
  - Usually begins within the first 2-4 days after rapid ascent.
  - Onset during the second night of sleep at altitude very common.
  - Can also occur in acclimatized soldiers who ascend rapidly from a high to a higher elevation.
  - Can progress very rapidly (<12 hours) to coma and death.

Risk factors:

- Moderate to severe exertion.
- Cold exposure.
- Anxiety.
- Young age.
- Male sex.
- Obesity.
- Low hypoxic ventilatory response.
- Congenital absence of one pulmonary artery.
- Prior episode of HAPE.

Symptoms/Signs:

- Early pulmonary edema: nonproductive cough and a few rales (common at high altitude even without HAPE).
- Early hypoxemia: dyspnea on exertion, fatigue and weakness with decreased tolerance for physical activity, and increased time needed for recovery after physical exertion.
- Resting tachycardia and tachypnea greater than that induced by altitude alone.
- Nail beds and lips more cyanotic than others' at the same altitude.
- Cough may become productive of frothy, pink or blood-streaked sputum.
- Rales become more numerous and widespread, and wheezing may develop.
- Lung sounds may progress to an audible gurgling in the airway that can be heard without a stethoscope, especially when the affected person is supine.
- Orthopnea may occur in some individuals (<20%).
- Progressive hypoxemia causes progressive dyspnea and cyanosis.
- Mental status deteriorates with progressive confusion; sometimes vivid hallucinations. Ultimately obtundation, coma, and death will occur without treatment.
- Slight fever (≤l00°F, 37.8°C) may be present.
- Mild increase in white blood cell count.
- CXR shows multiple patchy interstitial or alveolar pulmonary infiltrates May be predominant in the right middle lobe). Pulmonary vasculature may be widened, but heart size usually is normal.

- EKG shows right strain pattern with rightward axis, clockwise rotation, T-wave inversion in the precordial leads and an R-wave in leads V_{1-2} and an S-wave in leads V_{5-6}.

Diagnosis:

- Presumptive:
  - Two of the following symptoms:
    - Dyspnea at rest
    - Cough
    - Weakness
    - Chest tightness or congestion

    PLUS
  - Two of the following signs:
    - Rales or wheezing in at least one lung field
    - Central cyanosis or inappropriate tachypnea or tachycardia are present.
- Differential:
  - Pneumonia
  - Congestive heart failure
  - Pulmonary embolus
  - In a military setting, possible exposure to chemical warfare agents.

Prevention and Public Health Measures:

- Adequate acclimatization, avoidance of risk factors, and pharmacologic prophylaxis.

- Unacclimatized soldiers should sleep at as low an altitude as possible.
  - Avoid cold exposure and strenuous exertion until adequately acclimatized.
  - Acetazolamide may help prevent HAPE.
- Nifedipine 20 mg PO Q8H, starting on day of ascent, continuing thru 3 days at destination is indicated only for those with a history of prior episodes. Because hypotension is a possible side effect of this dose regimen, medical officers should consider administering a test dose or starting the regimen prior to ascent.

Treatment:

- Immediate descent is the definitive treatment, and should never be voluntarily delayed. Descent of even a few thousand feet (300-1,000 m) may be beneficial.
  - Descent should be by passive means (exertion, cold, and anxiety can increase pulmonary artery pressure).
  - Keep soldier as warm and comfortable as possible, and administer supplemental oxygen (4-6 L/min until improvement, then 2-4 L/min) during descent.
  - Soldiers with mild HAPE symptoms and who are ambulatory may walk down slowly.
  - **Soldiers with *any* altitude illness should not be unaccompanied**.
- Use portable hyperbaric chamber if descent not possible or oxygen unavailable (may require 4 or more hours of treatment in the chamber to be effective for HAPE).

- Increase beneficial effect and conserve oxygen supply by:
  - expiratory positive airway pressure mask (EPAP)
  - pursed-lips breathing
- Nifedipine: 10 mg sublingual then extended release formulation 30 mg PO Q12-24H.
- After evacuation to lower altitude:
  - continue to ensure adequate oxygen and reduced pulmonary artery pressure
  - bed rest, supplemental oxygen and nifedipine. (Invasive procedures such as bronchoscopy or pulmonary artery catheterization are *not* indicated unless the clinical course deteriorates and the diagnosis is in doubt. Endotrachael intubation seldom necessary.)

HIGH ALTITUDE CEREBRAL EDEMA (HACE)

- Clinically apparent edema in the brain associated with a rapid ascent to high altitude:
  - hypoxia-induced increase in permeability of the blood-brain barrier (vasogenic edema), or
  - hypoxia-induced alteration of cellular fluid regulation with an intracellular fluid shift (cytotoxic edema), or
  - some combination of the two mechanisms.
- HACE patients often have HAPE, while most HAPE patients may not have concomitant HACE.
- Significant impact on military units operating at high altitude due to serious prognosis and the need for rapid evacuation.

Incidence:

- Occurs in unacclimatized individuals who ascend rapidly from low to high altitude, or from high to higher altitude.
  - Overall incidence (1% of rapid ascenders) lower than that of AMS or HAPE.
  - Majority of cases occur above 12,000 ft (3,600 m).
- Risk factors same as for AMS. AMS itself and previous episode of HACE are risk factors.
- Time of onset following high altitude exposure generally occurs later than AMS or HAPE. Mean duration of exposure before onset of HACE symptoms may be 5 days with a range of 1-13 days.
- Progression to death if untreated: 12-72 hours.

