Brief overview of Ebola disease with a focus on Sudan virus disease (SVD)

caused by Sudan Virus (SUDV) from the *Orthoebolavirus Sudanese* species

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EPI-WIN Sudan Virus Disease Outbreak: What we know?
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Nzara factory, epicentre of 1976 SVD outbreak, South Sudan.
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Ebola disease (EBOD)

- **Ebola disease (EBOD)*** is a severe, often fatal illness caused by viruses belonging to the *Orthoebolavirus* genus**.
- To date, **6 species of Orthoebolaviruses** have been identified with 3 of them associated with large outbreaks in humans:
  - **Bundibugyo virus** (BDBV) causing **Bundibugyo virus disease** (BVD);
  - **Ebola virus** (EBOV) causing **Ebola virus disease** (EVD); and
  - **Sudan virus** (SUDV) causing **Sudan virus disease**.

Table 1. Member species of the *Orthoebolavirus* genus

Species	Virus name (abbrev.)	Infection / disease in humans?
Orthoebolavirus bombaliense	Bombali virus (BOMV)	No human infection recorded
Orthoebolavirus bundibugyoense	**Bundibugyo virus (BDBV)**	**Human infections associated with disease**
Orthoebolavirus restonense	Reston virus (RESTV)	Human infections NOT associated with disease
Orthoebolavirus sudanense	**Sudan virus (SUDV)**	**Human infections associated with disease**
Orthoebolavirus taiense	Taï Forest virus (TAFV)	Human infections associated with disease
Orthoebolavirus zairense	**Ebola virus (EBOV)**	**Human infections associated with disease**

*International Classification of Disease ; ** International Committee on Taxonomy of Viruses.

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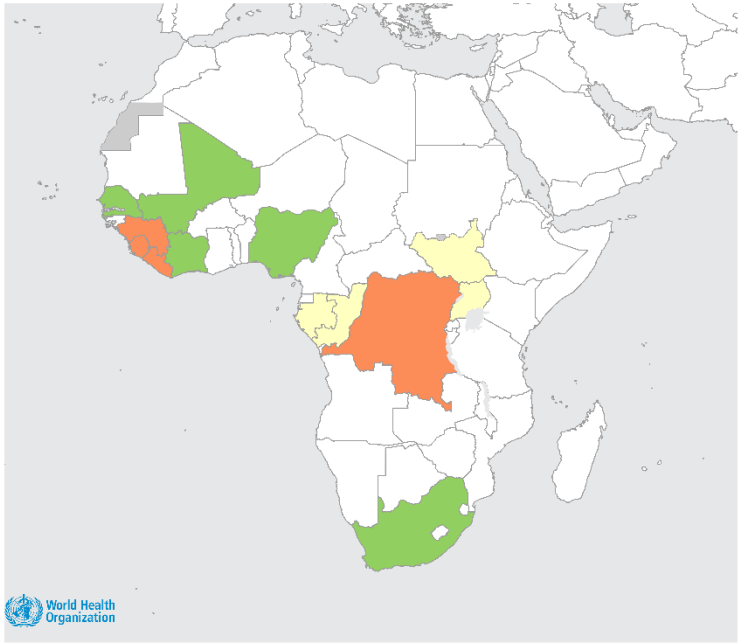
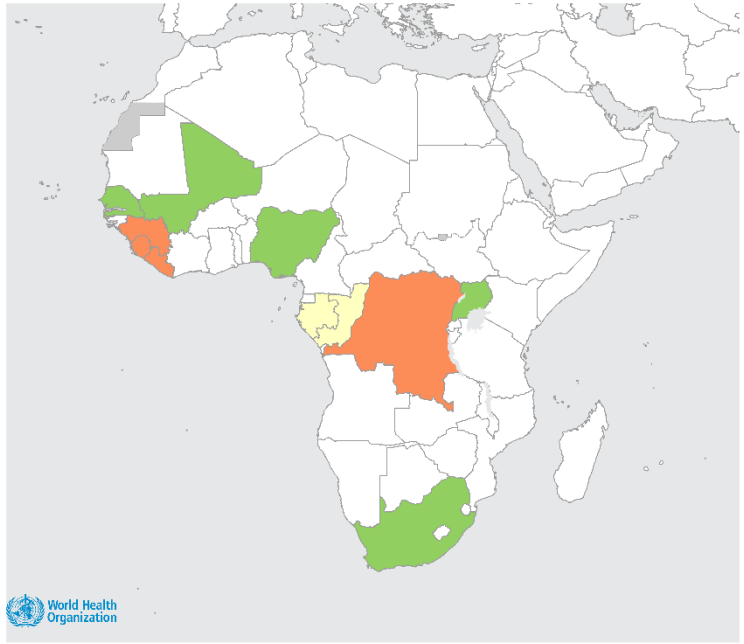
Geographic distribution of Ebola disease outbreaks

- Since 1976, **42 outbreaks of Ebola disease** have been reported.
- 31 of Ebola virus disease (23,045 cases including 14,885 deaths), 8 of Sudan virus disease (956 cases including 503 deaths) and 2 of Bundibugyo virus disease (206 cases including 66 deaths).

