VETERINARY PREVENTIVE MEDICINE

COURSE NO: VETM-5233

CONTENTS

1. Vector-Borne diseases

RVF, Rabies, AHS

2. Soil-Borne diseases

Anthrax, Clostridial Diseases

3. Contact diseases

TB, PPR, FMD, Mycoplasmosis, Brucellosis

VECTOR-BORNE DISEASES

OBJECTIVES

At the end of this chapter the students will be able to:

- Describe what is meant by **TAD**, **EID** and **Re-EID**?
- Know factors for emergence and re-emergence of infectious diseases
- Understand the **methods of VBD transmission**
- Recognize the **methods used for the prevention and control of VBD**

BRAINSTORMING

- What is meant by **TAD**, **EID** and **Re-EID**?
- Mention **possible factors for the Emergence** and **Re-emergence** of infectious diseases?
- What is meant by **VBD**?
- Mention some possible **methods of transmission** for RVF, Rabies and AHS?
- Mention the **possible prevention and control measures** for the aforementioned diseases?

INTRODUCTION

What is TADs?

- TADs are those diseases that are of ***significant economic***, ***trade*** and/or ***food security importance*** for a **considerable number of countries**; which can **easily spread to other countries** and **reach epidemic proportions**; and where **control/management**, including **exclusion**, requires ***cooperation between several countries***.

E.g. FMD, RP, CBPP, RVF, PPR, ASF, NCD and HPAI

Emerging Infectious Diseases

- **Emerging infectious disease** is caused by a ***newly discovered infectious agent*** or by a ***newly identified variant of a known pathogen***, which has emerged and whose incidence in humans or animals has increased during the last two decades and is threatening to increase in the near future.

E.g. COVID19, HIV/AIDS, SARS and H5N1 influenza

Re-emerging infectious diseases

- Are those that have been **around for decades or centuries**, but have ***come back in a different form*** or a ***different location,*** or ***expands its host range***.

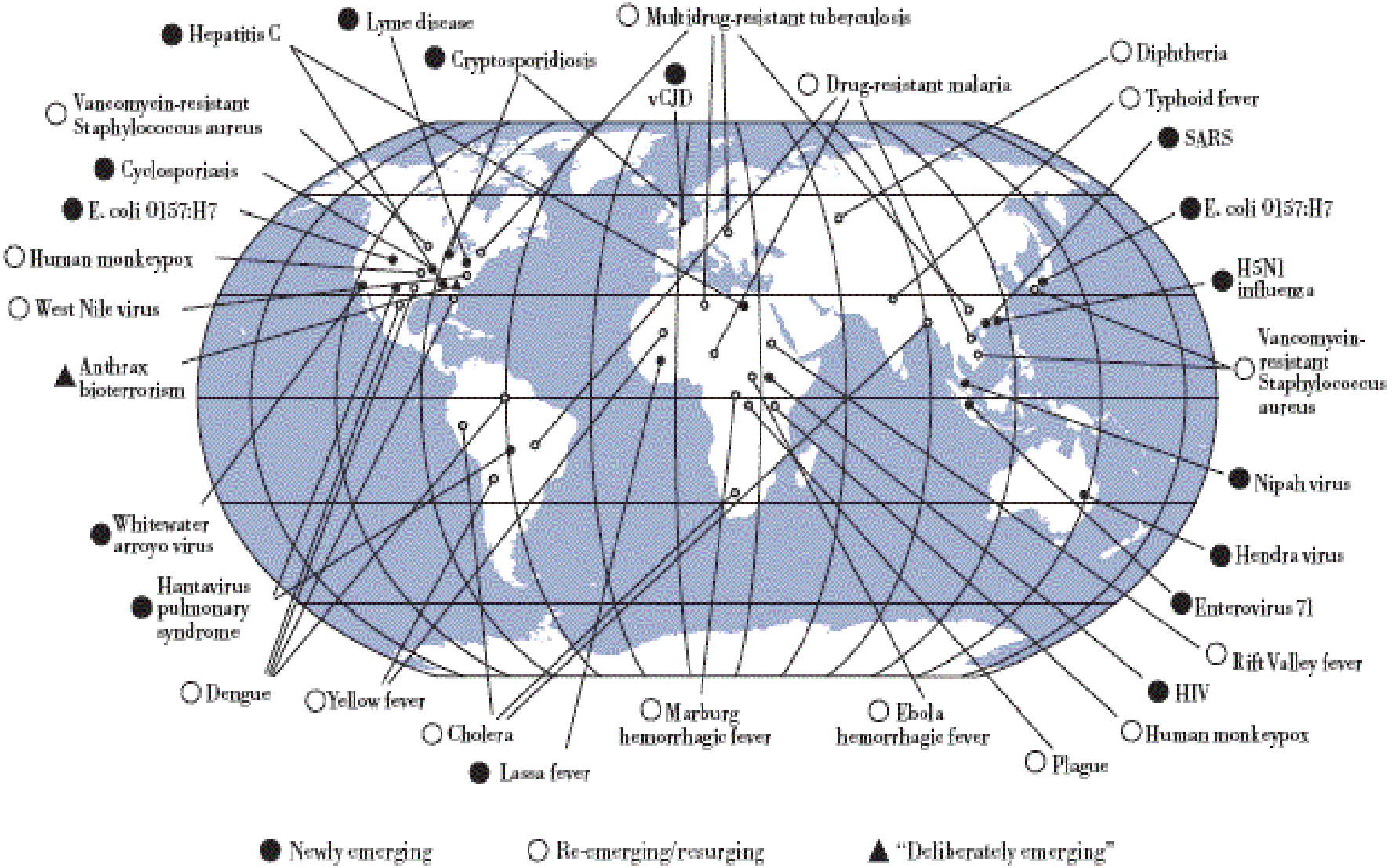
- A **re-emerging infectious disease** is a one which was previously controlled but once again has risen to be a significant health problem.

E.g. West Nile virus, Ebola, Monkey pox and Dengue

- **Deliberately emerging diseases** are those that are ***intentionally introduced***.

- These are agents of ***bioterror***, the most recent and important example of which is **anthrax**.

