Technical Annexes

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Guidance Notes

These annexes contain compilations of frequently used reference information. This information has helped us analyze field data, generate REA and health situation reports, and answer countless questions from our colleagues. Selected comments follow below.
Humanitarian Programs (Annex 8.1)
Annex 8.1 contains conceptual frameworks on global clusters, humanitarian assistance, program implementation, and early recovery.

Security Sector (Annex 8.2)
Annex 8.2 contains key definitions from the Rome Statute of the International Criminal Court.

Health Sector (Annex 8.3 with glossary)
Annex 8.3 contains a broad range of core health technical information including environmental classification of water and excreta-related diseases, disease prevention measures, water treatment end points, anthropometric classifications, micronutrient deficiency states, management of chemical weapon exposures, and epi methods.

Tropical Medicine (Annex 8.4 with glossary)
Annex 8.4 contains clinical summaries of selected tropical infectious diseases. It briefly overviews pathophysiology, differential diagnosis, and management keys. The accompanying tables provide disease-specific profiles which identify the disease vector and host, clinical presentation, diagnostic lab tests, clinical epidemiology, and therapy. Table 1 on Vector-Borne and Zoonotic Diseases is organized by vector. Table 2 on Non Vector-Borne Diseases is organized by phylogeny. For detailed information on these and other communicable diseases, please refer to references cited in Section 1.

Epidemic Preparedness and Response (Annex 8.5)
Annex 8.5 contains core principles of epidemic preparedness and response.

Communicable Disease Control (Annex 8.6 with glossary)
Annex 8.6 contains an overview of selected communicable diseases of epidemic potential whose incidence, management complexity, or mortality obliges particular attention. These diseases are: diarrhea, influenza, malaria, measles, meningitis, and viral hemorrhagic fever.

Disease profiles are structured to quickly orient field staff to key issues in:
- Pathogens
- Epidemiology
- Preventive medicine
- Epidemiological surveillance
- Clinical medicine
- Epidemic management

This overview is designed to supplement the superb communicable disease toolkits produced by the WHO Communicable Disease Working Group on Emergencies. Those published toolkits are disaster-specific and typically include the following reference information:
- Health Risks for Infectious Diseases
- Risk Factors for Outbreak in Emergency Situations
- Case Definitions for Health Events
- Suggested Alert threshold to Trigger Further Investigation
- Steps in Outbreak Management
- Outbreak Alert Form
- Case Investigation Form
- Flowchart for Laboratory Confirmation of [list disease]
- Diseases Under Surveillance which Require Laboratory Confirmation

Diagnostic Laboratory (Annex 8.7 with glossary)
Annex 8.7 contains guidance on lab specimen handling and testing.

Acronyms (Annex 8.8)
Annex 8.8 contains acronyms commonly used in disaster management and humanitarian assistance (DM/HA).
Annex 8.1
HUMANITARIAN PROGRAMS

I. HUMANITARIAN ASSISTANCE VALUES AND GOALS

A. Core Values
   1. Humanity
   2. Impartiality
   3. Neutrality
   4. Independence

B. Goals
   1. Save lives
   2. Alleviate suffering
   3. Reduce economic and social impact of disaster
   4. Maintain peace and security
   5. Uphold law and order (host government)
   6. Support vulnerable groups
   7. Implement durable solutions (UNHCR)
      a. repatriation
      b. local integration
      c. resettlement
   8. Mitigate hazards

II. GLOBAL CLUSTERS AND LEADS (IASC [1, 2])

A. Technical Areas
   1. Nutrition UNICEF
   2. Health WHO
   3. Water/sanitation UNICEF
   4. Emergency shelter IDPs from conflict UNHCR
   5. Food security IFRC

B. Cross-cutting Areas
   1. Camp coordination IDPs from conflict UNHCR
   2. Protection IOM
   3. Early recovery UNHCR
   4. Education UNDP

C. Common Service Areas
   1. Logistics WFP
   2. Emergency telecoms WFP

III. SECTORS AND THEMES

A. Sectors
   1. Coordination
   2. Protection and Registration
3. Security and Demobilization
4. Logistics
5. Site Planning
6. Water and Sanitation
7. Food Aid
8. Agriculture
9. Non-food Aid (household support)
10. Shelter
11. Health
12. Rehabilitation
13. Education and Training
14. Economic Recovery and Community Development
15. Durable Solutions

B. Cross-cutting Themes (IASC)
1. Human Rights & Protection
2. Gender
3. HIV/AIDS
4. Environment

C. Themes Per Donor Grants Guidelines
1. Artisanal Production
2. Capacity Building/Training
3. Cash Distribution
4. Cash for Work
5. Children
6. Conflict Resolution
7. Gender Relations
8. HIV/AIDS
9. Host Communities
10. Host Government
11. IDPs
12. Information Systems
13. Infrastructure Rehabilitation
14. Livelihoods/Income Generation
15. Market Rehabilitation
16. Micro-Finance/Micro-Credit
17. Nomads/Pastoralists
18. Protection Mainstreaming
19. Returnees
20. Slavery/Trafficking
21. Vouchers

IV. RELIEF PROGRAMS

A. Keys to Emergency Relief (M Toole, Burnet Institute, Melbourne, Australia, unpublished)
1. Intervene early
2. Support, not undermine, community coping strategies
3. Prevent communities from migrating
4. Avoid establishing large refugee camps
5. Establish a health information system
6. Ensure resources provided do not further divide communities
7. Focus on disease prevention
8. Work through existing structures and institutions
9. Insist that women control the distribution of relief supplies
10. Ensure open communication and coordination

B. Implementation Principles
1. Address identified needs in underserved areas
2. Encourage local participation
3. Integrate beneficiaries into program planning
4. Collaborate with all stakeholders
5. Coordinate with all implementing partners
6. Plan comprehensive approaches
7. Develop community-based programs
8. Make inter-sectoral linkages (sector-wide approaches)
9. Use existing resources
10. Leverage outside resources of donors and private sector
11. Build on existing platforms
12. Apply international best practices
13. Target vulnerable populations
14. Focus on high impact activities
15. Ensure equitable access to services
16. Provide assistance acceptable to beneficiaries
17. Implement with cultural sensitivity
18. Reduce the local burden of disease
19. Enhance capacities
20. Reduce vulnerabilities
21. Alleviate poverty
22. Avoid dependency
23. Foster sustainable development
24. Support governmental priorities
25. Operate cost-effectively, transparently, and accountably

C. Implementation Mechanics
1. Reallocation of existing local & national resources
2. Revision/refinement of present (medical) practices
   a. use of essential drugs
   b. use of standardized case management
   c. elimination of dated practices
3. Financial assistance (critical funding)
4. Technical assistance (critical skills)
   a. complement donated goods
   b. support appropriate technology
   c. develop information systems
5. Material assistance (critical goods)
   a. essential drugs and vaccines
   b. consumable supplies
   c. other stated needs of health authorities
6. Direct service provision (substitution)
7. Coordination of external assistance
   NB cooperation = shared goals; coordination = shared tasks; collaboration = shared resources
   a. identification and registration of actors
   b. actor/area/activity (who/what/where) matrix
   c. gap analysis and priority setting
   d. establishment of rapid response mechanism
e. gap filling via complementary inputs linking iNGOs & local NGOs to local health authorities
   (1) technical
   (2) material
   (3) financial
f. identification of deliverables and timetables
g. consolidated reporting and dissemination
   (1) group terms of reference
   (2) meeting minutes
   (3) epidemiology updates
   (4) health sitreps
   (5) component analysis
   (6) field documentation (toolkit) for new arrivals

8. Capacity building of host authorities
9. Civil society partnership and support
   a. organize community leaders
   b. encourage gender mainstreaming
   c. encourage privatization
   d. discourage entitlements
10. Advocacy
11. Transition to early recovery

D. **Strategy for Livelihood/Economic Relief**

1. Restore productive assets (supply side interventions)
   a. in-kind donations (e.g. food, seeds, tools, fishing nets, etc.)
   b. types of community projects in food-for-assets programs
      (1) natural resources development
         (a) water harvesting
         (b) soil conservation
      (2) restoration of agri(aqua)culture potential
         (a) irrigation systems
         (b) seed systems
      (3) infrastructure rehabilitation
         (a) schools
         (b) market places
         (c) community granaries
         (d) warehouses
         (e) roads
         (f) bridges
      (4) diversification of livelihoods
         (a) training and experience sharing

2. Increase individual purchasing power
   a. cash distribution
   b. cash for work (cash for assets)
   c. vouchers
   d. micro-credit
   e. job fairs
   f. artisanal production
   g. livelihoods/income generation

3. Support market resumption
   a. market rehabilitation
   b. infrastructure rehabilitation
   c. micro-finance institutions
E. **Strategy for Early Recovery**

Goals—protect what’s left (1 month), restore the system (6 months), improve the system (6 months)

1. **Adopt systems approach**
   a. health services
   b. health workforce
   c. medical logistics (drugs, vaccines, equipment, supplies, & technology)
   d. health information system
   e. health financing
   f. leadership & governance

2. **Phase in assistance to beneficiaries**
   a. technical assistance
   b. material assistance
      (1) food
      (2) non-food items
   c. financial assistance
      (1) cash grants
      (2) cash for work
      (3) microfinance (loans)
      (4) livelihood/income generation

3. **Ensure responsible resource management**
   a. human resources management
      (1) incident management command and control
      (2) team structure and function
      (3) staff selection
         (a) internationals
         (b) homologues
      (4) field activities
         (a) briefing
         (b) meetings and reports
         (c) debriefing
      (5) operations support
         (a) comms
         (b) transport
         (c) office
         (d) food and lodging
      (6) personal health maintenance and morale
   b. material resources management
   c. financial resources management
   d. supervision
   e. monitoring and evaluation

4. **Scale up coverage of priority health interventions**

5. **Address bottlenecks of the disrupted health system (otherwise temporary solutions become permanent)**

6. **Protect essential public health infrastructures**

7. **Build capacity of local authorities with focus on sustainable systems**
   a. technical oversight—hiring of local experts
   b. material assistance—production of key commodities
   c. financial assistance

8. **Provide incentives for host government**

9. **Support host country non-beneficiary population**

10. **Find new partners in the development community**

11. **Use health Sustainable Development Goals as targets for recovery activities**

12. **Seek opportunities and develop mechanisms for transition and phase out**
F. Program Constraints and Failures

1. Programmatic constraints
   a. staff
      (1) western trained
      (2) hospital-based
      (3) resource intensive
      (4) technology dependent
      (5) procedurally oriented
      (6) invasive
      (7) monolingual
      (8) hazard naïve
   b. supervision
      (1) limited responsibility
      (2) limited authority
      (3) limited accountability
   c. projects
      (1) acute
      (2) curative
      (3) short-term
      (4) intermittent
   d. systems
      (1) inadequate security
      (2) weak rule of law
      (3) limited accountability framework
      (4) uncoordinated humanitarian action

2. Project feasibility constraints
   a. security
   b. political
   c. administrative
   d. logistical
   e. technical
   f. economic
   g. developmental

3. Hazard-specific constraints (complex emergencies)
   a. hostile armed elements
   b. limited access
   c. overburdened provincial services
   d. limited information on beneficiaries

V. HUMANITARIAN FINANCING [3]

A. Shrink the Needs
B. Deepen the Resource Base
C. Improve Delivery (Grand Bargain [4] on Efficiency)

1. Transparency
2. Frontline responders
3. Cash-based programming
4. Management cost reductions
5. Joint and impartial needs assessments
6. Participation revolution—including beneficiaries in decision-making
7. Multi-year humanitarian funding
8. Fewer earmarks
9. Harmonized/simplified reporting
10. Engagement between relief and development actors

VI. RESILIENCE (hazards + environment + infrastructure + institutions + livelihoods)

A. Comprehensive Disaster Risk Management
   1. DRM/DRR (where risk = hazard × vulnerability; also likelihood × impact)
   2. Hazard and vulnerability analysis
   3. Hazard and structural mitigation (e.g. climate change adaptation plans)
   4. Disaster plans
      a. all-hazard plans vs. hazard-specific plans
      b. preparedness plans
      c. contingency plans
      d. evacuation plans
      e. repurposing plans
      f. business continuity plans
      g. recovery plans
      h. R2D considerations
   5. Early warning/early action systems
   6. Emergency operation centers
   7. Emergency relief supply systems
   8. Disaster simulation exercises, table tops, drills

B. Political
   1. Proactive legislation and policy (not reactive)
   2. Clear non-overlapping mandates
   3. Funding commitment to comprehensive disaster management
   4. Vertical and horizontal linkages in policy implementation
   5. Comprehensive approaches to ecosystem protection rather than fragmentation based upon political jurisdictions
   6. Generic approaches to managing technical (best) practices, but local approaches to managing community vulnerabilities
   7. Communication and cooperation enabled between public and private sector, national level and local communities, and individual jurisdictions

C. Socioeconomic
   1. Environmental impact of population growth
   2. Environmental impact of dominant practices in land use and key livelihood sectors—agriculture, mining, manufacturing, pastoralism, etc.
   3. Environmental and economic impact of hazard-specific zones, damages, and losses on biodiversity, ecosystems, and communities
   4. Poverty alleviation and economic diversification programs
   5. Inclusiveness thru use of gender disaggregated data
   6. Indigenous knowledge and contribution to DRR
   7. (Re)insurance mechanisms

D. Institutional
   1. Leadership training programs
   2. Transparent resource management
   3. Open redundant communication channels
4. Streamlined work flows
5. Robust information management and information sharing
6. MEAL programs
7. Accountability frameworks
8. Inter-agency coordination
9. Partnership development

E. Environment and Infrastructure
1. Hazard zoning
2. Hazard and structural mitigation
3. Remote sensing and early warning systems
4. Preventive maintenance

F. Community Capacities and Vulnerabilities
1. Lifeline protection (key infrastructure assets and systems)
   NB food for assets (using food, cash, or vouchers) programs can help build physical assets listed below (see IV D 1 b)
   a. security
   b. communication
   c. transportation
   d. energy
   e. environmental health (e.g. water supply, food security, shelter and housing)
   f. public health (e.g. disease surveillance, primary prevention)
   g. health
      (1) safe hospitals program
   h. education to achieve a literate and informed public
   i. information and DRR technologies
2. Social protection and safety nets (focus on women, vulnerable groups)
3. Livelihood protection

VII. DEVELOPMENT PROGRAMS
A. Strategic Objectives (USAID Policy Framework for Bilateral Foreign Aid [5])
1. Promote transformational development
   Support far-reaching, fundamental changes in relatively stable developing countries, with emphasis on improvements in governance and institutions, human capacity, and economic structure, so that countries can sustain further economic and social progress without depending on foreign aid. Focus on those countries with significant need for assistance and with adequate (or better) commitment to ruling justly, promoting economic freedom, and investing in people.
2. Strengthen fragile states
   Reduce fragility and establish the foundation for development progress by supporting stabilization, reform, and capacity development in fragile states when and where U.S. assistance can make a significant difference.
3. Support strategic states
   Help achieve major U.S. foreign policy goals in specific countries of high priority from a strategic standpoint.
4. Provide humanitarian relief
   Help meet immediate human needs, save lives, and alleviate suffering in countries afflicted by violent conflict, crisis, natural disasters, or persistent dire poverty.
5. Address global issues
   HIV/AIDS, other infectious diseases, climate change, direct support for international trade agreements, and counter narcotics.
B. Approaches (USAID Gender Equality and Female Empowerment Policy [6])
   1. Adopt inclusive approach
   2. Integrate gender equality into all work
   3. Build partnerships
   4. Harness science, technology, and innovation
   5. Address unique challenges in crises and conflict-affected communities
   6. Serve as thought leader
   7. Be accountable

C. Partnership Mechanisms (US National Strategy for Pandemic Influenza [7])
   1. International cooperation to protect lives and health
   2. Timely and sustained high-level political leadership to the disease
   3. Transparency in reporting of cases of disease in humans and in animals caused by strains that have pandemic potential to increase understanding, enhance preparedness, and ensure rapid and timely response to potential outbreaks
   4. Immediate sharing of epidemiological data and clinical samples with the World Health Organization (WHO) and the international community to characterize the nature and evolution of any outbreaks as quickly as possible
   5. Prevention and containment of an incipient epidemic through capacity building and in-country collaboration with international partners
   6. Rapid response to the first signs of accelerated disease transmission
   7. Work in a manner supportive of key multilateral organizations (WHO, FAO, OIE)
   8. Timely coordination of bilateral and multilateral resource allocations; dedication of domestic resources (human and financial); improvements in public awareness; and development of economic and trade contingency plans
   9. Increased coordination and harmonization of preparedness, prevention, response and containment activities among nations
   10. Actions based on the best available science

D. Program Innovations at Community Level
   1. Community interventions
      a. sector-wide approaches (SWAps)
      b. integrated health interventions
         (1) PHC
         (2) SPHC
         (3) IMCI
      c. home-based interventions
         (1) CTC
      d. microfinance
         (1) Grameen Bank
   2. Best practice program models (centers of excellence arising within a community)
      a. Matlab Health Research Center (part of ICDDR, Bangladesh)
      b. Shoklo Malaria Research Unit, Tak Province, Thailand
      c. Fistula Hospital, Addis Ababa, Ethiopia
      d. Behrhorst Clinic, Guatemala
   3. Self-replicating centers of excellence
      a. Fistula Hospital, Addis Ababa, Ethiopia
VIII. SEEDS OF CHANGE

A. Innovators
B. Thought Leaders
C. Change Agents
D. Early Adopters
E. Craft Groups
F. Centers of Excellence
G. Communities of Practice
H. Global Alliance
I. Crowds

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6. USAID. Gender equality and female empowerment policy. Available from https://www.usaid.gov/sites/default/files/documents/1865/GenderEqualityPolicy_0.pdf.
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Annex 8.2
SECURITY SECTOR

I. DEFINITIONS (Rome Statute [1])

A. Crimes (within the International Criminal Court’s Jurisdiction) (Article 5)
   1. Genocide (Article 6)—acts committed with intent to destroy, in whole or in part, a national, ethnic, racial, or religious group
      a. killing members of the group
      b. causing serious bodily or mental harm to members of the group
      c. inflicting on the group conditions of life calculated to bring about its physical destruction in whole or in part
      d. imposing measures intended to prevent births within the group
      e. forcibly transferring children of the group to another group
   2. Crimes against humanity (Article 7)—acts committed as part of a widespread or systematic attack against any civilian population, with knowledge of the attack
      a. murder
      b. extermination
      c. enslavement
      d. deportation
      e. imprisonment in violation of international law
      f. torture
      g. rape, sexual slavery, enforced prostitution, forced pregnancy, enforced sterilization, or other comparable form of sexual violence
      h. persecution on political, racial, national, ethnic, cultural, religious, gender, or other grounds universally recognized as impermissible under international law
      i. enforced disappearance
      j. apartheid
      k. other inhumane acts intentionally causing great suffering or serious injury to body or to mental or physical health
   3. War crimes (Article 8)
      a. grave breaches of the Geneva Conventions of 12 Aug 1949
         (1) willful killing
         (2) torture or inhumane treatment including biological experiments
         (3) willfully causing great suffering
         (4) extensive destruction and appropriation of property
         (5) compelling a POW to serve in the armed forces of a hostile power
         (6) willfully depriving a POW of the right to a fair trial
         (7) unlawful deportation
         (8) taking of hostages
      b. serious violations of laws and customs applicable in international armed conflict
         (1) intentionally directing attacks against the civilian population or against civilians not taking direct part in hostilities
         (2) intentionally directing attacks against civilian objects
         (3) intentionally directing attacks against personnel, installations, material, units, or vehicles involved in humanitarian assistance or peacekeeping mission
         (4) intentionally launching an attack in the knowledge that it will cause incidental civilian loss of life or severe damage to the natural environment
         (5) attacking undefended towns, villages, dwellings, or buildings which are not military targets
         (6) killing or wounding a combatant who has surrendered
         (7) improper use of a flag of truce, flag or insignia or uniform of the enemy or of the UN, or emblems of the Geneva conventions resulting in death or serious personal injury
(8) transfer by the Occupying Power of parts of its own civilian population into the territory it occupies, or the deportation or transfer of all or parts of the population of the occupied territory within or outside the territory

(9) intentionally directing attacks against buildings dedicated to religion, education, art, science, charitable purposes, historic monuments, hospitals, and places where sick are collected, provided they are not military objectives

(10) subjecting persons to physical mutilation or to medical or scientific experiments which are not justified by the medical treatment nor carried out in his/her interest

(11) killing or wounding treacherously individuals belonging to the hostile nation or army

(12) declaring that no quarter will be given

(13) destroying or seizing the enemy’s property unless such be imperatively demanded by the necessities of war

(14) declaring abolished, suspended, or inadmissible in a court of law the rights and actions of the nationals of the hostile party

(15) compelling the nationals of the hostile party to take part in the operations of war directed against their own country

(16) pillaging a town or place, even when taken by assault

(17) employing poison or poison weapons

(18) employing asphyxiating, poisonous or other gases, and all analogous liquids, materials, or devices

(19) employing bullets which expand or flatten easily in the human body

(20) employing weapons, projectiles, material and methods of warfare which cause superfluous injury or unnecessary suffering

(21) committing outrages upon personal dignity, in particular humiliating and degrading treatment

(22) committing rape, sexual slavery, enforced prostitution, forced pregnancy, enforced sterilization, or other comparable form of sexual violence

(23) utilizing a civilian or other protected person to render certain areas or military forces immune from military operations

(24) intentionally directing attacks against buildings, material, medical units, transport, and personnel using the emblems of the Geneva Conventions in conformity with international law

(25) enlisting or enlisting children under the age of 15 years

c. serious violations of common article 3 applicable in non-international armed conflict, i.e. acts vs. persons taking no active part in the hostilities, including armed forces placed hors de combat by sickness, wounds, detention, or other cause

(1) violence to life and person

(2) outrages upon personal dignity

(3) taking of hostages

(4) passing of sentences and carrying out of executions

d. non-applicability of c (above) to internal disturbances (riots, sporadic violence, etc.)

e. other serious violations of laws and customs applicable in non-international armed conflict

4. Crime of aggression (provision to be adopted)

II. SECURITY OBJECTIVES

A. Unimpeded Access to Beneficiaries

1. Registration/verification

2. Protection

3. Humanitarian assistance

4. Family reunification

5. Information dissemination
B. Security for Refugees and Humanitarian Personnel
C. Law Enforcement (perpetrators of violence are arrested, charged, and tried in a civil court of law)
D. Free and Informed Choices
E. Program Participation of Beneficiaries (especially women)
F. Relocation (only if voluntary, people are medically fit, and families are united)

III. DISCRIMINATION PRETEXTS
A. Age
B. Gender
C. Race
D. Religion
E. Ethnicity
F. Geographic Origin
G. Socioeconomic Status
H. Sexual Orientation
I. Disability Status
J. HIV Status
K. Migratory Status
L. Forced Displacement

IV. ROLE OF HIC/OSOCC/CMOC
A. Access Negotiations
B. GIS, Maps, and Analysis
C. Interagency Convoys
D. Pipeline Monitoring
E. Contingency Planning

V. HEALTH CONSEQUENCES OF SECURITY BREAKDOWN
A. Decreased Access and Protection for Beneficiaries
B. Increased Morbidity and Mortality
   1. Direct trauma
   2. Diseases of overcrowding and displacement
   3. Outbreaks of preventable and controlled diseases
   4. Untreated chronic illnesses
   5. Excess mortality in affected population
C. **Degradation of Health System**
   1. Degradation/destruction of health infrastructure
   2. Degradation/disruption of health services
   3. Attrition of health personnel
   4. Disruption of medical logistics
   5. Increased demand for health financing
   6. Weaknesses in health governance

D. **Loss of Human Capital and Physical Assets**

E. **Loss of Development Opportunity**

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**Annex 8.3**  
**HEALTH SECTOR**

**Glossary**

| Abbreviation | Description |
|--------------|-------------|
| ABX          | antibiotics |
| AFP          | acute flaccid paralysis |
| AIDS         | acquired immune deficiency syndrome |
| ASDR         | age-specific death rate |
| BCG          | bacillus Calmette-Guérin |
| BMI          | body mass index |
| c            | with |
| cc           | cubic centimeter |
| CDR          | crude death rate |
| CFR          | case fatality ratio |
| CI           | confidence interval |
| cm           | centimeter |
| CSS          | cluster sample survey |
| CTC          | community therapeutic care (malnutrition management program) |
| d            | day |
| D5           | dextrose 5% in water |
| D10          | dextrose 10% in water |
| D&C          | dilation and curettage |
| D_{eff}      | design effect |
| DTP          | diphtheria + tetanus + pertussis vaccine |
| DRR          | disaster risk reduction |
| EOC          | Emergency Operations Center |
| EPI          | Expanded Programme on Immunization |
| gm           | gram |
| GAM          | global acute malnutrition |
| gtt          | drops |
| h            | hour |
| H            | height |
| HAM          | height-for-age median |
| HAZ          | height-for-age z score |
| HB           | hepatitis B |
| HCW          | health care worker |
| HH           | household |
| Hib          | *Haemophilus influenzae* type b |
| HIV          | human immunodeficiency virus |
| ICDDR        | International Centre for Diarrhoeal Disease Research, Bangladesh |
| ICS          | incident command system |
| ID           | infectious disease |
| IMCI         | Integrated Management of Childhood Illness (WHO initiative) |
| IMPAC        | Integrated Management of Pregnancy and Childbirth (WHO initiative) |
| IMR          | infant mortality rate |
| IPD          | inpatient department |
| IV           | intravenous |
| kg           | kilogram |
| L            | liter |
| L&D          | labor and delivery |
| m            | meter |
| MAM          | moderate acute malnutrition |
| MCI          | mass casualty incident |
I. DISASTER HEALTH CORE DISCIPLINES

A. Clinical Medicine
   1. Prehospital care
   2. Primary, preventive, and basic services
      a. comprehensive primary health care
      b. child health services
      c. reproductive health services
      d. trauma services
      e. mental health services
      f. chronic diseases
      g. infection control
   3. Referral care

B. Public Health
   1. Rapid epidemiological assessment (minimum essential data sets)
   2. Inter-agency health coordination
   3. Standardized case management
   4. Environmental health (minimum standards)
   5. Epidemic preparedness and response
   6. Disease surveillance (surveillance case definitions, data flow, and analysis)
   7. Special surveys (cluster sample surveys)
   8. Health policy and personnel planning
   9. Immunization programs (EPI)
   10. Medical logistics

C. Disaster Management
   1. Site security
   2. Urban search and rescue
   3. Hazard-specific issues (hazard analysis, mitigation, vulnerability reduction)
   4. Disaster response modalities (ICS/EOC)
   5. Geographic information systems
   6. Public information
   7. Community recovery

D. WHO Mandated Responsibilities in Disaster
   1. Core functions (World Health Assembly Res 58.1)
      a. needs assessment
      b. health coordination
      c. gap filling
      d. capacity building
      NB protection & nutrition are beyond the mandate of WHO
   2. Critical functions in emergency response (WHO Emergency Response Framework)
      a. leadership
      b. information
      c. technical expertise
      d. core services

II. PRIMARY HEALTH CARE PROGRAMS

A. Primary Health Care (Alma Ata Declaration [1])
   1. Health Education
   2. Food and Nutrition
3. Water and Sanitation  
4. Maternal and Child Health, Family Planning  
5. Immunization  
6. Prevention of Endemic Disease  
7. Treatment of Common Disease and Injury  
8. Essential Drugs  

B. Selective Primary Health Care (Walsh and Warren [2])  
1. Growth Monitoring  
2. Oral Rehydration Therapy  
3. Breast Feeding  
4. Immunization  
5. Female Literacy  
6. Family Planning  
7. Food Supplements

III. DISEASE PREVENTION  

A. Definitions  
1. Primary (individual without disease)  
   Goal—prevent the disease from starting (consider host-agent-environment)  
   a. limit pathogenesis of a disease-causing agent (e.g. lower cholesterol levels)  
   b. alter the environment to keep the disease from humans (e.g. regulate asbestos exposures)  
   c. strengthen host resistance to the disease (e.g. measles immunization, water fluoridation)  
2. Secondary (individual with disease but without symptoms)  
   Goal—prevent disease symptoms and complications from developing  
   a. intervene after exposure (e.g. rabies vaccination)  
   b. detect and treat disease before it becomes symptomatic (e.g. cancer screening)  
   c. prevent disease spread by treating contacts (e.g. TB exposure treatment)  
3. Tertiary (individual with symptomatic disease)  
   Goal—cure or control of clinical disease (bulk of clinical medicine)  
   a. cure disease or reverse clinical manifestations (e.g. appendectomy, thrombolysis)  
   b. control disease progression to avoid complications (e.g. retroviral drugs, anticoagulation in atrial fibrillation)  
   c. control spread of disease to others (e.g. TB case management)  

B. Great Public Health Achievements—US, 1900–9999 (CDC [3])  
1. Vaccination  
2. Motor-vehicle safety  
3. Safer workplaces  
4. Control of infectious diseases  
5. Decline in deaths from coronary heart disease and stroke  
6. Safer and healthier foods  
7. Healthier mothers and babies  
8. Family planning  
9. Fluoridation of drinking water  
10. Recognition of tobacco use as a health hazard

C. Great Public Health Achievements—US, 2001–2010 (CDC [4])  
1. Vaccine-preventable diseases  
2. Prevention and control of infectious diseases  
3. Tobacco control
4. Maternal and infant health
5. Motor vehicle safety
6. Cardiovascular disease prevention
7. Occupational safety
8. Cancer prevention
9. Childhood lead poisoning prevention
10. Public health preparedness and response

D. **Vaccinations**

1. Infant schedule (WHO)

   | Age   | Vaccine                                      |
   |-------|----------------------------------------------|
   | Birth | BCG, HB-1, ± OPV birth dose                  |
   | 6 wks | DTP-1, OPV/IPV-1, HB-2, Hib-1, PCV-1, RV-1   |
   | 10 wks| DTP-2, OPV/IPV-2, HB-3, Hib-2, PCV-2, RV-2  |
   | 14 wks| DTP-3, OPV/IPV-3, HB-4, Hib-3, PCV-3, RV-3  |
   | 9–12 mo| MCV-1 (e.g. MR or MMR)                      |
   | 15 mo | MCV-2                                        |

NB Table does not convey all options for vaccine administration. Diphtheria toxoid is not manufactured as monovalent vaccine. It is combined with tetanus toxoid—either full-strength dose for pediatric use (DT), or reduced-strength dose for adult use (Td). These are combined with acellular or whole-cell pertussis antigens—either full-strength dose for pediatric use (DTaP, DTwP), or reduced-strength dose for adolescent/adult use (Tdap).

