

# Epidemiology and Control of Communicable diseases

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graph TD; A[Diseases] --> B[Communicable]; A --> C[Non-Communicable]
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**Diseases**

**Communicable**

**Non-Communicable**

What is communicable diseases?

# Communicable diseases

- Diseases that can be transmitted from one person to another either directly or indirectly..
- A COMMUNICABLE DISEASE IS ONE IN WHICH THE PROGENY OF THE CAUSATIVE AGENT IS TRANSMISSIBLE FROM A RESERVOIR OR AN INFECTED PERSON TO A NEW SUSCEPTIBLE HOST

# EPIDEMIOLOGY OF COMMUNICABLE DISEASES

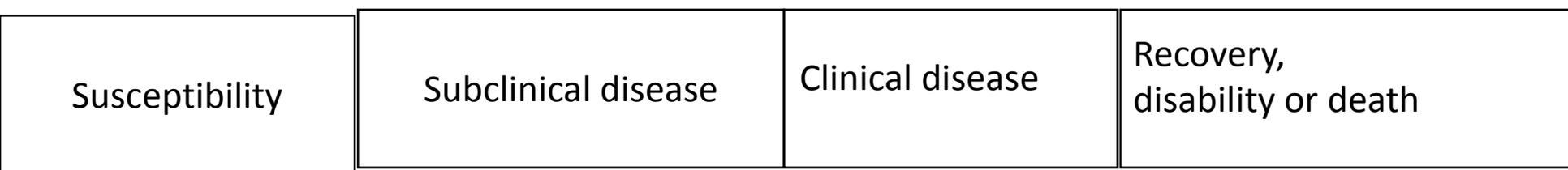
- Causative agent
- Reservoir of infection
- Portal of exit of agent from host
- Mode of transmission of the agent
- Portal of entry of agent to new host
- Host susceptibility

# Topics of Discussion

- Natural History and Spectrum of Disease
  - Infectivity
  - Incubation period
  - Pathogenicity
  - virulence
- Chain of Infection
  - Agent
  - Reservoir
  - Portal of exit
  - Mode of transmission
  - Portal of entry
  - Susceptible Host
- Implications for public Health
  - Preventive strategies/ measures
  - Levels of prevention
  - Control, elimination and eradication of infectious Diseases

# Natural history of and Spectrum of Disease

- Progress of a disease process in an individual over time, in the absence of intervention
- Process begins with exposure to factors capable of causing disease and ends with recovery, disability, or death- without medical intervention
- Stages in the natural history of disease include



- The onset of symptoms marks the transition from **subclinical illness to clinical disease**
- The spectrum of clinical disease range from mild to severe or fatal outcome
- **Infectivity**- refers to the proportion of exposed persons who become infected.
- **Pathogenicity**- proportion of infected persons who develop clinical disease
- **Virulence**- proportion of persons with clinical disease who become severely ill or die

- **Incubation period**-time between exposure and first symptom of disease
  - Varies with diseases, could be as brief as seconds in hypersensitivity or toxic reactions and as long as decades for mesothelioma
  - Usually has a range e.g. hepatitis A- 2 to 6 weeks
  - Disease is inapparent during this period, some pathologic changes may be detectable with lab, radiographic or other screening methods
  - Useful for
    - tracing the source of infection and contacts,
    - for determining the period of quarantine,
    - to prevent clinical illness by human immunoglobulin and antisera,
    - for identification of point source or propagated epidemics and
    - to determine the prognosis of a disease e.g. tetanus, rabies

# Chain of disease transmission

# III. Disease Transmission

Key terms defined

- **Epidemic** is the occurrence of more cases than would normally be expected in a specific place or group over a given period of time
- **Outbreak** is basically the same thing
- **Cluster** is a group of cases that may or may not represent a greater than expected rate
- **Endemic** is a persistent level of occurrence of a disease
- **Pandemic** is a very widespread, often global epidemic

# Disease Transmission

- For an outbreak, or epidemic, to occur, the basic elements of disease causation and an adequate chain of transmission must be present.
- Disease occurs when an outside **agent** capable of causing the disease meets a **host** that is vulnerable to the agent in an **environment** that allows the agent and host to interact.
- Then, given a chain of transmission from one host to another and a suitable mode of spread, an outbreak can develop.