Global examples of emerging and re-emerging infectious diseases



Geographic origin of EID events from 1940-2004

75% of the EID are zoonotic

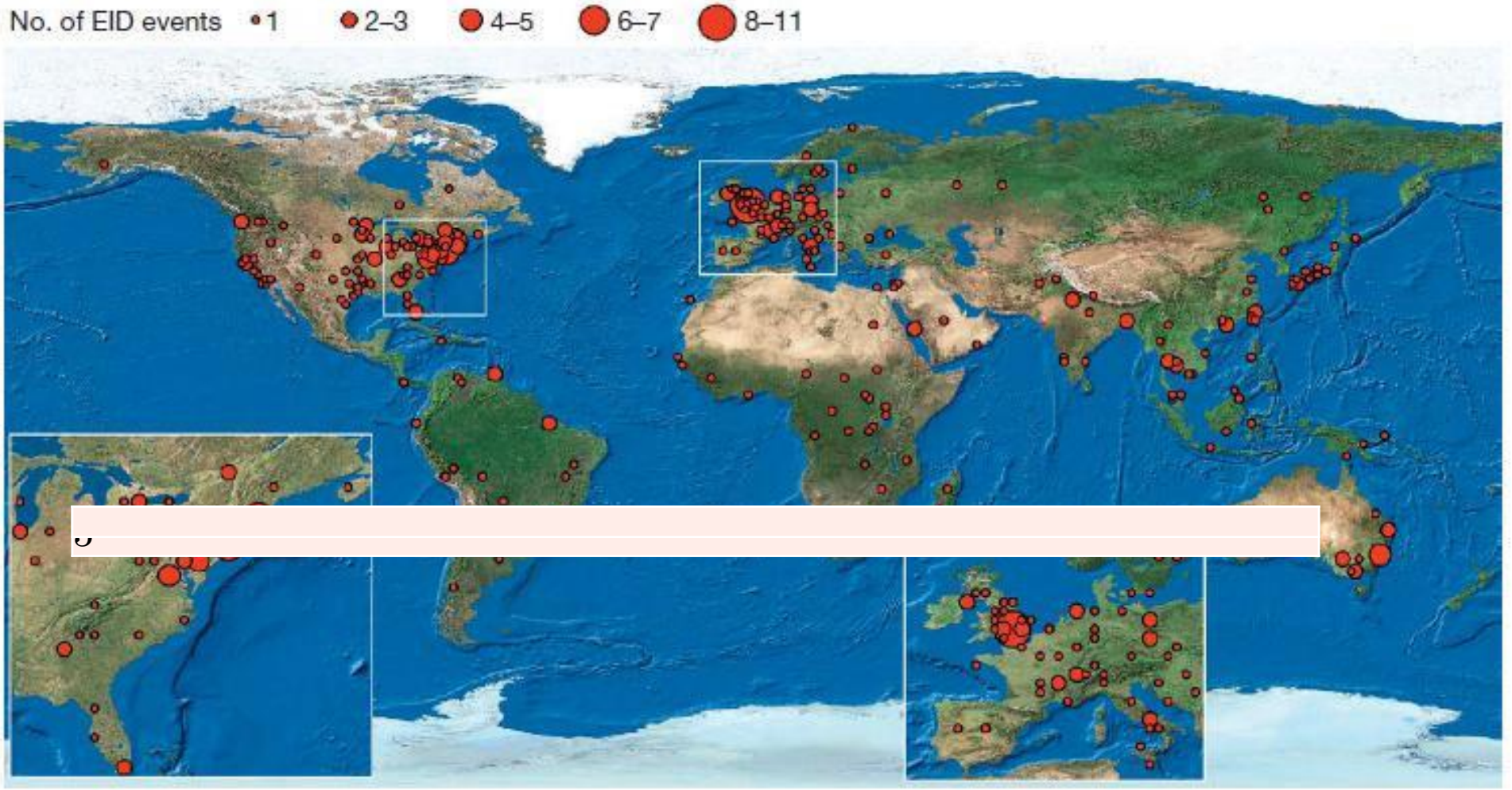
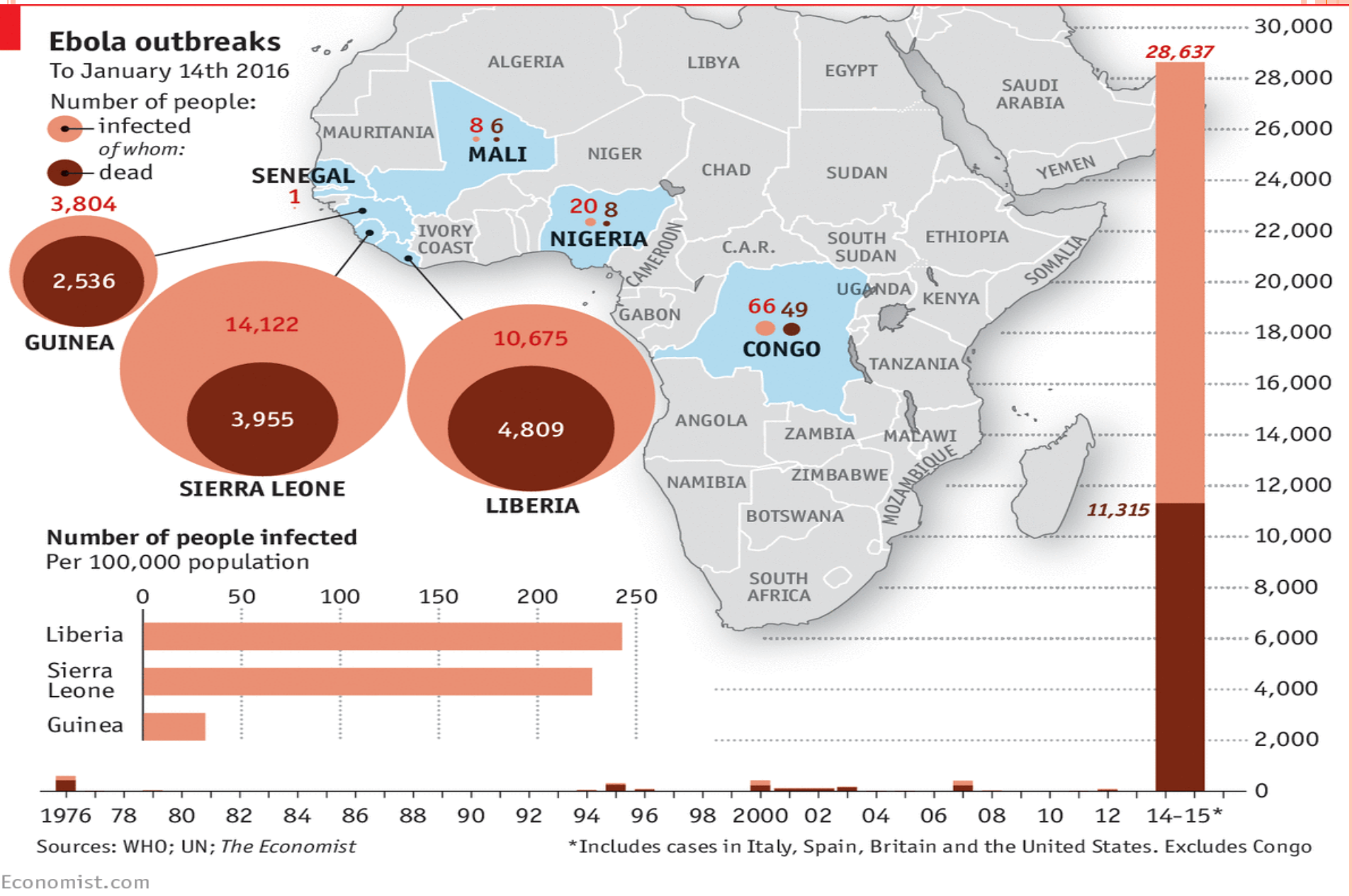


Figure 2 | Global richness map of the geographic origins of EID events from 1940 to 2004. The map is derived for EID events caused by all pathogen types. Circles represent one degree grid cells, and the area of the circle is proportional to the number of events in the cell.