Symptoms/Signs:

- Early (AMS signs):
  - Severe headache, nausea, vomiting and extreme lassitude. None is invariably present.
  - Cyanosis and general pallor.
  - Mental status: confusion, disorientation, drowsiness, impaired mentation, withdrawal.
  - Truncal ataxia and change in mental status help differentiate early HACE from AMS. May progress to ataxic gait.
  - Coexisting HAPE symptoms.
- Later:
  - Visual changes, anesthesias, paresthesias, rigidity, hemiparesis, clonus, pathological reflexes, hyperreflexia, bladder and bowel dysfunction, hallucinations, seizures and coma.
  - Papilledema (up to half of soldiers with HACE).
  - Lumbar puncture and CT / MRI (not necessary for dx): elevated CSF pressure, cerebral edema.

Diagnosis:

- Presumptive: If a soldier does not have symptoms of AMS, both ataxia and mental status changes should be present for a presumptive diagnosis of HACE.
- Differential: altitude-related stroke or transient ischemic attack, infection, migraine cephalgia, trauma, hypothermia, substance abuse, psychosis and severe cerebral hypoxia resulting from HAPE.

Prevention and Public Health Measures:

- No proven efficacy of preventive measures (low incidence precludes adequate studies).
- Based on hypothesis that AMS is a subclinical form of HACE, AMS preventive measures may prevent HACE.

Treatment (should be started on the basis of the presumptive diagnosis):

- Definitive treatment of HACE is immediate descent.
- Outcome improves with degree of descent (more than 1,000 ft may be needed for clinical improvement; descent to an altitude below 8,000 ft is optimal).
  - Ambulatory patients can descend by foot if accompanied.
  - Portable hyperbaric chamber can be lifesaving when descent is unavoidably delayed (may require at least 6 hours of pressurization).
- Continuous supplemental oxygen at flow rates of 2 - 6 L/min should always be administered if available (but not a substitute for descent). Supplemental oxygen can be added to the air intake of a portable hyperbaric chamber to increase its efficacy.
- Adjunctive therapy: Dexamethasone 4 to 8 mg PO initially, followed by 4 mg PO, IV, or IM BID.
- Loop diuretics and osmotic diuretic agents such as mannitol, urea and glycerol also have been suggested, but experience is limited. (Careful attention must be paid to volume status when using diuretic agents in the treatment of altitude illness syndromes, because many soldiers will have altitude-induced decrease in intravascular volume concomitant with their edema.)

- Following descent, hospital management of HACE consists of supplemental oxygen, dexamethasone, supportive care, and possibly also diuretic agents. Comatose patients may require intubation with hyperventilation and bladder catheterization.
- Evaluate for concomitant HAPE and treat immediately if present.

HIGH ALTITUDE PERIPHERAL EDEMA

Incidence:

- May occur in up to 1/3 of soldiers who ascend to high altitude.

Symptoms/Signs:

- Most evident in the hands and peripheral areas of the face, and most evident upon awakening.
- Benign, but may cause soldiers enough discomfort to degrade their performance to some degree; more common in females.
- Usually associated with decreased urine output and a weight gain of approximately 6-12 pounds.

Diagnosis:

- Presumptive:
  - Diagnosis can often be made by history alone because it tends to recur consistently with repeat ascents.
- Differential:
  - Differential diagnosis includes cardiogenic edema, allergic reactions, and edema of the upper extremities caused by pack straps or binding by tight clothing.

Treatment:

- Can be treated successfully with mild diuretics.
- Definitive treatment is descent to a lower elevation.

HIGH ALTITUDE RETINAL HEMORRHAGE (HARH)

Incidence:

- Areas of bleeding from retinal vessels during altitude exposure.
- Can be found in association with other altitude illness syndromes, but are not directly related to them.
- Usually asymptomatic and affects military operations only in the rare instance in which they affect an individual soldier's vision (i.e., hemorrhage into the macular area).
- Appears not to be related to the state of acclimatization, and multiple incidents of retinal hemorrhage are possible throughout any altitude deployment.

Symptoms/Signs:

- Fundoscopic exam will show hyperemia and engorgement of the disc and increased tortuosity of retinal vessels.
- Retinal hemorrhages appear as "splinter" and "flame" type hemorrhages in the superficial layers of the retina, but hemorrhages in the deeper layers can occur.

Diagnosis:

- Differential diagnosis includes hemorrhage from vascular disease, diabetes mellitus, septic infarcts or from hypoxia caused by cardiac and respiratory disease.

Treatment:

- Self-limited resolve 1-2 weeks after descent; descent is not necessary for hemorrhages outside of the macula.
- When a macular hemorrhage is diagnosed, descent is imperative to promote healing and prevent further hemorrhage.

THROMBOEMBOLIC EVENTS

- Soldiers who ascend to high altitude are at increased risk for thromboembolic events including: thrombophlebitis, deep venous thrombosis, pulmonary embolus, transient ischemic-attacks (TIA) and stroke.
- Unusual below 14,000 ft (4,300 m).
- Treatment follows standard clinical guidelines, including appropriate anticoagulation. In a field setting, low-dose subcutaneous heparin (5,000 units every 8 –12 hours) can be used for anticoagulation prior to and during evacuation.

HIGH ALTITUDE PHARYNGITIS AND BRONCHITIS

- Frequent during prolonged stays (>2 wks) at high altitude; common at altitudes over 18,000 ft.
- Sore throat, chronic cough and severe cough spasms provoked by exercise are the primary manifestations.
- Although desiccation of mucous membranes can lead to an increased number of upper respiratory infections, pharyngitis and bronchitis at high altitude are seldom due to infection
- The impact of altitude-related pharyngitis and bronchitis on military operations is related primarily to the discomfort it causes to individual soldiers. Cough spasms could cause soldiers to be easily detected by opposing forces in some tactical situations.
- Treatment involves ample hydration, steam inhalation, hard candies or soothing lozenges and a mild cough suppressant.
- A mask or a porous, breathable silk balaclava as a mouth covering to reduce respiratory heat and moisture loss.
- Decongestant nasal sprays may relieve cold-induced vasomotor rhinitis and lessen mouth breathing.