DTP-1 is a good indicator of access to care. DTP-3 is a good indicator of ultimate service delivery.

2. Immunization program

   | Intervention                  | Polio   | Measles                  |
   |-------------------------------|---------|--------------------------|
   | Routine immunization          | +       | +                        |
   | Supplementary immunization    | National immunization days (NID) | Supplementary immunization activities (SIA) |
   | Surveillance                  | Acute flaccid paralysis (AFP) | Case-based |
   | Case follow-up                | Mop-up campaign | Case management |

3. Vaccine quantities

   | Indicator & benchmark         | Quantity |
   |-------------------------------|----------|
   | Total population              | 100,000  |
   | Target population (6 mo–15 yr 45% total) | 45,000   |
   | Cover objective = 100%        | 45,000   |
   | Number of doses (1 for measles) | 45,000   |
   | Expected loss 15%             | 52,940   |
   | Increase reserve by 25%       | 66,175   |
   | Round up                      | 67,000   |
IV. CLINICAL FACILITIES

A. Generic Profile

| Fixed Clinics | Health Centers | Dist Hospitals |
|--------------|----------------|---------------|
| 5–10k        | <50k           | 100k          |

1. Quantity
2. Catchment population
3. Access to facility
4. Staffing
   a. quantity (~1/1000 p)
      2–5 staff
   b. skill mix
      1 HCW
      5 HCW, 1 MD
      5 MD, 1 surg
5. Caseload (% of catchment population/d)
6. Bed capacity (10/10,000 population)
7. Bed occupancy
8. Referral load (% of caseload)
9. Referral system
10. Clinical services
    a. departments/units (verify functioning of expected services)
       (1) clinical
          a. OPD
             + + +
          b. IPD
             – + +
          c. L&D
             – + +
          d. surgery
             – +/- +
       (2) dispensary
          +/- + +
       (3) diagnostic lab
          +/- + +
       (4) blood bank
          – – +
       (5) radiology
          – – +

V. REPRODUCTIVE HEALTH

A. Safe Motherhood (IMPAC, MISP)

NB 15% of pregnant women have complications requiring emergency OB care; 5% (3–7%) need C-section; 10% of deliveries will have primary post-partum hemorrhage within 24 h

1. Causes of maternal death
   a. other emergencies 22%
   b. hemorrhage 18%
   c. eclampsia 12%
   d. obstructed labor 8%
   e. sepsis 9%
   f. unsafe abortion 18%
   g. other indirect (malaria, HIV) 13%

2. Basic emergency obstetric care (1 facility/125k pop)
   a. parenteral antibiotics
   b. parenteral oxytocics
   c. parenteral anticonvulsants for pre-eclampsia & eclampsia
   d. manual removal of placenta
   e. removal of retained products (vacuum aspiration, D&C)
   f. assisted vaginal delivery (vacuum, forceps)

3. Comprehensive emergency obstetric care (as above plus below) (1 facility/500k pop)
   a. Caesarean section (5–15% of deliveries)
   b. blood transfusion
4. Treatment of obstructed labor
   a. McRoberts maneuver—flex thighs at the hips and push knees to maternal abdomen
   b. pressure on suprapubic area
   c. proctoeptiotomy
   d. Wood’s corkscrew maneuver—rotate shoulders 180° or to an oblique diameter to disengage the impacted shoulder
   e. delivery of the posterior arm (>incidence of humerus and clavicle fractures)
   f. symphysiotomy
   g. Zavanelli maneuver—replace head into the vagina and perform C-section

5. Essential newborn care
   a. basic newborn resuscitation
   b. warmth (drying and kangaroo care)
   c. eye prophylaxis (tetracycline ointment)
   d. clean cord care
   e. early and exclusive breast feeding

VI. WATER AND SANITATION

A. Classification (D Mara, R Feachem [5])

| Diseases                        | Pathogen/disease                                      | Preventive Measures                                      |
|--------------------------------|-------------------------------------------------------|----------------------------------------------------------|
| Fecal-oral = water-borne + water-washed | virus—hepatitis A/E/F, polio, rotavirus, adenovirus | water-washed: > H₂O quantity water-borne: > H₂O quality |
|                                | bacteria—Campylobacter, E. coli, Salmonella, Shigella, Vibrio |                                                          |
|                                | protozoa—Entamoeba, Balantidium, Cryptosporidium, Giardia, Isospora |                                                          |
|                                | helminths—Ascaris, Enterobius                         |                                                          |
| Non-fecal-oral water-washed    | skin infections—scabies, leprosy, yaws               | > H₂O quantity; > hygiene education                      |
|                                | eye infections—trachoma, conjunctivitis              |                                                          |
|                                | louse-borne fevers                                    |                                                          |
| Water-based                    | bacteria—Leptospira, Francisella, Legionella          | < contact with contaminated H₂O                          |
|                                | helminths—Schistosoma, Clonorchis, Fasciola, Paragonimus, Dracunculus |                                                      |
| Insect-vectored, water-related mosquitoes (breeding in water), flies (biting/breeding near water) | malaria, dengue, Rift Valley fever, Japanese encephalitis, yellow fever, sleeping sickness, oncho, filariasis | destroy breeding sites; use barrier precautions (ITNs) |
| Insect-vectored, excreta-related flies, cockroaches | includes all fecal-oral diseases + water-based helminths + geohelminths + taeniasis |                                                          |
| Rodent-vectored                | similar to insect-vectored, excreta-related but includes all water-based pathogens listed (except Legionella) | > rodent control; < contact with contaminated H₂O         |
| Geohelminths                   | roundworm, hookworm, whipworm                        | excreta disposal                                          |
| Taenia                         | beef and pork tapeworm                                | excreta disposal; proper meat cooking                     |

Source: D Mara, R Feachem in *Journal of Environmental Engineering* © 1999. Used with permission of ASCE
B. Prevention (adapted from R Feachem [6])

| Disease                                      | Prevention Measures | H₂O quality | H₂O quantity | Excreta disposal | Excreta Tx | Personal hygiene | Waste H₂O disposal | Food hygiene |
|----------------------------------------------|---------------------|-------------|--------------|------------------|-----------|-----------------|-------------------|-------------|
| Diarrheal disease & enteric fevers           |                     |             |              |                  |           |                 |                   |             |
| Viral                                         |                     | 2           | 2            | 1                | 1         | 2               | 0                 | 1           |
| Bacterial                                     |                     | 3           | 3            | 2                | 1         | 3               | 0                 | 3           |
| Protozoal                                     |                     | 1           | 3            | 2                | 1         | 3               | 0                 | 2           |
| Polio, Hepatitis A                            |                     | 1           | 3            | 2                | 1         | 3               | 0                 | 1           |
| Water-washed (skin, eye, louse-borne disease) |                     | 0           | 3            | 0                | 0         | 3               | 0                 | 0           |
| Water-based                                   |                     |             |              |                  |           |                 |                   |             |
| Schisto                                       |                     | 1           | 1            | 3                | 2         | 1               | 0                 | 0           |
| Guinea worm                                   |                     | 3           | 0            | 0                | 0         | 0               | 0                 | 0           |
| Clonorchis                                    |                     | 0           | 0            | 2                | 2         | 0               | 0                 | 3           |
| Water-related                                 |                     |             |              |                  |           |                 |                   |             |
| Malaria                                       |                     | 0           | 0            | 0                | 0         | 0               | 1                 | 0           |
| Dengue, YF                                    |                     | 0           | 0            | 0                | 0         | 0               | 1                 | 0           |
| Filariasis                                    |                     | 0           | 0            | 3                | 0         | 0               | 3                 | 0           |
| Worms without intermediate host               |                     | 0           | 1            | 3                | 2         | 1               | 0-1               | 1-2         |
| Worms with intermediate host                  |                     | 0           | 0            | 3                | 3         | 0               | 0                 | 3           |

Source: R Feachem in Water Supply and Sanitation in Developing Countries © 1983. Used with permission of Chartered Institution of Water and Environmental Management

A range of generic prevention measures should be considered for its impact on diseases in a biological “all-hazards” environment. Overall, excreta disposal, water quantity, personal hygiene, and food hygiene commonly contribute more to environmental health than do other listed measures. Epidemic threats will oblige heightened consideration of disease-specific strategies for prevention and control.

C. Water Treatment (bold of particular relevance in clinical facilities)

1 ppm = 1 mg/kg (solids)

= 1 mg/L (liquids) = 1 μg/mL (liquids) = basic unit of measure for chloroscopes

:. 10,000 ppm = 1%

| PPM  | Equivalents                | Concentration % | Use                                                      |
|------|----------------------------|-----------------|----------------------------------------------------------|
| 0.5  | 0.5 mg/L                   | 0.00005%        | piped water systems, goal for all end user drinking water|
|      | 0.0005 g/L, mg/mL          |                 |                                                          |
|      | 0.00005 g/100 mL           |                 |                                                          |
| 1    | 1 mg/L                     | 0.0001%         | standpost systems                                        |
|      | 0.001 g/L, mg/mL           |                 |                                                          |
|      | 0.0001 g/100 mL            |                 |                                                          |
| 2    | 2 mg/L                     | 0.0002%         | pre-treatment for selected/known water sources—tanker trucks at filling stations, protected tube wells, clear rainwater |
|      | 0.002 g/L, mg/mL           |                 |                                                          |
|      | 0.0002 g/100 mL            |                 |                                                          |
| 5    | 5 mg/L                     | 0.0005%         | pre-treatment for untested/unknown water sources—unprotected wells, cloudy surface water; filter/floculate before chlorinating |
|      | 0.005 g/L, mg/mL           |                 |                                                          |
|      | 0.0005 g/100 mL            |                 |                                                          |
VII. FOOD AND NUTRITION

Malnutrition is #1 risk to child health worldwide. It contributes to an estimated 2.5 M out of 6.3 M U5 deaths/year.

A. Prediction and Early Warning Systems

1. FEWS NET products
   a. Food Security Outlook (FSO)—assumptions and 8-mo projections issued 3x/year
   b. Food Security Outlook Update (FSOU)—update mid-term between FSOs
   c. Key Messages (KM)—precedes FSO
   d. Price Bulletin (PB)
   e. Food Assistance Outlook Brief (FAOB)—regional outlook

| PPM  | Equivalents | Concentration % | Use |
|------|-------------|-----------------|-----|
| 10   | 10 mg/L     | 0.001%          | water with known fecal contamination; filter/flocculate before chlorinating |
| 30   | 30 mg/L     | 0.003%          | water from contaminated well or borehole (needs super-chlorination to achieve breakpoint chlorination) |
| 50   | 50 mg/L     | 0.005%          | utensil rinse in restaurants (USA) |
| 500  | 500 mg/L    | 0.05%           | hands, skin (e.g. wash points) |
| 2000 | 2000 mg/L   | 0.2% (0.5% at ICDDR) | cholera cots, covers, floors, walls, equipment, clothing, isolation areas (cholera, dysentery, influenza epidemics) |
| 10,000 | 10,000 mg/L | 1%              | latrine door handles |
| 20,000 | 20,000 mg/L | 2%              | body fluids (stool, vomitus)—stool buckets, corpses (disinfection for burial), shoes (perimeter control) |
| 50,000 | 50,000 mg/L | 5%              | household bleach |

Table 8.3.7
Chlorine Products and Dilution

| Product                                       | Potable Water Treatment 0.0005% | Hands and Skin Cleaning 0.05% | Bedding/clothes Cleaning 0.5% | Body Fluid/corpses Cleaning 2.0% |
|----------------------------------------------|---------------------------------|-------------------------------|-------------------------------|---------------------------------|
| Household bleach Sodium hypochlorite solution 5% active chlorine (50 mg/mL) | 2.5 mL (0.5 t)/5 gal ≈ 8 gtt/gal; 2 gtt/L; 2.5 mL × 50 mg/mL = 125 mg Cl in 20 L ≈ 6 mg/L, or 6 PPM NB double if source is contaminated | 100 mL in 10 L water | 1 L in 10 L water | 4 L in 6 L water |
| Bleaching powder Chlorinated lime 30% active chlorine | 16 g (1 T) to 10 L water | 16 g (1 T) to 1 L water | 64 g (4 T) to 1 L water |
| High-test hypochlorite (HTH) Calcium hypochlorite Chlorine granules 70% active chlorine | 7 g (0.5 T) to 10 L water | 7 g (0.5 T) to 1 L water | 28 g (2 T) to 1 L water |
2. **FEWS NET distribution calendar**
   a. January—Key Messages (KM)
   b. **February**—Food Security Outlook (FSO)
   c. March—Key Messages (KM)
   d. April—Food Security Outlook Update (FSOU)
   e. May—Key Messages (KM)
   f. **June**—Food Security Outlook (FSO)
   g. July—Key Messages (KM)
   h. August—Food Security Outlook Update (FSOU)
   i. September—Key Messages (KM)
   j. **October**—Food Security Outlook (FSO)
   k. November—Key Messages (KM)
   l. December—Food Security Outlook Update (FSOU) (optional)

B. **Protein-calorie Malnutrition**

1. **Screening**
   U5—mid-upper arm circumference (MUAC) used as a screening tool in pedes and adults. In pedes, < 13.5 cm or edema is referred for W/H measurements.

2. **Individual diagnosis**
   a. pedes (U10)
   anthropometrics: $\Delta W/H$ before $\Delta W/Age$ before $\Delta H/Age$
   Acute $\leftrightarrow$ Chronic

| Combined Anthropometrics | W/H % of Median |
|-------------------------|-----------------|
|                         | $>80\%$ (NL)    | $<80\%$ |
| H/Age % of Median       |                 |
| >90% (NL)               | NL              | Wasted  |
| <90%                    | Stunted         | Wasted & stunted |

**Acute Malnutrition** (Wasting)

| Mild acute              | $-2 \leq z < -1$ | $80\% \leq % WHM < 90\%$ | $12.5 \leq MUAC < 13.5$ |
| Moderate acute (MAM)    | $-3 \leq z < -2$ | $70\% \leq % WHM < 80\%$ | $11.5 \leq MUAC < 12.5$ |
| Severe acute (SAM)      | $z < -3$ or symmetrical edema | WHM $< 70\%$ or symmetrical edema | MUAC $< 11.5$ or symmetrical edema |
| Global acute (GAM)      | $z < -2$ or symmetrical edema | WHM $< 80\%$ or symmetrical edema | MUAC $< 12.5$ or symmetrical edema |

**Chronic Malnutrition** (Stunting)

| Mild stunting           | $-2 \leq z < -1$ | $85\% \leq % HAM < 90\%$ |
| Moderately stunted      | $-3 \leq z < -2$ | $85\% \leq HAM < 90\%$ |
| Severely stunted        | $z < -3$ or symmetrical edema | $HAM < 85\%$ or symmetrical edema |

**Underweight**

| Mild                     | $-2 \leq z < -1$ |
| Moderate                 | $-3 \leq z < -2$ |
| Severe                   | $z < -3$ or symmetrical edema |

| Chronic Malnutrition     | H/Age % of Median |
|-------------------------|-----------------|
| (Stunting)              |                 |
| Mild stunting           | $-2 \leq z < -1$ | $85\% \leq % HAM < 90\%$ |
| Moderately stunted      | $-3 \leq z < -2$ | $85\% \leq HAM < 90\%$ |
| Severely stunted        | $z < -3$ or symmetrical edema | $HAM < 85\%$ or symmetrical edema |

Note: in U2, length is the preferred term over height
Wasting

- WHO defines three types of severe malnutrition: severe wasting (SAM), severe stunting, and edematous malnutrition. This last includes kwashiorkor and marasmic kwashiorkor in the Wellcome classification.
- SAM = severe wasting cases or bilateral pitting edema cases (where due to malnutrition)
- SAM = WHZ < −3, MUAC < 11.5 cm, or bilateral pitting edema (WHO). WHM not in definition.
- SAM prevalence worldwide ≈ 20,000,000.
- SAM mortality ≈ 9× mortality of normally nourished child and its CFR can be 10–50%.
- GAM = MAM + SAM
- GAM = moderate wasting cases, severe wasting cases, or bilateral pitting edema cases (where due to malnutrition)

Underweight

- Underweight is not used for screening or surveys in nutritional emergencies. It reflects past (chronic) and present (acute) undernutrition and is unable to distinguish between them. It encompasses children who are wasted and/or stunted. However, weight gain over time can be a sensitive indicator of growth faltering which is easily tracked on Road to Health charts.

Stunting

- Stunting generally occurs before age 2. It is irreversible.
- Stunting prevalence worldwide ≈ 165,000,000.
- Stunting is not a good predictor of mortality, but the CFR from IDs in cases of severe stunting ≈ 3× the CFR from IDs in cases without stunting.

Reference standards can be absolute MUAC, centile, % of median reference, or z scores:

- MUAC
- Easy to understand. An excellent predictor of mortality. Permits comparisons between age groups insofar as the low growth velocity of MUAC in the U5 age group makes data roughly comparable. May be used alone in “quick-and-dirty” convenience samples to estimate local prevalence of wasting. However, not used alone in authoritative anthropometric surveys, and is commonly part of a two stage screening process to determine eligibility for feeding programs.
- Centiles
- Easy to understand. Permits comparisons between age groups and outliers. However, data are not convenient to convert.
  E.g. \( z \cdot -4.0 = 0.0032\text{nd percentile} \)
- % of Median of reference population WHM is the preferred indicator to determine eligibility for feeding programs (Sphere). Calculations are easy and are used in the WHO Road to Health Charts.
  However, median reference data are not comparable between ages.
  eg 60% wt-for-age = severe malnutrition in infants  
      = moderate malnutrition in school age kids
  Moreover, median reference data are not comparable between indicators.
  eg 60% wt-for-age = severe malnutrition in infants  
      60% wt-for-ht = death
- Z scores
- Preferred indicator (Sphere, WHO) for reporting anthropometry survey results because it permits comparisons between age groups and nutritional indices.
  However, data may be difficult to understand.
  eg \( z \text{ score wt-for-age for } 1 \text{ y/o}: \)
  \[
  z = \frac{wt_{pt} - wt_{ref\ pop}}{SD_{ref\ pop}}
  \]
  \[
  = \frac{6.1\ kg - 10.1\ kg}{1.0}
  \]
  \[
  = -4 \text{ SD below median for his age}
  \]
Overall:
WHZ gives higher prevalence of malnutrition than WHM for the same population. This is most marked where there is low baseline prevalence of disease, and especially for adolescents (who get subsequently over-referred).
WHZ is more statistically valid, but WHM is better predictor of mortality and is used for admission to TFCs. Weight-for-age is influenced by weight-for-height and height-for-age. It can be difficult to interpret.

b. adults and adolescents (O10)
anthropometrics: BMI = weight (kg)/height (m)^2

| Nutritional Status | BMI (adults & adolescents) | MUAC (cm) (adults) | MUAC (cm) (pregnant & lactating) |
|--------------------|----------------------------|--------------------|----------------------------------|
| Obese              | 30+                        |                    |                                  |
| Overweight         | 25 ≤ BMI < 30              |                    |                                  |
| NL                 | 18.5 ≤ BMI < 25            |                    |                                  |
| Mild malnutrition  | 17 ≤ BMI < 18.5            | 16.0 ≤ MUAC < 18.5 | 17.0 ≤ MUAC < 18.5              |
| Severe malnutrition| BMI < 16 or edema or < 5% of 10–18 yr reference population | MUAC < 16.0 or edema | MUAC < 17.0 or edema |
| Global (mod + severe)| BMI < 17 or edema | MUAC < 18.5 or edema | MUAC < 18.5 or edema |

3. Population prevalence (U5)
a. survey key attributes
  (1) representative at unit of analysis
  (2) robust (>25 clusters recommended)
  (3) standardized (standardization test done)
  (4) data normally distributed (check standard deviation)
  (5) findings plausible (plausibility score)
b. preferences for indicator and methods (IPC)
  (1) GAM by WHZ from representative survey >
  (2) GAM by WHZ from sentinel sites >
  (3) GAM by MUAC from representative survey >
  (4) GAM by MUAC from exhaustive screening >
  (5) GAM by MUAC from sentinel sites >
  (6) GAM by MUAC from screening

Malnutrition Classification

| Malnutrition        | Acceptable (Low) | Poor (Med) | Serious (High) | Critical (Very high) |
|---------------------|------------------|------------|----------------|---------------------|
| Wasting (GAM)       | <5               | 5–9        | 10–14          | ≥15                 |
| Underweight         | <10              | 10–19      | 20–29          | ≥30                 |
| Stunting            | <20              | 20–29      | 30–39          | ≥40                 |

Source: World Health Organization. In: Global Database on Child Growth and Malnutrition © 2017. Used with permission of WHO
Acute Food Security Classification

Table 8.3.12
Area Food Security Reference Table (adapted from IPC [9])

| Phase Classification | Reference Data |
|----------------------|----------------|
| **Phase 1—Minimal** | CDR < 0.5/10,000/d, USD < 1/10,000/d |
| generally food secure | GAM < 5% |
| (green) | Food consumption usually adequate (> 2100 kcal/p/d) |
| | Livelihood assets sustainable utilization |
| **Phase 2—Stressed** | CDR < 0.5/10,000/d, USD < 1/10,000/d |
| borderline food insecure (yellow) | GAM 5–10% |
| | Food consumption borderline adequate (2100 kcal/p/d) |
| | 20%+ of HH c livelihood assets stressed & unsustainable utilization (livelihood deficit) |
| | Non-food expenditures (schools, health care) decrease |
| **Phase 3—Crisis** | CDR 0.5–1/10,000/d, USD 1–2/10,000/d |
| acute food and livelihood crisis (orange) | GAM 10–15% or greater than usual and increasing |
| | 20%+ of HH c food consumption gaps (<2100 kcal/p/d or 2100 kcal/p/d via asset stripping) (survival deficit) |
| | Livelihood assets accelerated & critical depletion |
| **Phase 4—Emergency** | CDR 1–2/10,000/d, USD > 2–4/10,000/d (excess mortality) |
| (red) | GAM > 15–30% or greater than usual and increasing |
| | 20%+ of HH c food consumption gaps marked (<2100 kcal/p/d) |
| | Livelihood assets near complete & irreversible depletion |
| **Phase 5—Famine** | CDR > 2/10,000/d, USD > 4/10,000/d |
| (maroon) | GAM > 30% |
| | 20%+ of HH c food consumption grossly inadequate (<< 2100 kcal/p/d) |
| | Livelihood assets complete loss |

Source: IPC Global Partners © 2016. Used with permission of IPC Global Partnership.

4. **Therapy**
   - IPC Phase 2 needs livelihood support.
   - IPC Phase 3+ needs above plus nutritional support.