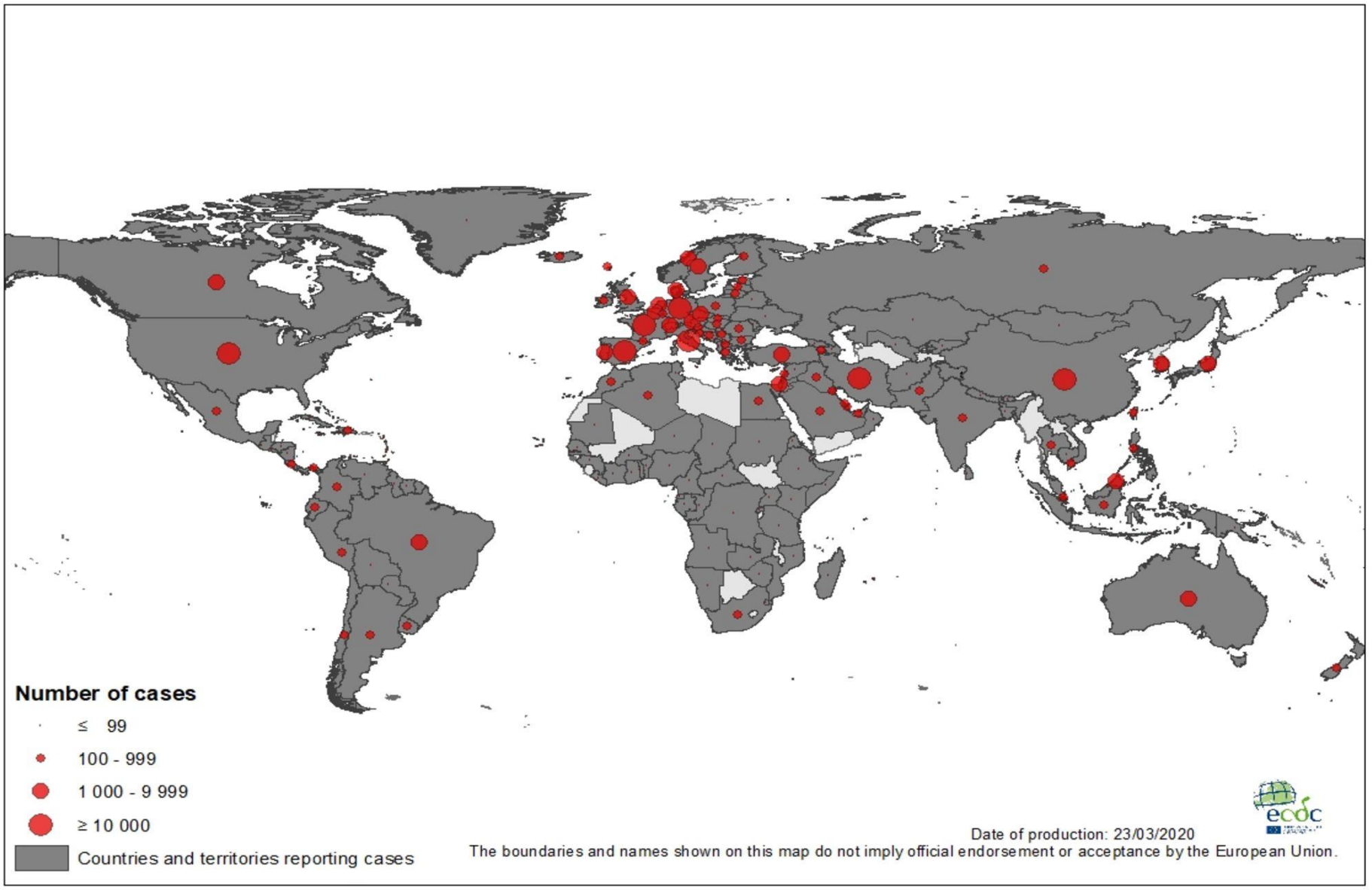
Jones *et al.*, 2008, Nature 451: 990-994

EBOLA IN AFRICA: THE END OF A TRAGEDY?