# Key Terms Defined: Agent

- **A g e n t** is the entity necessary to cause disease in a susceptible host
  - An agent can be biological, physical, chemical, or nutritional
- Agents have important characteristics
  - **Infectivity**: capacity to cause infection in host
  - **Pathogenicity**: capacity to cause disease in host
  - **Virulence**: severity of disease that agent causes

# **FACTORS INFLUENCING EXPOSURE AND INFECTION: Agent Factors**

Sources, Reservoirs, Transport and Persistence  
(in the Environment)

Ability to Enter a Portal in the Human or Other  
Host

Ability to Reach and Proliferate at Site(s) of  
Infection in the Host

Excretion of the Agent from the Host

Quantity and "Quality" (including virulence) of  
the Infectious

# Key Terms Defined: Host

- **H o s t** is the person that may be acted upon by the agent
- Status of the host is classified as
  - *susceptible to the agent*
  - *immune to the agent*
  - *infected by the agent*
- Host's response to exposure can show
  - no effect
  - manifest subclinical disease
  - atypical symptoms
  - straightforward illness
  - severe illness

# Factors Influencing Exposure and Infection: Host Factors and Host Susceptibility

- **Opportunities for host exposure**
  - transmission routes
  - host availability
- **Susceptibility factors**
  - Dosage (quantity) and "quality" of infectious organisms, including their "virulence";
  - age
  - immunity
  - nutritional status
  - immunocompetence and health status,
  - genetics
  - behavior (personal habits) of host.

# Key Terms Defined: Environment

- **Environment** = conditions or influences that are not part of either the agent or the host, but that influence their interaction
- Factors can include
  - physical
  - climatologic
  - biologic
  - social
  - economic conditions

# Factors Influencing Exposure and Infection: Environmental Factors

- Reservoirs: where organisms can live, accumulate or persist outside of the host of interest; could be another organism or the inanimate environment.
- Vehicles: inanimate objects/materials by which organisms get from one host to another; includes water, food, objects (called fomites) and biological products (e.g., blood).
- Amplifiers: Types of reservoirs where organisms proliferate; often applied to organisms transmitted by the airborne route.

# Factors Influencing Exposure and Infection: Environmental Factors

- Vectors: Living organisms bringing infectious organisms to a host.
  - Mechanical vectors: Microbes do not multiply in the vector
    - ex: biting insects infected with the infectious organism
  - Biological vectors: Microbes must propagate in the vector before they can be transmitted to a host.

# Disease Transmission

- Agent, host, and environment alone are not sufficient to cause an epidemic
- An adequate chain of transmission must be present
- A chain of transmission requires the following elements:
  - a source of the agent
  - a portal of exit from the source
  - a mode of transmission
  - and a portal of entry into the susceptible person

# Chain of infection

- This describe transmission of infective **agent** from its **reservoir** through a **portal of exit**, and is conveyed by some **mode of transmission**, and enters through an appropriate **portal of entry** to infect a **susceptible host**.
- **Agents**
  - Viruses
  - Bacteria
  - Protozoa
  - Fungi
  - rickettsiae

- Reservoir of an agent is the habitat in which an infectious agent normally lives, grows and multiplies
  - It includes humans, animals and the environment
  - May be different from the source of infection in certain cases
  - Human reservoirs
    - Usually transmitted from person to person without intermediaries
    - STDs, measles, mumps, most respiratory pathogens
    - Smallpox was eradicated because humans were the only reservoir
    - Two types exist, persons with symptomatic illness, cases and carriers

- A carrier is a person without apparent disease who is nonetheless capable of transmitting the agent to others
  - May be asymptomatic, incubatory, convalescent
  - A chronic carrier harbours an agent for an extended time following initial infection