Table 8.3.13
Nutritional Support of Malnourished Population

| Nutritional Status | Therapy |
|--------------------|---------|
| Mild acute (GAM > 10%) | Adequate general ration |
| Moderate acute (GAM > 10%) | Above + supplementary feeding or community therapeutic care |
| Severe acute (SAM > 2%) | Therapeutic feeding, community therapeutic care, or hospitalization |
**General Food Distribution (GFD)**

2100 kcal/p/d requires 12 kg food/p/mo or ≈ 15 kg food/p/mo in logistics pipeline.
Ration—WFP commonly aims for 50% ration in settings where resources are limited.
Cost—$1000/MT Title II bulk food from US sources

**Preventive Intervention** (for populations on edge of frank malnutrition)

Targeted—see SFP below

**Community Management of Acute Malnutrition (CMAM)**

4 Components:
Stabilization Center (SC)
admission criteria: age 6–59 mo, SAM (MUAC < 11.5 cm, WHZ < −3, or edema), anorexia, or severe medical complications
treatment: F75, F100, IVF, ABX
discharge criteria: appetite recovered, medical complication improved, pitting edema decreased, and clinically well

Outpatient Therapeutic Program (OTP)
admission criteria: age 6–59 mo, SAM (MUAC <11.5 cm), appetite intact, and no severe medical complications
treatment: RUTF (e.g. Plumpy’Nut® nutritionally = F100)
discharge criteria: 15% weight gain (from entry weight), no bilateral pitting edema x2 wks, and 2 mo minimum observation/treatment period

Supplementary Feeding Program (SFP)
blanket—all HH in geographically targeted catchment area (e.g. where IPC 3+ and GAM > 15% or 10–14% with aggravating factors)
targeted—some HH in catchment area (e.g. where GAM 10–14% or 5–9% with aggravating factors); U5 and pregnant or lactating women vs. U5 alone vs. U2 alone depending on resources available and challenges with case finding
overall programmatic target—50% coverage for SAM in rural areas (Sphere); 30% coverage for MAM in rural areas

admission criteria:

pedes: age 6–59 mo, MUAC <12.5 cm, with appetite, discharged from OTP, no severe medical complications
pregnant & lactating: MUAC <21.0 cm, and 2nd–3rd trimester or with infant <6 mo
treatment: RUSF as dry rations e.g. Plumpy’Sup®, CSB, CSB + (supercereal), CSB ++ (supercereal +)

NB CSB may also be cooked on-site as in emergency school feeding.
discharge criteria (pedes): weight gain, MUAC >12.5 cm, time in program > 2 months

Community Outreach with Mobile Brigades

**Therapeutic Feeding Program**

Admission criteria for U5: SAM (WHZ < −3, MUAC < 11.5 cm, or bilateral pitting edema)
Discharge criteria for U5: WHZ >−2.5, no edema, and clinically well (generally takes 4–6 weeks)

Treatment protocol (WHO, ICDDR)

Shock Severe dehydration: RL + D5, ½ strength Darrow’s + D5,
or ½ NS + D5Dose: 100 cc/kg IV

| Age     | Initial bolus                      | Balance                                      |
|---------|-----------------------------------|----------------------------------------------|
| <1 year | 30 cc/kg IV over 1 h              | 70 cc/kg IV over 5 h                         |
| >1 year | 30 cc/kg IV over ½ h              | 70 cc/kg IV over 2 ½ h                       |
| If severely malnourished (WHO) | 15 cc/kg IV over 1 h + ReSoMal 10 cc/kg by NGT | if improved after initial bolus, repeat 15 cc/kg IV over 1 h + ReSoMal 10 cc/kg/h PO/NGT × 10 h; if not improved after initial bolus, assume septic shock |
| If severely malnourished (ICDDR) | 20 cc/kg IV over 1 h               | 10 cc/kg/h over 10 h + ORS 5–10 cc/kg PO after each loose stool |
Dehydration

Moderate dehydration (5–10%): ReSoMal PO or NGT

With malnutrition: Dose 75–100 cc/kg PO/NGT over 12 h given as 5 cc/kg/half h × 4, then 5–10 cc/kg/h × 10 h (WHO)

Without malnutrition: Dose 75–100 cc/kg PO over 4 h (if age > 1 yr) or over 6 h (if < age 1 yr) (ICDDR)

NB ICDDR does not use ReSoMal but prefers rice-based ORS for all patients with diarrhea

Feeding c therapeutic milks—F75 (Phase 1), F100 (Phase 2)

D10 or F75 for hypoglycemia; blankets/warmer for hypothermia

3 Rx—ABX, mebendazole, antimalarial

Adjuncts—vitamins A–D, minerals, measles vaccine, Fe (only in rehab phase)

a. process indicators
   (1) daily average weight gain at TFC: > 8 g/kg/p

b. outcome indicators
   (1) cure
   (2) complications (~25% SAM will have medical complications)
   (3) death (~25% SAM will die with good care, and 50% will die with mediocre care)

Table 8.3.15
Exit Indicators in Therapeutic Feeding Programs

| Setting/reference | Exit indicator         | Cure | Mortality | Default | Non-Response |
|-------------------|------------------------|------|-----------|---------|--------------|
| TFC               | Target (SPHERE)        | >75% | <10%      | <15%    |              |
|                   | Target (NGO)           | >80% | <5%       | <10%    |              |
|                   | Alert (NGO)            | <50% | >15%      | >25%    |              |
| SFC               | Target (SPHERE)        | >75% | <3%       | <15%    |              |
|                   | Target (NGO)           | >75% | <3%       | <15%    | <20%         |
|                   | Alert (NGO)            | <50% | >10%      | >30%    | >30%         |

C. Micronutrient Deficiency

Table 8.3.16
Micronutrient Deficiency States

| Micronutrients | Disease | Clinical Findings |
|----------------|---------|-------------------|
| Vitamins       |         |                   |
| A (Thiamine)   | Avitamnosis A | night blindness, xerophthalmia, Bitot’s spots, corneal ulcer/keratomalacia, corneal scars |
| B₁ (Riboflavin)| Pellagra | dermatitis (sun-exposed areas e.g. Casal’s necklace; tongue bright red), diarrhea, dementia, death (4 Ds) |
| B₂ (Riboflavin)| Scurvy  | gingivitis, dental loosening, petechiae, delayed wound healing |
| D (Folate)     | Anemia  | glossitis, others as per anemia below |
|                | Scurvy  | gingivitis, dental loosening, petechiae, delayed wound healing |

Minerals

| Micronutrients | Disease | Clinical Findings |
|----------------|---------|-------------------|
| I (Iodine)     | Hypothyroid | goiter, cretinism (mental retardation, short stature, squint, deaf-mutism) |
| Zn (Zinc)      | Zinc deficiency | diarrhea, delayed wound healing |

Other Cofactors

| Micronutrients | Disease | Clinical Findings |
|----------------|---------|-------------------|
| Fe (Iron)      | Anemia  | fatigue, dyspnea, pallor, mental dullness |

(#1 nutritional disorder in the world)
### VIII. CHEMICAL WEAPONS

#### A. Chemical Agents

| Chemical agents | Physical Characteristics | Systems Affected | Sx | Decon First Aid | Tx Antidote |
|-----------------|--------------------------|------------------|----|-----------------|-------------|
| **Blister**     | oily light yellow-brown liquids with odor of garlic | eye—few hrs; resp & derm—2–24 h; **lethal in large doses** | red skin, blisters, eye burning, coughing | remove agent, S&W, flush with dilute bleach | none, supportive care |
| Mustard (H, HD, HN) | | | | | |
| **Blister**     | oily colorless liquid with odor of geraniums | derm—immediate pain; **lethal in large doses** | skin pain or irritation, eye burning, coughing | remove agent, S&W, flush with dilute bleach | BAL, supportive care |
| Lewisite (L)    | | | | | |
| **Blister**     | solid < 95° F but vaporizes | derm—immediate pain; **lethal in large doses** | skin pain, wheals, eye burning, coughing | remove agent, S&W, flush with dilute bleach | none, supportive care |
| Phosgene oxime (CX) | | | | | |
| **Blood**       | rapid evaporating liquids with odor of bitter almonds; gas lighter than air | resp, heme—death in min; **highly lethal** | cherry red skin or lips, rapid respirations, dizziness, HA, seizures, death | usually none; leave area, aeration, S&W | amyl nitrite, Na thiosulfate |
| Cyanide (AC)    | | | | | |
| **Blood**       | rapid evaporating liquids with odor of bitter almonds; gas heavier than air | resp, heme—death in min; **highly lethal** | cherry red skin or lips, rapid respirations, dizziness, HA, seizures, death | usually none; leave area, aeration, S&W | amyl nitrite, Na thiosulfate |
| Cyanogen Cl (CK) | | | | | |
| **Choking**     | rapid evaporating liquid with odor of mown hay | resp, derm—death in days; **lethal in large doses** | eye and resp irritation | leave area, aeration, s&w, eye irrigation | none, supportive care |
| Phosgene (CG)   | | | | | |
| **Choking**     | gas at room temp | resp—death in days; **lethal in large doses** | eye & resp irritation, chest tightness, delayed pulm edema | leave area, aeration, S&W, eye irrigation | none, supportive care |
| Chlorine (Cl)   | | | | | |
| **Nerve**       | colorless, odorless liquid; G agents less volatile than water | resp—seconds to minutes; derm—min to hrs; **highly lethal** | blurry vision, twitching, chest tightness, SOB, SLUDGE, Brady, broncho-spasm, seizures | remove agent, S&W, flush with dilute bleach | atropine, 2-PAM |
| Tabun (GA), Sarin (GB), Soman (GD) | | | | | |
| **Nerve**       | slight yellow colored liquid at room temp; V agents as volatile as motor oil | resp—seconds to minutes; derm—min to hrs; **highly lethal** | blurry vision, twitching, chest tightness, SOB, SLUDGE, Brady, bronchospasm, seizures | remove agent, S&W, flush with dilute bleach | atropine, 2-PAM |
| VX | | | | | |
| **Riot control** | gas at room temp | resp—seconds; non-lethal | eye & resp irritation | leave area, aeration, S&W, eye irrigation | none |
| Tear gas (CS), Mace (CN) | | | | | |

**Notes:**
- BAL: British anti-Lewisite
- 2-PAM: 2-pyridine aldoxime methyl chloride
- S&W: soap and water
- SLUDGE: salivation, lacrimation, urination, defecation, GI distress, emesis
- SOB: shortness of breath
B. **Management of MCI from Suspected Chemical Weapons** (adapted from Domestic Preparedness Training [10])

Overarching rule: **all responders should wear personal protective equipment to avoid becoming a victim.**

**Notification Phase (RAIN)**

1. **Recognize a problem**
   a. mass casualties
   b. syndromic casualty pattern
   c. dissemination device
   d. warning from perpetrator
   e. patient (host)—compelling symptoms
   f. agent—identifiable sights or smells
   g. environment—dead animals
2. **Avoid**
   a. distance—100 m from chemical attack, 300 m from explosion
   b. direction—upwind, upgrade, upstream
   c. 4 don'ts—don’t become a victim, don’t rush in, don’t TEST (taste, eat, smell, touch), don’t assume anything
3. **Isolate**
   a. cordon off the area to extent possible
   b. isolate the casualties
4. **Notify authorities**
   a. informant
   b. agent released
   c. immediate morbidity and mortality
   d. signs and symptoms
   e. type of device/vehicle/container—specify sights, smells, sounds
   f. secondary disaster of fire or explosion
   g. wind direction, weather conditions
   h. witnesses
   i. lead responder
   j. actions taken
   k. actions forthcoming
   l. meeting place for responders
   m. follow-up contact (time, means, channel)

**Response Phase**

1. **Site security**
   a. position equipment upwind, upgrade, and upstream from incident site
   b. isolate the area including downwind vapor hazard area
   c. establish hot (ambient hazard), warm (contaminated victims), and cold (clean treatment) zones
2. **Staff protection**
   a. PPE for providers in the hot zone
   b. ICS to manage the incident
   c. SOPs to guide responder actions
3. **Social controls (PINS)**
   a. Preserve evidence
   b. Identify the agent
   c. Neutralize contaminated areas
   d. Search for secondary devices
4. **Environmental and case management**
   a. corral casualties and victims
   b. establish decontamination stations
c. perform decontamination
d. provide first aid—triage, treat, transport

**Emergency Self-decontamination**
1. Wet or blot (blotting for chemical contamination; wetting down for bio or nuclear contamination)
2. Strip off clothing
3. Flush the affected area with water or dilute bleach
4. Cover the affected area

**C. Implications for Disaster Management**
1. Forensic
2. Clinical
3. Epidemiological
4. Pharmacological
5. Environmental
6. Social
7. Judicial
8. Political

**IX. EPI METHODS**

**A. Study Types**
1. Assessments and appraisals
2. Surveys
3. Surveillance
4. Screening

**B. Study Designs**
1. Prospective
   a. concurrent (cohort)
   b. nonconcurrent (retrospective cohort or trohoc)
2. Retrospective, case control

Measures of association quantify the strength or magnitude of the association between the exposure and the health problem of interest. They are independent of the size of the study and may be thought of as best guess of the true degree of association in the source population. However, they give no indication of the association’s reliability.

- cohort study—relative risk (RR) = riskexposed/riskunexposed
- in acute outbreaks, risk is represented by the attack rate (AR)
- case-control study—odds ratio (OR)
- no denominator with which to calculate an attack rate
- cross-sectional—prevalence ratio or prevalence odds ratio

**C. Survey Designs** (see R Magnani [11], and F Checchi [12])
1. Census—complete enumeration of the entire population
2. Sample
   a. probability sampling
      1. simple random sampling (SRS)
      It requires a complete enumeration of population $N$—names and locations of all persons or households (HH)—and sample size $n$
      NB Much effort is necessary to conform to requirements of random sampling. It is easier to sample less often but take more specimens as a cluster. Unfortunately, it is recognized that individuals from a cluster often share characteristics which < the precision of the method.
(2) systematic random sampling
It requires a complete enumeration of population $N$, and sample size $n$, to calculate the skip interval $k = \frac{N}{n}$.

(3) stratified random sampling
It requires a population size $N$ divided into groups or strata $L$, then SRS within each stratum. The method ensures over-sampling in under-represented groups. It yields separate estimates for each stratum at less cost. However, it requires extra info and has complicated analysis.

(4) cluster sampling, cluster sample survey (CSS)
It is used when you don’t have a complete enumeration $N$ of all people in the area, and thus can’t do random sampling; or when the area is too big to cover, and thus can’t do systematic random sampling.

- What should be done to compensate for the bias induced when one samples clusters rather than individuals? Use $2n$. Empiric data on association within clusters in smallpox immunization suggests doubling $n$. If $n = 96$, $2n = 192$.
- What is the minimum number of clusters that can be selected and still fulfill requirements of the theory on which binomial sampling is based? 30. Statistical theory demonstrates that $>30$ clusters help ensure cluster means have a normal distribution. The larger the number of clusters, the smaller the design effect (i.e. study efficiency improves, and the total number of study subjects needed will decrease). E.g. $40 \times 20 (n = 800)$ will prove more accurate and efficient than $30 \times 30 (n = 900)$. 50 clusters $\times$ 30 households will be more precise, but 30 clusters $\times$ 50 households may be more logistically feasible. Choice of cluster should be driven by what one team can complete in a day. $30 \times 30$ CSS leaves 7.5 min/HH/team, but $45 \times 18$ CSS leaves 15 min/HH/team. If a team can only measure 20 kids/day (which is common), then it’s best to increase the number of smaller clusters.
- To permit an equal number of children to be selected from each of 30 clusters, 6 children would not achieve the necessary $n$. Therefore, 7 children are selected per cluster ($30 \times 7 = 210$).

b. non-probability sampling
(1) convenience
(2) purposeful/judgment (most affected area, HHs, etc.)
(3) quota

D. Bias (see R Magnani [11], F Checchi [12], and SMART [13])
Systematic, non-sampling error which lowers accuracy of findings. It is usually not appreciated by the survey team. It is usually not apparent from the survey results. It cannot be arithmetically calculated or corrected. Its extent cannot be judged by readers of the report. Methods and materials must be explicit. Report authors must discuss possible sources of bias as limitations to their study. Accuracy depends on validity of findings. It is more important than precision (Section E), and bias should be prevented at all costs. Awareness of sources of bias is the first step in minimizing its impact on any study. As sample size increases, it is more difficult to control quality. More teams to train and supervise create higher risk of bias. It is better to have smaller sample size with less attendant precision but much less risk of bias.

1. Selection bias—respondents are not representative of the population
   a. project bias—assessors work where a project may be conceptually familiar to them
   b. spatial/access bias—assessors work where access is easiest (roadside or “windshield” bias)
   c. refusal or non-response bias (self-selection) bias—subject nonparticipation may undermine representativeness of the sample
   d. survivor bias—assessments are conducted where households have disappeared due to family death or migration. Mortality rate is thereby underestimated. This bias is most likely where HH size is low, recall period is long, mortality is high, and clustering is present.
e. class/ethnic bias—different social classes or ethnic groups are inadequately included if not excluded from the assessment. Local assessors may have ethnic bias, or the key informants may be drawn from one particular social class or ethnic group.

f. season bias—assessments are conducted during harvest season or periods of weather when segments of the population may be under-represented.

g. time of day/schedule bias—assessments are conducted at a time of day when segments of the population may be under-represented.

NB Items 2–3 below may also be grouped as information/measurement bias.

2. Interview bias
   a. interviewer bias
      (1) cultural bias—assessors cultural norms lead to incorrect assumptions about the interview subjects.
      (2) mandate or specialty bias—assessors mandate or specialty blinds them to needs outside of that mandate or specialty. E.g., a shelter specialist may only assess shelter needs while neglecting livelihood or nutrition needs.
      (3) gender bias—assessors interview only one gender
      (4) language bias—assessors may have a limited spectrum of people with whom they can communicate
      (5) key informant bias—assessors may be partial to key informants who appear credible in ways meaningful to the assessors
      (6) information/political bias—assessors focus on information that confirms preconceived notions rather than pursue evidence of alternate beliefs
      (7) mistranslation
      (8) interviewer error—assessors write down answers incorrectly
   b. subject (response) bias
      (1) event recall bias—retrospective surveys only, esp. with recall periods > 1 yr
         (a) informants underreport remote events (e.g. neonatal deaths)
         (b) calendar bias—informants over report events within the recall period
      (2) event reporting bias
         (a) taboos—informants underreport taboo subjects (e.g. neonatal deaths)
         (b) lies—informants misinterpret surveys as registration activities and over report family members or underreport deaths to maintain assistance
         (c) political bias—informants present information that conforms to their political agenda
      (3) age heaping/digit preference—informants exhibit digit preference

3. Instrument/measurement bias—errors in design or use of instrument (e.g. questionnaire, lab equipment, etc.)
   a. random errors in measurement
      random errors in weight measurement, even if yielding equal numbers of high and low measurements, widen the distribution curve without altering the mean. Hence, the prevalence of malnutrition is overestimated. The effect is greater for severe malnutrition than for moderate malnutrition, and greater when prevalence is low than when it is high. The data distribution should be checked for normal distribution with an SD between 0.8 and 1.2 z scores. Improving the data quality thus appears to reduce the prevalence of malnutrition.
   b. systematic errors in measurement
      systematic errors in weight measurement, even if small (e.g. 30 g error in presence of clothing), may alter the mean, but also widen the distribution curve. Hence, the prevalence of malnutrition is overestimated. Systematic errors in height measurement, such as erroneous lengthboard, may alter the mean without altering the SD. If the measurement is too short, there will be > stunting, albeit < wasting. If the measurement is too long, there will be < stunting, albeit > wasting. A standardization test is routine before undertaking anthropometric surveys.

NB Some scholars prefers terms “counted” and “calculated” to “measured” and “derived”

4. Data entry bias

5. Analytic bias
a. anchoring bias—focusing on one major piece of information
b. confirmation bias—favoring data which confirm underlying beliefs
c. familiarity bias—weighing familiar/understandable events and spokespersons more than unfamiliar ones
d. recency bias—weighing recent events more than remote ones
e. salience bias—weighing vivid events more than mundane ones
f. “time will tell” bias—collecting more data or letting time pass instead of making a hard decision

E. Imprecision (see R Magnani [11], F Checchi [12], and SMART [13])

Sampling, non-systematic error which lowers precision of findings and affects the level of certainty in extrapolating sampling estimates to the population’s true value. It is always present, unavoidable, and a function of chance. Its magnitude depends on sample size, sampling statistics, prevalence of condition, and length of recall period. Precision refers to consistency of results obtained from repeated measurements.

1. Sample size
   What is the sample size \( n \) of a random sample of binomial variables needed to yield a result of specified accuracy and precision?

\[
\text{n} = \left( \frac{z^2 pq}{d^2} \right) \times \text{design effect}
\]

\[n = \text{first estimate of sample size}\]
\[z = \text{confidence limits (accuracy), or normal deviate. Usually set at 95%}\]
\[.: z \text{ “score”} = 1.96\]
\[p = \text{proportion of the target population with attribute} \]
\[q = \text{proportion of the population without attribute} p = 1 - p. \text{Usually set at 0.5 to maximize}\]
\[\text{the} n \text{ of a study having a result of specified accuracy and precision. If you knew} p\]
\[\text{and} q, \text{you would not need to do a survey.}\]
\[d = \text{confidence interval (precision). Usually set at +/- 10%}\]
\[.: d = .1\]

\[n = \frac{(1.96)^2 (0.5)(0.5)}{(0.1)^2}\]
\[n = 96\]
\[\text{e.g. 2} \]
\[\text{There is a population of 6000 where the expected disease rate is 12%. To measure the}\]
\[\text{prevalence with precision of 2%, what sample size is required?}\]
\[n = \frac{(1.96)^2 (0.12)(0.88)}{(0.02)^2}\]
\[n = 1014\]

Once \( n \) is calculated, compare it to the size of the target population (\( N \)). If \( n < 10\% \) of \( N \),
then use \( n \) as final sample size. If \( n > 10\% \) of \( N \), then recalculate the final sample size \( (n_f) \)
by the following correction (a smaller sample size may be used).

\[n_f = \frac{n}{1 + n/N}\]
\[n_f = 1014/1.169\]
\[n_f = 867\]

NB n to calculate the mean weight may be much smaller than \( n \) to calculate the prevalence of
malnourished outliers (120 vs. 900).
2. Sampling statistics and error measurement
   a. malnutrition prevalence or death rate
      The higher the prevalence (or death rate), the lesser the precision (higher d) available through a fixed sample size. (This is a consequence of the formula.) 10% GAM is a common trigger for intervention. But, SMART discourages use of this because high survey precision is needed (narrow CI).
      \[ \text{Choose highest expected prevalence or rate—tends to } > n. \]
      NB At levels of malnutrition and mortality generally found in emergencies, precision has much greater effect on sample size than suspected prevalence of malnutrition or death rate. \( n \) is related to \( d^2 \). E.g., if the malnutrition rate estimate is 10%, and assuming a design effect of 2:
      - survey statistic with a CI of +/- 3% requires \( n = 768 \)
      - survey statistic with a CI of +/- 2% requires \( n = 1729 \)
      As rule of thumb, prevalence (%)/2 approximates the range of appropriate CI. E.g. malnutrition prevalence of 20% calls for a precision of +/- 5% (range of 10%). It’s generally unfeasible to achieve precision greater than +/- 3%.

   b. standard deviation (SD, \( \sigma \)).
      the degree to which individuals within the sample differ from the sample mean (\( \mu \)); unaffected by sample size

   c. standard error (SE = SD/\( \sqrt{n} \))
      Standard deviation of the sampling distribution of a statistic; decreases with larger sample sizes as estimate of the population mean improves, thus a lower SE is more precise
      (1) standard error of the mean (SEM) is standard deviation of a sample mean’s estimate of a population’s true mean; an estimate of how close to the population’s true mean the sample mean appears to be.
      (2) relative standard error (RSE)—SEM/\( \mu \) expressed as %
      - SE of 700 g on weight mean of 70 kg = RSE of 1%
      - SE of 1400 g on weight mean of 70 kg = RSE of 2%

   d. confidence interval (CI = \( \mu \pm z \times (SE) \))
      The margin of error around a point estimate. For normally distributed data, the CI yields the range in which a parameter is 95% likely to be found. A convention for reporting such data would be: “the most probable estimate of the parameter is X, and we are 95% confident the parameter lies somewhere between Y and Z [bounds of the CI]” (paraphrased from Checchi, 2005).
      NB In general, the lower the prevalence (or death rate), the greater the precision (lower d) needed to detect it and any subsequent changes in it. (This is intuitive.) Overall, there is no benchmark for precision. Increasing precision (decreasing d) slightly can dramatically increase \( n \). +/- 0.4 deaths/10,000/d is a practical limit in precision of mortality surveys.
      \[ \text{Choose widest acceptable CI—tends to } < n. \]

   e. design effect (Deff = variance of study design/variance of simple random sample)
      a measure of the (in)efficiency of a cluster sample survey compared to that of a simple random sample. If \( \text{Deff} > 1 \), but the analysis treats it as a SRS, then the confidence interval is inappropriately narrowed, and a test for differences is more likely to produce a positive result (Type 1 error).
      - If each child in a cluster had an unrelated probability of immunization, the precision of the sample estimate would match that of a simple random sample in which 210 children were chosen. \( \text{Deff} = 1 \). However, this is generally not the case.
If each child in a cluster had an identical probability of immunization, the precision of the sample estimate would match that of a simple random sample in which 30 children were chosen. 

\[ \text{Deff} = \text{cluster size of 7.} \]

NB Focal phenomena create clustering of findings which increase the \( \text{Deff} \).

### Table 8.3.19

| Magnitude | \( \text{Deff} \) | Examples |
|-----------|-----------------|----------|
| Low       | < 2.5 (gen 1.5, trends up to 2.0 in large studies) | malnutrition (wasting, stunting, underweight), anemia, EPI, mortality studies |
| Moderate  | 2.5–7.0         | diarrhea, ARI, malnutrition e edema (kwashiorkor) |
| High      | 7.0–10.0        | measles immunization |
| Very high | >10             | access to potable water, latrines, mortality from violence (Iraq surveys had \( \text{Deff} \) of 19) |

\[ \text{:. Choose largest } \text{Deff} \text{—tends to } n. \]

3. Length of recall period
   a. The shorter the recall period, the more accurate the mortality estimate (more distant events are more likely to be forgotten).
   b. The longer the recall period, the more precise the mortality estimate for a fixed sample size. The “sample” is effectively the number of person-days. For a fixed level of precision, the length of the recall period is inversely related to number of study subjects needed. If you cannot increase the sample size, you must increase the recall period.

F. Confounding

Confounders are extraneous variables that correlate with both dependent and independent variables of interest (e.g. both the exposure of interest and the outcome of interest), are unevenly distributed across the levels of exposure, but are not causally linked to exposure and outcome. Age and sex are the most common confounders. Hence, the importance of matching in intervention and control groups.

G. Validity

1. Study validity
   a. internal—capacity of the study to yield sound conclusions for the study population after considering bias, imprecision, and confounding (see D-F above)
   b. external—generalizability beyond the study population (ill-advised)

2. Measurement validity
   a. criterion validity
      (1) concurrent—sensitivity/specificity or correlation with a gold standard
      (2) predictive—ability to predict an event
   b. face validity—common sense
   c. content validity—all relevant elements of a composite variable are included
   d. construct validity (usually for a new measure)—extent to which the measure corresponds to theoretical concepts (constructs)
   e. consensual validity—extent to which experts agree the measure is valid

\[ \text{:. Strength of evidence: face validity, criterion validity } > \text{ content, construct, consensual validity. In absence of validity, a measurement may be embraced for its reliability (below).} \]

H. Rates

1. Death rates—calculated incidence of death expressed per 10,000 p/d or per 1000 p/mo; data collected by retrospective surveys (e.g. 3 month period) to gauge severity of public health emergency particularly where sudden events lead to spike in mortality
   a. CDR—crude death rate
b. ASDR—age-specific death rate (e.g. U5DR or death rate of children 0–5 yr) during a studied time interval (written as $M_0$ or 0-5DR); age of study cohort, e.g. 0–5 yr, should not be confused with study time intervals

| Situation                          | CDR | 0-5DR |
|------------------------------------|-----|-------|
| Baseline in developing countries   | << 1| 1     |
| Emergency under control            | <1  | <2    |
| Serious trouble                    | 1–2 | 2–4   |
| Emergency out of control           | >2  | >4    |
| Catastrophe                        | >4  |       |

2. Mortality rates—calculated probability of dying before a specified age expressed per 1000 live births; data collected by national health authorities in periodic (annual) demographic surveys to reflect ongoing health status
   a. CMR—calculated probability of mortality in given population for specific time
   b. IMR—calculated probability of a live borned child dying before 1 yr
   c. U5MR—calculated probability of a live borned child dying before 5 yr

NB MR ≠ DR. E.g. CMR ≠ CDR, U5MR ≠ U5DR. Different rates measure different things and are not directly comparable. However, MRs may be converted into DRs by the following: CDR or U5DR (deaths/10,000/d) = - ln(1-p/1000) × 5.47 where p = CMR or U5MR (deaths/1000 live births). However, this has little field utility.

NB MMR—maternal mortality ratio has different units in numerators (maternal deaths) and denominators (live births), thus is a ratio, not a rate

I. Reliability/Reproducibility
   1. Stability—inter/intra-observer variation
      a. discrete variables—kappa coefficient
      b. continuous variables—correlation coefficient
   2. Internal consistency—correlation among all items in the measure
   3. Tests of reliability—Cronbach’s alpha, Kuder-Richardson, split halves

J. Conclusions
   1. Interpolation
      The application of study findings to an entire population from which the sample was drawn. If the survey was well-conducted, the results may be considered representative of the entire population. This is scientifically justified. However a CI should accompany any parameter estimate of that population.
   2. Extrapolation
      The extension of study findings to a population or period which was not represented in the sample. It works by association—if 2 populations appear to be experiencing similar conditions, the morbidity/mortality experience of one may be imputed to the other. This is not scientifically justified, but is often done where data are insufficient or impossible to collect.

