



HANTA



REDUCING DEATHS AND SUFFERING
FROM TROPICAL DISEASES



Hantaviruses – Vector Biology

- 40% of mammal species are rodents
- Found on all continents other than Antarctica
- Common rodents include mice, rats, squirrels, porcupines, beavers, guinea pigs and hamsters
- Some species have historically been pests, eating seeds stored by people and spreading disease



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Hantaviruses – Vector Biology

Hantaviruses are carried and transmitted by rodents

Most common rodent vectors:



The cotton rat *Sigmodon hispidus* is a hantavirus carrier that becomes a threat when it enters human habitation in rural and suburban areas.



Deer mouse



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Hantaviruses – Vectors



Clethrionomys glareolus



Striped Field Mouse –
Apodemus agrarius



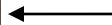
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Hantaviruses – Vectors



*Apodemus
flavicollis*



Brown rat –
Rattus norvegicus

White-footed mouse



Dick Cooper

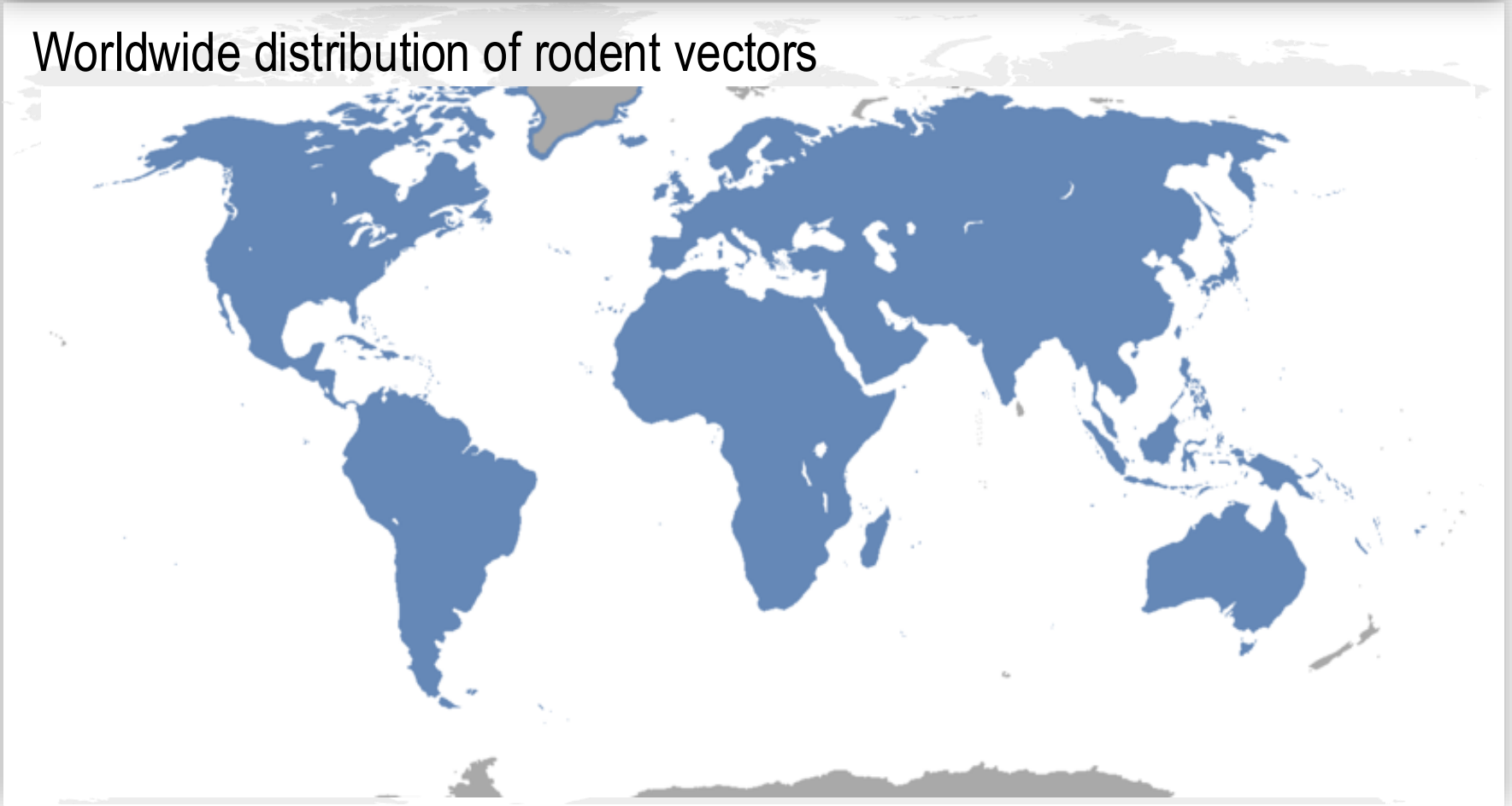


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Hantaviruses - Rodent Epidemiology

Worldwide distribution of rodent vectors



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Hantaviruses – Prevention

- Avoid contact with wild rodents and their urine, feces and saliva
- Avoid entering buildings infested with rodent
- Seal buildings for holes larger than 0.5 cm
- Do not disturb rodent nesting sites.
- Never keep wild rodents as pets.
- Spring-loaded traps OR rodenticides (some downsides)
- No vaccine against Hantavirus



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Hantaviruses – Rodent Traps



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Hantaviruses – Environmental Control

- Reduces risk of airborne transmission where people live, work, and recreate.
- Remove food sources used by rodents and make homes, buildings, warehouses, or feed sheds rodent-proof.
- Never handle rodents with your bare hands
 - Gloves should be worn to prevent bites and exposure to bodily secretions.
- Apply disinfectants to rodent carcasses and infested areas
 - A 10% bleach solution is very effective at killing Hantavirus



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Hantaviruses – Prevention

Public Health Education:

- Educating the general public and the medical community about how to avoid exposure to disease-bearing animals
- Report observations of sick or dead animals to the local health department
- Eliminate sources of food and nesting places for rodents around homes, work places, and recreation areas;
- If exposed to rodents/feces, wash hands and face well



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Hantaviruses – Key Points

- **Diagnosis**

Serologic tests, immunohistochemical staining and microscope examination

- **Treatment**

Supportive care; fluid (hydration) and electrolytes, maintenance of correct oxygen and blood pressure levels, Intravenous ribavirin, an antiviral drug

- **Rodent Control**

Environmental control – clearing sources of food and shelter for rodents, spraying with rodenticides in and around homes eliminates source of infection around people's homes, impractical to attempt to clear rodent reservoir



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Hantaviruses – Key Points

Vector Control

Community education/sensitization people aware of the risks of Hantavirus and practices to eliminate them, protect themselves & each other



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Hantaviruses – M & E/ Messages to Community

- Keep good hygiene and clean living conditions
- Look out for signs and symptoms –
- Treat living spaces with rodenticides and traps to eliminate rodents
- Care when cleaning rodent infested areas/dead rodents



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And Now for Something Completely Different



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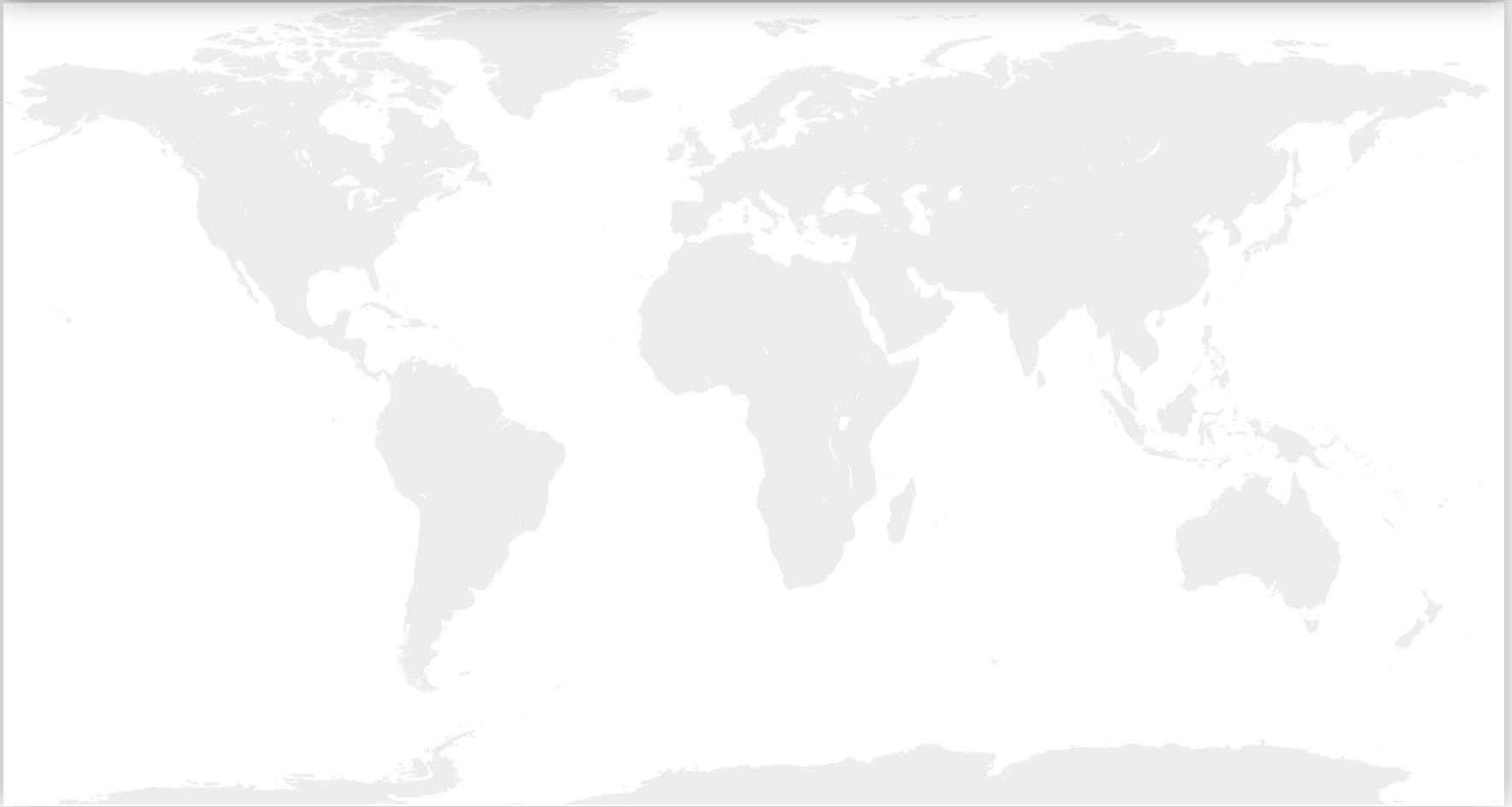
Lassa fever virus



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Focus on Lassa / rat reservoir



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Lassa Fever: A Zoonotic Disease

- Multimammate rats (*Mastomys natalensis*) are the animal reservoir for Lassa virus
- Virus is secreted in high concentrations in urine and feces
- Transmission to humans occurs via inhalation of aerosolized excreta, direct contact with excreta, or even ingestion of infected rats as a source of meat