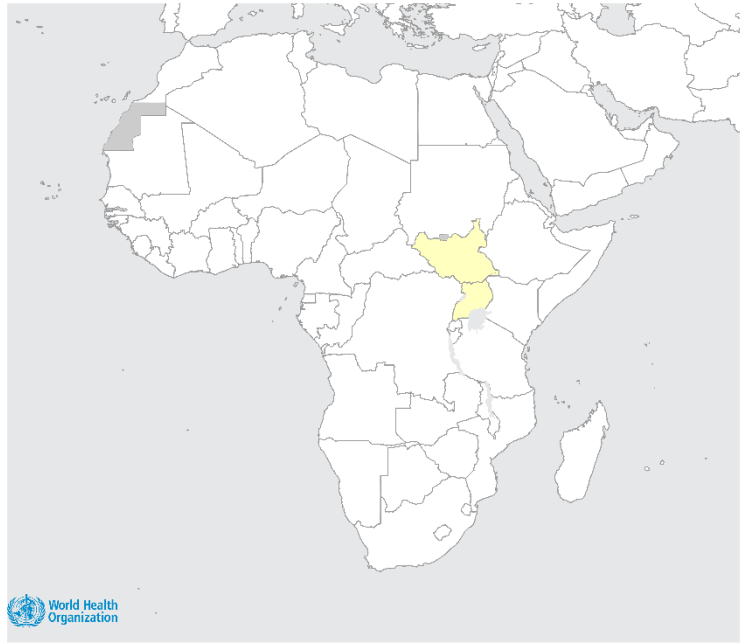
Ebola diseases
reported cases in Africa (1976-2024)



Ebola virus disease
reported cases in Africa (1976-2024)



Sudan virus disease cases
reported in Africa (1976-2024)



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Characteristics of EVD compared to SVD

Characteristics	Ebola virus disease (EVD)	Sudan virus disease (SVD)
N outbreaks (n country)	31 (11 incl. 5 from imported cases)	8 (2)
Estimated CFR (range)	65% (40-100%)	53% (41-71%)
Transmission route	Spillover from wildlife then human-to-human transmission. Resurgence linked to viral persistence in people who recovered documented.	Spillover from wildlife then human-to-human transmission.
Diagnostic (acute cases)	Open PRC platform, semi-automated near patient PCR, Ag RDT (oral fluids from deceased individual)	Open PCR platform
Approved vaccines	Yes - two vaccines	No - candidate vaccines, for clinical trials
Approved therapeutics	Yes - two monoclonal antibodies	No - candidate therapeutics, for clinical trials

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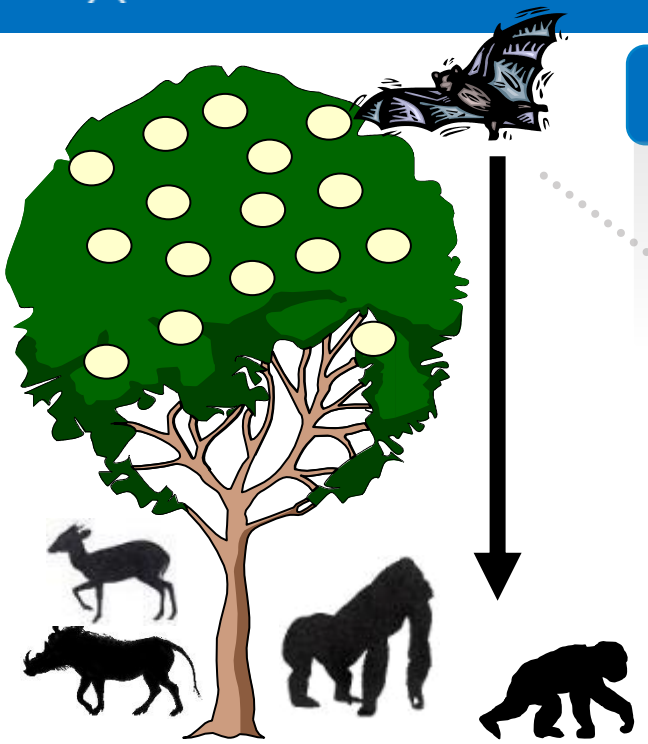
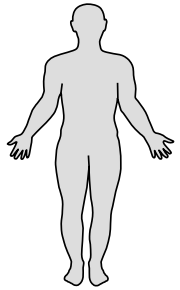
Transmission of Orthoebolaviruses



1. Virus reservoir: fruit bats

It is thought that the virus maintains itself in fruit bats of the Pteropodidea family.