K. Major Criteria in Evaluating a Health Intervention
   1. Does it < mortality?
   2. Does it < morbidity?
   3. Does it enhance the health system?
   4. Does it lower cost?
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### Annex 8.4
### TROPICAL MEDICINE

| Glossary | Definition |
|----------|------------|
| abd | abdomen |
| ABX | antibiotics |
| ACP | asymptomatic cyst passer |
| ACT | artemisinin-based combination therapy |
| AF | acid-fast (e.g. Ziehl-Neelsen) |
| AFP | acute flaccid paralysis |
| Ag | antigen |
| aggl | agglutination |
| AHF | acute hepatic failure |
| AIDS | acquired immunodeficiency syndrome |
| AR | attack rate |
| ARDS | acute respiratory distress syndrome |
| ARF | acute renal failure |
| ARI | acute respiratory infection |
| ART | antiretroviral therapy |
| Aus | Australia |
| AVB | atrioventricular block |
| BAL | bronchoalveolar lavage |
| BC | blood culture |
| BM | bone marrow |
| BW (A, B) | biological weapon, biological warfare (threat class) |
| Bx | biopsy |
| c | century; with |
| C | centigrade; chills |
| CA | Central America |
| Ca | cancer |
| CE | complex emergency |
| CFR | case fatality ratio |
| CHF | congestive heart failure |
| CI | chronic illnesses |
| CMI | cell-mediated immunity |
| CMP | cardiomyopathy |
| CNS | central nervous system |
| CP | complications |
| CSF | cerebrospinal fluid |
| CT | chemotherapy; cholera toxin; computed tomography |
| d | day(s) |
| D | diarrhea |
| DAA | direct-acting antivirals |
| DC | developing country |
| DDx | differential diagnosis |
| DF | dengue fever |
| DIC | disseminated intravascular coagulation |
| DOTS | directly observed therapy short course |
| DRC | Democratic Republic of the Congo |
| Dx | diagnosis |
| E | east, eastern |
| EAEC | enteroadherent E. coli |
| EHEC | enterohemorrhagic E. coli |
| EIEC | enteroinvasive E. coli |
| ELISA | enzyme-linked immunosorbent assay |
| EM | erythema migrans |
| ENL | erythema nodosum leprosum |
| ETEC | enterotoxigenic E. coli |
| Eur | Europe |
| exts | extremities |
| F | female; fever |
| FAR | fever, arthritis, and rash |
| FO | fecal-oral |
| FQ | fluoroquinolone |
| FSU | former Soviet Union |
| FTT | failure to thrive |
| FUO | fever of unknown origin |
| GB | gall bladder |
| GI | gastrointestinal |
| GIB | gastrointestinal bleed |
| H2H | human-to-human (transmission) |
| HA | headache |
| Abbreviation | Description |
|--------------|-------------|
| HAV          | hepatitis A virus |
| HB           | heart block; hepatitis B |
| HBG          | hepatitis B immunoglobulin |
| HBV          | hepatitis B virus |
| HCC          | hepatocellular carcinoma |
| HD           | heart disease |
| HeAn         | hemolytic anemia |
| hemor        | hemorrhage |
| HF           | hemorrhagic fever |
| HIV          | human immunodeficiency virus |
| HM           | hepatomegaly |
| HSM          | hepatosplenomegaly |
| HSV          | herpes simplex virus |
| HTN          | hypertension |
| HUS          | hemolytic-uremic syndrome |
| HZ           | herpes zoster |
| I            | incidence |
| IC           | industrialized country |
| ICP          | immunocompromised person |
| ID           | infectious disease |
| ID50         | median infectious dose |
| IDU          | injecting drug user |
| IE           | infective endocarditis |
| IFA          | immunofluorescence assay |
| IG           | immune (serum) globulin |
| JH           | Jarisch-Herxheimer (reaction) |
| LA           | Latin America (Central America + South America) |
| LBRF         | louse-borne relapsing fever |
| LBTF         | louse-borne typhus fever |
| LBW          | low birth weight |
| LE           | lower extremity |
| LF           | Lassa fever |
| LGV          | lymphogranuloma venereum |
| LN           | lymph node, lymphadenopathy |
| Lx           | laboratory |
| M            | male |
| MB           | multibacillary |
| MDR          | multidrug resistant |
| ME           | Middle East |
| MM           | mucous membranes |
| MODS         | multiple organ dysfunction syndrome |
| MS           | mental status |
| N            | nausea; north, northern |
| NA           | North America |
| NAf          | North Africa |
| NFI          | nerve function impairment |
| NH           | northern hemisphere |
| NL           | normal |
| NV           | nausea and vomiting |
| OD           | opportunistic disease |
| OI           | opportunistic infection |
| org          | pathological organism |
| p            | after |
| P            | prevalence |
| PB           | paucibacillary |
| PCN          | penicillin |
| PCR          | polymerase chain reaction |
| PEP          | post-exposure prophylaxis |
| perf         | perforation |
| PGL          | persistent generalized lymphadenopathy |
| PMN          | polymorphonuclear leukocyte |
| PNG          | Papua New Guinea |
| PS           | peripheral blood smear |
| Pt           | patient |
| PUD          | peptic ulcer disease |
| Px           | physical exam |
| RBBB         | right bundle branch block |
| RDT          | rapid diagnostic test |
| RHZE         | rifampicin + isoniazid + pyrazinamide + ethambutol |
| RTPCR        | reverse transcriptase polymerase chain reaction |
| RUQ          | right upper quadrant |
| Rx           | drug therapy |
| s            | without |
| S            | south, southern |
| SA           | South America |
| SAFE         | surgery, antibiotics, facial cleanliness, environmental improvement |
| SAM          | severe acute malnutrition |
| Abbreviation | Full Form |
|--------------|-----------|
| SBE          | subacute bacterial endocarditis |
| SC           | stool culture |
| SD1          | S. dysenteriae type 1 |
| SE           | southeast |
| SM           | splenomegaly |
| SSA          | sub-Saharan Africa |
| SSD          | sickle cell disease |
| S/Sx         | signs and symptoms |
| STEC         | shiga toxin-producing E. coli |
| STI          | sexually transmitted infection |
| Sx           | symptoms |
| Sz           | seizure |
| TB           | tuberculosis |
| TIG          | tetanus immune globulin |
| TMP/SMZ      | trimethoprim + sulfamethoxazole |
| TPE          | tropical pulmonary eosinophilia |
| Tx           | treatment |
| U5           | under 5 year-old |
| UC           | urine culture |
| UE           | upper extremity |
| US           | ultrasound |
| UTI          | urinary tract infection |
| V            | vomiting |
| VBD          | vector-borne disease |
| VE           | viral encephalitis |
| VHF          | viral hemorrhagic fever |
| VL           | visceral leishmaniasis |
| W            | west, western |
| wk           | week |
| YF           | yellow fever |
| ∆            | change in |
| //           | similar to |

**Pathophysiology**

Why does this person from this place get this disease at this time?

**Person**

Think of new exposure for Pts from non-endemic or developed areas. Think of breakdown in immunity for Pts from endemic or undeveloped areas. For systemic infection, infective dose is a function of immunity and innoculum. Immunity relates to host and may be altered by congenital, acquired, or iatrogenic causes. Innoculum relates to infectious organism and the environment.

**Place**

Think geographic medicine.

**Time**

Think seasonality. Malaria is classic:

- Holo-endemic areas (e.g. Congo) have an intense level of malaria transmission year-round. Epidemics don’t occur unless displacement brings in non-immune populations. Infection may be asymptomatic. Effective partial immunity develops in adults which enables clinical tolerance of infection and protects against serious episodes. Mortality is highest in pedes U5 and pregnant women.
- Hyper-endemic areas (e.g. W. Africa) have an intense but unstable level of transmission in seasonal peaks when the climatic conditions are favorable. Epidemics occur. Infection is generally symptomatic. Partial immunity fails to develop. Mortality occurs across all age groups.
- Hypo-endemic areas (e.g. Thai-Burmese border) have a low level of transmission year-round. Epidemics occur. Infection is generally symptomatic. Partial immunity fails to develop. Mortality occurs across all age groups.

**Sx**

Think differential diagnosis (below).
Differential Diagnosis or Special Considerations in Common Presentations

Etiological summary  trauma, vessel, neoplasm, infection, drugs, toxins, congenital, metabolic, endocrine, nutrition, connective tissue diseases (autoimmune), psyche

Diarrhea
watery (secretory, small intestine)
  viruses, \textit{E. coli} (ETEC, EAEC), campylobacter, salmonella, vibrio, bacillus, \textit{C. perfringens}, enteric protozoa except entamoeba
  NB giardia, cryptosporidium often yield frothy D due to gut malabsorption
bloody (inflammatory, large intestine)
  \textit{E. coli} (EHEC or STEC e.g. O157:H7, EIEC), campylobacter, salmonella, shigella, \textit{C. difficile}, yersinia; entamoeba

Dyspnea
  hantavirus pulmonary syndrome and pneumonic plague present similarly and are co-endemic

Fever < 7 d
  PMNs > focal bacterial infections, lepto, amoeba (liver abscess), borrelia, sepsis (non-typhi salmonella, pneumococcus, staph, strep, meningococcus)
  PMNs < or NL rickettsia, malaria, typhoid, viruses
  s localizing signs sepsis (non-typhi salmonella, pneumococci, staph, strep, meningococcus), malaria, UTI, typhoid, HIV
  Lx: malaria smear, BC, UC, serology
  rash/hemorrhage as for fever s focal bacterial infections or amoeba
  petechial rash meningococcal sepsis, IE, DIC, Henoch-Schonlein purpura, VHF
  jaundice bacteria/parasite (coxiella, lepto, malaria, sepsis); SSD; viruses (YF, hepatitis); worms (ascaris, echinococcus, liver flukes)

Fever > 7 d
  PMNs > leprosy (erythema nodosum leprosum), amoeba (liver abscess), borrelia, deep sepsis
  Eos > tissue nematodes, zoonotic nematodes, strongyloides > other gut nematodes c heart-lung migration, cestodes (excluding gut tapeworms), trematodes
  PMNs NL brucella, chronic meningococcal sepsis, SBE, syphilis, TB (localized), toxo, tryps
  PMNs < brucella, HIV, malaria, TB (disseminated), typhoid, VL
  NB fever + Δ vital functions = emergency
  fever + any 2 = potentially lethal lesion (e.g. fever + jaundice + acute renal failure)
  borrelia // lepto in acute fevers; coxiella // brucella in chronic fevers

Hepatomegaly
  hepatitis, hepatoma, hepatic abscess, hydatid, schisto, TB, malaria

Jaundice
prehepatic malaria, sepsis, hemolysis, hemoglobinopathy
hepatic viral hepatitis, YF, Q fever, lepto, drugs
post-hepatic gallstones, choledochocarcinoma, hydatid in biliary tree, ascariasis in biliary tree, liver flukes

Neuro signs unexplained TB, HIV and OIs, syphilis, Lyme disease, Whipple’s disease, brain abscess
**Paralysis**
- flaccid: Guillain-Barre syndrome (immune mediated), polio (anterior horn infection)
- spastic: trauma, vascular, neoplasm, infection—HIV/HTLV, abscess, TB, subacute combined degeneration

**Splenomegaly—massive**
- congestive: SSD, schisto
- reactive: malaria
- infiltrative: amyloid, VL, lymphoma, leukemia
- combined

**Splenomegaly—moderate**
above + differential diagnosis for F > 7 d c PMNs < or NL

**STI—bubo**
- ulcer: chancroid, granuloma inguinale
- no ulcer: LGV
- no STD: plague, filariasis, LE infection

**STI—ulcer**
- single, painless: 1° syphilis (s LN), LGV (transient, c bubo), granuloma inguinale (persistent and progressive c pseudobuboes)
  - granuloma diseases start with one painless ulcer, but develop painful bubos
- single, painful: superinfection of painless lesion, TB
- mult, painless: 2° syphilis
- mult, painful: herpes (often c systemic Sx & LN), chancroid (c bubo)

**BW syndromes**
- influenza: many BW agents initially present as flu-like syndrome (F, C, HA, malaise, myalgia)
- pulmonary: anthrax*, plague, tularemia, Q fever, melioidosis, hantavirus
- jaundice: HA
- encephalitis: VE, Q fever
- rash, cutaneous: smallpox*, tularemia, typhus fever
- septicemia/shock: anthrax*, plague, typhus fever, VHF
- occult death

* not further characterized as tropical disease in Tables 8.4.1 and 8.4.2 below
Vectors and Intermediate Hosts

Vector—comes to you (not necessarily required for development of the organism)
- mosquito and ticks transmit the most types of infectious pathogens
- *Aedes* transmit all mosquito-vectored VHF

Intermediate hosts—you come to the intermediate host (required for development of the organism)
- intestinal nematodes have none
- all trematodes + 1 zoonotic nematode require snails

Management Keys

Know the local epidemiology
- Leading US causes of death worldwide—LRI (15%), prematurity (15%), birth asphyxia (11%), diarrhea (9%), malaria (7%), neonatal sepsis (7%)
- Leading ID causes of death worldwide—LRI, diarrhea, HIV/AIDS, TB, malaria, measles, meningitis

Know the golden rules of infectious diseases (abstracted from A Yung [1] and used with permission).
1. Rigors are always important—serious bacterial infections are the most likely cause.
2. Severe muscle pain may be a symptom of sepsis even without fever.
3. Elderly patients with sepsis may be afebrile. In elderly patients, fever is rarely caused by a viral infection.
4. Septic patients who are hypothermic have a worse prognosis than those with high fever. Treat as a medical emergency.
5. Fever in a postoperative patient is usually related to the surgical procedure (e.g. pneumonia, UTI, wound, or deep infection).
6. Fever with jaundice is rarely due to viral hepatitis. Think liver abscess, cholangitis, etc.
7. The rash of early meningococcal infection may resemble a viral rash.
8. Generalized rashes involving the palms and soles may be due to drugs, viral infections, rickettsial infections, or syphilis.
9. All febrile travelers in or returned from a malaria infected area must have malaria excluded.
10. Disseminated TB must be suspected in all elderly patients with fever and multisystem disease who have been in an area with endemic TB.
11. Septic arthritis may be present even in a joint which is mobile.
12. Back pain with fever may be caused by vertebral osteomyelitis or an epidural abscess.
13. A patient may have more than one infection requiring treatment (e.g. malaria and typhoid), especially if they are elderly, immunosuppressed, or have travelled.
14. Always remember common infections, not just opportunistic infections, in AIDS patients with a fever.

Understand morbidity multipliers.
- measles, malnutrition, and TB/HIV

Understand occult co-morbidities.
- For any undifferentiated illness, even in infants, think of HIV, TB, syphilis, and sarcoid.
- For any child, think of malaria, hookworm, & anemia; malarial anemia usually in pedes <3 year-old, hookworm anemia usually in pedes >3 year-old.
- For any ICP, think of TB, VL, histoplasmosis, strongyloides. Must treat early.

DDx Failure to thrive without F in infants is worked up like F without localizing signs.
- Watch for clinical mimics—malaria presenting as pneumonia or diarrhea in pedes; VL presenting as malaria in adults; lepto presenting as mild DF (esp in DF endemic areas where the Pt has mild onset of illness, worsening course, and no rash but jaundice after a week).

Tx Do basic things well, use equipment you understand, teach others, delegate.
| Vectors [Reservoir] | Organism | Arboviral and Zoonotic Viral Diseases | Group/Name | Clinical | Misc | Annual Incidence or Prevalence | Deaths/year or CFR Rx, Vaccine |
|---------------------|----------|--------------------------------------|------------|---------|-----|-------------------------------|-------------------------------|
| **Mosquitoes (F)**  |          |                                      |            |         |     |                               |                               |
| Aedes               | Alphavirus | Chikungunya Virus Disease (Kimakonde verb—to be contorted) | Fever, Arthritis, & Rash (FAR) | +       | +   | incubation < 3 wk | SSA, S & SE Asia, Caribbean very rare no vaccine |
| Anopheles [humans] | Alphavirus | O’nyong-nyong                         | +          |         |     | epidemic polyarthritis        | SSA                            |
| Aedes, Culex        | Alphavirus | Ross River Fever                      | +          |         |     | epidemic polyarthritis        | Australia                       |
| Culex               | Alphavirus | Sindbis Virus Disease (Ockelbo disease, Pogosta disease) | +          |         |     | flu-like illness over 5d; CP of persisting arthritis | I-100s foci worldwide not NA, LA 0 |
| Aedes aegypti, albopictus [humans—urban; monkeys—rural] | Flavivirus (4 serotypes) | Dengue Fever (DF) (breakbone fever) | +   | + | severe disease c F, C, retroorbital HA, back pain, myalgia, arthralgia, morbilliform rash; CP of DHF | I-100,000,000 apparent 300,000,000 inapparent #1 viral VBD Asia, LA, SSA; rainy season <1% vaccine in trial |
| Culex               | Flavivirus | West Nile Fever (WNF)                 | +          | +       |     | mild disease c F, malaise, HA, myalgia, anorexia, NV, rash → CNS (1%) | Africa, ME, Eur, NA, CA; early fall in NH c CNS, 25% c FAR, 0% no vaccine |
| Aedes               | Flavivirus | Zika Fever (from Zika Forest in Uganda) | +          |         |     | generally mild disease c F, malaise, HA, arthralgia, rash; neonatal microcephaly if contracted early in utero | Africa, Asia, Polynesia, SA 0 no vaccine |
| **Sandflies (F)**   |          |                                      |            |         |     |                               |                               |
| Phlebotomus         | Bunyavirus | Sandfly Fever (phlebotomus fever, 3-day fever, pappataci fever) | +          |         |     |                               | S Europe, N Africa, E Mediterranean to N India very rare |
| Phlebotomus         | Rhabdovirus | Vesicular Stomatitis Virus (vesicular stomatitis fever) | +          | +       |     |                               | very rare                     |
| Ticks (M & F) | Reovirus | Colorado Tick Fever (CTF) (mountain tick fever) | + | + | Biphasic illness over 6 d; rare CP of Δ CNS, VHF | W NA; summer | very rare no vaccine |
|---|---|---|---|---|---|---|---|
| **Dermacentor** (wood tick) | | | | | | | |
| **Viral Encephalitis** (VE) | most infections asymptomatic; severe infections c F, HA, Δ MS, meningeal signs | incubation < 3 wk Lx—serology, ELISA, PCR H2H—Nipah |
| **Mosquitoes** (F) | Alphavirus | Eastern Equine E (EEE) | + | | often severe | rare E NA, CA, SA | 25–50% esp pedes vaccine for horses, but not humans |
| *Culiseta, Aedes* [birds] | Alphavirus | Western Equine E (WEE) | + | | milder than EEE | rare W NA, CA, SA 5% vaccine for horses, but not humans |
| *Culex, Culiseta* [birds] | Alphavirus | Venezuelan Equine E (VEE) | + | + | large epidemics SA (esp Venezuela), CA, NA | <1% vaccine for horses, but not humans |
| *Aedes, Culex, et al* [rodents, birds, horses] | Bunyavirus (serogroup c La Crosse E) | California E | + | | 1-100 esp pedes W NA; summer, fall | < 1% no vaccine |
| *Aedes* [squirrels, lagomorphs] | Flavivirus | Japanese E (JE) | + | | 99+% s Sx; 50% of survivors c neuro disability | 90,000 esp pedes E Asia, S Asia, W Pacific | 90,000 esp US 20–30% vaccine |
| *Culex* [water fowl, pigs] | Flavivirus | Murray Valley E (MVE) (Australian E) | + | | 99%+ s Sx; 40% of survivors c neuro disability | Australia, PNG; summer monsoon season | 90,000 esp pedes E Asia, S Asia, W Pacific | 90,000 esp US 20–30% vaccine |
| *Culex* [water fowl] | Flavivirus | St. Louis E (SLE) | + | | | | no vaccine |
| *Culex* [birds] | Flavivirus | Tick-borne E (TBE) | + | | biphasic illness—febrile phase c flu-like Sx → neuro phase c Δ CNS | 1,5000 Ear, FSU, Asia; summer, fall esp rural & recreational areas | 1–2% vaccine |
| **Ticks (M & F) [Mammals]** | Hendra Virus | Hendra Virus Disease | + | | pneumonia early | Australia | 50% vaccine for horses, but not humans |
| horses, fruit bats | Nipah Virus | Nipah Virus Disease | + | + | flu-like Sx initially | S Asia | 50% vaccine for primates, but not humans |
### Dogs, foxes, coyotes, skunks, raccoons, bats (infectious saliva)

**Rabies Virus**
- Rabies (hydrophobia)
- F, HA → 2 syndromes: encephalitic (furious) rabies (80%)—intermittent agitation & terror // mania alt c lucid intervals, autonomic hyperactivity, bulbar spasm to water (hydrophobia), spasticity, sz → death in days; paralytic rabies (20%)—ascending sensorimotor AFP, fasciculation, paraparesis, bulbar paralysis s hydrophobia → death in wks

**Viral Hemorrhagic Fever (VHF)**
- F, malaise, HA, conjunctivitis, pharyngitis, myalgia, arthralgia, rash (morbilliform to petechial); CP of Δ vasc perm, bleeding, shock, ARF, AHF, MODS
- incubation <3 wk
- Lx—serology, ELISA, PCR
- H2H—many but only from Pt c Sx

**Mosquitoes (F)**

| Mosquitoes | Virus Family | Disease | Incubation | Symptoms | Duration | Transmission | Treatment |
|------------|--------------|---------|------------|----------|----------|--------------|-----------|
| *Aedes, Culex, *al* | Bunaviruses | Rift Valley Fever (RVF) | + | CAP leak c 4 clinical classes | I-50,000 | livestock via inoculation or inhalation; abortion storm heralds human transmission risk | ribavirin; vaccine for animals, but not humans |
| *Aedes aegypti, albo pictus* | Flaviviruses (4 serotypes) | Dengue HF/Dengue Shock Syndrome (DHF/DSS) | + | biphasic illness— F phase then CAP leak c 4 clinical classes | I-200,000 | many but only from Pt c Sx | no vaccine |
| *Aedes aegypti, et al* | Flaviviruses | Yellow Fever (YF) | + | F, C, HA, NV, jaundice; CP (20%) of AHF, GIB, ARF | I-200,000 | endemic SSA (90% cases) | 30,000 |
| *Hyalomma* | Bunaviruses | Congo-Crimea HF (CCHF) | + | flu-like Sx—F, HA, eye pain, myalgias, abd pain, hepatitis; CP of hemor rapidly fatal (2 wks) s Tx | Central, S Asia, Africa; esp butchers, shepherds | 20–50% | ribavirin; no vaccine |
| *Haemaphysalis* | Flaviviruses | Kyasanur Forest Disease (monkey fever) | + | flu-like Sx—F, HA, myalgias; CP of hemor in biphasic illness | I-500 | endemic 10% sporadic 50% | |
| *Dermacentor* | Flaviviruses | Omsk HF | + | flu-like Sx—F, C, HA, myalgias, palatal rash, cervical LN; CP of hemor, Δ CNS | FSU esp Siberia | 1–3% | |
| [Mammals] | | | | | |
|---|---|---|---|---|---|
| **Calomys** (rodents) via aerosols from urine, saliva, or stool, or food contamination | **Arenavirus** | Argentine HF (Junin) | + | VHF // LF, but 1/3 of untreated cases become severe c hemor and neuro signs | 1-100 C Argentina; Mar-Apr; farm workers at corn harvest | s Tx 20% c Tx < 2% vaccine |
| **Calomys** (rodents) via aerosols from urine, saliva, or stool, or food contamination | **Arenavirus** | Bolivian HF (Machupho) (black typhus) | + | VHF Sx + low back pain | Bolivia | s Tx 20% |
| rodents suspected via aerosols from urine, saliva, or stool, or food contamination | **Arenavirus** | Brazilian HF (Sabia) | + | VHF // LF, but 1/3 of untreated cases become severe c hemor and neuro signs | Brazil | no vaccine |
| **Sigmodon, et al** (cotton rat, cane mouse) via aerosols from urine, saliva, or stool, or food contamination | **Arenavirus** | Venezuelan HF (Guanarito) | + | VHF // LF, but 1/3 of untreated cases become severe c hemor and neuro signs | W Venezuela; Nov-Jan | s Tx > 30% no vaccine |
| **Mastomys, et al** (rodents) via aerosols or direct contact with stool or urine | **Arenavirus** | Lassa Fever (LF) | + | VHF // LF, most s Sx; VHF Sx in 4 phases: F, malaise, fatigue (1–3 d); HA, sore throat, myalgia, DNV, cough (4–7 d); edema, bleeding (20% of Pt c Sx), Δ CNS (7+ d); coma (14 d); deafness common in survivors | l00,000-300,000 W SSA; Jan-May; 5000; 2–20% ribavirin; experimental vaccine |
| **Mastomys** (rodents) | **Arenavirus** | Lujo HF | + | VHF Sx | < 10 in history S Africa, Zambia | s Tx 80% |
| **Apodemus, et al** (field mice) via bites or aerosols from urine, saliva, or stool | **Bunyavirus** (Hantavirus is 1 of 5 genera) | Hemorrhagic Fever with Renal Syndrome (HFRS) (Korean hemorrhagic fever from Hantan River area in S Korea) | + | 5 phases: F, HA, malaise, fatigue, back pain, NV, conj injection, rash (3–7 d); ↓ BP due to hemor (1–3 d); oliguria (3–7 d); diuresis (wks); recovery (months) | E Asia, Eur, NA, SA; late fall, early winter | c Tx 5–15% ribavirin; experimental vaccine |
| **Peromyscus, et al** (deer mice) as above | **Bunyavirus** (Hantavirus is 1 of 5 genera) | Hantavirus Pulmonary Syndrome (hantavirus ARDS) | + | cardiopulmonary syndrome as above; only Andes variant capable of H2H transmission | c Tx 30–40% no vaccine |
| ? fruit bats → gorillas, duikers via saliva contaminated dropped fruits | **Filovirus** (5 types of Ebola; Sudan strain mildest) | Ebola-Marburg Diseases (EHF, African HF) | + | VHF Sx + DNV; VHF CP (50% of Pt c hemor); rapidly fatal s Tx | SSA | Ebola 60–90% Marburg 30% experimental vaccine |
### Table 8.4.1b
Tropical Infectious Diseases—Vector-Borne and Zoonotic

| Vectors [Reservoir] | Organism | Non-viral Diseases | Annual Incidence or Prevalence | Deaths/year or CFR Rx |
|---------------------|----------|---------------------|-------------------------------|-----------------------|
| **Bugs (M & F)**    |          |                     |                               |                       |
| Triatoma (cone-nosed, kissing bugs) via direct contact with vector feces, food contamination, or congenital [humans in chronic disease] | Trypanosoma cruzi | American Trypanosomiasis (Chagas’ disease) | acute—chagoma, F, LN, HSM; chronic (25%)—HD (CMP, RBBB, CHF), megacolon | amastigotes in tissue Bx; tryps in stained PS (rare); serology | I-300,000 P-10,000,000 LA (3rd most common VBD p malaria & DF) | 11,000 rare acutely nifurtimox |
| **Fleas (M & F)**   |          |                     |                               |                       |
| Xenopsylla via feces [rodents, feral cats, opossums] | Rickettsia typhi | Typhus Fever (FBTF) (endemic, murine) | // LBTF but milder | serology | worldwide; warm climates esp summer-fall | 1–5% doxycycline |
| Xenopsylla, Pulex via regurgitation, direct contact c org from infected HH pets [rodents] | Yersinia pestis | Plague | bubonic—sudden onset F, C, extreme malaise, myalgia, tender LN at site of inoculation (baubo); CP of sepsis, pneumonia (pneumonic plague), meningitis, DIC; 10–25% of plague cases have primary septicemia; yes H2H; rapidly fatal s Tx | bacteria in smear, gram stain | bacteria in smear, gram stain | I-< 2500 worldwide foci; Africa esp DRC | bubonic s Tx 50% pneumonic s Tx 100% streptomycin, gentamycin, doxycycline |
| **Flies (gen F)**   |          |                     |                               |                       |
| Phlebotomus, et al (sandflies, F) | Leishmania | Cutaneous Leishmaniasis (CL) (Baghdad boil, Delhi boil, rose of Jericho) | papule → nodule → painless ulcer occs c nodular lymphangitis, LN; CP of mucosal involvement (espundia) in New World disease | amastigotes in stained slit skin smears; culture; Leishmanin test | I-1,000,000 worldwide foci; most in SA, Mediterranean, & ME-central Asia | rare sodium stibogluconate (New World only) |
| Phlebotomus, et al (sandflies, F) [various mammals] | Leishmania donovani et al (Old World), chagasi (New World) | Visceral Leishmaniasis (VL) (kala-azar = black fever) | most s Sx; F, LN, massive HSM → cirrhosis, pancytopenia, dark skin at head & mouth (kala-azar); some c F, malaise, cough, D (// malaria); post-K-A dermal leish (PKDL) c diffuse papules & nodules at mouth, face, & trunk | amastigotes in spleen > liver > BM > LN aspirate; serology | I-200–400k worldwide foci; 90% in rural (sub) tropics of Brazil, Ethiopia, India, Somalia, S Sudan, Sudan | 20–40,000 10% sodium stibogluconate |
| **Chrysops** (deerflies, F) | **Loa loa** (Calabar swelling, African eyeworm) | most s Sx; migratory Calabar swellings, pruritis, myalgia; CP of F, HA, meningism | micro filariae in stained PS of noon spec | P-13,000,000 tropical SSA | DEC 0 albedazole rarely needed |
|-----------------------------|---------------------------------------------|-----------------------------------------------------------------------------|------------------------------------------|--------------------------|-----------------------------|
| **Culicoides** (biting midges, F) | **Mansonella** Mansonnelliasis | most s Sx; transient itch, HA, arthralgia | micro filariae in stained PS | SSA, LA | 0 albendazole rarely needed |
| **Simulium** (blackflies, F) | **Onchocerca** | most s Sx; SC nodules, itch, rash (sowda, lizard skin, leopard skin), blindness | micro filariae in skin Bx; if non-Dx, DEC challenge | P-18,000,000 30k blind SSA >> LA riverine areas | 0 ivermectin + albedazole |
| **Glossina** (tsetse flies, M & F) | **Trypanosoma brucei gambiense, rhodesiense** African Trypanosomiasis (sleeping sickness) | chancre (occas c hemorrh) → hemolymphatic stage—F, HA, local & occipital LN, SM → CNS stage—psyc Δs, sleep Δs, tremor, ataxia; Tbr >> Tbg | tryps in stained PS, lymph, CSF; serology | 1-500,000 W SSA Tbg E SSA Tbr | 400,000 s Tx 100% s CNS suramin c CNS melarsoprol |