MEDICATIONS FOR TREATMENT OF ALTITUDE ILLNESSES

MEDICATION	INDICATIONS	DOSAGE	COMMENTS
oxygen	Severe AMS headache, cyanosis HAPE HACE	2-6 L/min 2-6 L/min 2-6 L/min	 DO NOT DELAY DESCENT DO NOT DELAY DESCENT
acetazolamide	AMS prevention AMS treatment sleep disorders peripheral edema	125 mg PO QID or 250 mg PO BID, starting 48 H before ascent, continuing for 48 H after ascent. 125 mg PO QID or 500 mg PO TID 250 mg PO TID or 250 mg PO QID 250 mg PO TID for 3 doses	Side effects: paresthesias, fatigue, altered taste. Contraindicated with sulfa sensitivity.
dexamethasone	AMS treatment HACE	2-4 mg, PO QID 4-6 mg Q6H PO, IM or IV	For <u>severe</u> AMS only DO NOT DELAY DESCENT Few side effects if used only 3-4 days
acetaminophen	AMS headache	325 mg PO Q4H to 1000 mg PO QID	
ibuprofen	AMS headache	200-800 mg PO TID or QID	Other non-steroidal anti-inflammatories Stomach irritation
aspirin	AMS headache superficial thrombophlebitis	325-1000 mg PO Q4-6H 325-1000 mg PO Q4-6H	Stomach irritation

heparin	thromboembolism deep venous thrombophlebitis	PTT adjusted to 2-3 INR; 5000 U SC, Q8-12H in the field	REQUIRES EVACUATION
triazolam	insomnia	0.125 mg, PO QHS	Short-term use only. Possible short-term memory loss
temazepam	insomnia	30 mg, PO QHS	
nifedipine	HAPE treatment HAPE prevention	10 mg sublingually, followed by 30 mg PO QID 20 mg PO TID started, 24 H before ascent, continuing Q8H until 72 H after ascent	
prochlorperazine	nausea/vomiting	5-10 mg Q6-8H PO or IV; or 25 mg PO BID	Also stimulates respiration

Cold Weather

FREEZING INJURY (FROSTBITE)

- Most common cold-induced injury encountered in the U.S. Army.
- Most freezing injuries will be recognized and initially managed by nonphysician medical providers.
- Initially, all frozen tissue has the same appearance: cold, hard, and bloodless.
- Digits, nose, ears, and face are the most commonly affected areas.
- Injury often painless, concealed in mittens, gloves, or boots.

Symptoms/Signs:

- First degree frostbite
  - minor injury to superficial skin
  - blanches white, thaws quickly, forms red, painful wheel, no blisters; desquamation of skin in 7-10 days
- Second degree frostbite
  - whole epidermis involved
  - limited motion over site of injury
  - blisters form, clear fluid confirms 2° injury
  - blood in blister means deep 2° or early 3° injury
  - tissue under blisters susceptible to infection, leave blister intact
- Third degree frostbite
  - dermis to reticular layer involved
  - tissue is white, hard, and immobile

- deep tissues cyanotic
- skin loss through sloughing and mummification, healing slow
- residual cold sensitivity is common

- Fourth degree frostbite
  - involves skin, underlying tissues, sometimes bone
  - with rewarming, no blister formation distal but blisters may occur proximal in less damaged tissue
  - rewarming brings significant pain
  - permanent anatomic and functional loss
- Corneal frostbite is a rare, but profoundly disabling injury. The evolution is similar to any deep ocular keratitis. Permanent corneal opacification requiring corneal transplant is a common outcome.

First Aid and Field Management:

- It is important to remember that active warming of frozen tissue should be deferred until there is no risk that injured tissue will be refrozen. Once tissue has thawed, it is absolutely essential that it be protected from re-exposure to cold.
- If refreezing can be prevented during evacuation, then frozen tissue can be immediately warmed by contact with warm skin. The groin or axillae are particularly effective areas for warming frozen tissue.
- Tissue must not be exposed to temperatures in excess of 102-103^{0}F which will aggravate the injury. Exposure to motor engine manifolds or exhaust, hot water, open flames, stove tops, or incandescent bulbs is particularly dangerous. Many frostbite injuries have been substantially worsened by exposure to inappropriate warming techniques.

- Frostbitten tissue is vulnerable to trauma and infection and should be carefully protected from physical injury during evacuation.

Hospital Management:

- Warming of still-frozen tissue, treatment of various phases, of the injury as it evolves, and evaluation for coincident injury and illness. If the tissue has already thawed on arrival at the MTF, additional active warming should not be done
- Digits or entire hands or feet can be warmed in a temperature monitored water bath kept at 102-104°F. The face or ears can be warmed by towels kept wet with water warmed to 102-104°F. Warming should be continued until no further improvement in circulation and mobility is noted. This usually requires 15-45 minutes depending on the initial temperature and size of the injured part.
- After warming, the frostbitten tissue should be carefully and atraumatically dried, completely covered in bulky dry dressings, and kept slightly elevated to moderate swelling.
- Establish IV access (dehydration and hypovolemia are common with significant cold injuries and cold exposure)
- Tetanus prophylaxis as appropriate (frostbite is a tetanus-prone wound).
- Analgesia should be provided with NSAIDs (may reduce post-injury ischemia) and narcotics as needed.
- Because wound anaerobes and streptococci appear to be early causes of post-injury infection, prophylactic penicillin is recommended (2-4 M units IV OD or 500 mg PO QID).
- In second, third and fourth degree injuries, necrotic tissue is usually removed by whirlpool debridement once or twice daily in skin temperature saline or dilute Betadine.