## – Animal reservoirs

- Infectious diseases that are transmissible under normal conditions to humans are called zoonoses
  - Brucellosis (cows and pigs), anthrax (sheep), plague (rodents), rabies (bats, dogs, raccoons and other mammals), trichinosis (swine)
- Also those caused by viruses, transmitted by insects and those caused by parasites that have complex life cycles with different reservoirs at different stages of development
  - St Louis encephalitis, malaria, schistosomiasis, lyme disease (deer)

- Environmental reservoirs

- Plants (Cholera), soil (histoplasmosis), water (legionnaires bacillus)

- Portal of Exit

- Path by which an agent leaves the source host
- Corresponds to the site at which the agent is localised
- Tubercle bacilli, influenza viruses exit the respiratory tract, schistosomes through urine, cholera vibrios in feces, sarcoptes scabiei in scabies skin lesions etc

- Modes of transmission

- Direct ,involves immediate transfer of agent from reservoirs to a susceptible host by direct contact or by droplet spread
  - Direct contact through kissing, skin to skin, and sexual intercourse eg infectious mononucleosis, gonorrhoea, hoo

- Droplet spread refers to spray with relatively large, short range aerosols produced by sneezing, coughing or even talking
- Indirect transmission could be airborne, vehicle borne, or vector borne
  - Airborne is by particles suspended in the air which could be dust or droplet nuclei (residue of dried droplets)
  - vehicles inanimate intermediaries and include food, water, blood, and fomites (objects such as handkerchiefs, bedding, or surgical scalpels)
  - Vectors- invertebrate animals mostly arthropods
    - Transmission may be mechanical or biological
    - Malaria, guineaworm, onchocerciasis, lymphatic filariasis etc

- Portal of Entry
  - Provide access to tissues in which the agent can multiply or a toxin can act
  - Often similar to the portal of exit eg influenza virus
  - The route for many enteric agents is described as faeco- oral
  - Hookworm (skin), syphilis, trachoma (mucous membranes, hepatitis (blood)
- Susceptible Host
  - Depends on genetic factors, specified acquired immunity, nutrition, age, sex, gastric acidity, cilia in respiratory tract, cough reflex

# Transmission cycle

- Bacterial meningitis: exchange of respiratory and throat secretions (Kissing, close contacts)
- Cholera: Eating food or drinking water contaminated with the bacterium
- Measles: droplet spread into the air, through breathing, coughing, sneezing
- Influenza: Respiratory droplets

# Transmission cycle

- Viral Haemorrhagic (Lassa) fever:
  - Mastomys rodents shed virus in urine and droppings. Virus could be transmitted directly through contact with contaminated materials, touching or eating food, or through cuts or sores.
  - Also through inhalation of contaminated particles. Infection can occur during catching and preparation as food.
  - Person to person through blood, tissue, secretions or excretion , contaminated medical equipment such as needles

# Requirements for an Outbreak or Epidemic:

- (i) presence of an infected host or other source of infection.
- (ii) adequate number of susceptible individuals
- (iii) an effective method of contact for transmission to occur.

# Principles of Prevention and Control

# Principles of Prevention and Control

- Chain of infection may be interrupted at any of the links using appropriate measures/ strategies
- Reservoir-
  - Early diagnosis and treatment of cases and carriers
  - Notification
  - Epidemiological investigation
  - Isolation
  - Quarantine
- Mode of transmission
  - Interrupting transmission through personal and environmental hygiene including water treatment, food hygiene, adequate housing, vector control etc

- Susceptible host
  - Active immunization with increase in herd immunity
  - Passive immunization with immunoglobulins, antisera antitoxins
  - Combined immunization
  - Chemoprophylaxis
  - Non specific measures
    - Improvement in the quality of life
    - Legislation
    - Community involvement
    - Provision of health infrastructure eg public health lab facilities, manpower to investigate epidemics
  - surveillance

- **Levels of Prevention**

- **Primary level;**

- General health promotion – health education, nutrition education, lifestyle changes e.t.c
- Specific protection; using immunization, chemoprophylaxis, nutritional supplementation e.t.c.