**Lice** (M & F)

| **Pediculus humanus** (body, clothing lice) | **Bartonella quintana** (Quintana fever) | F, malaise, HA, SM, shin pain, rash | BC; serology | foci in Central Asia, LA, E & N Africa | 0 doxycycline × 5 d; wash clothes at 50 °C or leave unworn × 1 wk |
|---------------------------------------------|-----------------------------------------|----------------------------------|----------------|-------------------------------------------|-----------------------------------------------|
| via feces, not directly via bite [humans] | via feces, not directly via bite [humans] | heavy clothing + poor sanitation = lice proliferation | heavy clothing + poor sanitation = lice proliferation | | |
| **Borrelia recurrentis** Relapsing Fever (LBRF) (epidemic, louse-borne) | **Typhus Fever** (LBTF) (epidemic, classic, jail fever, red louse disease) vector color indicative as bacteria multiply in gut & lyse epithelium → blood enters body cavity turning louse red; recrudescence years later = Brill-Zinsser disease | F 2–9 d alt s F 2–4 d c 1–3 relapses; assoc c HA, myalgia, NV, HSM, jaundice, petechial rash, Δ CNS; CP of nephritis, meningitis, myocarditis; may be rapidly fatal s Tx | orgs in stained or darkfield PS | foci in cold, rural, highland, temperate areas of Asia, E Africa, SA | s Tx 10% doxycycline × 5 d (JH in 90%); wash clothes at 50 °C or leave unworn × 1 wk |
| via feces, not directly via bite [humans] | via feces, not directly via bite [humans] | heavy clothing + poor sanitation = lice proliferation | heavy clothing + poor sanitation = lice proliferation | | |
| **Rickettsia prowazekii** | | | | | |
### Mites (M & F larvae)

| Species                          | Taxon                           | Stage                                  | Mode of transmission                                    | Clinical manifestations                                      | Diagnostics                                      | Foci                                                                 | Tx | Notes |
|----------------------------------|---------------------------------|----------------------------------------|----------------------------------------------------------|-------------------------------------------------------------|----------------------------------------------------|----------------------------------------------------------------------|-----|-------|
| *Leptotrombidium* (mite typhus, tsutsugamushi) | *Orientia tsutsugamushi* (trombiculid larval mites or chiggers) via saliva of rodents | Scrub Typhus (MBTF)                     | Painless ulcer, eschar (distinguishes case from DDx of malaria, typhoid) → // LBTF + conjunctivitis, LN, HSM → vasculitis c DIC, ARF, MODS; fatal s Tx but lower mortality than LBTF | serology—Weil-Felix reaction, IFA (gold standard) | foci in scrub areas of S, SE Asia, Pacific islands; monsoon season | s Tx 1–30% gen < LBTF doxycycline |     |       |
| *Liponyssoides*                  | *Rickettsia*                    | Rickettsial Pox (vesicular rickettsiosis) | Painless ulcer, eschar (distinguishes case from DDx of malaria, typhoid) → // LBTF + conjunctivitis, LN, HSM → vasculitis c DIC, ARF, MODS; fatal s Tx but lower mortality than LBTF | serology | E NA, Central Asia | rare doxycycline |     |       |
| *Mites* (M & F larvae)           |                                 |                                        |                                                          |                                                             |                                                    |                                                                       |     |       |
| **Annex 8.4—Tropical Medicine** |                                 |                                        |                                                          |                                                             |                                                    |                                                                       |     |       |
| **Amblyomma** (hard ticks in Ixodidae family) | **Rickettsia africae** | **African Tick Bite Fever** | multiple painless eschars, lymphangitis, LN, subtle rash // TBTF | **serology** | **SSA:** people on safari | 0 doxycycline |
|---|---|---|---|---|---|---|
| **Rhipicephalus sp.** (hard ticks in Ixodidae family e.g. brown dog ticks) | **Rickettsia conorii** complex (multiple sero-types) | **Tick-borne Typhus Fever** (TBTF) (Mediterranean tick fever or spotted fever, boutonneuse fever, tick typhus of Kenya, Crimea, India, Ismel) | painless button eschar, LN, peripheral mac-pap rash d4 (palms, soles, & face) | **serology** | **Africa, India, Mediterranean** | 3–30% doxycycline |
| **Dermacentor, et al** (hard ticks in Ixodidae family e.g. dog ticks, wood ticks) | **Rickettsia rickettsii** | **Rocky Mtn Spotted Fever** (RMSF) (NA tick typhus, Sao Paolo fever, Tobia fever) | F, C, malaise, HA, myalgia, centripetal rash d5 (pink macules on palms, soles, & face → central petechiae) | **serology** | **ENA, LA:** summer | **s Tx 15–25%** c Tx 3–5% doxycycline |
| > 40 tick species | none—neurotoxin | **Tick Paralysis** | ascending, lower motor neuron paralysis c paresthesia → progressive c bulbar & resp paralysis | none—Dx is based on finding the tick; DDx Guillain-Barre | worldwide foci; most in W NA, E Australia | rare esp pedes < 10 supportive Tx |
| Hosts [Intermediate] Mechanism | Organism | Diseases | Annual Incidence or Prevalence | Deaths/year or CFR Rx |
|-------------------------------|----------|----------|-------------------------------|------------------------|
| **Bacteria**                  |          |          |                               |                        |
| Actinomycyes                  | Actinomycosis | induration & draining sinuses in jaw, thorax (DDx fungi) | orgs in gram stain | worldwide sporadic | ampicillin |
| cats                          | Bartonella henselae | Cat-scratch Disease | regional LN (10% suppurate); atypical presentations (5%) c lung or liver lesions, encephalitis, FUO | IFA; Bx | worldwide | none azithromycin or none |
| cattle, pigs, goats, sheep    | Brucella abortus, melitensis, suis | Brucellosis (undulant fever, Malta fever) | recurrent F, C, night sweats, lethargy, HA, arthralgia, visceral µ abscesses, wt loss; CP of osteoarthritis, orchitis, endocarditis, meningitis | BC, BM culture; serology; PCR | worldwide | s Tx 2% rifampicin + doxycycline |
| environmental saprophyte [none—soil reservoir; animals may contract illness, but org is not zoonosis.] | Burkholderia pseudomallei | Melioidosis (Whitmore’s disease, first described in Myanmar) | most s Sx; bacteremia (60%) c sepsis, multiple abscesses, or typhoidal syndrome esp in ICPs or Cls; localized infection (40%) esp in lung (may look // TB), liver, spleen, skin → late reactivations | BC, UC, pus culture; serology | SE Asia, N Aus, SSA, LA; esp ICPs; rainy season | ceftazidime; chloro + cotri + doxycycline |
|                               | Chlamydia | Trachoma | conjunctival folliculitis → intense inflammation → scarring → trichiasis → corneal opacity → scarring → blindness | orgs in epithelial cells of conj swab | P-150,000,000 2m blind worldwide dry areas | SAFE c azithromycin, tetracycline ointment |
|                               | Clostridium | Tetanus | onset 1 wk p injury; neonate—weakness, floppiness, irritability, inability to feed, spams; adult—trismus, local & generalized spams (4 prognostic classes) | none—Dx is clinical | I-1,000,000 pedes I-200,000 | 10–90% PCN + TIG |
|                               | Corynebacterium | Diphtheria | F, toxicity, tonsillopharyngitis c pseudomembran & bleeding points, LN, neck edema; painful, cutaneous ulceration c palsy; CP of airway obstruction, myocarditis, HB | non-cutaneous 5–10% procaine PCN + antitoxin |
| sheep, cattle, goats, cats, dogs via airborne | Coxiella burnetii | Q Fever (query fever) | acute—F, C, malaise, HA, atypical pneumonia; chronic (< 1%)—FUO, granulomatous hepatitis c jaundice, endocarditis | serology | worldwide hot, dusty areas esp ranchers, livestock farmers | < 2% doxycycline, FQ |
| cattle, other ruminants       | Escherichia coli (6 pathotypes—ETEC, EHEC, EIEC, etc.) | Gastroenteritis (travelers diarrhea, shiga toxin-producing E. coli) | acute DNV; dysentery if EHEC, EIEC; CP (5–10%) of HUS from EHEC O157:H7 | SC | I-200,000,000 ETEC | 380,000 ETEC mostly US in DCs no vaccine |
| Pathogen          | Disease                          | Clinical Features                                                                 |
|-------------------|----------------------------------|------------------------------------------------------------------------------------|
| *Leptospira*      | Leptospirosis (hemorrhagic jaundice, mud fever, ricefield fever, cane cutters' disease, Weil's disease) | anicteric syndrome (90%) (due to bacteremia)—F, C, HA, DNV, cough, conjunctivitis, rash, myalgia (lumbar & calf), malaise; myocardial, renal, liver disease (10%) → icteric syndrome (1%) (Weil’s disease)—anicteric syndrome + HSM, deep jaundice, rash (orange skin), HeAn, purpura, GIB, HUS, ARF, AHF |
| *Neisseria meningitides* (serogroups A, B, C, W, Y) | Meningococcal Disease | sepsis, meningitis, petechial rash; rapidly fatal s Tx; orgs in CSF gram stain; BC, CSF culture |
| *Salmonella enterica* var Paratyphi (pathotypes A, B, C) | Paratyphoid Fever | // typhoid F but milder—F, NVD (occas dysentery) c 10 d course; CP of bacteremia → bone, joints, GB, other organs (esp in SSD, HIV) |
| *Salmonella enterica* var Typhi | Typhoid Fever (enteric fever, typhus abdominalis—confused c epidemic typhus thru 18th c) | sustained or remittent F, C, malaise, fatigue, relative brady, HA, cough, myalgia, anorexia, N, abd pain, constipation, D, HSM, rose spots; CP of lower GIB (10%) & bowel perf (3%) from Peyer’s patches, encephalopathy, meningitis, ARF, abscess |
| *Shigella* (4 species—*S. dysenteriae* type 1 (SD1) most severe, esp in emerg settings; *S. flexneri* most common in DCs; *S. sonnei* most common in ICs; *S. sonnei* & *S. boydi* c mild D) | Shigellosis (bacillary dysentery) | F, NVD (initially watery, then small volume dysentery), anorexia, low abd pain, cramps, tenesmus, rectal prolapse (pedes); 25% will not have dysentery, but when present, it can last wks-months; CP (esp in SD1) of hypoglycemia, sepsis, encephalopathy, toxic megacolon, GI perf, HUS |

**Serology**

- worldwide tropics
- c fresh water rivers, floods, or rainy season;
- esp farming, abattoir, sewerage workers; riverine tourists

- Weil’s 10%
- doxycycline, PCN

- Neisseria meningitides
- Meningococcal Disease
- sepsis, meningitis, petechial rash; rapidly fatal s Tx |
- orgs in CSF gram stain; BC, CSF culture

- 1-500,000 esp US worldwide; dry season epidemics of group A in SSA
- 30-60,000 c Tx 10% ceftriaxone

- Salmonella enterica var Paratyphi
- Paratyphoid Fever
- // typhoid F but milder—F, NVD (occas dysentery) c 10 d course; CP of bacteremia → bone, joints, GB, other organs (esp in SSD, HIV) |
- BC, SC |
- I<< typhoid F
- << typhoid F
- FQ, ceftriaxone

- Salmonella enterica var Typhi
- Typhoid Fever (enteric fever, typhus abdominalis—confused c epidemic typhus thru 18th c) |
- sustained or remittent F, C, malaise, fatigue, relative brady, HA, cough, myalgia, anorexia, N, abd pain, constipation, D, HSM, rose spots; CP of lower GIB (10%) & bowel perf (3%) from Peyer’s patches, encephalopathy, meningitis, ARF, abscess |
- BC > SC wk 1
- SC > BC wk 2+
- UC, BM culture if above NG; Widal poor test but used in DCs |
- I-27,000,000 epidemic AR 6%
- P-2–5% infected chronically
- S Asia >> Africa
- 600,000 c Tx 10–20% ceftriaxone

- Shigella (4 species—*S. dysenteriae* type 1 (SD1) most severe, esp in emerg settings; *S. flexneri* most common in DCs; *S. sonnei* most common in ICs; *S. sonnei* & *S. boydi* c mild D) |
- Shigellosis (bacillary dysentery) |
- F, NVD (initially watery, then small volume dysentery), anorexia, low abd pain, cramps, tenesmus, rectal prolapse (pedes); 25% will not have dysentery, but when present, it can last wks-months; CP (esp in SD1) of hypoglycemia, sepsis, encephalopathy, toxic megacolon, GI perf, HUS |
- SC, BC |
- ID$_{50}$ for SD1 = 10
- SD1 (Shiga bacillus) produces Shiga toxin causing severe disease, longest duration of illness, higher ABX resistance, and highest CFR |
- I-175,000,000 esp US
- mostly US c Tx 20% FQ
| **Streptococcus** | Rheumatic Fever | major manifestations—carditis (mitral > aortic), polyarthritis (large joints), chorea, ery marginatum, or subcut nodules; minor manifestations—arthralgia, fever | serology e.g., ASO titer. Dx is clinical (2 major or 1 major + 2 minor) supported by Lx | 1-300,000 P-15,000,000 developing countries; winter-spring esp adolescents | 225,000 benzathine PCN |
| **Treponema pallidum pertenue** | Yaws | 3 phases—papilloma → frambesial lesions (wks-months); widespread esp palms & soles (months); destruction of skin & bone at exts (10%+ of Pts) (5 years) | P-2,500,000 tropics, esp pedes | benzathine PCN, azithromycin |
| **Vibrio cholerae (O1 & O139 serogroups cause epidemics. O1 El Tor is cause of current (7th) pandemic. Other serogroups cause individual illness.)** | Cholera | afebrile DNV c acute onset of profuse, painless, ricewater stools. No clinical differences between epidemic strains. | SC ID$_{50}$ = 100,000+ 1st test is agglutination c O1 & O139 antisera. O1 serogroup divided into Inaba & Ogawa serotypes, plus classical & El Tor biotypes. All strains tested for CT—strains s CT do not cause epidemics. | I-2,800,000 worldwide; epidemic AR: 5% (refugees c malnut); 2% (rural underserved in non-endemic areas); 1% (WHO typical estimate of overall disease burden); 0.6% (endemic areas c poor sanitation) | 100,000 s Tx 50% in severe disease c Tx < 1% |

| **Sexually Transmitted Bacteria and HSV** |
| **Chlamydia trachomatis** | Lymphogranuloma Venereum (LGV) (tropical bubo) | single, small, painless, transient genital ulcer → suppurative inguinal & pelvic LN (M c inguinal buboes, F c proctitis); CP of lymphedema, rectal stricture | IFA, PCR, culture of LN aspirate; serology | worldwide esp tropics & subtropics | rare doxycycline, erythromycin x 3 wks |
| **Haemophilus ducreyi** | Chancroid (soft chancre) | single or multiple deep, painful, necrotic, soft ulcers → painful, suppurative LN | culture, IFA, PCR of exudate; serology | worldwide esp inner city; M > F | ciprofloxacin × 3 d |
| **Herpes Simplex virus (HSV)** | Herpes Simplex | multiple painful vesiculo-pustular lesions → ulcers → systemic Sx c nonsuppurative inguinal LN → resolution | Dx gen clinical; Tzanck prep, viral culture of lesion | worldwide | 0 acyclovir |
| **Klebsiella (prev Calymmatobacterium) granulomatis** | Granuloma Inguinale (donovanosis) | indurated papule → painless, beefy red ulcer c rolled edges → progressive ulceration & scarring c destruction of genitals → heme seeding to viscera & bone | organs in stained granulation tissue smear, Bx; PCR | tropics & subtropics esp India, PNG, Caribbean | rare doxycycline, erythromycin x 3 wks |
| Treponema pallidum (lues) | **1°**— single, painless, firm chancre s LN (3 wks); **2°**—mac-pap rash including palms & soles, generalized LN (6 wks); **3°**—gummas (5 years), aortitis (10 years), meningitis (15 years). Pregnancy → still-birth (25%), neonatal death (15%), surviving syphilitic infant (40%) | serology | 12,000,000 worldwide | benzathine PCN |
|--------------------------|-------------------------------------------------|----------|---------------------|----------------|
| Treponema pallidum (congenital) | Syphilis, congenital, early congenital—LBW, feeding difficulty, bullous rash, jaundice, HSM; early congenital—NL at birth, but develops FTT, rash (3 months); 2° syph c desquamation of palms & soles, saddle nose, nasal discharge, HSM | serology | developing countries | benzathine PCN |
| **Mycobacteria** | **Leprosy (Hansen’s disease)** | hypopigmented/red skin patches c ↓/ absent sensation (no itch or sweat) (≤ 5 patches = PB, > 5 patches = MB), peripheral nerve thickening; evolution of asymmetric tuberculoid disease → symmetric lepromatous disease; early CP of Type 1 reactions (skin and nerve inflammation), Type 2 reactions (ENL, F, malaise), silent NFI; late CP of iritis, osteitis, loss of digits | orgs in AF stained slit skin smears ranging from PB to MB | P-650,000 S, SE Asia rural tropics | rifampicin + dapsone + clofazimine + steroids (if CP) |
| **Mycobacterium tuberculosis** | Tuberculosis (TB, consumption) | F, night sweats, wt loss, pulm Sx (85%), extrapulm Sx (15%)—LN (25%), pleunsy (25%), GU (15%), military (10%), bone (10%), CNS (5%), peritoneum (5%) | orgs in AF stained sputum, body fluid, or tissue Bx; miliary orgs in liver Bx > transbronchial Bx > BM | 1-9,000,000 MDR 500,000 P-17,000,000 infected 2 billion disease risk: s HIV 5–10% over lifetime; c HIV 10%/year | 1,400,000 430,000 HIV+ 50% die/year RHZE via DOTS |
| **Mycobacterium ulcerans** | Buruli Ulcer | painless, firm papule, nodule, or plaque (LE > UE) → ulcer c undermined edge → non-healing & extending | orgs in AF stained smear | worldwide tropics, SE Aus; esp pedes | rifampicin + adjunct ABX; debridement or excision if wide ulcer |
| Fungi | Subcutaneous | Systemic | Endemic Respiratory |
|-------|--------------|----------|---------------------|
| **Mycetoma**<br>(Maduromycosis, Madura foot) | Mycetoma<br>(Maduromycosis, Madura foot) | **Histoplasma capsulatum**<br>(Gilchrist disease) | **Histoplasma capsulatum**<br>(Gilchrist disease) |
| **Phialophora, Fonsecaea, et al**<br>(Chromoblastomycosis, Dermatitis verrucosa) | Chromomycosis<br>(Chromoblastomycosis, Dermatitis verrucosa) | **Coccidioides immitis**<br>(San Joaquin fever, desert fever) | **Coccidioides immitis**<br>(San Joaquin fever, desert fever) |
| **Sporothrix**<br>(Sporotrichosis nodules) | Sporotrichosis<br>(Sporotrichosis nodules) | **Histoplasma capsulatum**<br>(African histoplasmosis) | **Histoplasma capsulatum**<br>(African histoplasmosis) |
| **Paracoccidioides**<br>(African blastomycosis) | Paracoccidioidomycosis<br>(S American blastomycosis) | **Paracoccidioides**<br>(African blastomycosis) | **Paracoccidioides**<br>(African blastomycosis) |
| Painless, chronic subcut swelling, suppurative, & sinus tracts on extremities, esp foot; osteo | Org clusters (granules) in smear, histology | Orgs in unstained sputum smears | Orgs in unstained sputum smears |
| Orgs in tissue Bx or scrapings; Bx culture | Tropical LA, SSA; agric workers esp barefoot | Orgs in sputum smear, fluid, Bx | Orgs in stained smears of body fluids |
| Culture of tissue Bx or pus; orgs rare on smear | Worldwide; esp farmers & gardeners | Orgs in sputum smear, fluid, Bx | Orgs in sputum smear of granuloma, tissue Bx |
| Culture of tissue Bx or pus; orgs rare on smear | Worldwide; esp farmers & gardeners | Orgs in sputum smear of granuloma, tissue Bx | Orgs in sputum smear of granuloma, tissue Bx |
| Orgs in stained smear of granuloma, tissue Bx | South Africa | Orgs in sputum smear of granuloma, tissue Bx | Orgs in sputum smear of granuloma, tissue Bx |
| Tropical LA; esp agric workers | Tuberculosis c cavitation | Tuberculosis c cavitation | Tuberculosis c cavitation |
| Itraconazole, Amphotericin | Itraconazole, Amphotericin | Itraconazole, Amphotericin | Itraconazole, Amphotericin |
| Itraconazole, Amphotericin | Itraconazole, Amphotericin | Itraconazole, Amphotericin | Itraconazole, Amphotericin |
| Opportunistic Systemic | Disease | Symptoms | Diagnosis | Frequency | Treatment |
|------------------------|---------|----------|-----------|-----------|-----------|
| **Aspergillus** | Aspergillosis | allergic bronchopulmonary aspergillosis; pulm aspergilloma (fungus ball); cold skin abscesses; invasive end organ effects in brain, kidneys | orgs in histology; culture | worldwide; uncommon & sporadic ICPs | itraconazole |
| **Candida** | Candidiasis | F, end organ effects | orgs in histology; culture | worldwide; ICPs | fluconazole, amphotericin |
| **Cryptococcus** | Cryptococcosis | subacute-chronic meningitis esp in ICP; pneumonia | orgs in stained CSF; serology | worldwide; ICPs | fluconazole, amphotericin |
| **Pneumocystis jirovecii (prev carinii)** | Pneumocystis Pneumonia (PCP) (plasma-cell pneumonia) | pneumonia in ICP | orgs in stained sputum, BAL, or lung Bx | worldwide; ICPs | TMP/SMZ |
| **Rhizopus, et al (Mucoraceae)** | Mucormycosis | nasal or paranasal infection → craniofacial necrosis; blood vessel thrombosis c infarction of lung, gut | orgs in tissue Bx; Bx culture | worldwide; ICPs | amphotericin |
| Humans | Nematodes | Intestinal Nematodes | Symptoms | Diagnosis | Treatment |
|--------|-----------|----------------------|----------|-----------|-----------|
| via FO | *Ascaris* (roundworm) | Ascariasis | most s Sx; F, dry cough, wheeze (Loeffler’s syndrome); intestinal worms rarely noted; colicky abd pain, bowel obstruction, appendicitis, pancreatitis | ova or worms in stool, sputum | P-1.5 billion tropics; esp pedes | mebendazole, albendazole |
| via FO | *Enterobius* (threadworm, pinworm) | Enterobiasis | most s Sx; **perianal itch**, anorexia, D | ova on scotch tape swab (uncommon in stool) | P-350,000,000 esp pedes | mebendazole, albendazole |
| via skin of LE | *Ancylostoma, Necator* (hookworm) | Ancylostomiasis, Necatoriasis | most s Sx; ground itch, cutaneous larva migrans (esp c dog & cat hookworms), dry cough (// Loeffler’s), abd pain, D, **hypochromic anemia** | ova in stool (larvae in old specs) | P-900,000,000 women on agric plantation using nightsoil | 50–60,000 mebendazole, albendazole |
| via skin of LE | *Strongyloides* | Strongyloidiasis | **trial of urticarial rash, abd pain** (// PUD), D; also larva currens, dry cough (// Loeffler’s), dysentery; CP of hyperinfection syndrome c foul D, malabsorption, bowel perf, sepsis, *encephalitis* | larvae in stool (ova uncommon unless D); duodenal aspirate; serology | P-60,000,000 co-existing c hookworm | albendazole, ivermectin preferred |
| via FO | *Trichuris* (whipworm) | Trichuriasis | most s Sx; abd pain, chronic dysentery, rectal bleeding & prolapse, anemia, malnutrition (trichuris dysentery syndrome) | ova in stool; adult worm on sigmoidoscopy | P-500,000,000 tropics; esp pedes | mebendazole, albendazole |

| Filarial/Tissue Nematodes |
|--------------------------|
| *Loa loa* | see vector table—flies |
| *Mansonella* | see vector table—flies |
| *Onchocerca* | see vector table—flies |
| *Wuchereria, Brugia* | see vector table—mosquitoes |