2. Epizootics in animals

- Infected fruit bats enter in direct or indirect contact with other animals and pass on the infection.
- Large-scale epidemics in primates or mammals (e.g. forest antelopes) can happen.

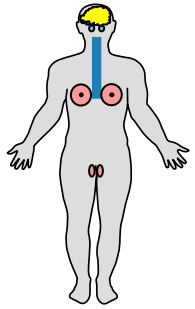
3. Introduction in human population

Humans are infected either through:

- handling infected dead or sick animals found in the forest (more frequent);
- or through direct contact with infected bats (rare event).

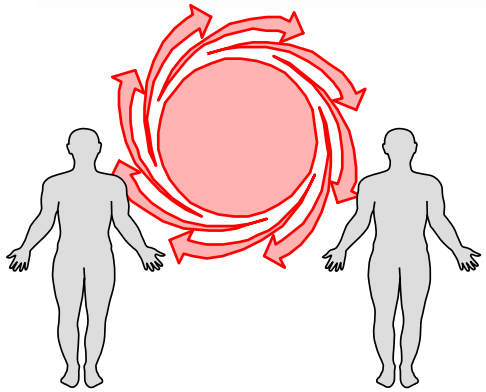
4. Secondary human transmission

- Secondary human-to-human transmission occurs through direct contact with the blood, secretions, organs or other body fluids of infected persons.
- High transmission risk when providing direct patient care or handling dead bodies (funerals).



5. Virus persistence

Persistence of virus in body fluids (semen mostly) of people who recovered.



10% Health Care Workers

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At-risk population for Ebola disease

- People with contact **with animals sick or dead** in rainforest
- People in close contact such **as family members or care givers with sick people exhibiting symptoms**.
- **Healthcare workers and medical personnel** caring for EBOD patients.
- **Laboratory workers** handling specimens from EBOD patients.
- **People handling bodies** of people who died of EBOD.
- **Traditional healers** caring for EBOD patients.

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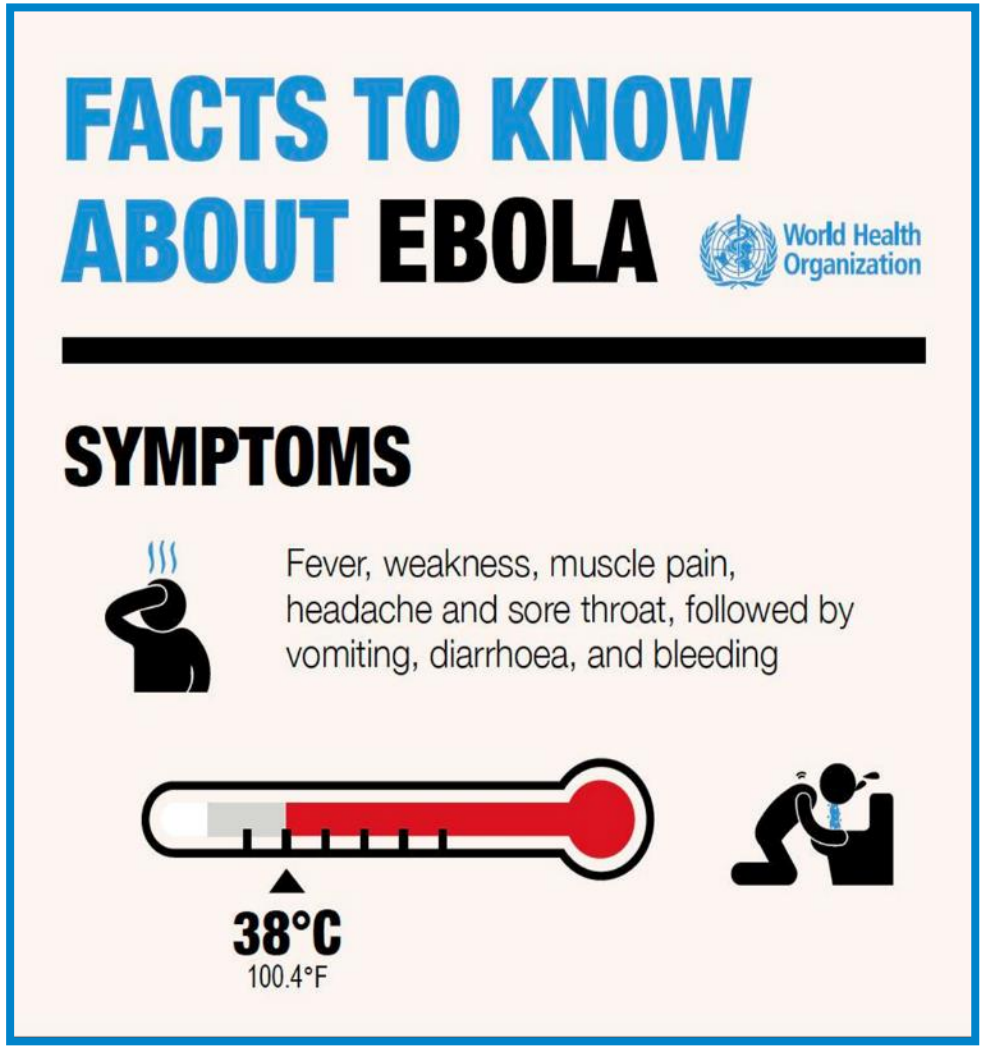
Clinical features of Ebola disease