- **Secondary level;**

- Early diagnosis and treatment through screening to prevent further damage in the individual and spread of diseases in the community

- **Tertiary level**

- Limitation of disability using skilled clinical care and social support to limit social and physical damage
- Rehabilitation to reverse function and capability through physical and social rehabilitation
- Surveillance

- Elimination of a disease- preventive efforts aimed at reducing the incidence of a disease to a zero level (interrupting transmission) within a delimited geographical area. Measures are continuous once aim is achieved. Lymphatic elimination programme tropical Africa.
- Eradication of a disease – preventive effort aimed at reducing the incidence of a disease to a zero level globally. Measures are discontinuous once the aimed is certified to have been achieved.
  - Smallpox
  - G/worm, Poliomyelitis

# Control Measures

- Control –preventive efforts aimed at reducing the prevalence and the incidence of a disease to a level that the disease no longer constitutes a public health problem. Measures are continuous when aim is achieved. Eg rollback malaria programme, Onchocerciasis control programme etc

# Role of Surveillance in Disease Control

- Prediction and early detection of epidemics
- Early and adequate response to Epidemics
- Disease containment through contact tracing and follow up
- Priority setting and planning,
- Resource mobilization and allocation
- Monitoring and evaluation of intervention programmes

# Endemic Communicable Diseases in Nigeria

# Endemic Priority Diseases in Nigeria

## **Epidemic Prone Diseases**

- Cerebrospinal Meningitis (CSM)
- Cholera
- Measles
- Viral Hemorrhagic fever (Lassa)
- Human Influenza caused by a new subtype
- Yellow fever
- Diarrhoea with blood (shigella)
- SARS
- Smallpox
- Dengue
- Anthrax
- SARI

## **Diseases targeted for elimination and eradication**

- Neonatal Tetanus
- Leprosy
- Lymphatic filariasis
- Acute Flaccid Paralysis/Poliomyelitis
- Dracunculiasis
- Tuberculosis

## **Other Diseases of Public Health importance**

- Diarrhoea in children < 5years of age
- Hepatitis-B
- HIV/AIDS
- Malaria
- Onchocerciasis
- Pertussis
- Pneumonia in children < 5years
- Sexually Transmitted Infections (STIs)
- Trypanosomiasis
- Buruli ulcer
- Asthma
- Diabetes mellitus
- Epilepsy
- High Blood pressure
- Sickle cell disease
- Malnutrition
- Plaque
- Trachoma
- Typhoid
- Human rabies
- Schistosomiasis
- Noma

# Overview of EVD outbreak

# What is Ebola?

- Ebola virus disease (EVD) is an acute viral haemorrhagic fever
- It is caused by infection with a virus of the genus *Ebola virus*
- One of the most virulent viral diseases known to mankind
- It is a severe, often fatal disease in humans and nonhuman primates (such as monkeys, gorillas, and chimpanzees)
- Most fatal viral hemorrhagic fever