NON-FREEZING COLD INJURY (NFCI, IMMERSION INJURY)

- Results from prolonged (hours/days) exposure to wet-cold; but above freezing conditions.
- The feet are the most common area of injury, but injuries can occur to hands.
- Two principal types: trench foot (combined effects of sustained cold exposure and restricted circulation during ground operations); and immersion foot (continuous immersion in cold water).
- Injured tissue is pale, anesthetic, pulseless and immobile.
- Diagnosis confirmed when above signs and symptoms do not change after warming.
- Skin is frequently macerated and slightly edematous. The degree of the injury is usually not completely apparent early on.
- After several hours (occasionally as long as 24-36 hours), a marked hyperemia develops associated with severe burning pain and reappearance of sensation proximally, but not distally; blanches with elevation; lasts a few days to many weeks depending on the severity of the injury.
- Edema and blisters develop in the injured areas as perfusion increases. Poorly perfused skin will slough.
- Persistence of no pulse in an extremity after 48 hours suggests severe deep injury and high likelihood of substantial tissue loss.
- Boots and socks should not be replaced until feet are warm and have normal feeling.
- Injured extremity must be carefully protected during evacuation.

- Severe pain may develop during evacuation if warming occurs, but extremity should not intentionally be deprived of passive warming (dry covering and protection from cold). Soldiers performing the evacuation should be equipped and trained to provide adequate analgesia.
- Do not massage or actively warm extremity.
- NFCI's should be evacuated to a rear echelon hospital.
- The skin should be protected with dry dressings. Intact blisters should be left intact; ruptured blisters should be sharply debrided and dressed. Open blisters, ulcers, and areas of necrosis should be periodically monitored with surveillance aerobic cultures.
- Infections should be treated immediately with antibiotics.

HYPOTHERMIA

- "Core" temperature (clinically usually taken to be the same as rectal temperature) is below 95°F (35°C). Hypothermia is caused by greater heat loss to the environment in excess of heat production by the body.
- The principal manifestations of mild to moderate hypothermia are shivering and mental status change.
- Persistent shivering is evidence of incipient hypothermia and should always be taken seriously. Shivering will diminish as hypothermia worsens.
- Mental status change may be the only clinical evidence of significant hypothermia. Withdrawal and irritability are common. As hypothermia worsens, subtle mental status changes progress to frank confusion, lethargy, withdrawn behavior, and obtundation. The degree of mental status change is not a reliable guide to the degree of hypothermia.

Clinical Manifestations:

- 90-95°F (32-35°C)
  - Mild hypothermia
  - Shivering and vasoconstriction present
  - Impaired fine and gross motor skills
  - Mental processes slow, errors in judgment
  - Bradycardia with PVC's possible

- 82.5-90°F (28-32°C)
  - Moderate hypothermia
  - Shivering and vasoconstriction attenuated or gone
  - Lethargy, staggering gait
  - Atrial arrhythmias
  - Bradycardia
  - Hypopnea

- < 82.5°F (< 28°C)
  - Severe hypothermia
  - Absent shivering or vasoconstriction
  - Loss of consciousness
  - Muscles and joints rigid
  - Vital signs reduced or absent
  - Risk of ventricular fibrillation/cardiac arrest
  - Core temperature below 77°F (25°C) – spontaneous ventricular fibrillation

PATIENT ISN'T DEAD UNTIL WARM & DEAD

Field Management:

- Anyone suspected of hypothermia should be considered to be at risk of sudden death from ventricular fibrillation or hypotension, and steps should be taken to prevent those complications. Handling should be minimal and gentle.
- Copious insulation to prevent heat loss (incompressible material under casualty if possible).
- Protection from wind and wet. Get wet clothes off.
- Scarf or non-occlusive bandage is available to prevent airway heat loss.
- When indicated, endotracheal intubation is safe as it does not seem to increase the risk of ventricular fibrillation.
- Oxygen supplementation is usually not needed because of the low oxygen requirements in hypothermia; ventilation can be assisted by mask and bag.
- Treat dehydration and hypovolemia (common in hypothermic casualties).

- Victims of severe hypothermia often appear to be in cardiac arrest; they are unconscious and without perceptible signs of life. Initiating CPR in the absence of solid clinical indications may unnecessarily result in conversion of perfusing and quiet bradycardia ventricular fibrillation. Use cardiac monitoring if available. If not, then take extra time to assess pulse, which may be slow and difficult to appreciate.
- Give glucose/sugar if available.

Hospital Management:

- Casualties who have stable circulation and only mild to moderate degrees of hypothermia can be given the chance to rewarm spontaneously. If they fail to rewarm spontaneously, then active rewarming should be started. They should be admitted to an intensive care unit be given warmed humidified oxygen and gradual rehydration.
- Although virtually every cavity in the body has been lavaged with warm fluid for the treatment of hypothermia (stomach, urinary bladder, colon, abdomen and chest), the two in most common use are gastric lavage and intraperitoneal lavage using peritoneal dialysis equipment. These techniques are effective and ample. They raise core temperature 0.5 to 1.5°F per hour.
- Use heated systems if available.
- The following steps are suggested for the management of hypothermic cardiac arrest. Endotracheal intubation, if not already done in the field, should be done, and assisted ventilation begun with heated humidified oxygen. Since hypothermic resuscitation tends to be prolonged, early institution of mechanical compression

and ventilation is appropriate. In the hypothermic casualty, oxygen requirements and carbon dioxide production will be low. Ventilation needs to be guided by blood gas measurements to avoid excessive respiratory alkalosis. Blood gas measurements can be interpreted as reported by the laboratory; temperature "correction" is no longer considered appropriate.