Photo courtesy of the University of Greenwich



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Lassa – Rodent Reservoir



Mastomys species complex

M. huberti: more common in peridomestic habitat

M. Erytholeucus more common in brush habitat

Others exist too



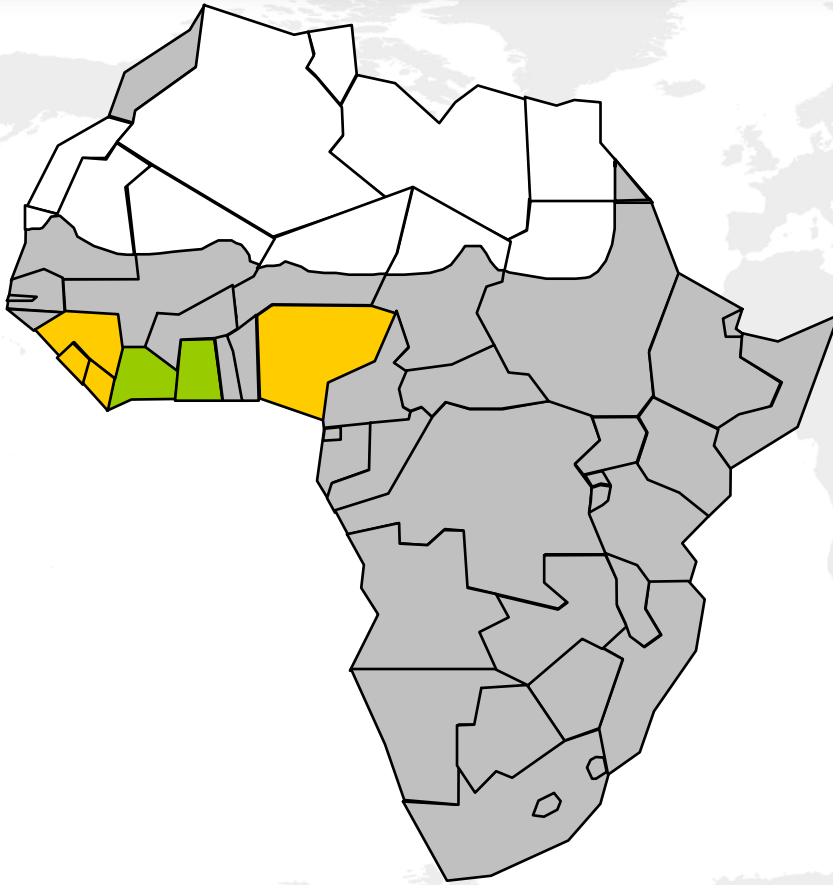
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Known Distribution of the Lassa rat - *Mastomys*

**MASTOMYS
DISTRIBUTION**

LASSA discovered in 1969



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Lassa Virus: Risk Factors

- Frequent contact with bush rats, especially when rodents are present in and around food storage
- Dry regions due to increased aerosolization of excreta
- Victims of conflict, village destruction, displacement and resettlement
- Health workers and family members caring for infected patients



Public Health Agency of Canada



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Lassa Fever – Transmission

Rodent-to-human:

- Inhalation of aerolized virus
- Ingestion of food or materials contaminated by infected rodent urine / excreta
- Open wound contact with rat urinated bedding (rats eating skin off the soles of your feet!)
- Handling of live or dead infected *Mastomys* (as urine contaminates their fur)



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Lassa Fever – Transmission

Human-to human:

- Direct contact with blood, tissues, secretions, body fluids or excretions of infected humans
- Needle stick injury or cut
- Inhalation of aerolized virus



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Rodent Reservoir – Biology

- ***Mastomys*** is a genus of rodent in the family Muridae.
- Most common species is the Natal multimammate rat
- (*M. natalensis*), the common African rat, or the African soft-furred rat.
- Found throughout Africa
- Its natural habitats are subtropical or tropical dry forests, subtropical or tropical moist lowland forests, dry savanna, moist savanna, subtropical or tropical dry shrubland, arable land, pastureland, rural gardens, urban areas, irrigated land, and seasonally flooded agricultural land.



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Lassa Fever – Prevention & Control

1. Village based programmes for rodent control and avoidance
2. Active case detection and reporting
3. Hospital training programmes to avoid nosocomial spread: barrier nursing
4. Early diagnosis
5. Early antiviral therapy



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Rodent Control

- Control of the *Mastomys* rodent population should be limited to compounds, living and sleeping areas, and food stores:
- Proper storage of food in rodent proof containers
- Cleaning around house/personal hygiene
- Repairing holes in wall and doors to block rat entry into house
- Trapping and killing rodents with proper and safe disposal of carcasses (gloves, never touched directly)
- Avoid rodents as food source



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Rat Traps and Leaves



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Active Case Detection

- Identify all recent contacts for patients presenting with Lassa symptoms
- Send out contact team to village of origin.
- Find all recent contacts (last 2 weeks)
- Return all contacts to a dedicated area by the hospital base
- Administer ribavirin full dose
- Observe contacts for next 24 hours
- Remember to give ribavirin to your contact team



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Lassa Prevention – Barrier Nursing Technique

1) Use standard precautions with all patients-regardless of infection status

- Routine handwashing practices.
- safe handling and disposal of used needles and syringes

2) Identify suspected cases of VHF

- In a non-outbreak situation, suspect VHF in patients with fever, severe illness, and signs of unexplained bleeding.
- Alert relevant health facility staff and begin VHF Isolation Precautions
- Report the suspected case to designated health authorities



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Lassa Prevention – Barrier Nursing Technique

3) **Isolate the patient-** Select a site for the isolation area and set up:

- The patient's room, family entrance
- A changing room for health care workers when changing clothes
- A changing room for other health facility staff to use near work area
- A security barrier around the entire isolation area.
- Counsel family members about patient care



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Lassa Prevention – Barrier Nursing Technique

4) Wear protective clothing

- All family, doctors, nurses, health care support and lab workers who provide direct patient care to suspected VHF patients or handle specimens and equipment used on patient.
- Scrub suit or inner layer of clothing, gloves, overshoes, biomask, head covering, glasses
- A plastic apron worn over both layers of clothes