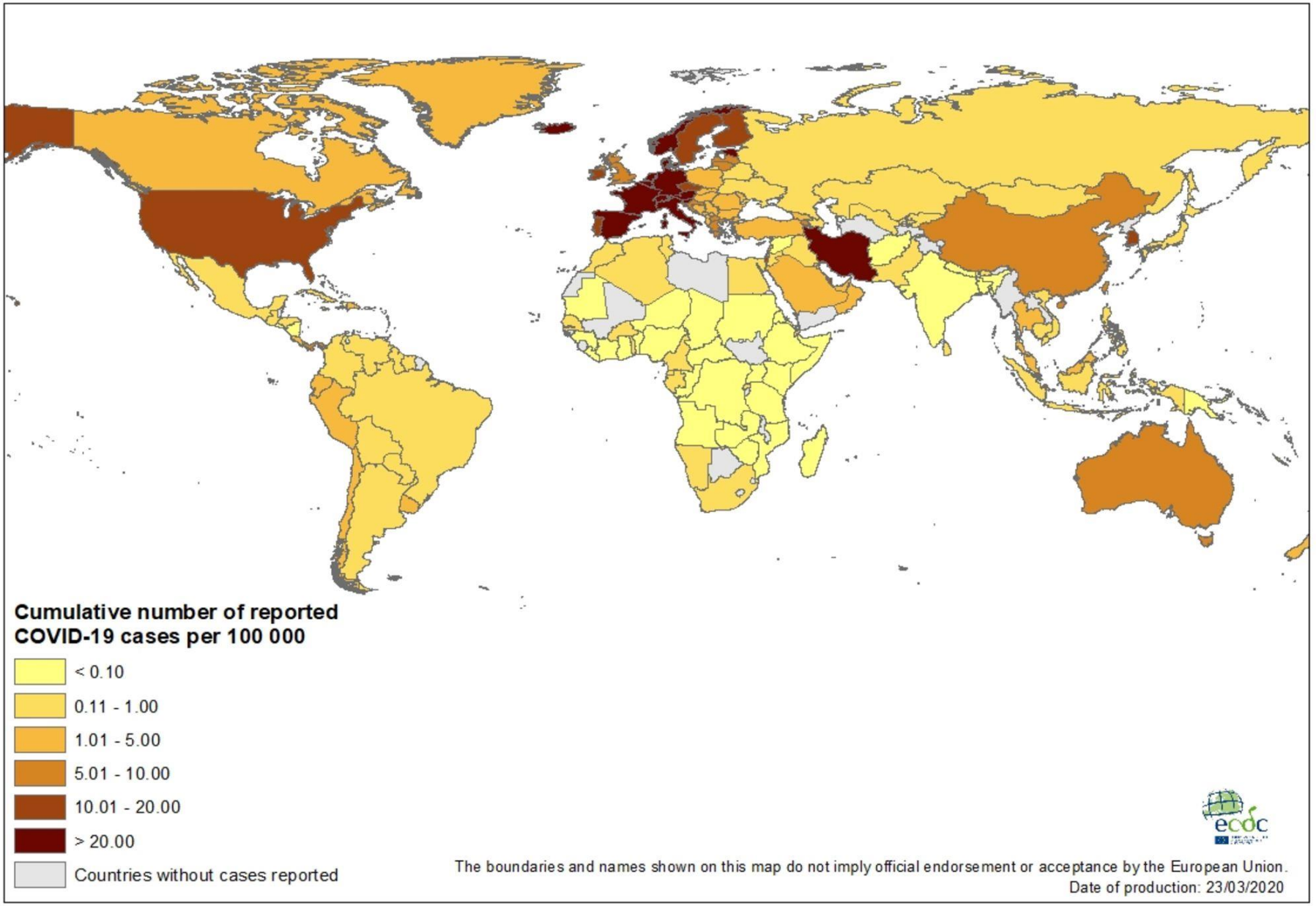


http://www.economist.com/blogs/graphicdetail/2016/01/daily-chart-12

Number of cases of COVID 19 reported in the world, March 23



COVID 19 cases per 100,000 population



Factors for the emergence and re-emergence of infectious diseases:

- Ecological changes (Dams, Agriculture, Irrigations..)
- Human demographics behavior (Population growth and migration, sexual behavior, civil conflict….)
- International travel commerce (Air travel, World wide movement of goods and people..)

- Technology and industry (Globalization of food supplies, wide spread use of antibiotics..)
- Microbial adaptation and change (Microbial evolution..)
- Breakdown in public health measures (Reduction in prevention programs…)

1.1 Rift valley fever

- **Importance**
  - A **zoonotic**, an ***emerging***, **mosquito–borne viral disease** important in domestic ruminants
  - Characterized by ***high mortality rates in young animals*** and ***abortions in pregnant*** ruminants
  - Animal **movement** and **trade restrictions** during epidemics.
- **Etiology**
  - **Family**- *Bunyaviridae*, **Genus**- *Phlebovirus*,
  - RVFV is very susceptible to acidic pH

RVF: EPIDEMIOLOGY

Susceptible species

- Sheep, goats, cattle, goats and camels are the domestic animal species most affected by RVFV
- Humans are also highly susceptible to RVFV infection
- There is also considerable difference in susceptibility amongst different breeds of animal hosts
- The indigenous domestic ruminants in tropical and subtropical zones of Africa are believed to be fairly resistant to RVF

RVF: EPIDEMIOLOGY…..

Transmission

- Transmitted to animals via bites from different species of infected mosquito during inter-epizootic periods
- ***Aedes*** and ***Culex*** mosquitoes are considered as the most important maintenance host for RVFV
- Trans-ovarian transmission in the vector

- Infected eggs lie dormant for years until flooding occurs (In dried mud)
- Outbreaks occur irregularly at 5 to 15 year intervals or longer in drier areas
- Epizootic outbreaks linked with unusual rains or warm seasons favoring the hatching of infected Aedes eggs that are then able to initiate the virus circulation

RVF: EPIDEMIOLOGY…..

Most human infections are occurred:

- Direct or indirect contact with body fluids such as blood, fetal membrane of infected animals
- Through aerosol during the handling of infected animal tissues
- Fresh and raw meat may be a source of infection

- In east Africa, RVF outbreaks are known to be closely associated with heavy rainfall events (Dam construction).

- Modification in the ecological and/or environmental conditions appeared to be responsible for the emergence of the virus