- The incubation period is **2 - 21 days**.
- Humans **are NOT infectious until they develop symptoms**.
- Initial symptoms can include **sudden onset of fever and fatigue, muscle pain, headache and sore throat**.
- Usually followed by vomiting, diarrhoea, rash, impaired kidney and liver function, spontaneous bleeding internally and externally (in some patients).



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Ebola disease diagnosis

- **Symptoms are non-specific**; clinical diagnosis may be difficult.
- Differential diagnosis includes other viral haemorrhagic fevers, yellow fever, malaria, typhoid fever, shigellosis, and other viral and bacterial diseases.
- **Patient history** is essential and should include:
  - **Contact with a dead or sick animal**;
  - **Contact with a suspected, probable or confirmed Ebola disease patient**

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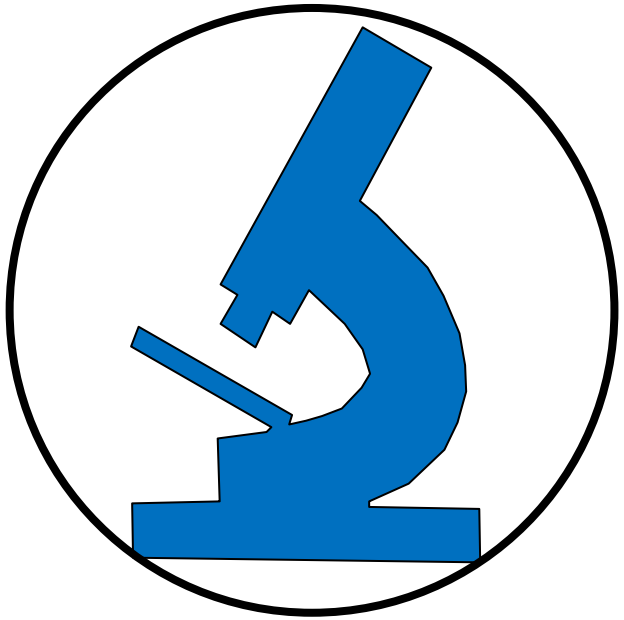
Ebola disease laboratory diagnosis

Definitive diagnosis requires testing:

- **Reverse transcriptase polymerase chain reaction (RT-PCR) assay**
- IgG and IgM antibodies enzyme-linked immunosorbent assay (ELISA)
- antigen detection tests
- virus isolation by cell culture



Handling and processing specimen requires **suitably equipped laboratories under maximum biological containment conditions** and staff collecting samples should be **trained**. More information : **Diagnostic testing for Ebola and Marburg diseases**