5) Dispose of waste safely

- Disinfect **all** equipment used on patient, discard waste properly-burn

6) Use safe burial practices

- Bodies isolated, vehicles disinfected



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**What are the key IEC messages
you need to include in your
prevention programme?
5 minutes**



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Lassa Fever - M & E/Messages to community

- Everyone is at equal risk of infection
- Early case detection and treatment saves lives
- Finding and treating case contacts (even health ones) saves more lives and stops spread of the disease
- Repair your home to keep rodents out
- Store all food in rat proof containers
- Avoid direct contact with rodents dead or alive
- If you trap rats in the house, handle them with waxy leaves and avoid any direct contact
- Burn all dead rats, do not bury or chuck on the rubbish pile as they will infect others (children play in rubbish)



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Marburg – Transmission

- Natural reservoir of the virus is unknown, how the virus first appears in a human at the start of an outbreak not been determined.
- Researchers have hypothesized that the first patient becomes infected through contact with an infected animal.
- Human to human transmission via contact with the blood and/or secretions of an infected person.
- Spread often through families and friends coming into contact with secretions when caring for infected persons.
- Nosocomial transmission occurs frequently during Ebola outbreaks where barrier nursing techniques not followed



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Marburg Virus: Unknown Reservoir

- In 2009, the successful isolation of infectious MARV was reported from caught healthy Egyptian rousettes (*Rousettus aegyptiacus*)
- Strong suggestion that Old World fruit bats involved in natural maintenance of marburgviruses.



Photo courtesy of Dietmar Nill and naturepl.com

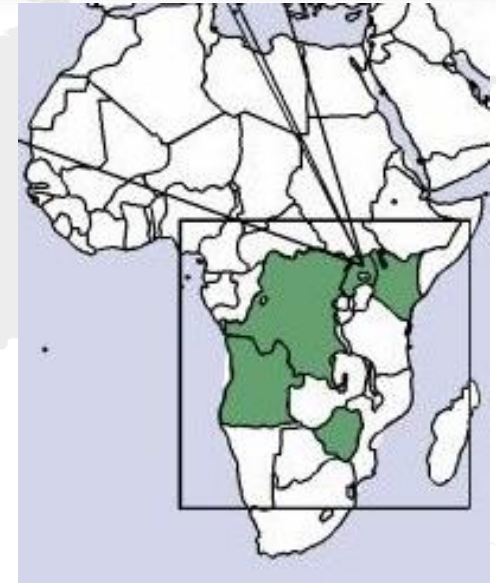


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Marburg Virus – Epidemiology

- Confirmed cases of Marburg HF reported in Uganda, Zimbabwe, the Democratic Republic of the Congo, Kenya, and Angola.
- Marburg HF typically appears in sporadic outbreaks throughout Africa.
- **Many of the outbreaks have occurred among male mine workers** with the virus transmitted throughout their communities by ways of cultural practices, under protected family care settings and under protected health staff



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Marburg Outbreaks

- 1967 Hamburg and Marburg, Germany and Belgrade, Yugoslavia
- 1975 Johannesburg, South Africa, 3 died
- 1980 Western Kenya, 2 Died (Physician died in Nairobi)
- 1987 Young man traveling extensively in Kenya
- 1999-2000 Durba, Republic of Congo
 - » Cases linked to workers in a gold mine



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Marburg – Prevention and Control

1. Active case detection and reporting
2. Hospital training programmes to avoid nosocomial spread: barrier nursing
3. Early diagnosis
4. Early Treatment



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Marburg Virus- Risk Factors

- Mining projects and workers in caves
- Hospital staff and family members who care for patients with the disease are at risk if they do not use proper barrier nursing techniques



Photo courtesy of CDC Outbreak control



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Marburg Prevention



Protection for Clinical Care – Ideally Respirator



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Protection for Culture (P4)

**What are the key IEC messages
you need to include in your
prevention programme?
5 minutes**



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Messages to community

- Early case detection and reporting of cases means faster treatment and lives saved
- Avoid visiting places where bats reside
- Miners should wear masks
- Barrier Nursing Techniques should be used in all HFs
- Community education of transmission route and risk factors



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Ebola Virus- A mysterious reservoir



Photos courtesy of the Public Domain Images Library



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Ebola – Transmission

- Natural reservoir of the virus is unknown, how the virus first appears in a human at the start of an outbreak not been determined.
- Researchers have hypothesized that the first patient becomes infected through contact with an infected animal.
- Human – human transmission via contact with the blood and/or secretions of an infected person.
- Spread often through families and friends coming into contact with secretions when caring for infected persons.
- People also exposed to Ebola virus through contact with needles contaminated with infected secretions.
- Nosocomial transmission occurs frequently during Ebola outbreaks where barrier nursing techniques not followed



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Ebola Virus- Risk Factors



Photo courtesy of Nathan Wolfe



Photo courtesy of the CDC PHIL

- Contact with wild animals, especially non-human primates in a hunting and butchering context
- Healthcare workers and family



Ebola Outbreak - Uganda 2000-2001



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Ebola Outbreak: Uganda 2000-2001

425 cases, 224
fatalities

(53% mortality)