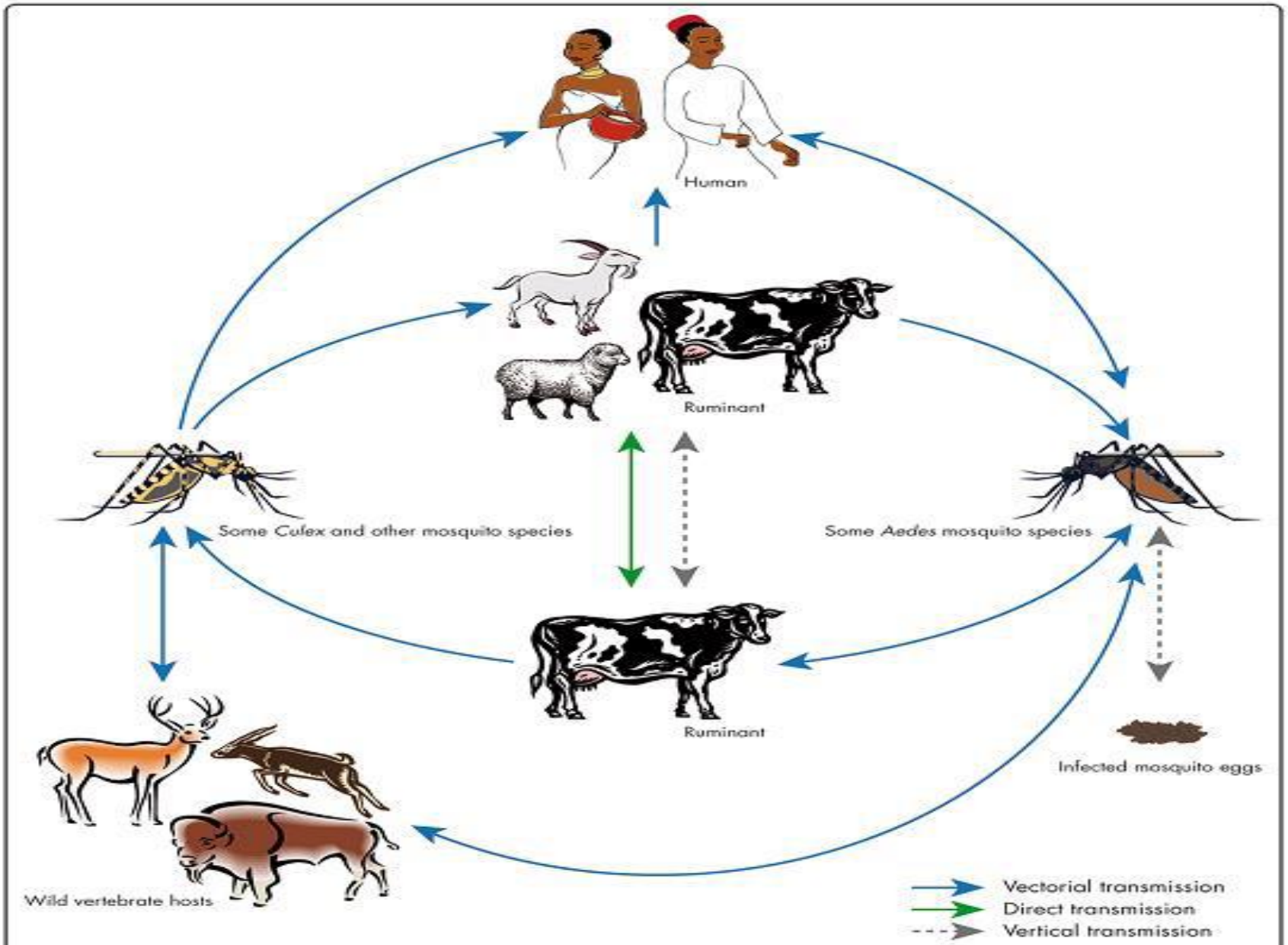
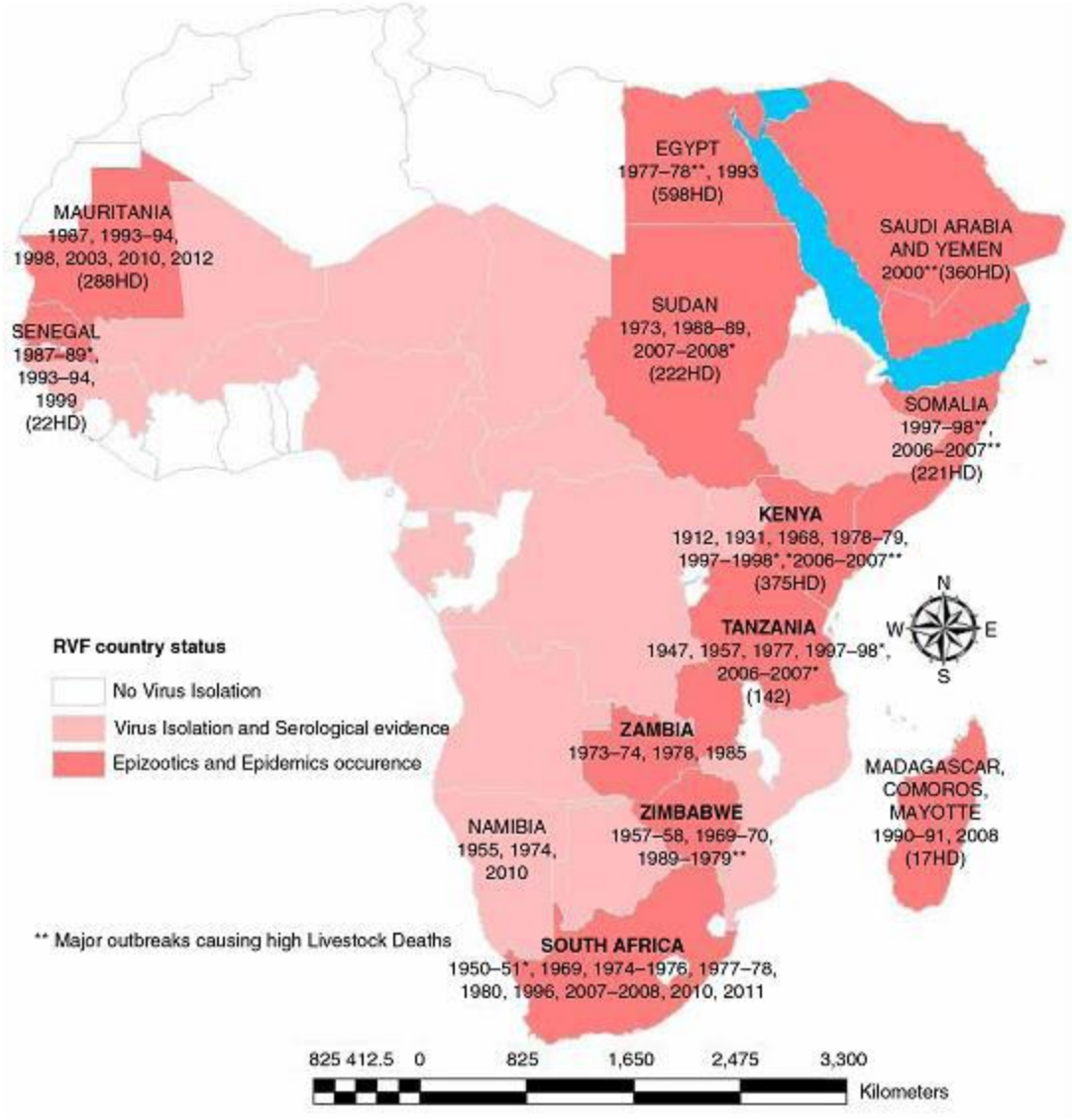


Figure 2 Cycle of Rift Valley fever. The virus can be maintained in an enzootic cycle involving *Aedes* mosquitoes which are able to transmit the virus vertically to their offspring. Epizootic outbreaks are often linked with unusual rains or warm seasons, favoring the hatching of infected *Aedes* eggs that are then able to initiate the virus circulation. Subsequently, large numbers of secondary vectors belonging to the *Culex* genus could be infected and induce the emergence of epidemic/epizootic outbreaks. Transmission to humans occurs through direct contact with high virus loads when aborted fetuses are manipulated.

Geographical distribution

- RVF is found in most of African & endemic in southeastern Africa
- First reported in 1931 in sheep in the **Rift Valley of Kenya**
- Since then, outbreaks occurred in 1977 in Egypt (major epidemic)
  - In 1997-98 in Kenya, Somalia and Tanzania
  - In 2000 RVF cases confirmed in Saudi Arabia and Yemen
  - In 2007 in Kenya, Tanzania and Somalia

RVF DISTRIBUTION, OUTBREAK AND SPREAD



RVF: EPIDEMIOLOGY…..