- As a general rule, antiarrhythmic and vasoactive drugs are not useful during resuscitation from hypothermia until core temperatures exceed 90^0F. Below that temperature, drug effects are absent or unpredictable. Also, since drug metabolism is markedly slowed below 90^0F, applying American Heart Association Advanced Cardiac Life Support (ACLS) drug protocols in hypothermia causes the accumulation of drugs which have no manifest effect when administered, but which suddenly and dramatically express themselves as they regain activity at higher core temperatures. If drug therapy of ventricular fibrillation is required, bretylium at its usual doses would be the drug of choice.

Heat

HEAT CRAMPS

- Patients with heat cramps present with painful tonic contractions of skeletal muscle.
  - can occur during work or many hours after work
  - usually preceded by palpable or visible fasciculation and lasts 2-3 minutes
  - recurrent and may be precipitated by manipulation of muscle
  - involve the voluntary muscles of the trunk and extremities
  - no systemic manifestations except those attributable to pain
  - despite the salt depletion associated with heat cramps, frank signs and symptoms of heat exhaustion are unusual
  - no significant complications have been reported from heat cramps except muscle soreness
- Differential Diagnosis:
  - tetany due to alkalosis (hyperventilation, severe gastroenteritis, cholera) or hypocalcemia
  - compartment syndrome
  - strychnine poisoning
  - black widow spider envenomation
  - abdominal colic

Management:

- Replenish salt orally or parenterally.
  - Response to therapy is sufficiently dramatic to be valuable in the differential diagnosis.
  - Route of administration determined by the urgency of symptom relief.
  - Salt tablets should not be used as an oral salt source.

HEAT EXHAUSTION

- Presenting complaints: thirst, syncope, profound physical fatigue, nausea, vomiting, symptomatic hyperventilation with acroparesthesia and carpopedal spasm, dyspnea, muscle cramps, confusion, anxiety and agitation, mood change, orthostatic dizziness, ataxia, hyperthermia and frontal headache.
- Frequently superimposed on other conditions that increase circulatory load, such as febrile illness, or produce fluid-electrolyte losses, such as gastroenteritis.
- Rectal temperature should be frequently monitored to ensure that core temperature is falling to normothermic levels.
- The management of heat exhaustion is directed to correcting the two pathogenic components of the illness: excessive cardiovascular demand and water-electrolyte depletion. The load on the heart is reduced by rest and cooling. Water-electrolyte depletion is corrected by administering oral or parenteral fluids.

Heat exhaustion casualties retain the ability to cool spontaneously if removed from the stressful circumstances. However, spontaneous cooling is necessarily observed only **AFTER** cooling has occurred. Casualties with incipient heat stroke and heat exhaustion are hard to distinguish initially. **THEREFORE, ACTIVE COOLING SHOULD BE PROVIDED FOR ALL CASUALTIES WHO ARE AT RISK FOR HEAT STROKE.**

- Normal saline should initially be given in 200-250 mL boluses to an amount sufficient to restore normal circulatory function. No more than 2 liters of NS should be administered without laboratory surveillance if laboratory support is available. Subsequent parenteral fluid replacement should be D5/O.5 NS or D5/0.2 NS.
- A single episode of heat exhaustion does not imply any predisposition to heat injury. Repeated episodes of heat exhaustion require thorough evaluation.

HEAT STROKE

At presentation, the distinction between heat exhaustion and incipient heat stroke is frequently impossible. Individuals who do not respond dramatically to rest and fluid-electrolyte repletion should be observed for 24 hours with laboratory surveillance for the delayed complications of heat stroke. Coagulopathy, persistent encephalopathy or persistent elevation of body temperature suggest the probability of severe heat stroke. Immediate institution of active cooling and evacuation to a rear echelon hospital is required. Active cooling should be continued throughout evacuation.

Incidence:

- Heat stroke occurs in two settings sufficiently different to produce different clinical pictures and management. The primary clinical difference between the two is that exertional heat stroke is complicated by acute rhabdomyolysis with consequent renal failure.
  - "Classical" heat stroke occurs in individuals, frequently with impaired thermoregulation due to illness or medication, exposed passively to heat and dehydration. It is principally an epidemic affliction of young children and elderly occurring during urban heat waves.
  - "Exertional" heat stroke occurs in physically active individuals experiencing substantial endogenous heat loads.

- Encephalopathy is a sine-qua-non of heat stroke. Its presentation ranges from loss of consciousness and confusion to seizures or coma with decerebrate rigidity. The etiology of encephalopathy is not known.
- Coagulopathy due to DIC is common. The principal causes of DIC seem to be thermal damage to endothelium, rhabdomyolysis, and direct thermal platelet activation causing intravascular microthrombi. Fibrinolysis is secondarily activated. Hepatic dysfunction and thermal injury to megakaryocytes slows the repletion of clotting factors.
- Hepatic injury is common. Transaminase enzyme elevation, clotting factor deficiencies, and jaundice can be seen in the course of heat stroke.
- Renal failure following heat stroke can be caused by several factors: myoglobinuria from rhabdomyolysis in exertional heat stroke, acute tubular necrosis due to hypoperfusion, glomerulopathy due to DIC, direct thermal injury and hyperuricemia.
- Rhabdomyolysis is a frequent acute complication of exertional heat stroke. Acute muscular necrosis releases large quantities of potassium, myoglobin, phosphate, and uric acid, and sequesters calcium in the exposed contractile proteins.

If heat stroke is suspected and temperature is elevated, cooling should not be delayed to accomplish a diagnostic evaluation. Cooling and evaluation should proceed simultaneously.