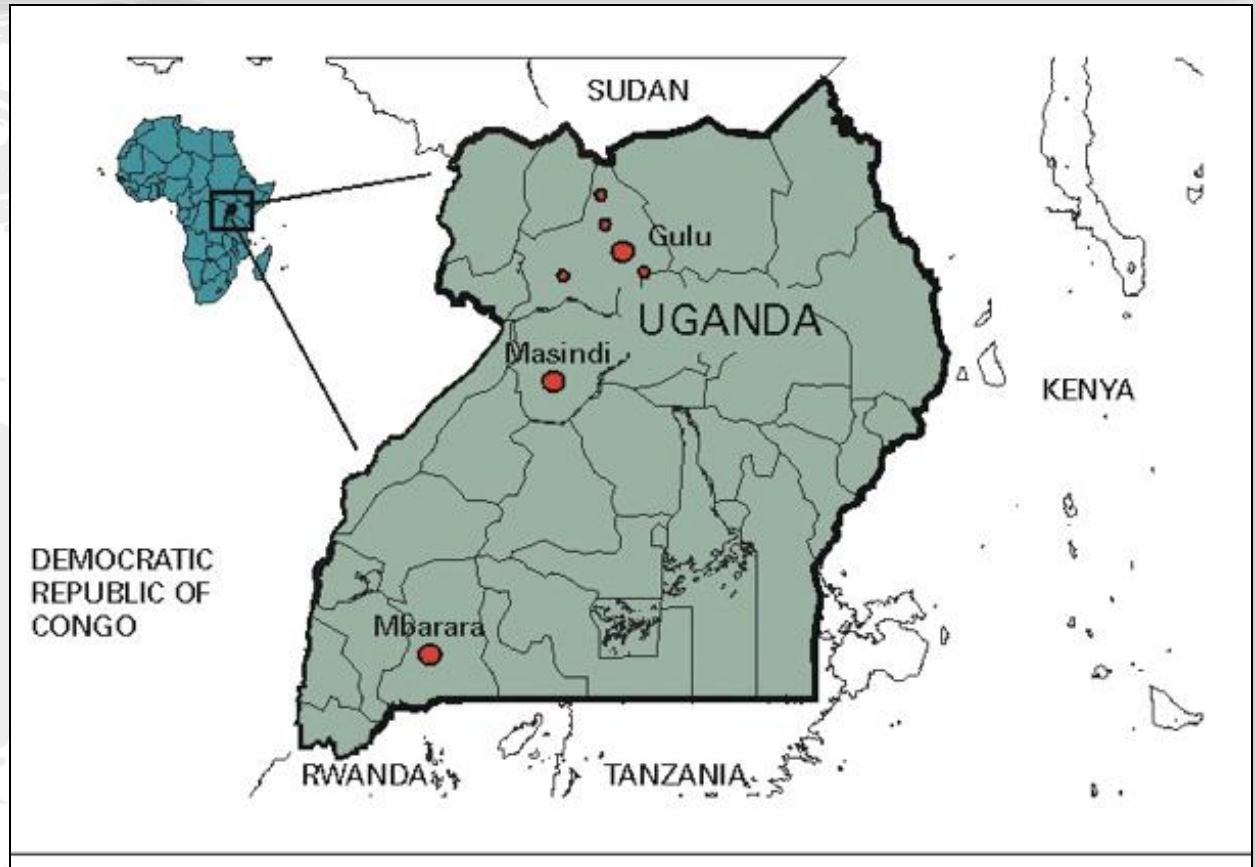


Photo courtesy of the CDC.



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Uganda Outbreak: Timeline

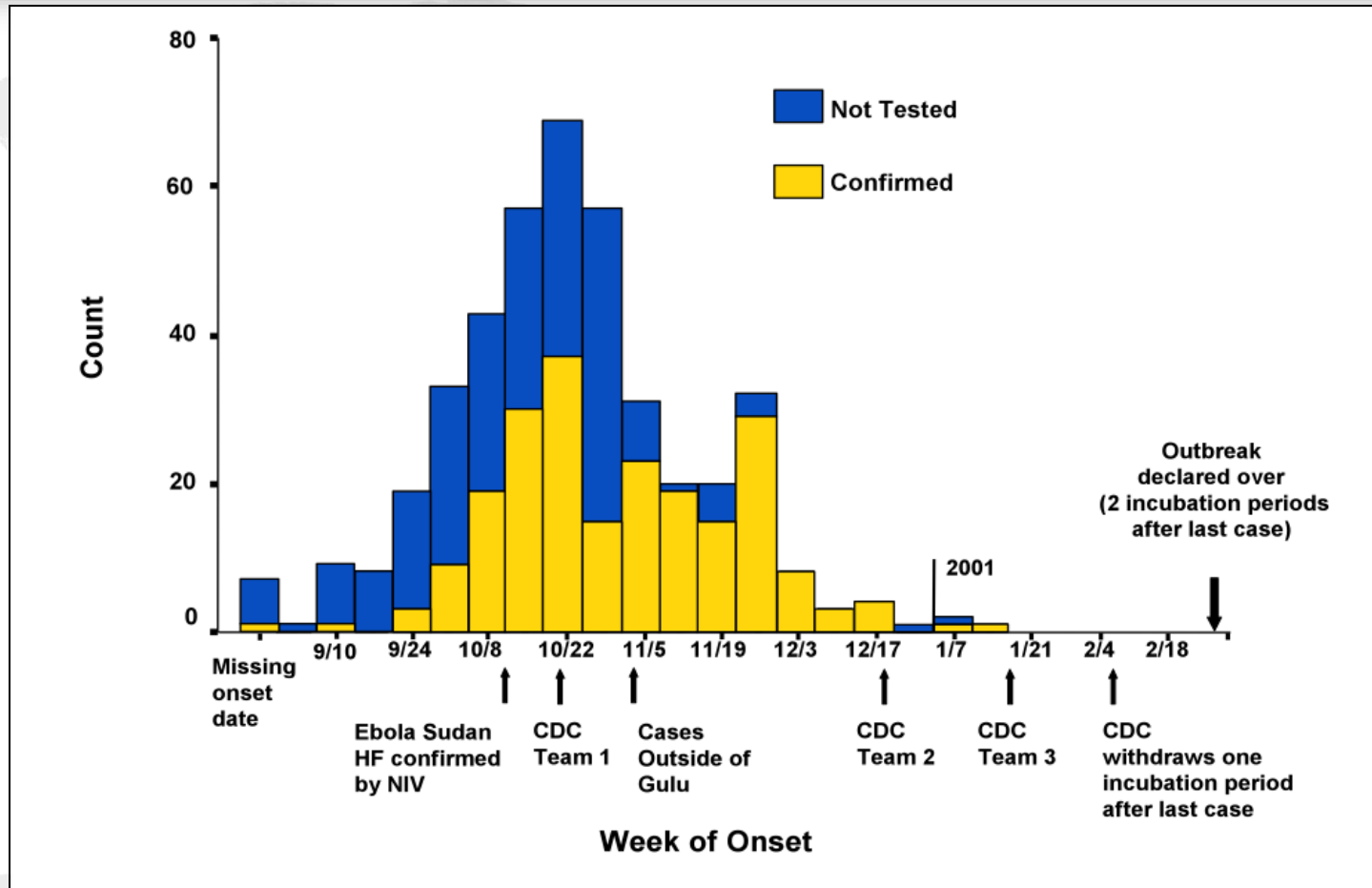


Photo courtesy of Scott Harper and the CDC



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Ebola - Outbreak Containment & Control