- In Ethiopia cases of disease in livestock have never been officially reported and detected

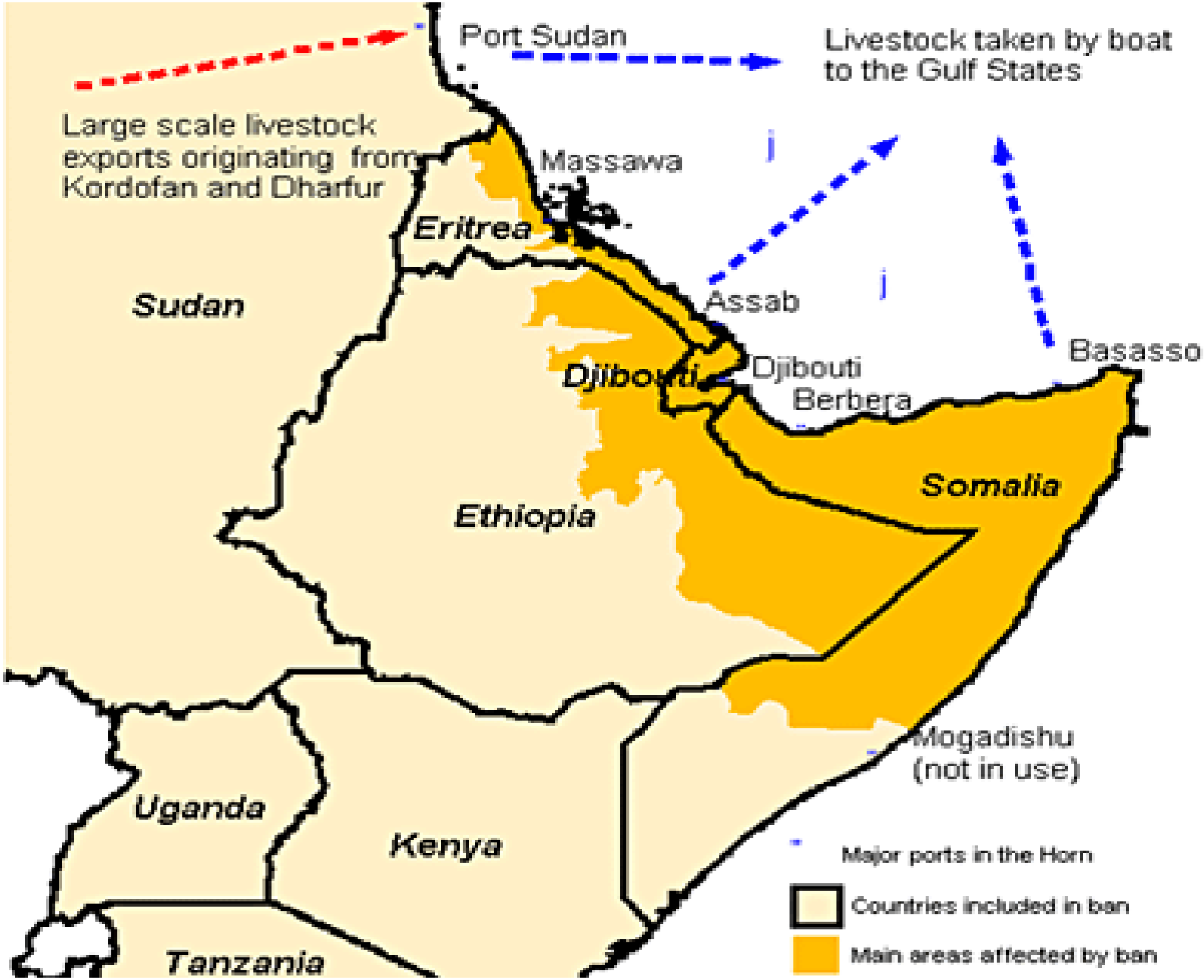
- Ethiopia will always be vulnerable to clinical RVF during the epizootic periods of the disease in the Horn of Africa region:

  - The geographical proximity of the country to RVF endemic countries such as Kenya, Sudan and Somali.

  - The nature of livestock movement across the international boarders

  - The ease with which infected mosquitoes can be moved longer distances by the help of wind

RVF AFFECTED AREAS AND BAN COUNTRIES



RVF: CLINICAL SIGNS

- Clinical manifestation vary depending on age
- Very young lambs, calves and kids are highly susceptible to infection with RVFV
  - The mortality rate is 90 – 100% in lambs and kids, and 10 – 70% in calves
- **In young:** the first sign may be sudden rise of body temperature (41-42 ºC), followed by collapse and death within 36 hrs.
- **In adult:** high temperature, salivation, anorexia, general weakness, rapid decrease in lactation and abortion.

RVF: PREVENTION AND CONTROL

- **Animal vaccination**

  - Live-attenuated (smith burn vaccine)
    - ✓ Produce better immunity- 3 yrs
    - ✓ Abortions & birth defects in pregnant animals

  - Inactivated vaccines (virulent field origin strain)
    - ✓ Safe & effective
    - ✓ Two doses (short term immunity)

- **Vector controls** (larvicidal treatment of breeding habitat, insect repellent on animals and mosquito netting).
- Movement of stock to higher altitudes
- Keeping of young stock in insect-proof stables

RVF CONTINGENCY AND PREPAREDNESS PLAN FOR ETHIOPIA

Early warning planning

- Aims to rapidly detect the existence of RVF viral activity in an area
- By monitoring climatic data, active disease search, serological survey, vector survey and public awareness programs

Early reaction planning

- Aims to minimize the socio-economic and public health impacts of the disease
- The first thing is define the area(s) that are likely to become infected (flood areas, vector distribution)
- Quarantine and movement control
- Disease prevention and control activities
  - Notify local administrators, farmers and other stakeholders about the situation

RVF CONTINGENCY AND PREPAREDNESS…..

- Culling of infected animals
- Treatment of products and by-products
  - Milk from the infected zone must be pasteurized before consumption
- Disposal of carcass and infected materials
- Decontamination
  - RVFV is susceptible to acid pH a
- Vaccination
- Vector control

1.2. RABIES

- **The disease**

  - Rabies is **an acute viral encephalomyelitis** that principally affects ***carnivores*** and ***bats***, although it can affect any mammal.

  - It is almost **invariably fatal** once clinical signs appeared.

- It founds through out the world, but few countries claim to be free of the disease due to:
  - Successful elimination programs and/or to their island status
  - Enforcement of rigorous quarantine regulations

❖ Canine rabies predominates in Africa, Asia, Latin America and the Middle East.

❖ Rabies has a ***public health significance*** as well as **agricultural** and **economic significance**

- Loss of livestock: **costs millions dollars annually** throughout the world

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Incidence and economic impact of rabies in the cattle population of Ethiopia

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ABSTRACT

Rabies is a viral disease that can cause fatal encephalomyelitis both in animals and humans. Although incidences of the disease in cattle have been reported, insight in the economic impact of the disease in livestock remains limited. By affecting cattle in subsistence systems, rabies may have extensive economic impacts at household and country levels, in addition to the effects on human health. This study presents estimates of the direct economic impact of rabies at herd level in two representative subsistence cattle-farming systems in Ethiopia, the mixed crop-livestock and pastoral production systems. The economic impacts were assessed by a structured questionnaire administered to 532 cattle-owning households. These households were selected from four districts within two administrative zones; each zone representing a cattle production system. Rabies incidence rates of 21% and 11% at herd level were calculated for the mixed crop-livestock and pastoral production systems, respectively. The incidence rate at cattle level was the same in both systems., i.e. 2%. Herd-level incidence rates were higher in the mixed crop-livestock system than in the pastoral system ($P < 0.05$). Average economic losses per herd due to rabies were estimated at 49 USD per year for the mixed-crop livestock system, and at 52 USD per year for the pastoral system; whereas in affected herds the average losses per year were 228 USD (range 48–1016 USD) in the mixed crop-livestock system, and 477 USD (range 173–1140 USD) in the pastoral system. The average herd-level economic losses were not significantly different between the farming systems;