# Ebola Taxonomy

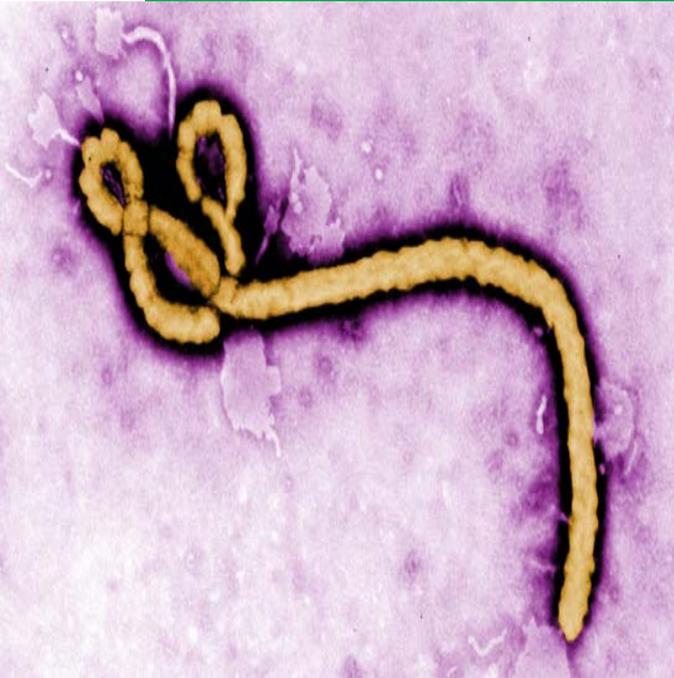
## Scientific Classification

Order: ***Mononegavirales***

Family: ***Filoviridae***

Genus: ***Ebola like viruses***

Species: ***Ebola***



# EBV Serotypes

- Genus Ebolavirus is 1 of 3 members of the Filoviridae family.
- Genus Ebolavirus comprises 5 distinct species:
  1. Zaire ebolavirus (EBOV)
  2. Sudan ebolavirus (SUDV)
  3. Bundibugyo ebolavirus (BDBV)
  4. Reston ebolavirus (RESTV)
  5. Tai Forest ebolavirus (TAFV).

# Natural Host

## Fruit Bat species

- *Hypsignathus monstrosus*
- *Epomops franqueti*
- *Myonycteris torquata*