1. Logistics and coordination:
barrier nursing supplies &
organization of teams,
isolation unit for patients
2. Social mobilization:
Outreach to the public
3. Laboratory diagnosis
4. Epidemiology and
surveillance: database of
cases and case contacts



Photo courtesy of ABC news



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Ebola in Humanitarian Crises

- High population density encourages transmission
- Medical resources are limited
- Surveillance is difficult or impossible
- Isolation wards and hospital protocols are compromised



Photo courtesy of Melanie Kotsopoulos



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Key strategies for crisis settings

- **Isolation:** ideally find a separate room or building for infected patients, but a corner of a large room can still help reduce nosocomial spread
- Use tarps or sheets to separate beds to avoid cross contamination with spills or splashes
- Minimize flow of people through the area, and put most severe cases toward the back



Photo courtesy of Paul Jawor



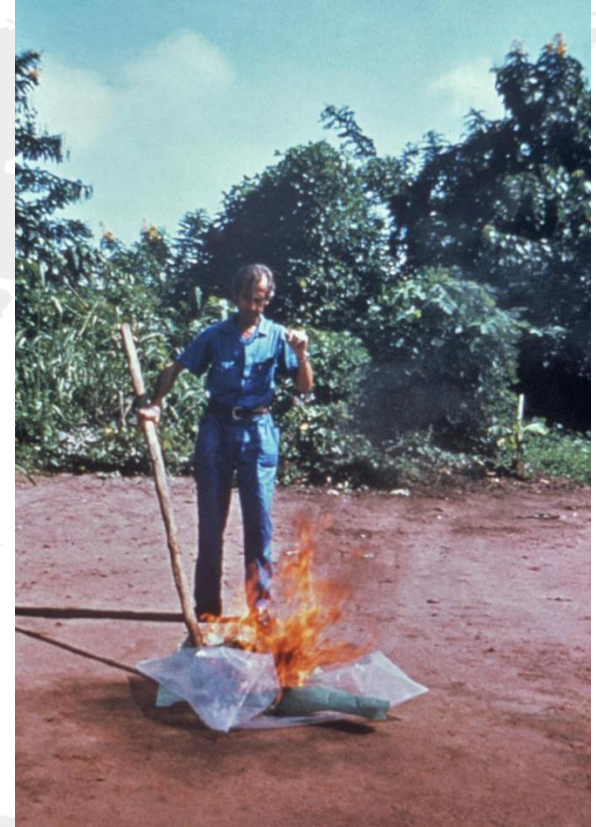
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Ebola - Reducing Transmission



Photos courtesy of the CDC PHIL



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Supplies for low-resource settings

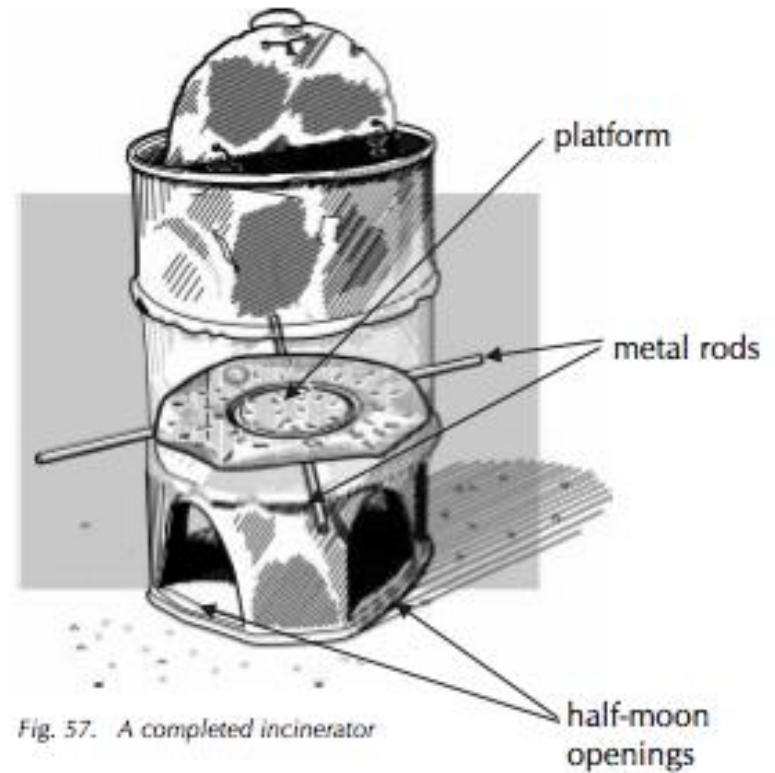


Fig. 57. A completed incinerator

Pictures courtesy of the CDC



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Ebola Virus- M & E/ Messages to community

- Early case detection and reporting of cases, means faster treatment, and saves lives.
- Important to confirm cases in order to monitor outbreaks –using ELISA/virus culture
- Avoid contact with “bush meat”
- Use barrier nursing techniques in all HFs
- Community aware of transmission and risk factors