| Zoonotic Nematodes |
|--------------------|
| *Angiostrongylus* (dog, cat hookworm) | *Cutaneous Larva Migrans* (creeping eruption) | reticulated subcutaneous track on foot or buttock | none | albendazole, ivermectin |
| *Angiostrongylus* (eosinophilic meningitis, visceral larva migrans) | meningitis, eosinophilia | often none; Hx of eating raw snails + meningitis + eos in PS, CSF; orgs in granuloma Bx | Asia-Pacific, LA tropics & subtropics | mebendazole |
| Marine Fish | Anisakis | Anisakiasis (visceral larva migrans) | abd pain, NV, enteric abscesses, malaise | Orgs on endos-copy; Tissue Bx; Serology | Japan, Asia-Pacific, Scandinavia | Excision |
|-------------|---------|------------------------------------|--------------------------------------|--------------------------------------|---------------------------------|---------|
| Humans      | Dracunculus (Guinea worm) | Dracunculiasis | Blister on leg/foot, ulcer; Emergence of worm | None | P-100,000 SSA c dry Climate | Extraction +/- Ivermectin |
| Dogs, Cats  | Gnathostoma (visceral larva migrans) | Gnathostomiasis | Abdominal pain, NV, abdominal abscesses, malaise | Orgs in granuloma Bx; Serology | SE Asia | Albendazole |
| Freshwater Fish | Onchocerca (prev Capillaria) | Onchocerciasis (intestinal onchocerciasis) | Intermittent D, abdominal pain, malabsorption (protein losing), wt loss | Ova or larvae in stool | Philippines, Thailand | Rare but rapid Metronidazole |
| Dogs, Cats  | Toxocara canis, cati (dog, cat roundworm) | Toxocariasis (visceral larva migrans) | Most mild & chronic; F, malaise, cough, bronchospasm (/ Loeffler's), HSM, LN, endophthalmitis | Orgs in granuloma Bx; Serology | Worldwide; ESP pedes | Albendazole |
| Pigs        | Trichinella | Trichinellosis | F, myalgia, rash, periorb edema (/ flu + facial edema); Dry cough, myocarditis | Orgs in muscle Bx (classic spiral) | P-10,000,000 | Albendazole |
| Cestodes    | Diphyllobothrium (fish tapeworm) | Diphyllobothriasis | Most Sx; D, megaloblastic anemia | | P-10,000,000 Alaska, Canada | Praziquantel |
| Dogs        | Echinococcus granulosus (dog tapeworm) | Echinococcosis (cystic or unilocular E, hydatid disease) | Most Sx until enlarge; S/Sx referable to liver (70%), lung (20%), other organs (10%) | US, CT; Serology | P-2,700,000 Including E. multilocularis Grazing Countries Where Dog Eat Viscera | 2-5% Albendazole + Praziquantel Excision p CT |
| Foxes, Dogs, Cats | Echinococcus multilocularis | Echinococcosis (alveolar or multilocular E, hydatid disease) | Most Sx until enlarge; S/Sx referable to liver, lung, brain; Local invasion // Tumor → Death | US, CT; Serology | P-as above N hemis—FSU, central Eur, N Japan, Alaska | Surgery s Tx 90% c Tx 20% |
| Rodents     | Hymenolepis (dwarf tapeworm) | Hymenolepiasis | Most Sx; abdominal pain, D | Ova in stool | P-75,000,000 Worldwide Cities #1 Human Tapeworm in NA, LA | Praziquantel |
| Cattle      | Taenia saginata (beef tapeworm) | Taeniasis | Most Sx | Proglottid or ova in stool | P-77,000,000 | Praziquantel |
| Pigs        | Taenia solium (pork tapeworm, cysticercosis) | Taeniasis | Adult worm (from eating pig cysticerci)—Anorexia, abdominal pain; larvae (from FO transmission of ova)—S/Sx referable to muscle, brain (epilepsy, HA, psyC), other organs | Proglottid or ova in stool; Larvae in Imaging & Bx; Serology | P-10,000,000 | Praziquantel |
| Fish [freshwater snails → fish] | **Trematodes** | **Symptoms** | **Diagnosis** | **Prevalence** | **Treatment** |
|--------------------------------|----------------|--------------|---------------|----------------|---------------|
| Clonorchis or Opisthorchis (oriental liver fluke) | Clonorchiasis (Chinese liver fluke disease) | Anorexia, biliary colic, HM, cirrhosis, ascites, jaundice, cholangitis, CA | Ova in stool; serology | P:7,000,000 Asia | Praziquantel |
| Clonorchiasis (Chinese liver fluke disease) | Fascioliasis | F, malaise, RUQ pain, biliary colic, HM, wt loss, jaundice, urticaria | Ova in stool; serology | P:2,000,000 worldwide | Triclabendazole |
| Fasciolopsis (intestinal fluke) | Fasciolopsiasis | Anorexia, DNV | Ova in stool | P:15,000,000 SE Asia | Praziquantel |
| Paragonimus (lung fluke) | Paragonimiasis | Malaise, urticarial rash → chronic cough, hemoptysis, pleuritic chest pain | Ova in sputum or stool | P:20,000,000 worldwide foci China, Korea | Praziquantel |
| Schistosoma mansoni (S.m), hematobium (S.h), japonicum (S.j), et al (blood fluke) | Schistosomiasis (bilharziasis, snail fever, Katayama fever) | F, urticaria, species specific Sx—terminal hematuria, obstructive uropathy (S.h); HSM, portal HTN, dysentery (S.m); Katayama F c urticaria, D, HSM, cough (4 wks p primary infection) (S.j) | Ova in stool (S.m, S.j), midday terminal urine (S.h); serology | P:200,000,000 Africa, SE Asia, SA 85% in SSA S.h > S.m > S.j > S.i > S.mek | 200,000 Praziquantel |
| Invasive Ectoparasites | Symptom | Treatment |
|------------------------|---------|-----------|
| **Domestic, field hosts**<br>e.g. dogs, rats, humans (accidental) via direct contact with larva from eggs laid in soil or damp cloth | **Condylobia**<br>(tumbu fly, mango fly) | Myiasis | boils | none | SSA | topical petroleum jelly, forceps extraction |
| via direct contact with fly eggs from vector or intermediate vector (e.g. housefly) | **Dermatobia**<br>(bot fly) | Myiasis | boils | none | LA | excision |
| via direct contact with adult mite | **Sarcoptes**<br>(mite) | Scabies | papules, burrows | orgs on Px, micro | worldwide | permethrin |
| domestic, field hosts via direct contact with adult flea | **Tunga**<br>(jigger flea, sand flea) | Myiasis<br>(tungiasis) | pustules on toe webs | none | worldwide tropics | needle extraction |
| Protozoa | Enteric | Non-Enteric |
|----------|---------|------------|
| **Balantidium** | Balantidiasis | D (dysentery) NV, cramps, tenesmus | trophs or cysts in wet or stained [stool] | metronidazole + iodoquinol |
| **Cryptosporidium parvum** | Cryptosporidiosis | chronic watery D esp in ICP | oocysts in AF stained [stool] | 50,000 none |
| **Cyclospora cayatanensis** | Cyclosporosis | chronic watery D in ICP | oocysts in AF stained [stool] | TMP/SMZ |
| **Entamoeba histolytica** | Amoebiasis | most s Sx as ACPs; dysentery; liver abscess (gen s prior GI Sx, M > F) | trophs or cysts in wet or stained [stool]; serology | I-50,000,000 P-500,000,000 tropics c poor sanitation | 70,000 metronidazole + iodoquinol |
| **Giardia lamblia** | Giardiasis | chronic watery D | cysts or trophs in stained [stool]; string test | I-500,000,000 metronidazole |
| **Isospora** | Isosporosis | chronic watery D in ICP | cysts in AF stained [stool] | TMP/SMZ |
| **Toxoplasma gondii** | Toxoplasmosis | most s Sx; mono-like—F, LN; congenital triad of hydrocephalus, cerebral calcification, chorioretinitis; encephalitis & chorioretinitis in OD | serology; PCR; orgs in tissue Bx | I-100,000,000 worldwide | 300,000 pyrimethamine + sulfadiazine |
| **Trichomonas** | Trichomoniasis | mucosal discharge | orgs in wet prep | I-175,000,000 metronidazole |
| Virus Type | Path of Transmission | Infection Route | Symptoms | Diagnosis | Incidence | Complications | Prevention/Vaccination |
|------------|----------------------|----------------|----------|-----------|-----------|--------------|------------------------|
| Hepatitis A virus (HAV) | via FO | Hepatitis A | F, malaise, anorexia, NV, RUQ pain, jaundice; no chronic infection | serology | I-1,400,000 | | 0.1–0.3% vaccine IG for PEP |
| Hepatitis B virus (HBV) | via sexual, perinatal, IDU, nosocomial | Hepatitis B | F, malaise, anorexia, NV, RUQ pain, jaundice → acute fulminant (0.1–0.6%) c CFR 70%, chronic carriers (10%) → cirrhosis, HCC, hepatic failure | serology | I-5,000,000 | P-250,000,000 chronic carriers | 2 billion infected worldwide 75% in Asia |
| Hepatitis C virus (HCV) | via sexual, perinatal, IDU, nosocomial | Hepatitis C | Most s Sx → chronic carriers (80%) → cirrhosis, HCC, hepatic failure (// HBV) | serology | P-200,000,000 | 80% chronic carriers | 50,000 50% no vaccine HBIG for PEP |
| Hepatitis D virus (HDV) | via sexual, perinatal, IDU, nosocomial | Hepatitis D | F, malaise, anorexia, NV, RUQ pain, jaundice → chronic carriers → cirrhosis, HCC, hepatic failure | serology | P-10,000,000 | | 2–20% no vaccine HBIG ineffective for PEP |
| Hepatitis E virus (HEV) | via FO, esp from contaminated water | Hepatitis E | F, malaise, anorexia, NV, RUQ pain, jaundice; no chronic infections (// HAV) | serology | I-20,000,000 | 3,000,000 acute cases epidemic AR 7% | 57,000 < 1% unless pregnant, then 20% in 3rd tri no vaccine IG ineffective for PEP |
| Human immunodeficiency virus (HIV) | via sexual, perinatal, IDU, nosocomial | HIV/AIDS | acute seroconversion over 1–2 wks c mac-pap rash (includes palms, soles), multiple Sx // mononucleosis; 4 stages—PGL → mild c mucocut Δs or HZ → intermediate c F, weight loss, chronic D → severe c AIDS, OIs | serology | I-1,900,000 | P-35,000,000 70% in SSA (5% of all adults in the region) | 1,500,000 from TB, OD 70% in SSA ART trial vaccine |
| Influenza virus (types A, B, C; only A subtypes cause pandemic) | via droplet nuclei | Influenza | F, HA, malaise, nonproductive cough, sore throat, rhinitis | virus isolation, IFA, RT-PCR, serology | I-5–10% | | 1,500,000 non-pandemic highest CFR U1 vaccine |
| Disease          | Transmission | Virus Type                  | Clinical Signs                                                                 | Diagnostic Methods       | Incidence/Prevalence | Geographical Distribution |
|------------------|--------------|-----------------------------|--------------------------------------------------------------------------------|--------------------------|-----------------------|---------------------------|
| Measles          | via droplet nuclei | *Morbillivirus* | cough, coryza, conjunctivitis, Koplik’s spots, rash d3 x 4 d; CP of D, pneumonia, croup, deafness, brain damage | serology                 | unknown               | SSA cool, rainy season except Sahel where peaks in dry season |
|                  | via FO       | Poliovirus (types 1, 2, 3; type 2 eliminated in wild in 1999) | Poliomyelitis (infantile paralysis) | virus isolation from stool; serology | 1-< 100 COUNT | endemic in Pakistan, Afghanistan 5–10% c paralytic polio polyvalent vaccine |

NB Disease incidence and prevalence estimates of chronic viruses and helminthes include subclinical infections for which asymptomatic carriers are common. For those infections, P_{infection} > P_{disease}

**Reference**

1. Yung, A. (2005). Golden rules of infectious diseases. In: A. Yung, M. McDonald, D. Spelman, et al. (Eds.), *Infectious diseases—a clinical approach*, 2nd ed. Hawthorn East, Victoria, Australia: IP Communications.
Annex 8.5
EPIDEMIC PREPAREDNESS AND RESPONSE

I. EPIDEMIC PREPAREDNESS

A. Prior to Seasonal Epidemic
   1. Establish a National Coordinating Committee (NCC).
   2. Designate a lead agency and lead official in the NCC.
   3. Establish a Local Coordinating Committee (LCC).
   4. Designate a lead official in the LCC.
   5. Anticipate roles for partner agencies (e.g. inter-agency and team coordination, disease surveillance, field epidemiological investigation, laboratory identification, case management guideline development, outbreak logistics, public information, and social mobilization).
   6. Identify sources of funds.
   7. Intensify disease surveillance.
   8. Identify reference lab(s) for communicable diseases of epidemic potential.
   9. Ensure mechanism for specimen transport.

II. OUTBREAK RESPONSE

A. Initial Response to Suspected Outbreak
   1. Form an emergency team to investigate and manage the outbreak
      a. identify key roles on the outbreak investigation team(s)
         (1) epidemiology and surveillance
         (2) case management
         (3) water and sanitation
         (4) laboratory services
         (5) communication
      b. staff those roles
         (1) epidemiologist—to monitor proper data collection and surveillance procedures
         (2) physician—to confirm clinical S/Sx and train health workers in case management
         (3) water and sanitation expert—to develop a plan for reducing sources of contamination
         (4) microbiologist—to take environmental/biological samples for laboratory confirmation, train health workers in proper sampling techniques, and confirm use of appropriate methods in the diagnostic laboratory
         (5) behavior change communication (BCC) specialist—to assess the population’s reaction to the outbreak, create, and disseminate appropriate health messages

B. Outbreak Investigation Protocol
   1. Establish access, contacts, logistics.
   2. Verify outbreak.
   3. Confirm diagnosis.
   4. Develop case definition.
      a. What are most patients complaining of?
      b. Describe a typical patient.
      c. Choose a case definition from the community descriptions confirmed by your own observations.
   5. Count cases and determine demographic data.
      a. How many people live in the outbreak area?
      b. Who are the patients?
      c. What is their background—age, sex?
      d. Where are the patients coming from?
      e. When did the patients arrive?
f. Why are the patients arriving?
g. Count the number of patients fitting the case definition.
h. Count the number of fresh graves or bodies at health facilities and inquire as to cause.

6. Orient the descriptive data—person, place, and time.
   a. Tabulate data on affected patients.
   b. Make a spot map.
      (1) When and where was/were the first reported case(s) seen indicating an outbreak?
   c. Plot an epidemic curve.
      (1) What is the present # of patients/day or week?
      (2) What is the usual # of patients/day or week?
      (3) Is this an increase?
      (4) What is the present # of deaths/week or month?
      (5) What is the usual # of deaths/week or month?
      (6) Is this an increase?
   d. Calculate attack rates and case fatality ratios for total patients, U5, O5, and gender.

7. Develop hypothesis.
   a. Postulate sources of disease and mechanism of spread.
   b. Estimate the population at risk of contracting disease and of dying from it.
      Consider especially:
      (1) poor
      (2) those with limited access to health services
      (3) minorities
      (4) malnourished
      (5) pregnant and lactating
      (6) infants not breast fed, children unvaccinated
      (7) elderly

8. Initiate control measures considering agent, host, and environment.
   a. What action has the community taken?
   b. Identify local response capacity.
      (1) What number and type of staff are locally available?
      (2) What drugs and supplies are locally available?
   c. Determine immediate unmet needs.
      (1) specimen collection and lab diagnosis
      (2) logistics
      (3) support for clinical care—staff, drugs, and supplies
      (4) support for environmental health
   d. Undertake further necessary actions.
      (1) case management with secondary prevention
      (2) patient isolation
      (3) health education
      (4) agent and reservoir identification
      (5) environmental decontamination
      (6) primary prevention
      (7) public information

9. Inform authorities with investigation report.
10. Initiate ongoing disease surveillance.

C. During Epidemic

1. NCC should meet at least weekly.
2. LCC should meet daily at first, then reduce meeting frequency as circumstances warrant.
D. **Surveillance Systems Lessons Learned**

1. Start small, keep it simple
   a. active surveillance at sentinel sites
   b. simple standard operating procedures
      (1) case investigation
      (2) specimen collection
2. Invest in local people and systems
3. Focus the system on performance-based indicators
   a. polio—non-polio acute flaccid paralysis detection rate of 1:100,000
   b. gastroenteritis—stool specimen collection rate of 80%
4. Link data to action
   a. case detection → local response
   b. case locations → need for (sub)national immunization days
   c. lab info → recognition of imported vs indigenous cases
   d. other process indicators → system improvement
5. Show success, then expand
Annex 8.6
COMMUNICABLE DISEASE CONTROL

Glossary

ABX antibiotics
AM morning
AR attack rate
ARI acute respiratory infection
bd twice daily
C&S culture and antibiotic sensitivity
CFR case fatality rate
CHW community health worker
COTS Cholera Outbreak Training and Shigellosis Program (training program developed at ICDDR)
CT cholera toxin
d day
D diarrhea
DF dengue fever
DOC drug of choice
Dx diagnosis
EHEC enterohemorrhagic E. coli
EPI Expanded Programme on Immunization
ETEC enterotoxigenic E. coli
F fever
h hour
HPI history of present illness
HUS hemolytic-uremic syndrome
ICDDR International Centre for Diarrhoeal Disease Research, Bangladesh
ID<sub>50</sub> median infective dose
IPD inpatient department
IPT intermittent preventive treatment
IRS indoor residual spraying
ITN insecticide treated net
IV intravenous
IVF intravenous fluids
L liter
LCC Local Coordinating Committee
MOH Ministry of Health
N nausea
N/A not available
NCC National Coordinating Committee
NGT nasogastric tube
O5 over 5 year-old
OCV oral cholera vaccine
OPD outpatient department
ORS oral rehydration salts/solution
p person
PO by mouth
PPE personal protective equipment
PRN as needed
Pt(s) patient(s)
PT population total
| Abbreviation | Definition |
|--------------|------------|
| q            | every      |
| qd           | daily      |
| rBS          | recombinant beta subunit (of cholera toxin) |
| RDT          | rapid diagnostic test |
| SD1          | *S. dysenteriae* type 1 |
| SSU          | short stay unit |
| S/Sx         | signs and symptoms |
| STEC         | Shiga toxin producing *E. coli* |
| Sx           | symptoms |
| T            | temperature |
| U2           | under 2 year-old |
| U5           | under 5 year-old |
| V            | vomiting |
| WHO          | World Health Organization |
| YF           | yellow fever |
| yr           | year |
| Zn           | zinc |
DIARRHEA

Pathogens

Cholera

*V. cholerae* has > 200 serogroups. Serogroups are classified by biotype, and for serogroup O1, by serotype and biotype. Humans are the only known vertebrate host for cholera, and only serogroups O1 and O139 cause epidemic disease. There is no clinical difference between them. Other serogroups may cause disease in individuals, but not epidemics. When a suspected cholera serotype (strain) is isolated in the lab, one of the first tests performed is bacterial agglutination with O1 and O139 antisera. Strains are thereby identified as *V. cholerae* O1, O139, or non-O1/non-O139.

- If (+) agglutination to O1 antisera, then the strain is further tested for agglutination to antiserum of Ogawa and Inaba serotypes.
- If (+) agglutination to O139 antisera, then the strain is not further subdivided (except as producer or non-producer of CT as noted below).
- If (−) agglutination to O1 and O139 antisera, then the strain is known as non-O1, non-O139 *V. cholerae*.

A strain is further identified as a producer or non-producer of cholera toxin (CT). CT production is a major determinant of disease development. Strains lacking CT do not produce epidemics even if from the O1 or O139 serogroup.

- Serogroup O1 exists as 2 main biotypes—classical and El Tor—though hybrids also exist. Each biotype occurs as two serotypes—Ogawa and Inaba. Classic biotype caused the 5th and 6th pandemics but little epidemic disease since the 1970s though it still causes cases in India. **El Tor biotype** caused the 7th (current) pandemic and almost all recent outbreaks. El Tor was first isolated in 1905 in El Tor, Egypt after importation by Indonesian pilgrims travelling to Mecca. It survives longer in the environment and produces CT similar to the classical biotype. Presumably because of CT pathogenicity, the % of cholera patients with severe disease has doubled over the past 10 yrs. These patients tend to require IV fluid therapy.

- Serogroup O139 may have evolved from strains of O1 El Tor as they share many properties though not agglutination. In spring of 2002 in Dhaka, O139 cases exceeded O1 El Tor cases for the first time, and it was postulated that O139 may become the cause of an 8th pandemic. However, since then, O1 has again become dominant.

Infective dose depends on individual susceptibility. Relevant host factors include immunity produced by prior infection with serogroup O1 as well as stomach acidity. ID\(_{50}\) may be 100,000 orgs, so personal hygiene plays a lesser role than in shigellosis where the ID\(_{50}\) is much lower.

Shigella

*Shigella* has 4 species.

- *S. dysenteriae* type 1 (SD1 or Shiga bacillus) causes the severest disease of all *Shigella* sp because of its neurotoxin (Shiga toxin), longer duration of illness, higher ABX resistance, higher CFR thru invasive complications, and great epidemic potential.
- *S. flexneri* is the most common, and is generally endemic, in developing countries
- *S. sonnei* is the most common in industrial countries
- *S. boydii* and *S. sonnei* give mild disease.

| Shigella Species | Serogroup | Serotypes | Notes |
|------------------|-----------|-----------|-------|
| *S. dysenteriae*  | A         | 1–15      | SD1 gives most severe disease with complications of HUS |
| *S. flexneri*     | B         | 1–6 (15 subtypes) | Greatest burden of disease and main cause of endemic shigellosis |
| *S. boydii*       | C         | 1–18      | Mild disease |
| *S. sonnei*       | D         | 1         | Mild disease |
ID$_{50}$ may be 10 orgs, so personal hygiene plays a greater role than in cholera.

**E. coli**

Some kinds of *E. coli* produce a Shiga toxin. Shiga toxin genes reside in bacteriophage genome integrated into the bacterial chromosome. Some ABX, e.g. fluoroquinolones, induce expression of phage genes. The bacteria that make these toxins are variously called “Shiga toxin-producing *E. coli*” (STEC), “enterohemorrhagic *E. coli*” (EHEC), or “vero-cytotoxic *E. coli*” (VTEC). All terms refer to the same group of bacteria.

- *E. coli* O157:H7 (often called “*E. coli* O157” or “O157”) is the most commonly identified STEC in North America, and it causes most *E. coli* outbreaks. Approximately 5–10% of EHEC infections result in HUS.
- Non-O157 STEC serogroups also cause disease. In the USA, serogroups O26, O111, and O103 are the most commonly identified *E. coli* pathogens overall.

**Epidemiology**

Diarrhea epidemiology is seasonally dependent. Environmental temperature directly influences biologic activity—Δ5°C is proportional to 3× risk of disease

- temperate climates: bacterial diarrhea in warmer, humid season; rotavirus diarrhea in cooler, dry season
- tropical climates: bacterial diarrhea in rainy season; rotavirus diarrhea year round with increased incidence in cooler season
- most common pathogens for watery diarrhea—rotavirus, ETEC, *V. cholerae*; most important pathogen for epidemic watery diarrhea—*V. cholerae*
- most common pathogens for dysentery—shigella species, salmonella species, *Campylobacter jejuni, Clostridium difficile, EIEC, EHEC, E. coli* O157:H7, *Entamoeba histolytica, Yersinia enteroocolitica*; most important pathogens for epidemic dysentery—*S. dysenteriae* serotype 1 (developing countries), *E. coli* O157:H7 (developed countries)

Bangladesh has two seasonal cholera peaks: pre-monsoon with hot, humid weather (esp weeks 15–20 in Apr-May) creating increased biological activity; post-monsoon (esp weeks 30–40 in Aug–Sep) with contamination of water sources. Pre-monsoon epidemics are generally worse than post-monsoon ones. Dysentery has low level year-round incidence, but epidemics occur roughly each decade. Epidemic strains display new, additive antibiotic resistance which probably triggers the epidemic. Once resistant strains have become endemic, antibiotic susceptibility rarely reappears. SD1 acquires resistance quickly. *Sf* acquires it more slowly, and that resistance may wane with decreasing ABX pressure.

At ICDDR, annual proportional incidence approximates the following:

| Proportional Incidence of Diarrheal Pathogens in Bangladesh |
|------------------------------------------------------------|
| **Total** | **Pedes** |
| Rotavirus | 30% | Rotavirus | 45% |
| Cholera (O1 >> O139) | 20% | *E. coli* | 45% |
| ETEC | 15% | Camplyobacter | 10% |
| Shigella (flexneri >> boydii, sonnei, SD1) | 5% |
| Other | 30% |

- *E. coli* overall = 35% of cases, but ETEC = 15%.
- *E. coli* tends to dominate before monsoon season and flooding.
- Cholera tends to dominate after monsoon season and flooding.
- Overall, 60–70% of diarrhea cases may be vaccine-preventable.
- 30% of Pts have no pathogen identified.

**Preventive Medicine**

Clean water and waste management for cholera.
Personal hygiene (hand washing with soap and clean towels) for shigella.
Water  safe drinking water (boiled, chlorinated)
   NB Sphere standards are not enough—you need increased quantities of chlorinated water at household level.
San  clean latrines for safe disposal of excreta
   hand washing with soap
Food  safe food (cooked, stored)
   breast feeding
Fomites  safe disposal of dead bodies with disinfection of clothing
   NB After outbreak of a fecal-oral pathogen, food hygiene and funereal practices may influence human-to-
   human transmission more than water quality.
Health education to affected population
   Wash hands with soap:
      after using toilets/latrines.
      after disposing of children’s feces.
      before preparing food.
      before eating.
      before feeding children.
   Boil or disinfect water with chlorine solution. (Bottle it, boil it, ferment it, or forget it.)
   Eat only freshly cooked food. (Peel it, cook it, or leave it.)
   Do not defecate near water sources.
   Use latrines and keep them clean.
Consider vaccination for areas and populations most at risk. Pre-emptive vaccination for new arrivals (esp nutritionally
impaired IDPs) moving into an endemic area is increasingly accepted. Reactive vaccination where cholera has
broken out is more controversial—particularly if vaccine stocks are not locally available and remain limited world-
wide. There are 2 types of oral cholera vaccines licensed internationally: one with dead \textit{V. cholerae}, and one with live \textit{V. cholerae}. (Parenteral cholera vaccine is not recommended because of low protective efficacy and frequent severe adverse reactions.)
\textbf{Killed whole cell \textit{V. cholerae} O1 vaccine}
   \textbullet  Dukoral—mixture of the classical biotype (both Inaba and Ogawa serotypes) and the El Tor biotype (only Inaba serotype) + purified recombinant B-subunit of CT (rBS)
      Dose: 3 cc vaccine given in 150 cc of buffer solution; 2 doses, 1–6 wks apart; cold chain required. The regime is identical for all patients, and thus can’t be given to pedes < 2 yr because of volume loading.
      Dukoral has been the main vaccine considered for use in high-risk populations.
   \textbullet  mORC-VAX and Shanchol—similar to Dukoral except they do not contain the rBS, hence do not require a buffer, and are 1/3 the cost to produce. mORC-VAX, produced in Vietnam, is derived from a vaccine admin-
      istered to millions of people since 1997, but is not WHO pre-qualified, and is not expected to have interna-
      tional distribution. Shanchol, produced in India, has international distribution (e.g. used in the Haiti cholera vaccination campaign of 2012), and is now the agent of choice for WHO. It confers immunity 10d p 2nd
cose, effectiveness > 85% at 6 mo, and protection > 50% at 5 yr. Also confers short-term protection vs ETEC.
      Dose: 1.5 cc vaccine followed by water ingestion but no fasting needed; 2 doses, 2 wks apart; cold chain
      required except for day of use.
\textbf{Live-attenuated genetically modified \textit{V. cholerae} O1 vaccine}
   \textbullet  Orochol—bivalent formulation as in Dukoral without rBS of CT.
      Dose: single dose. No longer manufactured.
WHO recommendations: “Vaccination should not disrupt the provision of other high-priority health interventions to control or prevent cholera outbreaks. Vaccines provide a short-term effect that can be implemented to bring about an immediate response while the longer term interventions of improving water and sanitation, which involve large investments, are put into place” [1].
ICDDR recommendations: “Because of limitations in terms of transport, formulation, and cost of the current Dukoral vaccine, the COTS program does NOT require the utilization of the vaccine during an outbreak; it is NOT necessary to vaccinate to overcome an outbreak. However, if Dukoral is readily available and staff are properly trained in its use according to the guidelines that come with the vaccine, the COTS program PERMITS Dukoral’s use (ideally before an outbreak) in the following high-risk populations: refugee populations in which cholera is present, health care workers managing cholera cases, and communities in which the incidence rate is greater than 1 in 1000 annually” [2].
Epidemiological Surveillance

Cholera

Epidemiological assumptions (WHO, COTS):

Estimated attack rates

- 10–20% extremely vulnerable hosts and poor environmental health (WHO)
- 5% (refugee camps with malnutrition) (COTS)
- 2% (rural communities of < 5000 p) (COTS)
- 1% (severe epidemic—good estimate of ultimate disease burden) (WHO)
- 0.6% (endemic areas with bad sanitation) (COTS)
- 0.2% (endemic areas in open settings—suitable for initial calculations of early resource requirements)

NB Overall, 90% of cases are mild and difficult to distinguish from other types of D. Asymptomatic carriers are very common (10x # of cases).

Referral rates for IVs 20% of cases (much higher—70% at ICDDR as it shortens recovery time)

Case fatality ratios 1% (with good care)

The following catchment populations will yield 100 acute Pts of whom 20 will be severely dehydrated:

- refugee camp of 2000 people (AR of 5% = 100 Pts)
- open settings in endemic area with 50,000 people (AR 0.2% = 100 Pts)

A population of 100,000 infected individuals in an epidemic area will yield the following (WHO):

- Population infected 100,000
- Clinical cases 1,000 + (1% of infected population)
- Cases needing early resources 200 + (20% of cases)
- Cases needing IV therapy 200 + (20% of cases, 0.2% of infected population)
- Anticipated deaths 10 + (1% CFR)

NB In non-endemic areas, AR adults > AR pedes because adults have higher exposure risks.

In endemic areas, AR pedes > AR adults because adults have been exposed since childhood.

Clinical Medicine

Delivery of Health Services

Active case finding through CHWs

Treatment facilities—2 types

- outpatient ORS center
  - ORS packets, Zn
  - clean water
  - ABX (in the case of a shigellosis outbreak)
  - recording form for demographic information
  - trained staff (nurse, health aides)
  - if budget allows:
    - soap to give to families (especially in the case of a shigellosis outbreak)
    - communication (radio, telephone) with the treatment facility for patients who need transfer, and means of transport (ambulance, horse, rickshaw, etc.)
- inpatient treatment facility (section of existing hospital/health center or makeshift facility)
  - one way traffic flow—from triage to OPD/home and IPD
  - running water or close proximity to water source
  - large quantities of safe water (40–60 L/p/d)
  - adequate waste disposal system
  - shelter from weather
  - recording form for patient demographic information and clinical status
  - IVs, suspension lines, ORS, meds, and other essential supplies in treatment areas
trained staff (physicians, nurses, health aides, and cleaners) with supervision of Pts 24/7
fee waiver policy for emergencies
1 family carer or visitor/Pt

Standardized Case Management

Suspected cholera outbreak definition
Pt > 5 yr develops acute watery diarrhea with severe dehydration or death,
any sudden increase in the daily # of patients with acute watery diarrhea especially if they pass typical rice-water stools

Case definitions
cholera where the disease is not known to be present
Pt > 5 yr with acute watery diarrhea plus severe dehydration or death
cholera where the disease is confirmed present
Pt > 2 yr with acute watery diarrhea
bacillary dysentery
Pt with acute diarrhea plus visible blood in the stool

Treatment protocols
Overview
assess for dehydration
rehydrate the Pt
maintain hydration by replacing ongoing fluid losses until diarrhea stops
give an oral antibiotic to the Pt with severe dehydration
feed the Pt

Triage by dehydration status
1/3 Pts without dehydration → OPD for ORS
2/3 Pts with dehydration → SSU for IVF, ORS
→ IPD for adults with D > 14d, typhoid fever, meningitis;
peides with malnutrition + infectious complications

HPI & stool appearance help make presumptive Dx

**Shigella**
HPI: 3 d of Sx with F + abdominal pain/cramps + bloody D (not voluminous) + tenesmus (from colonic mucosal inflammation and erosions), anorexia ± dehydration.
Stools: chunky style with visible coagulated blood (related to coagulation necrosis in bowel).
However, watery diarrhea may appear early in the illness.

**Cholera**
HPI: 6 h of Sx onset in early morning with V, profuse watery D without pain or cramps, marked dehydration.
Stools: homogeneous rice water, occasionally turbid with fine particulate, occasionally yellowish when mixed with urine.

**Vibrio parahemolyticus**
Stools: “meat-washed stool” treated similar to cholera

**Rotavirus**
HPI: V without F
Stools: look like mashed pulses

**Amoeba**
Stools: appears dark brown because the parasite oxidizes heme.

**IVF**
ASAP (< 1 min) if severely dehydrated. 75+% of Pts with dehydration at ICDDR get IVs because they feel better more quickly. Otherwise PO sufficient. NGT OK if IV and PO are unsuccessful (very rare).

**NB**
acetate in cholera saline may cause hypocalcemia and tetany.

**ORS for rehydration**
Pt < 6 months, glucose ORS
Pt > 6 months, rice-based ORS

**Zn**
Pt < 6 months, 10 mg PO qd × 10–14 d
Pt > 6 months to 5 yr, 20 mg PO qd × 10–14 d
ABX always given under physician supervision

**Cholera**
In epidemic season, use ABX × 1 dose with all dehydrated patients with suspected cholera.
In non-epidemic season, use clinical judgment on watery diarrhea.
If organism is sensitive, doxycycline is generally DOC. ICDDR has used azithro as DOC in all ages.

**Dysentery**
Use ABX for dysentery year round (if resources limited, prioritize high risk groups—U5, malnourished, toxic, post-measles, pregnant, old, etc.). If organism is sensitive, cipro is generally DOC. ICDDR has used cipro in adults and pivmecillinam in pedes. Ceftriaxone is 2nd choice for both age groups.