Diagnosis:

- Heat stroke presents as collapse with variably severe encephalopathy and hyperthermia. There may be clinical evidence of dehydration, coagulopathy or shock.
- Laboratory evaluation should be directed by the differential diagnosis appropriate for the clinical circumstances. Patients with heat stroke require serial monitoring of platelets and plasma clotting factors, renal and hepatic function, and electrolyte and acid-base status.
- Differential includes: infection (particularly meningococcemia and P. falciparum malaria), pontine or hypothalamic hemorrhage, drug intoxication (cocaine, amphetamines, phencyclidine, theophylline, tricyclic antidepressants), alcohol or sedative withdrawal, severe hypertonic dehydration, and thyroid storm.

The patient with heat stroke requires early evacuation to medical facilities with intensive care capabilities. Active cooling should be started immediately and continued during evacuation.

Treatment:

- Clinical outcome of patients with heat stroke is primarily a function of magnitude and duration of temperature elevation.
  - Most important therapeutic measure is rapid reduction of body temperature.
  - Any effective means of cooling is acceptable.
- Immersion in cool or iced water with skin massage is a classic technique for cooling heat stroke patients. Both have demonstrated effectiveness in lowering body temperature. Ice water probably produces the most rapid rate of cooling, but is uncomfortable and often difficult to obtain.

- ♦ In hot dry environments, construct field expedient immersion baths by:
  - digging plastic-lined shaded pits (The water is cooled by contact with cool subsurface sand and surface evaporation), or
  - rigging shallow canvas tubs in elevated frames in ventilated shade (The water is cooled by evaporation from the wetted canvas surface. In the case of canvas tubs, the water can cool to nearly the atmospheric dew point temperature, often as low as 50°F in deserts.)
- ♦ If immersion devices not prepared in advance, cool water can be kept in Lyster bags.

■ Cooling can also be accomplished by wetting the body surface and accelerating evaporation by fanning. The water can be applied by spraying or by application of thin conforming cloth wraps (sheets, cotton underwear).

(Circulating cooling blankets—unlikely to be available in the field situation—will also lower body temperature. Although cooling blankets have the advantage of maintaining a dry working environment, their limited contact surface provides slower cooling than immersion or surface wetting techniques. Their best use is probably maintaining normal body temperature in the period after resuscitation and rapid cooling where temperature instability is characteristic.)

■ Invasive cooling techniques (e.g., ice water lavage or enemas, peritoneal lavage with cool fluids) are NOT recommended because they do not provide faster cooling, and they do have associated complications.

- Rectal temperature should be closely monitored during active cooling; discontinue cooling at 39°C to avoid hypothermia.
- Heat stroke patients usually do not require aggressive fluid resuscitation.
  - Fluid requirements of 1 to 1.5 liters in the first few hours are typical. FLUID OVERLOAD MUST BE AVOIDED.
  - Since heat stroke patients are frequently hypoglycemic, the initial fluid should include dextrose.
- Airway control is essential. Vomiting is common.
  - Endotracheal intubation should be used in patients who cannot adequately protect their airways.
  - Supplemental oxygen should be provided when available.
  - Nasogastric intubation to control vomiting should be done as soon as practicable.
- Patients are frequently agitated, combative or seizing. Valium is effective for control and can be administered intravenously, endotracheally or rectally.
- Hyperkalemia is the most life threatening early clinical problem.
  - Measurement of plasma [K^+] is an early priority when available. Tall T-waves on the surface EKG are consistent with hyperkalemia but not definitive. The interpretation of plasma [K^+] early in the clinical course of heat stroke is difficult due to confounding electrolyte and acid-base disturbances.

- Clinically significant hyperkalemia is manifested by electrocardiographic changes including increased T-wave amplitude, slowed A-V conduction with widening of the P-R interval, diminishing P-wave amplitude and "sine wave" ventricular rhythms.
- Hyperkalemia greater than 6.5 meq/L or with electrocardiographic changes should be treated. Glucose (50 gms slow IV), insulin (20 units of regular insulin IV) and sodium bicarbonate (1-2 amps IV) will lower plasma [K^+] within minutes. Serious ventricular dysrhythmia should be treated with IV calcium chloride (1-2 amps).
- Cardiac monitoring and electrocardiography can be used to supplement laboratory monitoring for changes in plasma potassium (T-wave amplitude) and calcium (QT interval).

- Acute renal injury is common in exertional heat stroke.
  - Urinary catheterization to monitor urine output and obtain urine for [Na^+] should be done early.
  - Early management of suspected acute renal failure should include assuring adequate renal perfusion and mannitol (12.5-25 gms IV).
- After cooling and hemodynamic stabilization, continuing care is supportive and is directed at the complications of heat stroke as they appear.
  - Patients with heat stroke frequently have impaired temperature regulation for several days with alternate periods of hyperthermia and hypothermia. Constant monitoring is essential and clinically significant deviations in temperature may require either cooling or warming measures.

- The effects of rhabdomyolysis that require management are renal injury due to myoglobinuria and hyperuricemia, hyperkalemia, hypocalcemia and compartment syndromes due to muscle swelling. Assurance of adequate renal perfusion and urine flow will moderate the nephrotoxic effects of myoglobin and uric acid.
  - Hyperkalemia can be managed by Kayexalate or dialysis.
  - Hypocalcemia does not usually require treatment.
  - Increasing tenderness or tension in a muscle compartment may represent increasing intracompartmental pressures. Direct measurement of intramuscular pressure or fasciotomy should be considered at this point. Pain and paresthesias may not signal the compartment syndrome until permanent damage has occurred.
- Prognosis is worse in patients with more severe degrees of encephalopathy. Permanent neurologic sequelae can develop after heat stroke including cerebellar ataxia, paresis, seizure disorder, and cognitive dysfunction.
  - Management of encephalopathy is supportive, directed at minimizing cerebral edema by avoiding fluid overreplacement and assuring hemodynamic, thermal and metabolic stability. Intravenous mannitol has been used to treat life threatening cerebral edema if renal function is adequate. The efficacy of dexamethasone for treating heat stroke induced cerebral edema is not known.
  - Neurologic deterioration after initial recovery may represent intracranial hemorrhage related to DIC or hematoma related to trauma unrecognized at the time of initial presentation.