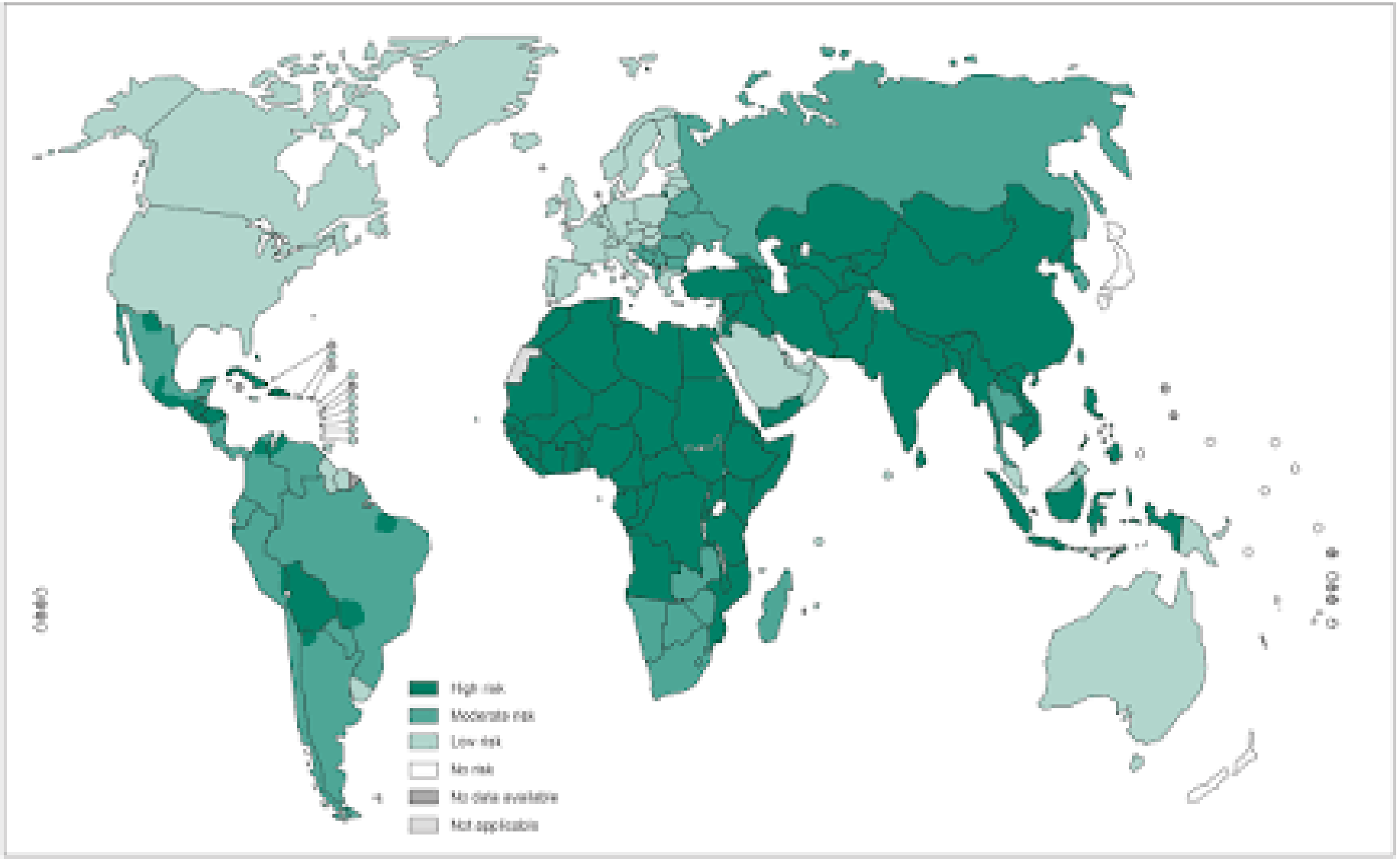
Rabies: Zoonotic implications

- The **prime importance of rabies** is its **transmissibility to humans**, with **veterinarians being at special risk**

- Human rabies is extremely rare in countries where canine rabies is controlled by regular vaccination

- **According to the WHO:**
  - Rabies occurs in more than 150 countries and territories
  - More than 60,000 die of rabies every year worldwide,
  - About 56% of which occur in Asia and 44% in Africa, particularly in rural areas on both continents.
  - 40% of people who are bitten by suspect rabid animals are children under 15 years of age
  - Dogs are the source of 99% of human rabies deaths.

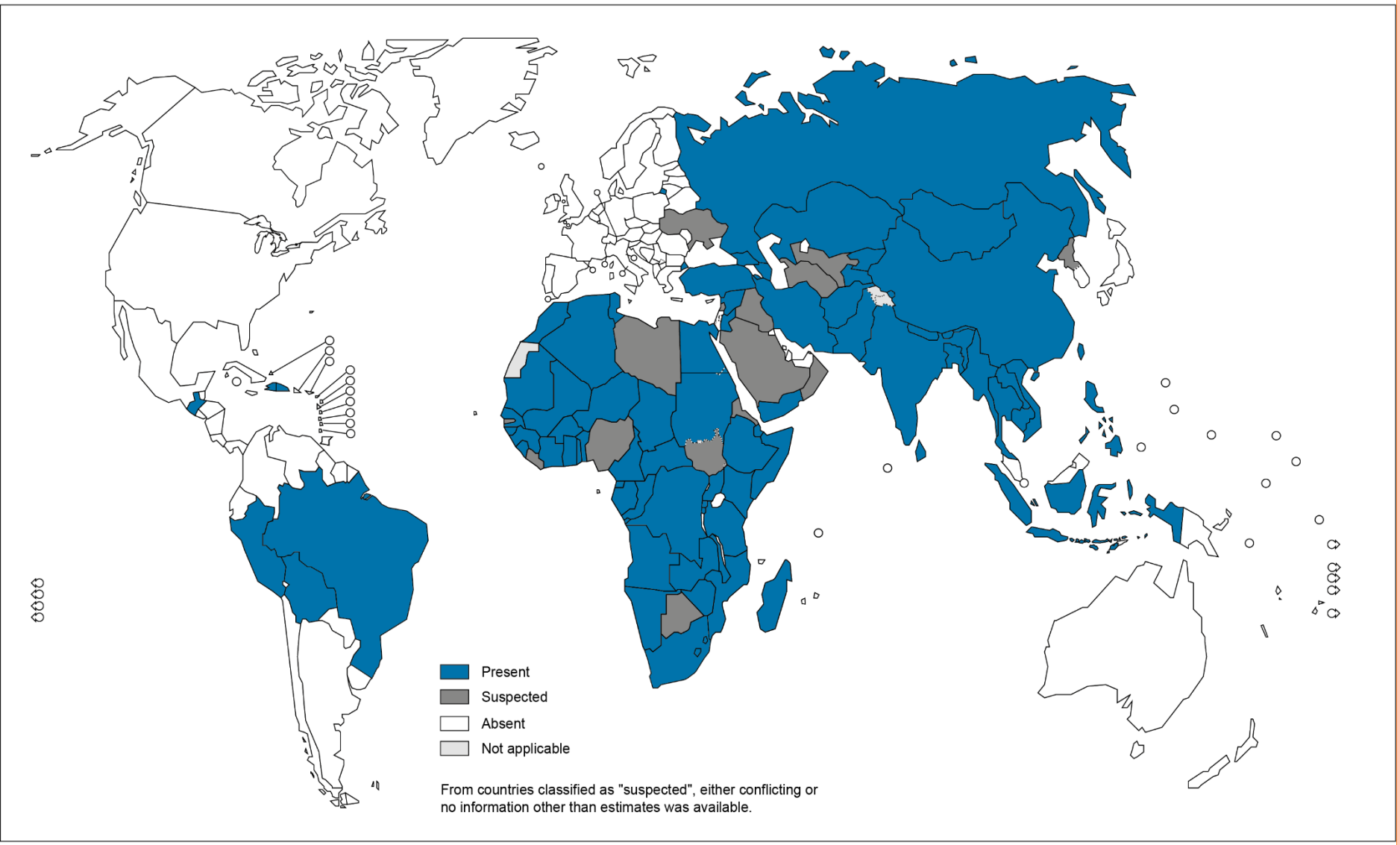
Distribution of risk levels for humans contacting rabies, worldwide, 2013