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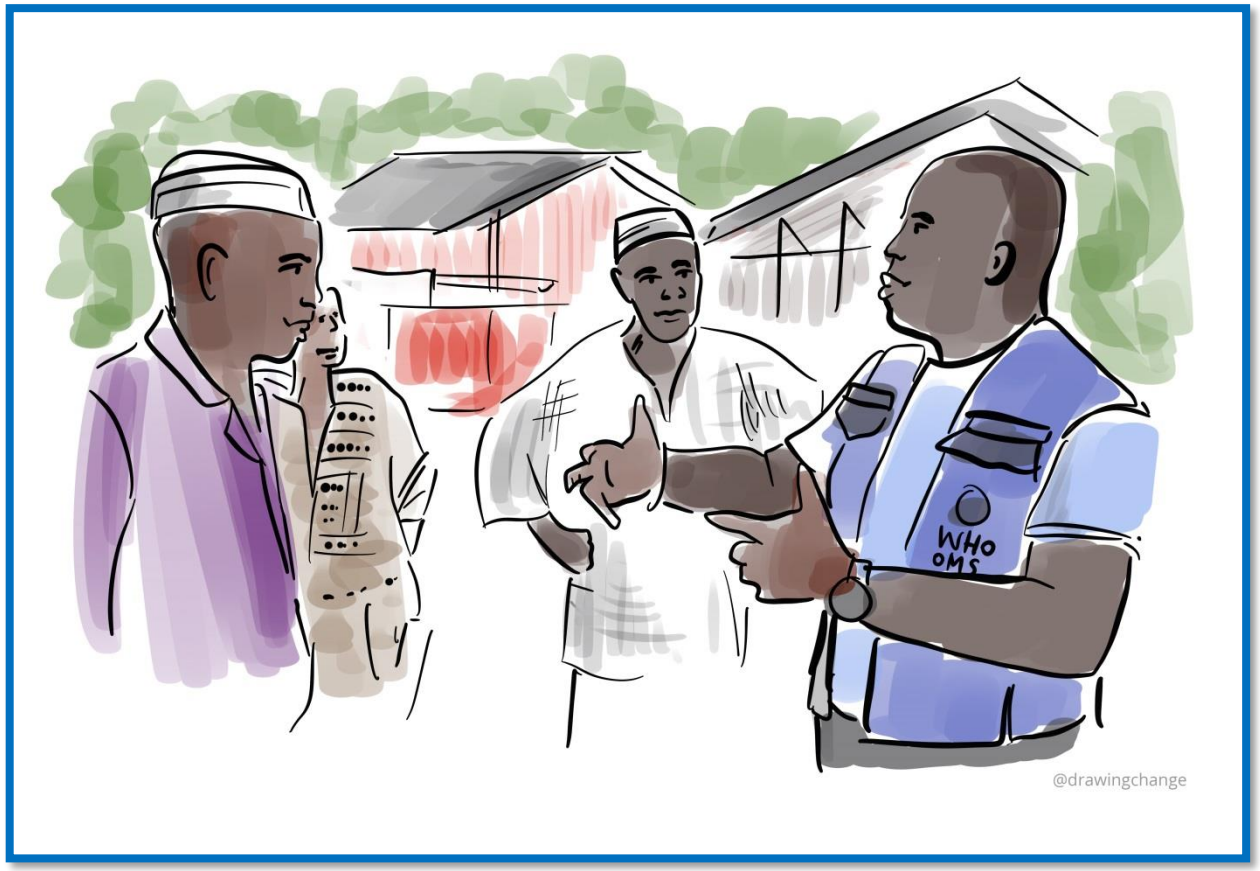
Community engagement and awareness

- Trust from communities has to be gained and respect shown to everyone affected by an outbreak.
- Engage with communities to promote desired health practices and behaviours, particularly on caring for sick and/or deceased persons.
- Provide accurate and timely health advice and information on the disease.



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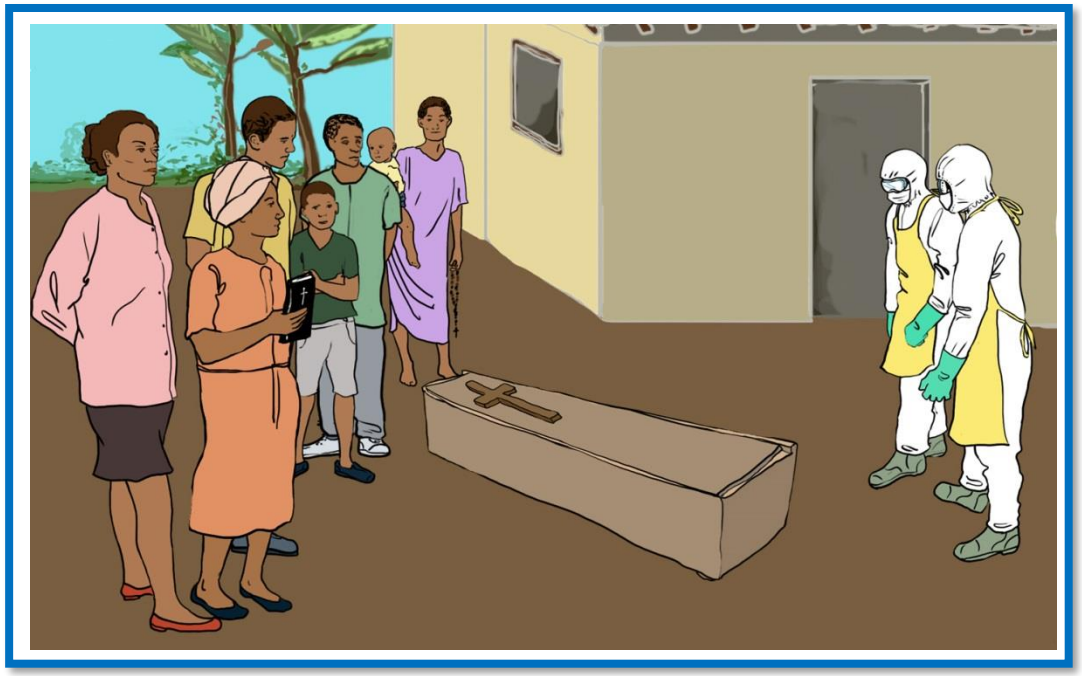
Reducing human-to-human transmission