- Subclinical coagulopathy does not require active management, but clinically significant bleeding is an ominous sign. Treatment is directed at reducing the rate of coagulation and replacement of depleted clotting factors.
- Other complications include gastrointestinal bleeding, jaundice due to hepatic injury, aspiration pneumonia, noncardiogenic pulmonary edema, and myocardial infarction. Immuno-incompetence and infection are late complications, particularly in patients with severe renal failure.

MEDICATIONS REPORTED TO INCREASE HEAT ILLNESS RISK

Anticholinergics	Antihistamines	Amphetamines
Atropine	Diuretics	Cocaine
Scopolamine	Tricyclic antidepressants	Ergogenic aids (especially
	Major tranquilizers	those containing ephedrine)
		Alcohol
		Beta-blockers

PREPARATION OF 0.1 PERCENT SALT SOLUTION: TWO METHODS

- Add table salt directly to drinking water using any of the following proportions:

  2 ten-grain salt tablets* dissolved in 1 quart canteen

  4 ten-grain salt tablets* dissolved in 2 quart canteen

  1 1/2 level mess kit spoons dissolved in 5-gallon can

  9 level mess kit spoons dissolved in Lyster bag

  1 level canteen cup dissolved in 250-gallon water trailer

  * Salt tablets should be crushed before attempting to dissolve them.

- Prepare a saturated salt solution (approximately 26%) and add specific quantities of this 26% saturated salt solution to drinking water to make a 0.1% salt solution:

  Saturated salt solution is made by adding 9 level teaspoons of table salt to 2/3 of a canteen cup of water. Saturated salt solutions are NOT safe to drink. Be sure saturated salt solutions are properly diluted.

0.1% salt solution can be made using saturated salt solution added to plain, potable water in any of the following proportions:

1/8 canteen cap (1 qt size) added to 1 quart canteen of water

1/4 canteen cap (2 qt size) added to 2 quart canteen of water

1 mess kit spoonful added to 1 gallon can of water

5 mess kit spoonfuls added to 5-gallon can of water

1/2 canteen cup added to 250-gallon water trailer

SKIN DISEASES SEEN IN THE DEVELOPING WORLD

Note: This table lists the most commonly seen skin diseases in rural areas of tropical developing nations. Urbanization, prosperity, and higher latitude will alter the mix.

Condition	Comment
Eczema and dermatitis	Often secondarily infected
Infestations of scabies and head lice;	Often secondarily infected
Tinea (pityriasis) versicolor	Nearly universal in some populations
Pyoderma	Primary infections or secondary infected sites
Dermatophytosis	
Acne vulgaris	
Pigmentary disorders	Often pityriasis alba, melasma, and vitiligo

EMERGENCY DERMATOLOGY HEALTH KIT

Basic unit

Benzyl benzoate lotion 25%
Chlorhexidine 5%
Gentian violet, powder (needs reconstitution)
Sulfamethoxazole-trimethoprim 400/80 mg
Tetracycline eye ointment 1% in 5 gm tubes
Mebendazole, aspirin, paracetamol acetominophen

Supplementary unit

Antibiotics	Corticosteroids	Topicals and miscellaneous
Ampicillin, 250-mg tablets Ampicillin, 500-mg vials Penicillin benzathine, 2.4-mU vials Penicillin procaine, 3.4-mU vials Chloramphenicol, 250-mg capsules Chloramphenicol, 1-g vials Nystatin, 100,000 IU tablet Tetracycline, 250-mg capsules	Dexamethasone (injectable) Prednisolone (oral)	Povidone iodine 10% solution Zinc oxide 10% ointment Benzoate 6% /salicyate 3%(Whitfield's) ointment Lidocaine

TREATMENT GUIDELINES FOR SELECTED SKIN CONDITIONS

Simple guidance for the training of primary healthcare workers using the basic unit. (Adapted from World Health Organization: The New Emergency Health Kit. WHO/DAP/90.1. Geneva, 1990.)

Wounds, limited and superficial	Clean with clean soap and water with diluted chlorhexidine solution. Apply gentian violet daily
Burns, mild or moderate	Immerse immediately in cold water or use a cool compress. Continue until pain eases then treat the wounds.
Bacterial infection, mild	Clean with clean soap and water or with diluted chlorhexidine solution. Apply gentian violet twice daily.
Fungal infection	Apply gentian violet daily for 5 days.
Scabies, noninfected	Apply benzyl benzoate.
Scabies, infected	Treat mild bacterial infection as above. When infection is cured, apply benzyl benzoate.