**Rotavirus**
Usually, no ABX, unless Pt is very ill and clinical picture suggests combined disease.

**ETEC**
Usually, no ABX, unless Pt develops severe dehydration.

**Misc Sx V** no antiemetics, but use NGT or IVF if Pt ultimately can’t take PO
F ± antipyretics depending upon resources available
Physician rounds q 2 h on severely ill Pts; 4x/d on Pts with some dehydration (SSU); 2x/d on Pts without dehydration (OPD).

**Disposition**
- **Cholera** improves quickly—young Pts get off IVF by 24 h, old Pts by 48 h.
- **ETEC** lasts for 3–5 d.
- **Shigella dysentery** lasts for 3–5 d if uncomplicated.
- **Rotavirus** lasts for 5 d until kids can feed again (strips off brush border). Maternal motivation is important during this time.

**Overall** rice-based ORS ends up adequately treating 85% of diarrheas

**Discharge**
- no dehydration, < purging, able to take ORS adequately
- 5–7% return visits are expected; > 10% return visits mean discharge policy is too aggressive

**Essential drugs & supplies**
- cholera kits
- drug choices driven by culture data (10–20 specs)

**Referral guidelines**
- refer all Pts refractory to rehydration and standard ABX to hospital for C&S

**Secondary prevention for the discharged patient**
- ORS liberally distributed with instructions for use—2 ORS sachets to all discharged Pts (home based salt solution is dangerous)
- soap distribution to accompanying persons

**Secondary prevention at the site**
- Isolate the affected Pt/ward/camp/defecation area.
- Impose hand washing upon entry/exit to affected hut/clinic/camp/defecation area, etc. (0.05% Cl).
- In-service staff—HCWs should not handle food or water (ORS); kitchen staff should not handle hospital waste.
- Recruit cleaners, establish cleaning routine (0.5% Cl).
  - wash spills ASAP
  - wash floor q 4 h
  - collect stool collection buckets bd or PRN (wash them with 2.0% Cl)
  - change and wash cot covers qd
  - wash cots after each Pt
  - spray the affected area qd (water storage containers, water distribution points, latrines, door handles, etc. in clinic, camp, and defecation area)
- Identify body fluid disposal site (2.0% Cl).
  - hold Cl treated fluids 2 h before dumping

**Establish hygienic funereal practices (2.0% Cl).**
Epidemic Management

Outbreak investigation protocol in place
- rapid response teams to investigate case reports
- epidemic investigation kits to mobilize
- specimen collection
  - labs to confirm Dx of *V. cholerae*, *S. dysenteriae*, other shigella, and *E. coli* O157:H7
- dipstick identification on representative sample of specs is useful for cholera, but C&S is essential because dipsticks are not available for shigella, ETEC. Vibrio are hardy if kept moist and cool. They can survive a week in Cary Blair media. Shigella are fragile and difficult to recover if transport time > 1 d.

5–10 isolates initially to confirm outbreak
30–50 isolates initially to create ABX use policy (bacterial resistance renders cotrimoxazole, amp/amox, nalidixic acid, and tetracycline unusable)
20–30 isolates monthly from IPD and OPD before ABX therapy to assess evolving ABX resistance
10–20 isolates periodically to reference laboratory to confirm ABX resistance patterns and undertake molecular studies
20 isolates at end of the outbreak to confirm that new diarrheas are not epidemic pathogens

NB Systematic sampling is most representative—e.g. every 10th Pt or all Pts q 2 weeks adjusted as needed to collect the necessary specs.
- Sensitivity >> important than specificity in RDT screening during an epidemic.
- Pts from one geographic area are more likely to constitute a cluster involving a new pathogen.
- An area may be considered cholera-free after 2 incubation periods (total of 10 d) have passed without cholera disease. However, hospital monitoring should continue for a year due to tendency of enteric pathogens to re-emerge long after they are declared gone.
- Cholera may be viable but nonculturable from the environment; environmental monitoring has many false negatives.

- consider improvements to existing diagnostic labs
- hotlines set up for reporting of rumor

Health reference and educational materials in place
- case definitions
- case management and referral guidelines for communicable diseases with epidemic potential
- Pt, provider, and community educational materials
- specimen handling protocols

Epidemic command & control center established under local health authorities using principles and practices of incident mgmt
- unified command of multi-disciplinary specialists
- information channel to government and stakeholders
- support by government for technical actions

Coordination with technical sectors—particularly WASH (CFR is a function of case mgmt, but AR overall is a function of WASH)
- water supply, purification, and distribution systems
- bucket chlorination is low tech but reasonable way to reach individual HH or small communities
- water treatment units need Ca hypochlorite, chlorimetric, and colimetric monitoring devices
- chlorinators worth considering at water sources of high public demand and epidemic activity
- hygiene promoters with environmental health assessors to address hand and food hygiene in communities around the outbreak area (think ring vaccination with knowledge)
- safe disposal of medical waste and infectious sludge from treatment facilities

Medical logistics–resource prepositioning and stockpiles
- cots (take one and have carpenter make copies)
- plastic sheets with defecation hole or sleeve
- buckets (white color for stool—enables recognition of diarrhea color; different color for emesis; different color for domestic waste)
- IVF, IV sets, IV poles or suspension cords (cholera kits)
ORS powder and ORS vats (> 50 L)
cups, spoons
NGTs, syringes
soap cleaning supplies
bleaching powder (e.g. Ca hypochlorite)—chlorinate water sources where feasible, otherwise bucket chlorinate at untreated sources
equipment (e.g. chlorimetric and colimetric monitors)

Information management
update local authorities
intensify disease surveillance (health authorities, WHO)
issue health advisories (health & political authorities)
establish cholera advisory task force
reinforce training of public health cadres on diarrhea prevention and control.
reinforce education of clinicians on diarrhea case management and secondary prevention
Initiate public awareness and health education campaign
  message content—WHO Cholera manual or COTS card for Health Promotion Worker)
  messages dissemination—printed, loudspeaker, broadcast, community groups
  messages uptake—community understands hand washing, ORS use, and 2 prevention measures

OCV  Cholera epidemic brings huge political pressures to DO something. This often translates into a hastily conceived vaccination campaign that distracts from core principles of cholera management. For every symptomatic Pt, there are 90–99 asymptomatic carriers, and the affected community is already extensively infected. Cholera vaccination, under these circumstances, has little public health benefit for the resource investment.
If undertaken, the following will apply:
Vaccination campaign requires numerous staff. Community mobilizers are key. Clinical staff should not be poached from their clinical duties. Supervisors must be free to move at will.
Logistics is key—if the 1st day goes bad, the campaign goes bad.
Mark the domiciles which are done.
Hold after-action meetings each day.
Last day, use mobilizers with mobile broadcasting to find those missed.
Second phase vaccination should include CHWs with multi-purpose messages on water and sanitation.

Key lessons in epidemic response
Avoid:  press exaggeration
ABX prophylaxis
reliance on IVF and insufficient ORS
lab investigation of cases once epidemic etiology is ascertained
prolonged hospitalization
hospital discharge criteria requiring multiple negative stool cultures
enthusiasm for OCV during epidemic
exaggerated water purification objectives
concentration of technical competencies in MOH at expense of districts
failure to share information with district stakeholders

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2. International Centre for Diarrhoeal Disease Research, Bangladesh, and Swiss Tropical Institute (Eds). Cholera outbreak training and shigellosis (COTS) program [CD-ROM version 1.0, undated]. Available from the International Centre for Diarrhoeal Disease Research, Bangladesh, and http://www.cotsprogram.com.
INFLUENZA

Pathogens

Influenza viruses comprise 3 genera—influenza types A, B, and C—each with 1 species.

• Influenza type A is divided into subtypes based upon serological response to hemagglutinin (HA) and neuraminidase (NA) glycoproteins. There are 16 different HA subtypes and 9 different NA subtypes. H1N1, H2N2, and H3N2 are responsible for the major human pandemics in the last century. H2N2 virus circulated between 1957 and 1968 but currently does not. Only influenza A subtypes infect birds, and all subtypes can do so. Bird flu viruses do not usually infect humans. But, in 1997, an outbreak of H5N1 avian influenza in poultry in Hong Kong marked the first known direct human transmission of avian influenza virus from birds to humans. Since then, H5, H7, and H9 avian influenza subtypes have been shown to infect humans.

• Influenza type B is morphologically similar to A and also creates seasonal and epidemic disease.

• Influenza type C is rare but can cause local epidemics.

Seasonal human influenza vaccine currently has 3 strains—H1N1/H3N2/B.

Influenza disease in humans has a short incubation period (1–3 d). Early symptoms are non-specific. It is highly infectious, especially early in the course of the disease, with a large # of asymptomatic carriers. Transmission potential ($R_0$) is a function of infectivity, period of contagiousness, daily contact rate, and host immunity. In general, the faster the transmission, the less feasible is interrupting transmission thru usual disease control tools of case finding, isolation, contact tracing, and ring vaccination.

| Table 8.6.3 | \( R_0 \) of Different Diseases (adapted from CDC [1]) |
|-------------|---------------------------|
| Disease     | \( R_0 \)             |
| Measles     | 12–18                    |
| Polio       | 5–7                      |
| Rubella     | 6–7                      |
| Diphtheria  | 6–7                      |
| Smallpox    | 5–7                      |
| Mumps       | 4–7                      |
| SARS        | 3 (excluding superspreaders) |
| Influenza pandemic | 2–3 (1918) |
| Influenza seasonal | 1.5–3             |

| Table 8.6.4 | Disease Comparison (adapted from US DHHS [2]) |
|-------------|---------------------------------------------|
| Attribute   | Disease | Smallpox | SARS |
| Transmissibility | Hi      | Med      | Low  |
| \( R_0 \)  | > 2 (estimated 1.8 for 1918 pandemic) | 5–7 | 3 (excluding superspreaders) |
| Geography | Widespread, multi-focal epidemics | Focal epidemics |
| Transmission location | Community | Within families and health care settings |
| Incubation period | 1–3 days | 10–12 days (CDC) | 7–10 days |
| Attack rate | 10–35% | 58% (CDC) | Low |
| CFR         | 1% (seasonal) 50% (highly pathogenic avian influenza) | 50% (unvaccinated) 30% (vaccinated post exposure) 11% (>20 y before exposure) 1.4 % (0–10 y before exposure) | 5–10% |
| Epidemic investigation | Unlikely to track spread based upon movement of infected persons or contacts | High ability to track spread based upon movement of infected persons or contacts | Potential ability to track spread based upon movement of infected persons or contacts |
Preventive Medicine
Vaccination when available, social distancing, cough etiquette, hand hygiene

Epidemiological Surveillance
Rapid case investigation, contact tracing, and the containment of small clusters of cases
Quick reporting of suspected cases by affected countries

Clinical Medicine

Delivery of Health Services
Passive case finding but use of influenza clinics and fever hospitals

Standardized Case Management
Case definitions
Treatment protocols
  technical expertise in case management including rational use of antiviral treatment and prophylaxis
Essential drugs
monitoring for counterfeit antiviral medications
Referral guidelines
what to do in resource poor settings
Secondary prevention
health care setting
  Pt isolation in specific hospital/ward designations
  private room or cohorting with other flu Pts
  minimize transport of Pt outside room
  limit # of HCWs interacting with flu Pt
  limit # of visitors interacting with flu Pt
infection control
  standard
  contact
  airborne (droplet nuclei)
  droplet
standard precautions with PPE and hand washing
hand hygiene
powered air purifying or N95 respirators, cough suppression
N95 respirators
home settings
  voluntary Pt isolation in private room
  minimize transport of Pt outside room
  limit # of family interacting with flu Pt
infection control
  standard
  contact
  airborne (droplet nuclei)
  droplet
  voluntary quarantine of contacts of known cases
standard precautions with PPE and hand washing
hand hygiene
N95 respirators, cough suppression
N95 respirators

Interventions to prevent transmission
International travel restrictions/screening possible but unlikely to prevent pandemic; quarantine unlikely; school closing and limits on public events likely; vaccination of priority groups
Vaccination effective if given within 4 d of infection
International travel restrictions/screening possible and likely to help prevent outbreaks; quarantine likely; school closing and limits on public events unlikely

Disruption of transportation infrastructure, community services
Widespread, widespread
Widespread, little

International travel restrictions/screening possible but unlikely to prevent pandemic; quarantine unlikely; school closing and limits on public events likely; vaccination of priority groups
Vaccination effective if given within 4 d of infection
International travel restrictions/screening possible and likely to help prevent outbreaks; quarantine likely; school closing and limits on public events unlikely

Disruption of transportation infrastructure, community services
Widespread, widespread
Widespread, little
management of contacts (contact tracing, contact monitoring) potentially useful only very early in epidemic
quarantine of close contacts for a complete incubation period potentially useful only very early in epidemic
all settings—try to decrease potential for infection
vaccination
seasonal or post-exposure antiviral chemoprophylaxis
< susceptibility to infection by 30%
if infection occurs, < infectiousness by 36%
if disease occurs, < probability of clinically recognizable Sx by 65%

Epidemic Management

Case definitions may change and become more specific as epidemic evolves
Case management guidelines for communicable diseases with epidemic potential
Outbreak management protocol
rapid response teams to investigate case reports
epidemic investigation kits to mobilize
specimens to collect
labs to verify diagnosis and share specimens with peer labs
Pts to identify, isolate, and treat (IPD and OPD settings)
contacts to trace and ? quarantine
hotline use and rumor investigation
Secondary prevention
specific groups of exposed or at risk in the community—most likely to work when there is limited disease transmission in the area, most cases can be traced to a specific contact or setting, and intervention is considered likely to slow the spread of disease
eg quarantine of groups of people at known common source exposure (e.g. airplane, school, workplace, hospital, public gathering; ensure delivery of medical care, food, and social services to persons in quarantine with special attention to vulnerable groups) (useless once there is community-based spread)
eg containment measures at specific sites or buildings of disease exposure (focused measures to > social distance)
cancel public events (concerts, sports, movies)
close buildings (recreational facilities, youth clubs)
restrict access to certain sites or buildings
community-wide measures (affecting exposed and non-exposed)—most likely to work where there is moderate to extensive disease transmission in the area, many cases cannot be traced, cases are increasing, and there is delay between Sx onset and case isolation.
egg infection control measures
ARI etiquette—cover nose/mouth during cough or sneeze, use tissues, wash hands
avoidance of public gatherings by persons at high risk of complications
NB use of masks by well persons is not recommended
egg “snow” (stay-at-home) days and self-shielding (reverse quarantine) for initial 10 d period of community outbreak—may reduce transmission without explicit activity restrictions
egg closure of schools, offices, large group gatherings, public transport (pedes more likely to transmit disease than adults)
NB community quarantine (cordon sanitaire)—restriction of travel in and out of an area is unlikely to prevent introduction or spread of disease
international travel
NB travel advisories to restrict international travel are generally useless in slowing epidemic spread
NB health screening for fever and respiratory Sx at ports of entry is also generally useless in slowing epidemic spread
Resource prepositioning, stockpiles, and supply chain management
facemasks
PPE
vaccines, antiviral drugs
Information management
health workers
political authorities
public via awareness campaign and behavior change communication
Contingency planning
incident/event management system and role designations
surveillance, investigation, and containment
vaccines, antivirals
provision of essential services (lifelines, health care, and emergency response)
culturally appropriate corpse management

Avian Influenza

Poultry epidemic
• Biosecurity
• Cull
• Disposal
• Disinfection
• Control movement
• Quarantine
• Count (surveillance around affected flocks)
• Ring vaccination
Overall
primary prevention: animal vaccination (prevents viral reassortment)
cases: biosecurity (of premises), cull, disposal (of carcasses), disinfection (of premises)
contacts: quarantine, control movement, count (surveillance), ring vaccination

Human epidemic
• Health Care—infection control (PPE)
• Control movement
• Quarantine
• Count (surveillance)
• Vaccines
• Antiviral drugs
Overall
primary prevention: animal vaccination (prevents viral reassortment)
cases: isolation -> infection control, antiviral therapy
contacts: quarantine, infection control, count (surveillance), vaccination, antivirals—chemoprophylaxis for high risk persons
NB: travel screening & restrictions, quarantine, and school cancellation are not effective control measures.

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MALARIA

Pathogen Vectors

Anopheles vector biology
- egg becomes adult mosquito: 9 d
- adult mosquito becomes infective: 12 d after bite on infected host
- susceptible human host becomes infective: 9 d after bite from infected mosquito
- earliest human clinical disease: 30 d after eggs are laid

Preventive Medicine

Health messages
- Follow the 4-D rule:
  - dusk and dawn stay indoors as much as possible with window screens in good repair
  - dress in light colored long sleeve shirts and long pants when outside
  - DEET (N,N-diethyl-M-toluamide) based mosquito repellants
  - drain any standing water from the area (flower pots, old tires, clogged rain gutters, etc.); flush troughs, birdbaths, wading pools, etc. every 3 days

Insecticide
- 10% DDT, 1% malathion, 1% permethrin
- insecticide treated nets (ITNs) (esp long-lasting nets with duration of 3–5 years)
- indoor residual spraying (IRS) (esp within 2 weeks of high transmission season; more effective in Asia than Africa; not appropriate for dengue)
  - deterrence: # mosquitoes which don’t enter room
  - repellence: # mosquitoes which enter then leave room
  - bite inhibition: # mosquitoes which enter room but don’t bite
  - direct knock down: # mosquitoes which are knocked down, but still live
  - direct death: # mosquitoes killed
- NB aerial spraying & outdoor spraying (fogging) are not especially useful in malaria
deterrence & repellence effectiveness is species-specific (e.g. aedes > anopheles > culex)
coils work by knockdown effect, not bite inhibition

Larvicide
- organophosphate (Temephos—safe for drinking water)
- Bacillus thuringiensis israelensis (bacterial toxin)
- Mesocyclops copepods (used in Vietnam in village water tanks)
- larvivorous fish (used in China in domestic water tanks)

| Vector Group | Species | Breeding Sites | Resting Sites | Transmission Activity | Blood Source | Diseases |
|--------------|---------|----------------|---------------|-----------------------|--------------|---------|
| Anopheles    | Anopheles | natural pools of unpolluted water | indoor/outdoor | evening and night | humans and animals | malaria, filariasis, arboviruses |
| Culicines    | Aedes   | water containers (tires), pools of stagnant water | indoor/outdoor | day | humans and animals | filariasis, YF, DF |
|              | Culex   | organically polluted water (sewers), natural pools of unpolluted water | indoor/outdoor | day and night | humans and animals | filariasis, viral encephalitis |
|              | Mansonia | unpolluted water with plants | indoor/outdoor | day and night | humans and animals | filariasis |

Source: M Connolly (ed) in Communicable disease control in emergencies—a field manual © 2005. Used with permission of the World Health Organization.
Insect repellents (useful for individuals who can afford it but not as public health intervention)

**DEET**

Chemoprophylaxis

- international staff travelling to endemic areas
- intermittent preventive treatment (IPT) for pregnant women in endemic areas where continuous chemoprophylaxis is not feasible

Generally, control programs rely upon:

- 3 major components—ITN, IPT, and prompt clinical treatment
- 2 ancillary components—IRS, environmental clean-up of breeding sites

**Epidemiological Surveillance**

Geographic reconnaissance

- mapping of target area before spraying
- mapping of homes for IRS

Entomological survey

- night mosquito survey
  - # mosquitoes trapped/hr (calculation of man-biting rate)
  - species identification
  - mosquito dissection (F only) to determine parity; % parity inversely related to spraying effectiveness

Malariometric survey

- prevalence in sample of 100 persons
- spleen rate in sample of 100 persons
- slide positivity rate (ratio of # confirmed cases/# clinically suspected cases)
- proportion of fever caused by malaria (# fever cases with confirmed parasitemia/# total fevers)

Malaria mortality (# malaria deaths/10,000 p/d for given area)

Case fatality rate in all malaria cases

Case fatality rate in severe malaria cases

Proportional mortality (# malaria deaths/# total deaths)

Malaria incidence rate

**Clinical Medicine**

**Delivery of Health Services**

Active case finding through CHWs

**Standardized Case Management**

Case definition

- Pt with F or history of F associated with Sx such as N, V, D, headache, back pain, chills, myalgia, where other infectious diseases have been clinically excluded

Rapid (point of care) diagnostic testing (RDT)

Treatment protocols per local health authorities

Essential drugs

Referral guidelines

Secondary prevention

- community education
  - health messages—printed, loudspeaker, broadcast, community groups
  - community understands transmission and prevention measures
Epidemic Management

Outbreak management protocol
Secondary prevention

Resource prepositioning (stockpiles & supply chain management)
  indoor residual spraying (IRS) (within 2 weeks of epidemic)
  mass fever treatment (MFT) (active case finding & fever treatment with antimalarials)
  mass drug administration (MDA) (cover 80% of population within 2 weeks)

Information management
Contingency planning

Reference

1. Connolly, M. (Ed.). (2005). *Communicable disease control in emergencies—a field manual.* Geneva: World Health Organization.
MEASLES

Preventive Medicine

EPI
Subnational immunization days
Measles immunization of contacts of confirmed case if contacts have < 2 doses of vaccine

Epidemiological Surveillance
Surveillance definition becomes clinical once outbreak is lab-confirmed

Clinical Medicine

Delivery of Health Services
Active case finding through CHWs

Standardized Case Management
Case definition
An illness characterized by all of the following clinical features: a generalized rash lasting greater than or equal to 3 d (exanthems generally without symmetry or pruritis); T ≥ 38.3 °C (101 °F); cough, or coryza, or conjunctivitis
Treatment protocols emphasizing supportive care and treatment of complications

Vitamin A

Vitamin A Treatment Schedules in Infant/Child Deficiency States

| Age          | Initial Dose | Next Day Dose |
|--------------|--------------|---------------|
| 0–6 months   | 50,000 IU    | 50,000 IU     |
| 6–11 months  | 100,000 IU   | 100,000 IU    |
| 1+ years     | 200,000 IU   | 200,000 IU    |

Essential drugs
Referral guidelines
Secondary prevention
community education
health messages—printed, loudspeaker, broadcast, community groups
community understands measles transmission and prevention measures

Epidemic Management
Identify cause of the outbreak
Undertake vaccination campaign
Strengthen routine immunization and surveillance

Population Vaccination Status and Contributing Causes

| Vaccination Status and Patient Age | Probably Cause |
|-----------------------------------|----------------|
| > 50% cases U5 & unvaccinated     | low coverage   |
| > 50% cases U5 & vaccinated       | not measles or vaccine ineffective |
| > 50% cases O5 in high coverage area | disease shift to older age group |
| high % of cases in infants        | low routine coverage |
MENINGITIS

Pathogens and Epidemiology

Meningitis is a disease with significant mortality. Meningococcus (Neisseria meningitides) is renown for its rapid onset, rapid progression (death sometimes within hours), and high mortality (50% untreated). There are 13 serogroups of Neisseria meningitides but only 6 (A, B, C, W, X, Y) are known to cause epidemics. The bacteria spread from person to person via respiratory and nasal secretions. Kissing, sharing eating and drinking utensils, cigarettes, coughing, and sneezing are recognized methods of transmission. Close contacts over a period of time, as between household or dormitory residents, are most commonly affected. Population movements (e.g. pilgrimages, displacement, military recruitment), poor living conditions, and overcrowding are epidemic risk factors. Large, recurring epidemics of meningitis occur in the “meningitis belt” of sub-Saharan Africa where over 430 million people live. This belt encompasses 26 countries from Senegal in the west to Ethiopia in the east and as far south as Tanzania and the Democratic Republic of Congo. Sub-saharan Arica has epidemic seasonality. Dry seasons and droughts favor epidemics. Rains stop them. Large regional epidemics, as well as epidemics in displaced populations and refugee camps, have mainly been due to meningococcus serogroup A. Since 2010, extensive use of meningococcal type A conjugate vaccine in the meningitis belt has reduced the incidence and case load of type A epidemics by nearly 60%. In 2016, the most common lab confirmed meningitis isolate was Streptococcus pneumoniae.

In non-epidemic settings, Neisseria meningitidis, Streptococcus pneumoniae, and Haemophilus influenzae account for 80% of all cases of bacterial meningitis. Prior to the availability of conjugate vaccines, H. influenza type b (Hib) was the most common cause of childhood bacterial meningitis outside of epidemics. Where Hib vaccines are in the routine infant immunization schedule, Hib meningitis has nearly disappeared.

Preventive Medicine

Polysaccharide vaccines are available with 2 serotypes (A and C), 3 serotypes (A, C and W) or 4 serotypes (A, C, W, and Y). Duration of immunity is approximately 3 years. Meningococcal protein conjugate vaccines confer longer immunity but at higher cost than polysaccharide vaccines. Monovalent conjugate vaccine against group C dates from 1999, and tetravalent (A, C, W and Y) conjugate vaccine dates from 2005. A group B vaccine made from 4 bacterial proteins has been licensed since 2014 but is not readily available. Meningococcal vaccines have a very low incidence of side effects.

Epidemiological Surveillance

Regular disease surveillance is necessary to detect outbreaks. The epidemic threshold is 10 suspected cases/100,000 population in any given week. Two suspected cases of meningitis in the same settlement should trigger an outbreak investigation. Nasopharyngeal carriage rates do not predict epidemics.

Clinical Medicine

80–85% of meningococcal disease presents with meningitis. 80% of cases occur in patients < 30 y/o. Peak incidence in meningitis belt is ages 5–10 yrs. Diagnosis is straightforward when patient presents with signs of meningitis—fever, headache, vomiting, changes in mental status. However, most patients have non-specific illness 1–3 days before onset of meningitis. CFR of untreated meningococcal meningitis can be 50%. CFR of properly treated meningococcal meningitis is <1%.

15–20% of meningococcal disease presents with septicemia unaccompanied by meningitis or other focal features. It is a dramatic illness which affects previously healthy children and young adults. It presents with acute fever leading to purpura fulminans (hemorrhagic or purpuric rash), shock, and Waterhouse-Friderichsen syndrome (acute adrenal failure). Etiologic diagnosis can be easily missed. CFR of meningococcal septicemia is 50% and may be 25% even with proper treatment. Diagnosis may be confirmed by agglutination tests, polymerase chain reaction, culture and sensitivity testing of spinal fluid and blood. In many situations, these tests are not available. Throat swabs may be helpful on occasions. Do not delay treatment for tests or test results. Minutes count. It is more important to have a live patient without a confirmed diagnosis than a dead one with a diagnosis.
Differential diagnosis in a tropical patient with fever and altered mental status, but without purpura or shock, includes cerebral malaria. Co-infection may occur.

Standardized case management of bacterial meningitis in developed countries involves 7–10 days of parenteral antibiotic therapy. Drug of choice in adults and older children is ceftriaxone which also rapidly eliminates the carrier state. Alternate drugs include ampicillin and benzylpenicillin which do not eliminate the carrier state. In developing countries, 4 days of parenteral antibiotic therapy are empirically shown to be effective. In large epidemics in resource-poor settings, a single IM dose of chloramphenicol in oil is the drug of choice. For patients who do not improve in 48 h, a repeat dose may be given.

Viral meningitis is rarely serious and requires only supportive care. Recovery is usually complete. Patient isolation and disinfection of the room, clothing, or bedding are not necessary. Respiratory precautions are advised particularly early in the course of treatment.

Chemoprophylaxis of contacts is available in some settings but rarely in the disaster setting. Vigilance and education of close contacts is mandatory.

**Epidemic Management**

Epidemic preparedness and early detection of outbreaks are key.

Vaccines against *N. meningitides* serogroups A, C, Y and W135 are very effective in controlling epidemics. In epidemic settings, children 2–10 are the priority target with serogroups A and C typically the priority antigens. Rapid mass vaccination campaigns can contain outbreaks in 2–3 weeks. For immunocompetent patients over 2 years, vaccine efficacy rate is 90% one week after injection. However, duration of immunity may be as little as 2 years in younger children. In some countries, vaccine may also be used with close contacts of sporadic disease cases to prevent secondary cases. Chemoprophylaxis of contacts is not recommended in epidemics, but community education and ready access to health care are essential.
VIRAL HEMORRHAGIC FEVER

Preventive Medicine

Source control/reduction/elimination
- Avoid unnecessary contact with suspected reservoir animals and known disease carrier species (e.g., primates).
- Avoid direct or close contact with symptomatic patients.
- Undertake quarantine and culling of sick reservoir animals and known disease carrier species.
- Avoid unnecessary contact with or consumption of dead reservoir animals or known disease carrier species.
- Establish appropriate communicable disease controls for burial of the dead.

Administrative controls

Environmental and engineering controls
- Avoid needle stick exposure to blood specimens thru automated machine handling

PPE
- Use standard precautions—gloves, masks, and protective clothing—if handling infected animals or patients.
- Wash hands after visiting sick patients.