- **Reducing the risk of human-to-human transmission:**
  - Avoiding close contact with EBOD patients and their body fluids;
  - Patients suspected or confirmed for EBOD to be referred to designated treatment center for early care and to avoid transmission at home.
  - Implement Standard Precautions with all patients – regardless of their diagnosis, including safe injection practices. Health care workers treating patients with EBOD to apply extra infection prevention control measures.
  - Safe and dignified burial practices should be facilitated for suspected or confirmed EBOD patients who died.



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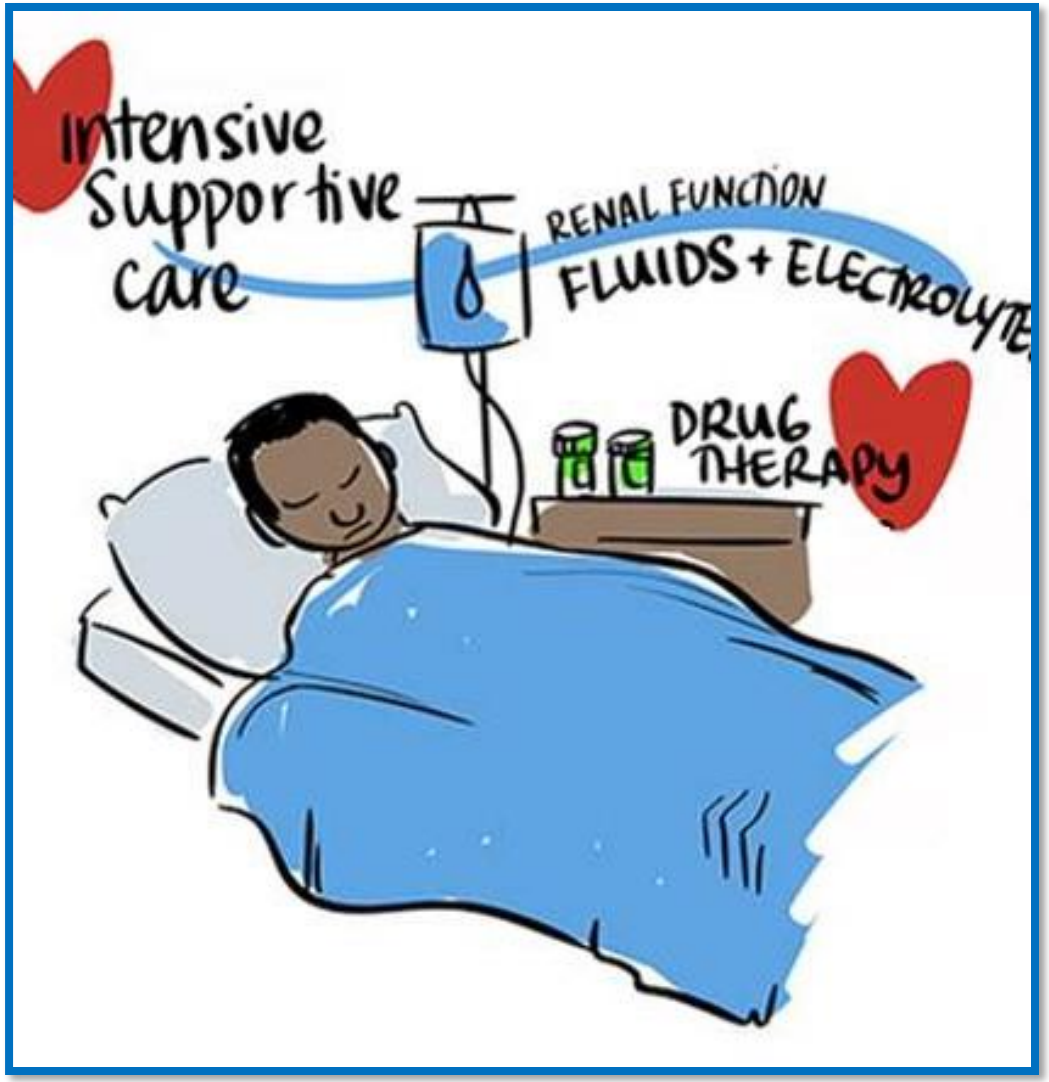
Caring for patients with Ebola disease