TRI-SERVICE REPORTABLE MEDICAL EVENTS

Amebiasis
Anthrax
Biological warfare agent exposure
Botulism
Brucellosis
Campylobacteriosis
Carbon monoxide intoxication
Chemical agent exposure
Chlamydia
Cholera
Coccidioidomycosis
Cold weather injury
Cryptosporidiosis
Cyclospora
Dengue fever
Diphtheria
E. coli 0157:H7
Ehrlichiosis
Encephalitis
Filariasis
Giardiasis
Gonorrhea
Haemophilus influenzae, invasive
Hantavirus disease
Heat exhaustion
Heat stroke
Hemorrhagic fever
Hepatitis A
Hepatitis B
Hepatitis C
Influenza
Lead poisoning
Legionellosis
Leishmaniasis, unspecified
Leprosy
Leptospirosis
Listeriosis
Lyme disease
Malaria
Measles
Meningococcal disease
Mumps
Pertussis
Plague
Pneumococcal pneumonia
Poliomyelitis
Q fever
Rabies, human
Relapsing fever
Rheumatic fever
Rift Valley fever
Rocky Mountain spotted fever
Rubella
Salmonellosis
Schistosomiasis
Shigellosis
Smallpox
Streptococcal infection, grp A
Syphilis
Tetanus
Toxic shock syndrome
Trichinosis
Trypanosomiasis
Tuberculosis
Tularemia
Typhoid fever
Typhus fever
Urethritis, non-gonococcal
Vaccine adverse event report
Varicella, active duty only
Yellow fever

USACHPPM TG 273 GLOSSARY OF ACRONYMS

ACLS
Advanced Cardiac Life Support
AFB
acid fast bacilli
ALT
alanine transaminase (SGPT)
AMS
acute mountain sickness
APG
Aberdeen Proving Ground
APHA
American Public Health Association
ARDS
adult respiratory distress syndrome
ASAP
as soon as possible
AST
aspartate transaminase (SGOT)
ATP
adenosine triphosphate
BAL
bronchio alveolar lavage
BID
twice per day
BP
blood pressure
BW
biological warfare
CBC
complete blood count

CCHF
Crimean-Congo Hemorrhagic Fever
CDC
Center for Disease Control
CINC
Commander in Chief
CNS
central nervous system
CONUS
continental United States
CPAP
continuous positive airway pressure
CPK
creative phosphokinase
CPR
cardiopulmonary resuscitation
CSF
cerebrospinal fluid
CXR
chest x-ray
DF
Dengue fever
DIC
disseminated intravascular coagulation
DNA
deoxyribonucleic acid
DOD
Department of Defense
DOT
directly observed therapy
EDTA
ethylenediamine tetra-acetic acid
EKG
electrocardiogram

ELISA
Enzyme-linked Immunosorbent Assay
EPAP
expiratory positive airway pressure
ESR
erythrocyte sedimentation rate
EVAC
evacuation (medical)
FAC
free available chlorine
FDA
Federal Drug Administration
FM
field manual
GCSF
granulocyte colony - stimulating factor
GI
gastrointestinal
HACE
high altitude cerebral edema
HAPE
high altitude pulmonary edema
HARH
high altitude retinal hemorrhage
HC
hydrocarbon
HcT
hematocrit
HDCV
human diploid cell vaccine
HEPA
high efficiency particulate

HF
hydrogen fluoride
HFRS
hemorrhagic fever with renal syndrome
HGB
hemoglobin
H-HC
halogenated hydrocarbon
HI
hemagglutination-inhibition
HRIG
human rabies immune globulin
HTH
high test hyprochlorite
ICU
intensive care unit
IFA
indirect fluorescent antibody (test)
IgG
immunoglobulin G
IgM
immunoglobulin M
IM
intramuscular
IND
investigational new drug
INH
isoniazid
IU/kg
international units per kilogram
IV
intravenous

LDH
lactate dehydrogenase
LP
lumbar puncture
MDI
methylene diisocyanate
MTF
military treatment facility
MTWTF
miosis, tachycardia, weakness, hypertension, and fasciculations
MW
molecular weight
NATO
North Atlantic Treaty Organization
NBC
nuclear biological chemical
NFCI
non-freezing cold injury
NNMC
National Naval Medical Center
NSAID
nonsteroidal antiinflammatory drug
NTE
neuropathic target esterase
OCONUS
outside continental United States
OD
once per day
OP
organophosphates
OSHA
Occupational Safety and Health Administration
PCE
perchlorethylene

PCR
polymerase chain reaction
PEEP
positive end expiratory pressure
PNS
peripheral nervous system
PO
by mouth
PPD
purified protein derivative
PT
prothrombin time
PTT
partial thromboplastin time
PVC
premature ventricular contractions
QD
per day
QID
four times per day
RADS
reactive airways dysfunction syndrome
RBC
red blood cell
RNA
ribonucleic acid
SEB
staphylococcal enterotoxin B
SLUDGE
salivation, lacrimation, urination, defecation, gastroenteritis, emesis
SMX
sulfamethoxazole
TB
tuberculosis

TCA
trichloroethane
TCE
trichloroethylene
TG
technical guide
TIA
transient ischemic attacks
TIC
toxic industrial chemical
TID
three times per day
TMP
trimethoprim
UAE
United Arab Emirates
USCENTCOM
U.S. Central Command
USAID
U.S. Agency for International Development
USAMRIID
U.S. Army Medical Research Institute of Infectious Diseases
UV
ultraviolet
VEE
Venezuelan equine encephalitis
VF
ventricular fibrillation
VHF
Venezuelan hemorrhagic fever
VT
ventricular tachycardia
WBC
white blood cell count

WNL
within normal limits
WP
white phosphorus
WRAMC
Walter Reed Army Medical Center

PART ONE: ENDEMIC INFECTIOUS DISEASES

PART TWO: EXPOSURE TO BIOLOGICAL WARFARE AGENTS

PART THREE: EXPOSURE TO CHEMICAL WARFARE AGENTS

PART FOUR: TOXIC INDUSTRIAL CHEMICAL EXPOSURES

PART FIVE: ILLNESSES DUE TO ENVIRONMENTAL STRESSORS