# How is it transmitted?

1. Transmitted to people from wild animals (especially bats & non-human primates) and spreads in the human population through human-to-human transmission:
  - Close contact with the blood, secretions, organs or other bodily fluids of infected people; and fomites
  - Contact with the body or body-fluids of the deceased person
  - Contacts with infected semen up to seven weeks after clinical recovery (possible)
2. Nosocomial infection in health facilities due to close contact without the use of correct infection control precautions and adequate barrier nursing procedures

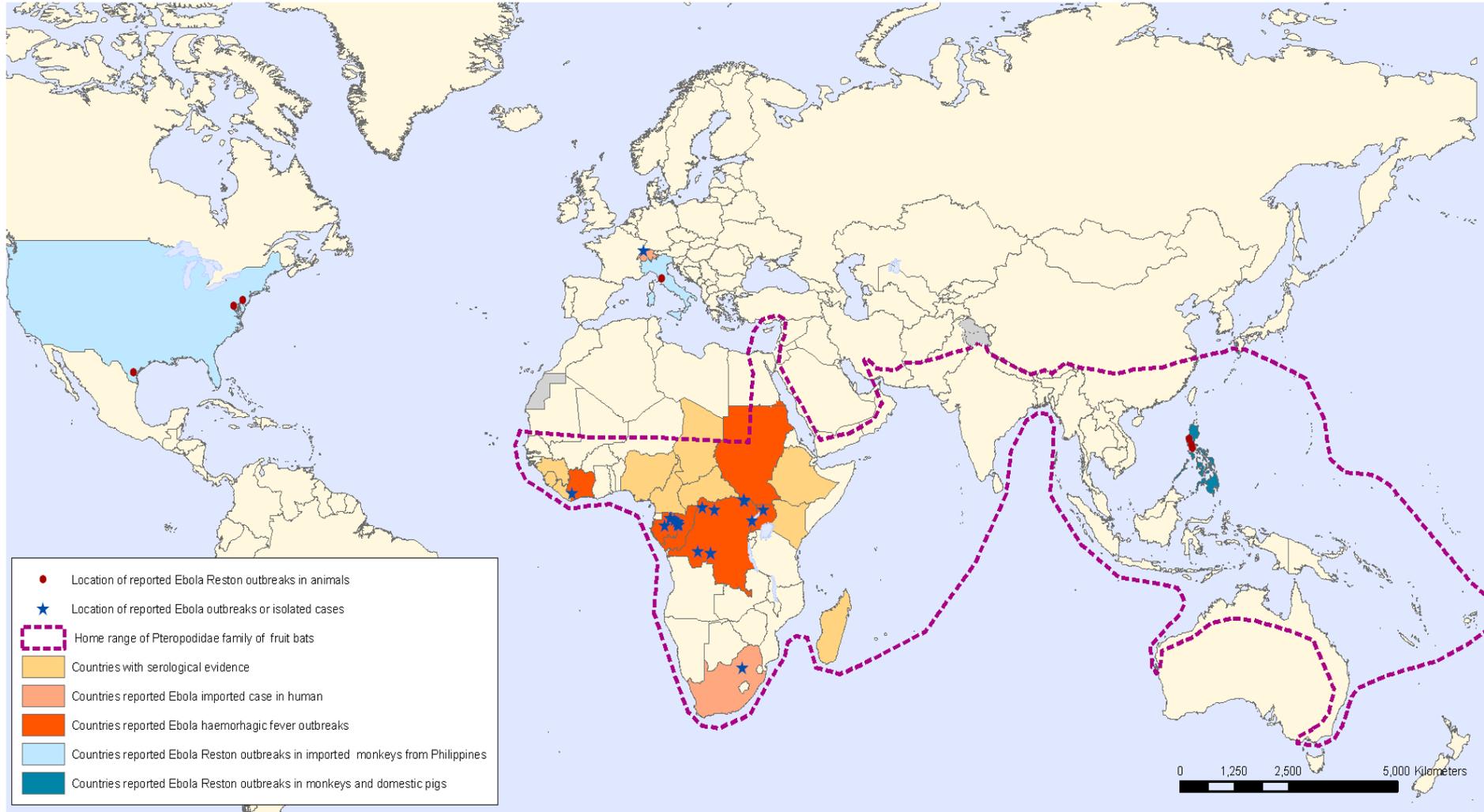
# What is infectious?