- **Chances of survival can be improved** through:
  - **Early intensive care support** such as monitoring fluids and electrolytes balance and vital signs, and careful rehydration.
  - **Supportive drug therapy** including painkillers, antiemetic for vomiting, anxiolytic for agitation, +/- antibiotics and/or antimalarial drugs.
  - See Optimized supportive care for Ebola disease: clinical management standard operating procedures
  - Psycho-social support and services are also critical.
- For Ebola virus disease, **WHO made strong recommendations for treatment with mAb114** (ansuvimab™) or **REGN-EB3** (Inmazeb™). There are **no approved specific therapeutics for other Ebola diseases**, though candidate therapeutics are under development and be rolled out through clinical trials.



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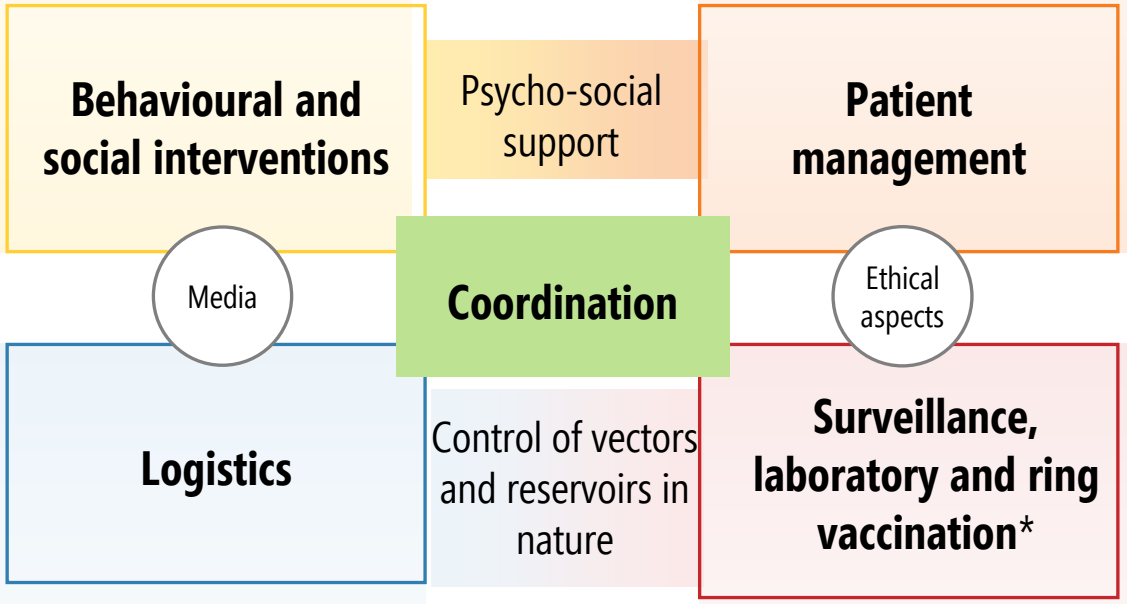
General strategy to control EBOD outbreaks

- Conduct social and cultural assessments
- Formal and informal communication
- Engage with key influencers: women and /or youth associations, traditional healers, local authorities, religious & opinion leaders
- Address community concerns



- Screening and triage
- Personal Protective Equipment
- Optimized supportive care and therapeutics*
- Infection control
- Safe and dignified burials
- Clinical trials
- Care for survivors

- Operational support and supplies
- Lodging, food
- Social and epi mobile teams
- Finances, salaries
- Transport vehicles
- Security

- Active case-finding
- Follow-up of contacts
- Specimens transport
- Laboratory testing
- Database analysis
- Search for the source
- Ring vaccination* or vaccine clinical trials

Source: Emergent pathogens, international surveillance and international health regulations (2005)]. Formenty P, Roth C, Gonzalez-Martin F, Grein T, Ryan M, Drury P, Kindhauser MK, Rodier G. Med Mal Infect. 2006 Jan;36(1):9-15.

*** For Ebola virus disease only**

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Ebola virus disease countermeasures

Disease-specific therapeutics and vaccines are approved for Ebola virus disease **only**.

Therapeutics

- WHO made strong recommendations for treatment with mAb114 (Ebanga™) or REGN-EB3 (Inmazeb™) for patients with RT-PCR confirmation of EVD.
- This is in addition to the implementation of optimized supportive care for all patients.