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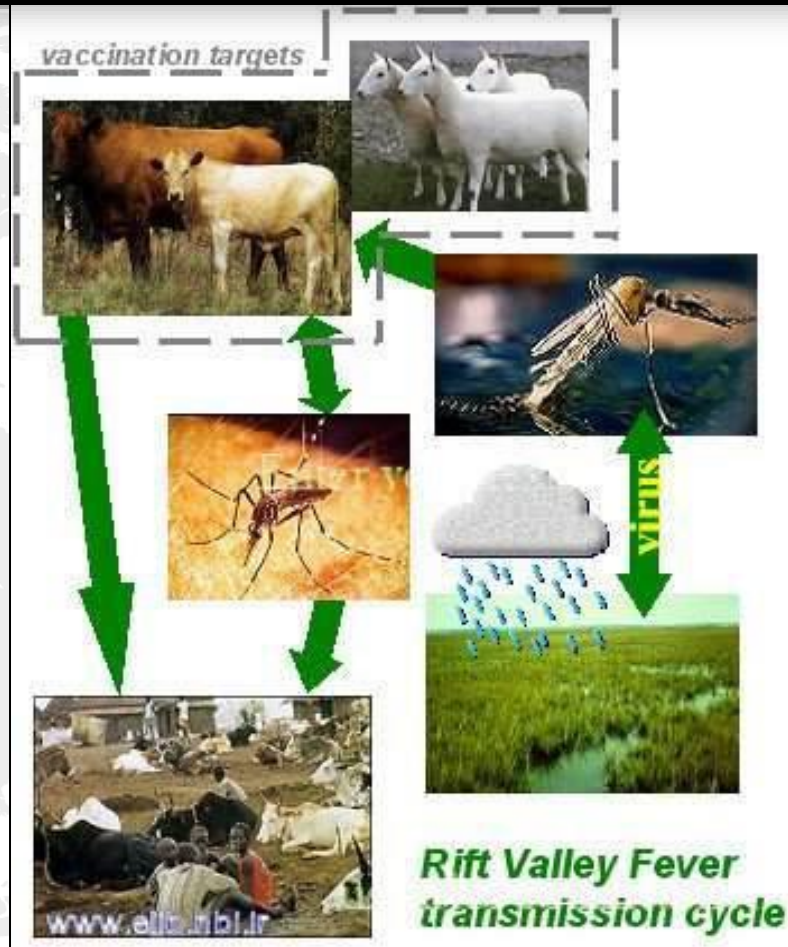
Rift Valley Fever



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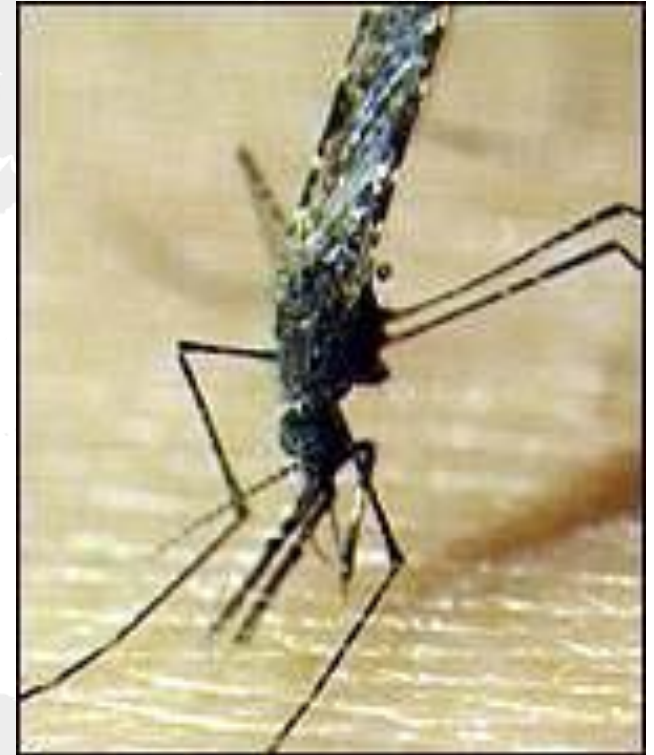


Transmission Cycle



Transmission

- RVF is primarily transmitted from animal to animal by a mosquito
- *Aedes*, *Culex*, *Anopheles*,
- *Erethmapodites*, *Monsosmia*



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Vectors

- Mosquitoes – *Aedes* species
 - Transovarial transmission
 - Eggs dormant in soil for long periods
 - Heavy rainfall, eggs hatch
- Ruminant amplifying host
- Secondary vectors can be infected
 - *Culex* and *Anopheles* mosquito species
 - Biting flies: midges, phlebotomids, stomoxids, simuliids



Amplifying Hosts

- Infected livestock
- High levels of viremia
- Amplifying
 - Sufficient to infect mosquito vectors
 - Establishes disease in environment
 - Leads to large epizootic epidemics
- Humans
 - Viremia enough to amplify



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Aerosol Transmission to Humans

- Direct contact is also significant for humans
- Humans get RVF from handling tissues, blood, secretions and excretions of infected animals.