Epidemiological Surveillance

Active surveillance and contact tracing (enhanced surveillance) through community-based mobile teams

Clinical Medicine

Delivery of Health Services

Active case finding (screening and triage) and contact tracing
Dedicated isolation facility
Food provision to isolated patients so they are not dependent on family

Standardized Case Management

Case definition
Treatment protocols emphasizing supportive care and treatment of complications
Essential drugs
Referral guidelines
Secondary prevention
  - barrier nursing strictly enforced
  - family and community education

Epidemic Management

Ministerial task force to address policy
Local health authority task force to address procedures
National level task forces to comprise
  - Response unit
    - epidemiology (case finding, contact tracing, monitoring, surveillance)
    - facilities preparation (build beds)
    - case management
    - laboratory
    - infection prevention and control (IPC) (including safe burial)
    - social mobilization, communication
    - training
  - Support unit (manage resources)
    - program & HR planning (16 positions)
    - staffing model
1. social/medical/cultural anthropologist
2. social mobilization/community engagement specialist
3. social mobilization coordinator at national level
4. epidemiologist
5. IPC specialist
6. PH advisor
7. subnational field coordinator
8. VHF lab specialist
9. case management specialist
10. EMTs
11. occupational health and safety specialist
12. logistics
13. exit screening
14. data management
15. health communications
16. finance

Research unit
new therapeutics
new tests
clinical trials
analytic epi and modelling

Long term measures
health systems recovery

Outbreak management in the field focuses on
alert verification
disease surveillance (not relying exclusively or even largely on health facility reporting)
burial < 48 h after death
spot checking of contact tracing effectiveness (< 5 is inadequate; 25–50 is reasonable; 75 is not extreme)
door-to-door community education campaigns
quarantine sustainment at HH level

Secondary prevention
Resource prepositioning (stockpiles & supply chain management)
Information management—refute inappropriate travel and trade restrictions

Community education and social mobilization
health messages—printed, loudspeaker, broadcast, community groups
community understands disease transmission and prevention measures

Contingency planning

NB it’s difficult to separate ebola from non-ebola fevers at onset
holding centers can amplify transmission
Annex 8.7

DIAGNOSTIC LABORATORY IN INFECTIOUS DISEASES

Glossary

| Abbreviation | Definition |
|--------------|------------|
| Ab           | antibody   |
| AFB          | acid-fast bacilli |
| Ag           | antigen    |
| C&S          | culture and antibiotic sensitivity |
| CIE          | counterimmunoelectrophoresis |
| COTS         | Cholera Outbreak Training and Shigellosis Program (training program developed at ICDDR) |
| CSF          | cerebrospinal fluid |
| ELISA        | enzyme-linked immunosorbent assay |
| d            | day        |
| HAI          | hemagglutination inhibition |
| IgG, IgM     | immunoglobulin G, M |
| O&P          | ova and parasite (stool slide examination) |
| PCR          | polymerase chain reaction |
| Pt           | patient    |
| RDT          | rapid diagnostic test |
| TB           | tuberculosis |

Lab Purposes

- Confirm syndromic or clinical diagnosis
  - Identify treatment options
  - Identify control measures
- Characterize the agent (serotype, biotype, antibiogram, etc.)
  - Evaluate potential effectiveness of treatment
  - Monitor the spread of a particular clone or subtype
- Detect an outbreak and confirm its end

Key Questions on Lab (WHO [1])

1. Is a laboratory available?
2. What tests does it perform?
3. Is there transport to and from the laboratory?
4. Who prepares transport media?
5. Who provides specimen collection material and supplies?
6. How can these supplies be obtained?
7. Who provides cool packs, transport boxes, car, driver …?
8. What forms/information must be sent with the specimens?
9. What epidemiological information must accompany test results?
10. How does the epidemiologist obtain results?

If a lab is not available, then you need a sampling strategy that addresses specimen acquisition, preparation, and transportation in compliance with international regulations on the transport of infectious substances.
Direct techniques
- microscopy (direct visualization)
- culture (isolation)
- immunological Ag techniques—immunochromatography, latex agglutination (vibrio)
- molecular Ag techniques—DNA or RNA PCR, antigen capture

Indirect serological (Ab) techniques
- bacterial agglutination
- hemagglutination inhibition assay
- ELISA for IgM, IgG
- microneutralization assay

NB no specific response from some organisms; little or no response in immunosuppression
delays in serological response oblige testing of early and late sera

### Table 8.7.1
**Indications, Laboratory Tests, and Expected Availability**

| Cases                          | Lab tests                                               | PHC clinic | Confirmation laboratory |
|-------------------------------|---------------------------------------------------------|------------|-------------------------|
| Watery diarrhea—dehydrating   | Fine microscopy for motility on wet prep, O&P           | +          | District lab            |
| (suspected cholera)            | Gram’s stain                                            | +          | District lab            |
|                               | Stool C&S                                               | +/−         | District lab            |
|                               | Toxin or polysaccharide (RDT)                          | ?          | District lab            |
| Diarrhea with blood           | Fine microscopy for O&P                                 | +          | District lab            |
| (shigella, salmonella, amoeba) | Stool C&S                                               | +/−         | District lab            |
| Acute respiratory infection   | Strep screen, throat C&S                                | +          | District lab            |
|                               | Microscopy with Ziehl-Neelsen stain for AFB             | +          | District lab            |
| Acute febrile illness         | Microscopy with Giemsa stain                            | +          | District lab            |
| (suspected malaria)           | Ag detection (RDT)                                      | +          | District lab            |
| Acute febrile illness         | Blood culture                                           | −          | District lab            |
| (suspected typhoid)           | Serology (ELISA, RDT)                                   | +          | District lab            |
| Meningitis                    | CSF microscopy with Gram’s stain                        | +          | District lab            |
| (suspected meningococcus)     | CSF C&S                                                 | −          | District lab            |
|                               | CSF PCR                                                 | −          | District lab            |
| Acute jaundice syndrome       | Serology                                                | −          | District lab            |
| (suspected viral hepatitis)   |                                                        |            |                         |
| Acute flaccid paralysis       | Virus isolation (cell culture from stool specimens)     | −          | Reference lab           |
| (suspected poliomyelitis)     |                                                        |            |                         |
| Measles                       | Serology (IgM)                                          | −          | District lab            |
| Neonatal tetanus              | None—clinical Dx                                        | −          | District lab            |
| Acute febrile illness         | Ag detection (RDT—Types A, B)                           | ?          | District lab            |
| (suspected influenza)         | PCR                                                     | −          | District lab            |
| Acute febrile illness         | Ab detection (RDT)                                      | −          | District lab            |
| (suspected dengue fever)      | immunochromatography                                   | −          | District lab            |
|                               | Serology (IgM of paired sera)                          | −          | Reference lab           |
|                               | PCR                                                     | −          | Reference lab           |
| Leptospirosis                 | Ab detection (RDT)                                      | −          | Reference lab           |
|                               | Serology (ELISA)                                        | −          | Reference lab           |
| Typhus                        | Serology                                                | −          | Reference lab           |
| Issue | Clinical Syndrome and Lab Details |
|-------|-----------------------------------|
| **When to sample?** | Early stages of infection, during peaks of fever, and before ABX |
| • acute diarrhea | • meningitis |
| • acute flaccid paralysis | • fevers |
| • icterus | • measles |
| • fevers | • misc |
| **What to sample?** | stool |
| • stool | cerebrospinal fluid |
| • cerebrospinal fluid | whole blood |
| • whole blood | sputum for TB |
| • sputum for TB | urine for schisto, lepto |
| • urine for schisto, lepto | bubo aspirate for plague |
| • bubo aspirate for plague | |
| **How many samples and how often to sample?** | 10–20 samples (different Pts) initially to confirm outbreak |
| • 10–20 samples (different Pts) initially to confirm outbreak | 10 samples initially, but strategy may vary with disease |
| • 10–20 samples each month to verify strain and drug susceptibility (systematic random sampling with skip interval of monthly total visits/sample size) | paired samples for serology—early and after 7–14 d |
| • 10–20 samples after epidemic to confirm resolution (COTS avoids this as cholera or shigella usually causes < 5% of all diarrhea outside of epidemic) | |
| • similar to stool protocol but half the number | |
| • 10–20 samples (different Pts) after epidemic to confirm resolution (COTS avoids this as cholera or shigella usually causes < 5% of all diarrhea outside of epidemic) | |
| • similar to stool protocol but half the number | |
| **Biosafety while sampling?** | protect yourself (universal precautions, personal protective equipment as needed) |
| • protect yourself (universal precautions, personal protective equipment as needed) | |
| • protect the Pt (disinfect, use single use materials) | |
| • protect the Pt (disinfect, use single use materials) | |
| • protect the environment (waste disposal, triple package the specimen) | |
| • protect the environment (waste disposal, triple package the specimen) | |
| **How to sample?** | collect liquid stool in leak-proof container |
| • collect liquid stool in leak-proof container | lumbar puncture in usual way |
| • use forceps to immerse swab or filter paper dots in liquid stool; place in specimen container with a few drops of sterile saline | venipuncture in usual way |
| • for bloody stool, sample several areas of specimen including blood, mucous, or tissue | |
| • for bloody stool, sample several areas of specimen including blood, mucous, or tissue | |
| **How to prepare the sample?** | Cary Blair* |
| • Cary Blair* | whole blood for CBC, microscopy (purple cap—EDTA tube) |
| • Trans Isolate (cost high) | serum for serology (red cap—no additive; orange cap—gel separator) |
| • Alcaline peptone water (if < 6 h before plating) | whole blood for blood culture (biphasic culture bottle—10% blood to media ratio) obtain before starting ABX |
| • saline solution | blood smear for malaria microscopy |
| • saline solution | |
| • Trans Isolate* | |

* Cary Blair and Trans Isolate are culture media used in diagnostic laboratories. Cary Blair is commonly used for bacterial growth, while Trans Isolate is used for specific pathogens or tissue culture.
| Issue | Clinical Syndrome and Lab Details |
|-------|-----------------------------------|
| How to preserve and send the sample? | • refrigerate if possible (4°C) or cool packs  
• incubate Trans Isolate for culture (25–37°C)  
• refrigerate other vials for cytology, chemistry (4°C)  
• incubate blood culture (25–37°C)  
• refrigerate sera (4-8°C)  
• ambient temp for smears  
• refrigerate specimen (4°C) |
| What to send with the sample? | Lab request form with:  
• sender’s name and contact info  
• patient name, age, sex  
• sample date, time  
• suspected clinical diagnosis with main signs and symptoms  
• sample macroscopic description  
• context—outbreak confirmation, ongoing verification, outbreak end, etc.  
• epidemiological or demographic data |
| Where to send the sample? | • reference lab  
• contact person |
| What and when to expect results? | |

Source: World Health Organization. Highlights of specimen collection in emergency situations. Undated. Used with permission of WHO.

* Semi-solid transport medium, easy to use  
  Place swab with sample in medium to immerse tip of swab. Break off wooden swab handle. Cap tightly.  
  Use with stool and other samples containing non-fragile bacterial pathogens.  
  Inexpensive medium. Long shelf life after preparation (about 1 year at 25°C). Can be prepared in advance and pre-positioned at peripheral levels.

* Biphasic transport medium with agar and broth  
  Pre-warm medium to 25–37°C before inoculation. Place 1 cc of specimen in sterile medium for culture. Immediately incubate or hold at 25–37°C. Ventilate bottle if > 4 days to lab.  
  Place 1 cc of specimen in another sterile vial for cytology, chemistry, and CIE. Refrigerate.  
  More expensive medium.

Reference

1. World Health Organization Department of Communicable Disease Surveillance and Response. Highlights of specimen collection in emergency situations. Undated. Available from WHO Laboratory and Epidemiology Capacity Strengthening Office in Lyon, France, and Retrieved June 9, 2017, from [http://www.who.int/hac/techguidance/training/highlights%20of%20specimen%20collection_en.pdf](http://www.who.int/hac/techguidance/training/highlights%20of%20specimen%20collection_en.pdf).
Annex 8.8
ACRONYMS

ABC abstain until marriage, be faithful, use condoms
ACAPS Assessment Capacities Project
ACT artemisinin-based combination therapy
ADB Asian Development Bank
AfDB African Development Bank Group
AFRO Africa Regional Office (WHO)
AI avian influenza
AIDS acquired immune deficiency syndrome
AKF Aga Khan Foundation
ALDAC all diplomatic and consular posts (USG)
ALNAP Active Learning Network for Accountability and Performance (ODI)
AMB E&P Ambassador Extraordinary and Plenipotentiary
AMRO Americas Regional Office (WHO)
APS annual program statement (USAID/OFDA statement of funding opportunities for NGOs)
APW agreement for the performance of work (WHO contractual work agreement)
ARI acute respiratory infection
ART antiretroviral therapy
AU African Union
BCC behavior change communication
BCP business continuity planning
BIC basic internet communications
BMS breast milk substitute
BSL biosafety security level
BWI Bretton Woods Institutions (World Bank and International Monetary Fund)
CA cooperative agreement
CAP consolidated appeals process (supplanted in 2013 by the humanitarian programme cycle; led by OCHA)
CBJ Congressional budget justification
CBO community-based organization
CBPF country-based pooled funds (amalgamation of Emergency Response Funds and Common Humanitarian Funds administered by OCHA)
CBRNE chemical, biological, radiological, nuclear, or explosive
CCCM camp coordination and camp management
CCS country cooperation strategy (WHO)
CCTV closed-circuit television
CD communicable diseases
CDC communicable disease control; Centers for Disease Control and Prevention (US)
CE complex emergency
CERF Central Emergency Response Fund (administered by OCHA)
CFE Contingency Fund for Emergencies (WHO)
CHW community health worker
CLA cluster lead agency
CMAM community-based management of acute malnutrition
CMOC civil-military operations center
CMR crude mortality rate
CO country office (WHO)
COD common operational dataset
CoDel Congressional Delegation
COG continuity of government
CONOPS concept of operations
CoOp continuity of operations
COP  common operating picture
CPA  comprehensive peace agreement
CRED Center for Research on the Epidemiology of Disasters (Belgium)
CSP  certified safety professional
CSW  commercial sex worker
CTC  community therapeutic care (of malnutrition)
CTO  cognizant technical officer
CTP  cash transfer program
DA  development assistance—US Congress appropriated funds with tight reporting requirements
DANIDA  Danish International Development Agency
DART  Disaster Assistance Response Team (USAID)
DCHA Bureau for Democracy, Conflict, and Humanitarian Assistance (USAID)
DDR(P)  disarmament, demobilization, and reintegration program
DDRR(P) disarmament, demobilization, rehabilitation, and reintegration program
DDRRR(P) disarmament, demobilization, repatriation, resettlement, and reintegration program
DFID  Department for International Development (UK)
DHN  digital humanitarian network
DHO District Health Office
DMAT  Disaster Medical Assistance Team (US)
DMORT Disaster Mortuary Operational Response Team
DO  designated official (UN)
DOD  Department of Defense (US)
DOS  Department of State (US)
DOTS direct observed therapy short-course (used for TB)
DRM  disaster risk management
DRR  disaster risk reduction
DS  diplomatic security
DTM  displacement tracking matrix
ECHO  European Community Humanitarian Office (European Commission Directorate General for Humanitarian Aid and Civil Protection which uses ECHO acronym)
EDG  Emergency Directors’ Group
EHK  emergency health kit
EIA  environmental impact assessment
EMRO Eastern Mediterranean Regional Office (WHO)
EMS  Emergency Medical Services
EMT  Emergency Medical Team
EOC  Emergency Operations Center
EOD  explosive ordnance disposal
EPI  Expanded Programme on Immunization
ERC  Emergency Relief Coordinator (UN)
ERF  Emergency Response Framework (WHO)
ERT  Emergency Response Team (WHO)
ESF  emergency school feeding
EST  Emergency Support Team (WHO)
EU  European Union
EURO European Regional Office (WHO)
EWAR, EWS early warning system
EWARN Early Warning Alert and Response Network
FACT  Field Assessment Coordination Team (IFRC)
FAO  Food and Agriculture Organization (UN)
FCV fragility, conflict, and violence
FEMA  Federal Emergency Management Agency (US)
FETP  Field Epidemiology Training Program
| Acronym | Description |
|---------|-------------|
| FEWS | Famine Early Warning Systems |
| FEWS NET | Famine Early Warning Systems Network |
| FFA | food assistance for assets (formerly food for work) |
| FFP | Food for Peace (USAID\DCHA office) |
| FOG | *Field Operations Guide* (OFDA) |
| FSN | foreign service national |
| FSO | field security officer |
| FTS | Financial Tracking Service (OCHA) |
| FY | fiscal year |
| G 8 | group of 8 countries |
| G 20 | group of 20 countries |
| G 77 | group of 77 countries |
| GAM | global acute malnutrition (moderate + severe acute malnutrition) |
| GBV | gender-based violence |
| GDACS | Global Disaster Alert and Coordination System |
| GDP | gross domestic product |
| GEMT | Global Emergency Management Team (WHO) |
| GFATM | Global Fund to Fight AIDS, Tuberculosis and Malaria |
| GFD | general food distribution |
| GFDDR | Global Facility for Disaster Reduction and Recovery (WBG) |
| GHC | Global Health Cluster |
| GHD | good humanitarian donorship (initiated by DFID) |
| GHSA | Global Health Security Agenda |
| GIC | Global Impact Charities (consortium of faith-based organizations involved in HA) |
| GIEWS | Global Information and Early Warning System (FAO) |
| GIS | geographic information system |
| GNP | gross national product |
| GO | governmental organization |
| GOARN | Global Outbreak Alert and Response Network |
| GPN | global private network |
| GTZ | German Technical Cooperation |
| HA | humanitarian assistance |
| HAART | highly active anti-retroviral treatment |
| HAZMAT | hazardous materials |
| HBP | Health as a Bridge for Peace (WHO headquarters program initiative, now discontinued) |
| HC | Humanitarian Coordinator (IASC) |
| HCC | Health Cluster Coordinator |
| HCT | Humanitarian Country Team |
| HCW | health care worker |
| HDR | humanitarian daily ration |
| HELP | Health Emergencies in Large Populations (ICRC training course) |
| HEPA | high efficiency particulate aspirator (air filter) |
| HeRAMS | Health Resources Availability and Mapping System |
| HEWS | Humanitarian Early Warning System |
| HH | household |
| HHA | humanitarian health assistance |
| HHS | Department of Health and Human Services (US) |
| HIC | Humanitarian Information Centre (OCHA) |
| HIS | health information system |
| HIU | Humanitarian Information Unit (US DOS) |
| HIV | human immunodeficiency virus |
| HNO | humanitarian needs overview |
| HOA | Head of Office |
HPAI  highly pathogenic avian influenza
HPC  humanitarian programme cycle
HPF  humanitarian pooled fund
HRP  humanitarian response plan (akin to SRP)
HWCO  Head of WHO Country Office
IAHE  interagency humanitarian evaluation (IASC process, triggered by L3 declaration, to be done within 12 m of declaration)
IAP  incident action plan
IASC  Interagency Standing Committee
IATA  International Air Transport Association
IBRD  International Bank for Reconstruction and Development (World Bank)
ICC  International Criminal Court
ICCG  Interccluster Coordination Group
ICDDR  International Centre for Diarrhoeal Disease Research, Bangladesh
ICMH  International Centre for Migration and Health
ICRC  International Committee of the Red Cross
ICS  Incident Command System
ID  infectious disease
IDA  International Development Association
IDFA  international disaster and famine account—US Congress appropriated funds which have no Congressional Note reporting requirements (see DA)
IDLH  immediately dangerous to life and health
IDP  internally displaced person
IDS  Integrated Disease Surveillance and Response (AFRO initiative expanded to other regions)
IDU  injection drug user
IEC  information, education, and communication materials
IED  improvised explosive device
IEIP  International Emerging Infections Programs—foreign centers of excellence working in partnership with domestic MOH and US CDC which train local scientists, provide diagnostic and epi resources in outbreaks, and undertake regional disease control activities
IFRC  International Federation of Red Cross and Red Crescent Societies
IGS  income generating scheme
IHL  international humanitarian law
IHR  International Health Regulations
IHRL  international human rights law
ILI  influenza-like illness
IMAI  Integrated Management of Adult Illness (WHO initiative)
IMCI  Integrated Management of Childhood Illness (WHO initiative)
IMF  International Monetary Fund
IMS  incident management system
INSARAG  International Search and Rescue Advisory Group
IO  international organization
IOM  International Organization for Migration
IPC  Integrated Food Security Phase Classification
IRA  initial rapid assessment
IRC  International Rescue Committee
IRIN  Integrated Regional Information Network (OCHA)
ISDR  International Strategy for Disaster Reduction
ITN  insecticide treated nets
ITPS  insecticide treated plastic sheeting
ITWL  insecticide treated wall lining
IYCFE  infant and young child feeding in emergencies
JICA  Japan International Cooperation Agency
| Acronym  | Definition                                                                 |
|----------|-----------------------------------------------------------------------------|
| L3       | level 3 (system-wide) emergency                                              |
| LOU      | letter of understanding                                                     |
| M&E      | monitoring and evaluation                                                   |
| MCH      | maternal and child health                                                   |
| MCI      | mass casualty incident                                                      |
| MDGs     | millennium development goals (supplanted by sustainable development goals) |
| MDM      | Médecins du Monde                                                           |
| MDRO     | Mission Disaster Relief Officer (USAID)                                    |
| MEAL     | monitoring, evaluation, accountability, and learning                        |
| MEB      | minimum expenditure basket                                                  |
| MEDS     | minimum essential datasets                                                  |
| MICS     | multiple indicator cluster survey                                           |
| MIRA     | multi-cluster initial rapid assessment                                      |
| MIS      | management information system                                               |
| MISP     | minimum initial service package (used in reproductive health)              |
| MOH      | Ministry of Health                                                          |
| MOSS     | minimum operating security standards (UNDSS)                                |
| MOU      | memorandum of understanding                                                 |
| MSF      | Médecins sans Frontières                                                    |
| MUAC     | mid-upper arm circumference                                                 |
| NAF      | needs analysis framework                                                    |
| NATO     | North Atlantic Treaty Organization                                          |
| NDMA     | National Disaster Management Agency                                         |
| NDMS     | National Disaster Medical System (US)                                       |
| NFI      | non-food item (emergency relief supplies)                                   |
| NGO      | non-governmental organization                                               |
| NIC      | National Influenza Center                                                   |
| NICS     | nutritional information in crisis situations                                |
| NID      | national immunization day                                                   |
| NIH      | National Institutes of Health (US)                                          |
| NIMA     | National Imagery and Mapping Agency (US)                                    |
| NRC      | Norwegian Refugee Council                                                   |
| NRF      | National Response Framework (US)                                            |
| NSS      | National Security Staff (US)                                                |
| NZODA    | New Zealand Official Development Assistance                                 |
| OCHA     | Office for the Coordination of Humanitarian Affairs (UN)                    |
| ODI      | Overseas Development Institute (UK)                                         |
| OECD     | Organization for Economic Cooperation and Development                        |
| OFDA     | Office of US Foreign Disaster Assistance (USAID)                            |
| OHCHR    | Office of the High Commissioner for Human Rights (UN)                       |
| OI       | opportunistic infection                                                     |
| OIE      | Office International des Epizooties (World Organization for Animal Health) |
| OPD      | outpatient department                                                       |
| OPR      | operational peer review (IASC process, triggered by L3 declaration, to be done within 90 d of declaration) |
| ORS      | oral rehydration salts/solution                                              |
| OSCE     | Office for Security and Cooperation in Europe                               |
| OSOCC    | On-Site Operations Coordination Center (UN)                                 |
| OVC      | orphans and vulnerable children                                              |
| PAHO     | Pan-American Health Organization (precursor to and functionally synonymous with AMRO) |
| PDD      | Presidential Decision Directive                                             |
| PDNA     | post-disaster needs assessment                                               |
| PEF      | Pandemic Emergency Financing Facility (WBG)                                  |
PEP  post-exposure prophylaxis
PEPFAR  President's Emergency Plan for AIDS Relief (US)
PHC  primary health care
PHEIC  public health event of international concern (IHR)
PHO  Provincial Health Office
PIO  public international organization
PKO  peace-keeping organization
PLWHA  person living with HIV/AIDS
PMTCT prevention of mother-to-child transmission
PNG  persona non grata
POC  point of contact
POLR  provider of last resort
POW  prisoner of war
PPE  personal protective equipment
PPM  parts per million = mg/L (1 ppm = 1mg/L = .0001% active ingredient)
PPRR  prevention, preparedness, response, and recovery
PRA  participatory rural appraisal (successor to the RRA)
PRRA  participatory rapid rural appraisal
PSC  personal services contractor
PSD  protective security detail
PSF  Pharmaciens Sans Frontières
PVO  private and voluntary organization
R2D  relief to development
R2P  responsibility to protect
R4  repatriation, reintegration, rehabilitation, and reconstruction
R&R  rest and recreation
RBM  Roll Back Malaria (WHO program)
RC  Resident Coordinator (UN)
REA  rapid epidemiological assessment
RFA  request for assistance
RFI  request for information
RFP  request for proposal
RFQ  request for quote
RH  reproductive health
RMO  Regional Medical Officer (US Department of State)
RMT  Response Management Team (USAID)
RNI  recommended nutritional intake (successor to the recommended daily allowance (RDA))
RO  regional office
RRA  rapid rural appraisal; rapid response account (WHO)
RRM  rapid response mechanism
RRT  rapid response team
RSO  Regional Security Officer (US Department of State)
RUSF  ready-to-use supplementary food
RUTF  ready-to-use therapeutic food
SAR  search and rescue
SARS  severe acute respiratory syndrome
SBU  sensitive but unclassified
SC  Security Council (UN)
SCF  Save the Children Foundation
SCI  secret compartmented information
SDGs  sustainable development goals
SEARO  South-East Asia Regional Office (WHO)
SFC  supplementary feeding center
Annex 8.8—Acronyms

SFP supplemental feeding program
SGBV sexual and gender-based violence
SHOC Strategic Health Operations Center (WHO)
SMART Standardized Monitoring and Assessment of Relief and Transitions
SME subject matter expert
SMS Security Management System (UN)
SMT Security Management Team (UN)
SNS Strategic National Stockpile (US)
SO strategic objective (> 5 yrs to achieve)
SOD sudden onset disaster
SOG standard operating guideline
SOP standard operating procedure
SPHC selective primary health care
SPHERE project of humanitarian agencies detailing a humanitarian charter and minimum standards
SpO special objective (< 5 yrs to achieve)
SRP strategic response plan
SRSG Special Representative of the Secretary General (UN)
STI sexually transmitted infection
SUMA supply management (PAHO/WHO program)
SWAP sector-wide approach
TAG Technical Assistance Group (USAID/OFDA)
TB tuberculosis
TBA traditional birth attendant
TFC therapeutic feeding center
TFP therapeutic feeding program
TOR terms of reference
UMDMT UN Disaster Management Team
UN United Nations
UNAIDS Joint United Nations AIDS Programme
UNCT UN Country Team
UNDAC UN Disaster Assessment and Coordination team
UNDAF UN Development Assistance Framework
UNDP UN Development Programme
UNDPKO UN Department of Peacekeeping Operations
UNDSS UN Department of Safety and Security
UNEP UN Environmental Programme
UNFPA UN Fund for Population Activities
UNGA UN General Assembly
UNHAS UN Humanitarian Air Service (WFP)
UNHCHR UN High Commissioner for Human Rights
UNHCR UN High Commissioner for Refugees
UNHRD UN Humanitarian Response Depot
UNICEF UN Children’s Fund
UNJLC UN Joint Logistics Center
UNPKO UN Peace-keeping Operations
UNRC UN Resident Coordinator
UNSE UN Special Envoy
UNSG UN Secretary General
UNV UN volunteer
USAID US Agency for International Development
USAR urban search and rescue
USCR US Committee for Refugees
USD US dollar
| Abbr. | Full Form |
|-------|-----------|
| USDA | US Department of Agriculture |
| USG  | Under Secretary General (UN); US Government |
| USPHS| US Public Health Service |
| UXO  | unexploded ordnance |
| VAC  | Vulnerability Assessment Committee |
| VAM  | vulnerability assessment and mapping (WFP) |
| VCT  | voluntary counseling and testing (HIV) |
| WASH | water, sanitation, and hygiene |
| WBG  | World Bank Group |
| WCO  | WHO Country Office |
| WFP  | World Food Programme (UN) |
| WHE  | WHO Health Emergencies Programme |
| WHO  | World Health Organization (UN) |
| WHZ  | weight-for-height z score |
| WMD  | weapons of mass destruction |
| WPRO | Western Pacific Regional Office (WHO) |
| WR   | WHO Representative (replaced by HWCO) |
| WWWW, 4W | who does what where when (matrix) |