Ebola is spread through direct physical contact with body fluids like:

- Blood
- Saliva
- Stool and urine
- Vomit
- Sweat
- Snot
- Sexual fluids
- Tears
- Breast milk

*Also belongings (linen, clothes...) that are touched by a person, sick or dead with Ebola can be infectious.*

# Geographic distribution of Ebola haemorrhagic fever outbreaks and fruit bats of Pteropodidae Family



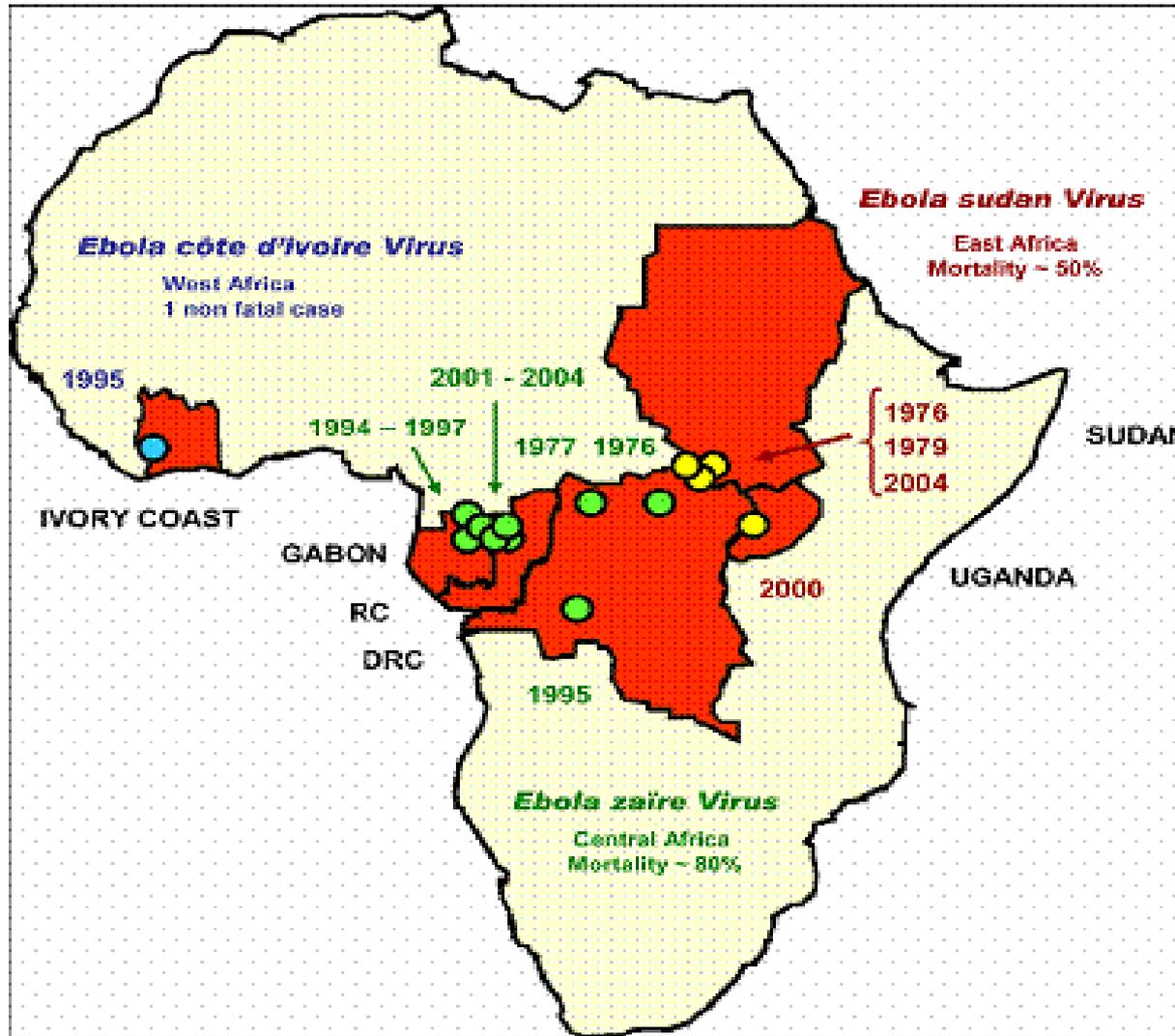
The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: Global Alert and Response Department  
 World Health Organization  
 Map Production: Public Health Information  
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# Previous outbreaks



# The Nigerian Outbreak

- **Outbreak began on 20 July when an infected traveler (diplomat) from Liberia arrived in Lagos → immediately hospitalized**
- **Subsequent spread of the disease in Lagos and Port Harcourt (PH) that marked the first EVD outbreak in Nigeria**
- **Lagos & PH are**
  - complex urban mega cities with combined population of 21 million
  - High influx of people from neighboring countries
  - Require adequate supporting infrastructure. Crowded, many slums and squatter settlements making the spread and control difficult
  - Main point of entry- Murtala Mohammed international airport in Lagos

# Number of cases and deaths in Nigeria

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<b>State</b>	<b>No. Cases*</b>	<b>No. deaths</b>
Lagos	16	6
Rivers	4	2
<b>Total</b>	<b>20</b>	<b>8</b>

**\*Cases include confirmed and probable cases**

## Socio demographic characteristics of EVD in Nigeria (n=20)

<b>Variable</b>	<b>EVD cases (%)</b>
<b>Age group (yrs)</b>	
<30	5 (25.0)
30-39	7 (35.0)
40-49	3 (15.0)
>=50	5 (25.0)
<b>Sex</b>	
Male	9 (45.0)
Female	11 (55.0)
<b>Occupation</b>	
Health Workers	13 (65.0)
Non Health Workers	7 (35.0)

# Response Teams

- 1) Case management/ Infection prevention & control**
- 2) Points of Entry (PoE)**
- 3) Social mobilization**
- 4) Treatment Research Group (TRG)**
- 5) Others: Logistics, Ambulance,**

# Points of Entry (PoE)

- Screening of incoming and exiting passengers
- SOP and Flow chart provided to PHS Staff
- Training of 100 PHS volunteers
- 247 Thermometers provided for screening temperature
- Secondary screening Areas established at the Centers



Thank you