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Transmission continued

- Direct contact or Aerosol
 - Tissue or body fluids of infected animals
 - Aborted fetuses, slaughter, butchery, necropsy
 - Milk contains virus: not known how important this is to transmission
 - High levels of virus in host animal's blood
 - Aerosol
 - Amplify virus
 - Infect other mosquitoes
 - Establish disease in environment
 - May lead to large outbreaks
- No person-to-person transmission
 - Humans possible source of virus for mosquitoes



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Rift Valley as a Biological Weapon

- Aerosol or droplets
 - 1 km downwind
 - 35,000 humans incapacitated
 - 400 deaths (1% mortality)
- Human introduction
- Animals as sentinels



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Main Animal Hosts

- Mainly a disease of sheep (& goats)
- Mortality in lambs under 2 weeks of
- Age approaches 100%
- Mortality in older sheep
- Reaches 30% with abortions approaching 100%
- Cattle are less susceptible than sheep, some are subclinical;
- Mortality averages 5% some abortions



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Other Hosts

- Springbok
- African Buffalo
- Camels (in Egypt) (inapparent disease, but some abortions)
- Dogs
- Cats
- Pigs
- Horses
- Water buffalo in Egypt (up to 50% abortion rate)



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Epidemiology

Endemic in tropical Africa

- Cyclic epidemics every 5-20 years
 - Susceptible animal populations
- Abnormally heavy rainfalls
- Peaks in late summer



Epidemic:

- Semi Arid Africa, Saudi Arabia, Yemen, and Egypt



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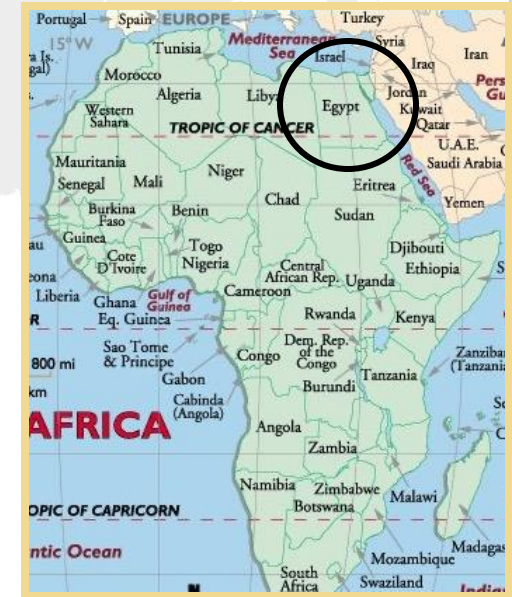


Rift Valley Fever



Egypt's epidemic: 1977-1978

- Humans
 - 18,000 cases
 - 598 deaths
 - Encephalitis and hemorrhagic fever
 - Case-fatality less than 1%
- Ruminants
 - Abortions and deaths
 - Sheep, cattle, goats
 - Water buffalo, and camels



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Other Important Outbreaks

- 1987: Senegal, Africa
 - Differed from other outbreaks
 - Not associated with rainfall
- 1997-98: Kenya, Africa
 - Largest outbreak reported
 - 89,000 humans cases - 478 deaths
- 2000-01: Saudi Arabia and Yemen
 - First outbreak outside of Africa
- 2003: Egypt
 - 45 cases; 17 deaths; All cases were Egyptian farmers



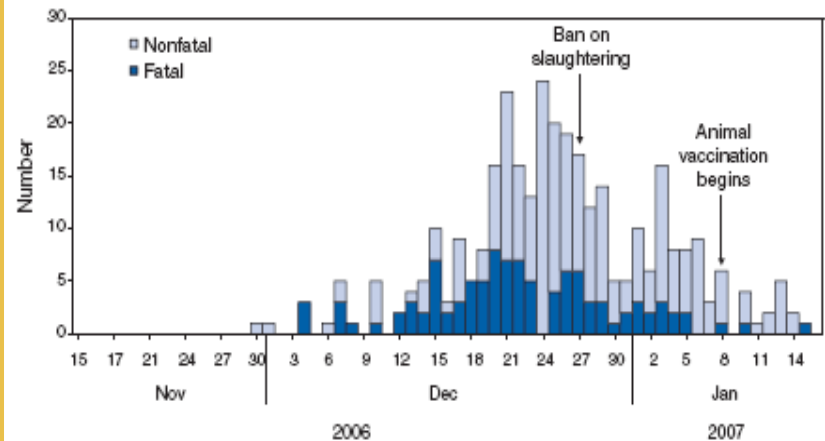
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East Africa Outbreak 2006-2007

- Began in Kenya
- Spread to U.R. Tanzania and Somalia
- By May 2007
 - Over 1000 human cases
 - 300 deaths
 - Case-fatality 23-45%

FIGURE 3. Number of reported Rift Valley fever cases (n = 330), by date of illness onset — Kenya November 2006–January 2007*



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Lessons learnt from 2007 Kenya Outbreak

Severe socio-economic consequences as a result of:

- Delayed detection and response
- Lack of emergency plans,
- Poor risk communication and inadequate information flow
- Inadequate collaboration between the sectors
- Lack of emergency fund
- Control of RVF in the livestock sector is most effective
- Improved cooperation between health and livestock sectors is critical



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Climate Indicators for RVF

- Correlation between RVF outbreaks, rainfall and Indian Ocean sea surface temperatures
- RVF outbreak prediction models use remotely-sensed environmental indicators
- Dec 2006: high RVF risk was predicted for eastern Africa, - outbreaks occurred
- Dec 2007: high risk predicted for s/ Africa, RVF outbreaks occurred in Madagascar
- Nov 2008: alert for east Africa, but no outbreak



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Controlling RVF in animals

Most effective method:

- Vaccination (prior to outbreak only)
- Surveillance essential
- Animal movement restrictions
- Destocking during drought (prior to outbreak)
- Vector control is of limited value...



Lutherian World Federation



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Infection Control - Animal Husbandry

- Gloves and facial protection handling, dead, sick, or potentially infected stock
- Burial/ Burning of carcasses
- IEC/ BCC



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Infection Control In Health Care Settings

Theoretical risk of human to human transmission

- Hand/ Cough Hygiene
- PPE
- Cleaning and waste disposal
- WHO aid memoire on standard precautions



FAO South Sudan



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What are the key IEC messages you need to include in your prevention programme?

5 minutes



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IEC BCC Messages

- Public health messages for risk reduction should focus on:
- Appropriate protective clothing should be worn and care taken when handling sick animals or their tissues or when slaughtering animals.
- No meat, blood or milk from infected animals can be touched or consumed.
- Use mosquito reduction methods as much as possible
Larviciding, LLINs, IRS and repellents



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