Vaccines

- Two vaccines, Ervebo (Merck & Co.) and Zabdeno and Mvabea (Janssen Pharmaceutica), are approved against Ebola virus disease. Ervebo vaccine is recommended as part of outbreak response. More information is available in the SAGE recommendations of July 2024.
- In case of a confirmed EVD outbreak, Ervebo vaccines can be accessed through the International Coordinating Group on vaccine provision.
- For preventive vaccination of healthcare and frontline workers, request of Ervebo vaccines can be made through GAVI Preventive Ebola vaccination.

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Candidate therapeutics for Ebola disease

There is no approved specific therapeutics against other Ebola disease (namely SVD or BDV), candidate therapeutics are at different stages of development and evaluation.

- Several compounds including monoclonal antibodies such as MBP134, and antiviral drug Remdesivir (GS-5734) had shown some level of efficacy in non-human primates, alone or in combination, against Sudan virus.
- Phase 1/2 studies are in process to assess pharmacokinetics and safety profile.
- Experts' deliberations on candidate treatments prioritization and trial design against Sudan virus were held in November 2022.
- As part of outbreak response, a CORE protocol for clinical trial is available.
- For more information on candidate therapeutics for filovirus diseases : https://www.who.int/teams/blueprint/ebolavirus

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Candidate vaccines for Ebola disease

There is no licensed vaccine to date for SVD or BVD, candidate vaccines are under development.

- Several candidate vaccines, including replicating Vesicular Stomatitis Virus vector and non-replicating chimpanzee adenovirus vector, have been reviewed in 2023 and conclusions are available here. All shown protection in animal model against SUDV.
- These candidate vaccines are undergoing phase I/II studies against SVD.
- As part of outbreak response, a CORE protocol to evaluate the safety, tolerability, immunogenicity, and efficacy of vaccine candidates is available.
- For more information on candidate vaccines for filovirus diseases: https://www.who.int/teams/blueprint/ebolavirus

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Ebola disease resources

Fact sheet and coordination

- Ebola disease - Fact Sheet (link)
- Ebola and Marburg disease epidemics: preparedness, alert, control, and evaluation (link)
- Ebola disease – Questions and answers (link)

Surveillance and contact tracing

- Case definition recommendations for Ebola or Marburg virus diseases (link)
- Implementation and management of contact tracing for Ebola virus disease (link)
- Ebola disease outbreak toolbox (link)

Risk communication and community engagement

- Communication for behavioural impact (COMBI) (link)
- WHO outbreak communication planning guide (link)

Safe and dignified burials

- How to conduct safe and dignified burial of a patient who has died from suspected or confirmed Ebola disease (link)

Travel and Points of Entry

- Considerations for border health and points of entry for filovirus disease outbreaks (link)
- Exit screening at airports, ports and land crossings: Interim guidance for Ebola disease (link)

Laboratory

- Diagnostic testing for Ebola and Marburg diseases: interim guidance (link)
- How to safely collect blood samples by phlebotomy from patients suspected to be infected with filovirus (link)
- How to safely collect oral swabs (saliva) from deceased patients suspected to be infected with filovirus (link)
- How to safely ship human blood samples from suspected EBOD cases within a country by road, rail and sea (link)

Clinical care

- Optimized supportive care for Ebola disease: clinical management standard operating procedures (link)
- Guidelines for the management of pregnant and breastfeeding women in the context of Ebola disease (link)
- Clinical care for survivors of Ebola disease: interim guidance (link)
- Ebola and Marburg treatment centres: facility design and construction standards for preparing for and responding to outbreaks (link)
- Essential Items Estimator Tool for health facilities in Ebola disease context (link)

Medical countermeasures for Ebola virus disease

- Therapeutics for Ebola virus disease (link)
- International Coordinating Group on vaccine provision – Ebola virus disease (link)
- SAGE recommendations on Ebola virus disease vaccine (link)

Infection Prevention and control

- Infection prevention and control guideline for Ebola and Marburg disease (link
- Steps to put on (link) and remove (link) personal protective equipment for Ebola/Marburg disease: Coverall
- Steps to put on (link) and remove (link) personal protective equipment (PPE) for Ebola/Marburg disease: Gown and headcover

Countermeasures R&D for Ebola diseases

- A WHO-Strategic Research Agenda for Filovirus Research and Monitoring (WHO-AFIRM) (link)
- CORE trial protocol for candidate therapeutics against Ebola disease (link)
- CORE trial protocol for candidate vaccines against Ebola disease (link)
- Filoviridae - Landscape of vaccines and therapeutics licensed or under development (link)

Trainings

- FiloTREAT - clinical management to filovirus disease (link)
- Design of screening and treatment centers for Ebola and Marburg (link)
- IPC measures in health-care settings for Ebola or Marburg disease outbreaks (link)
- International Coordinating Group on vaccine provision (link)

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Key contact

Thank you for your time!

Questions / suggestions?

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