Data Source: World Health Organization
Map Production: Control of Neglected Tropical Diseases (NTD)
World Health Organization

World Health Organization

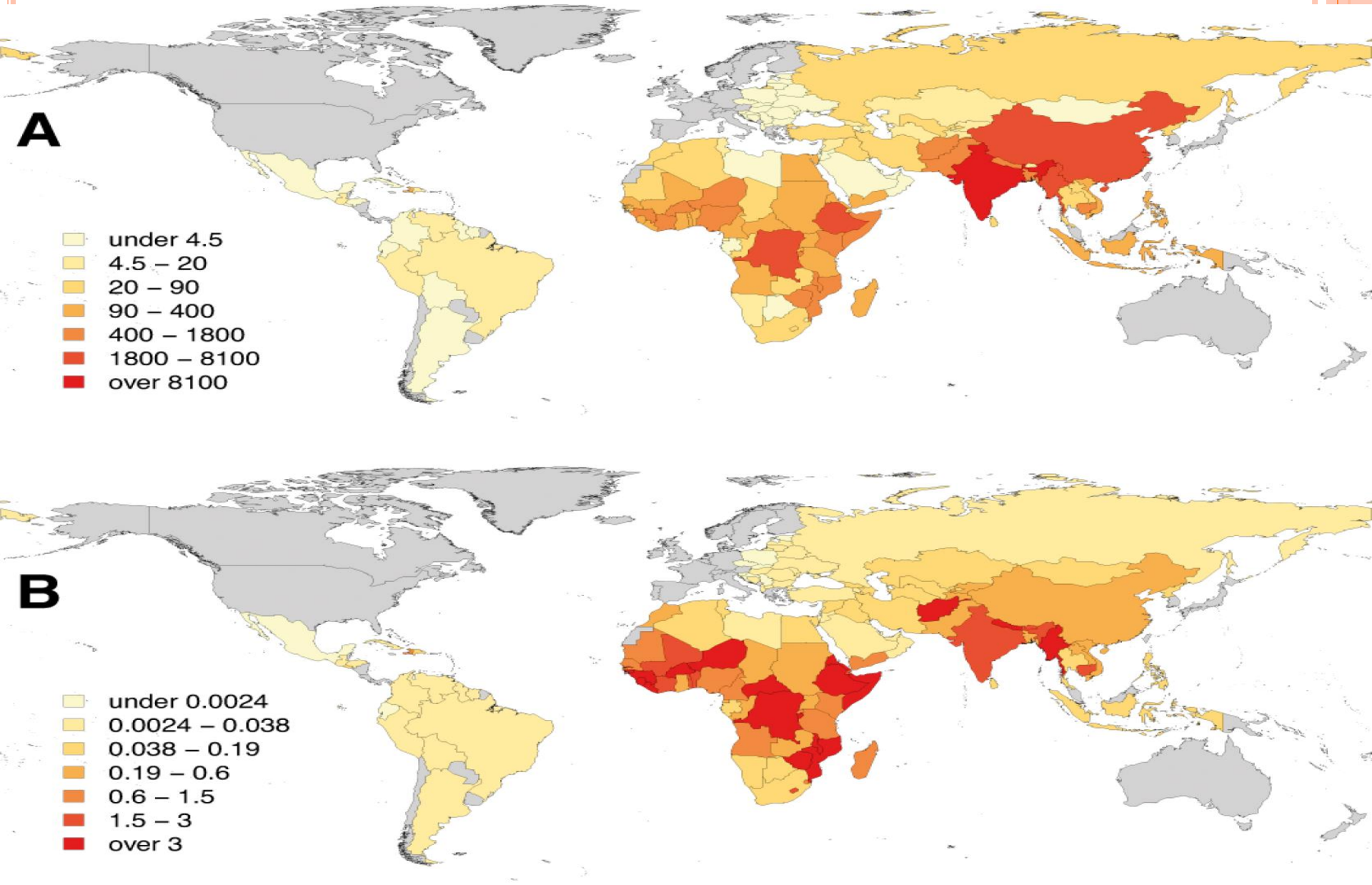
Presence of dog-transmitted human rabies based on most recent data points from different sources, 2010-2014



Data Source: World Health Organization
Map Production: Control of Neglected Tropical Diseases (NTD)
World Health Organization

World Health Organization

PRESENCE DOG MEDIATED HUMAN RABIES 2017



- An estimated 21,476 human deaths occur each year in Africa due to dog-mediated rabies.
- Africa is estimated to spend the least on PEP and have the highest cost of human mortality.
- With improved access to PEP and reduced prevalence of dog-mediated rabies, a significant number of lives could be saved (WHO, 2019).

Rabies in Ethiopia

- Each year, thousands of people are infected with rabies in Ethiopia and
- An estimated 2,700 people die, one of the highest rabies death rates in the world,
- Meanwhile, the true number of deaths caused by rabies is unknown because:
  - The disease is underreported and
  - Rabies diagnostic laboratories are not established (CDC, 2019)

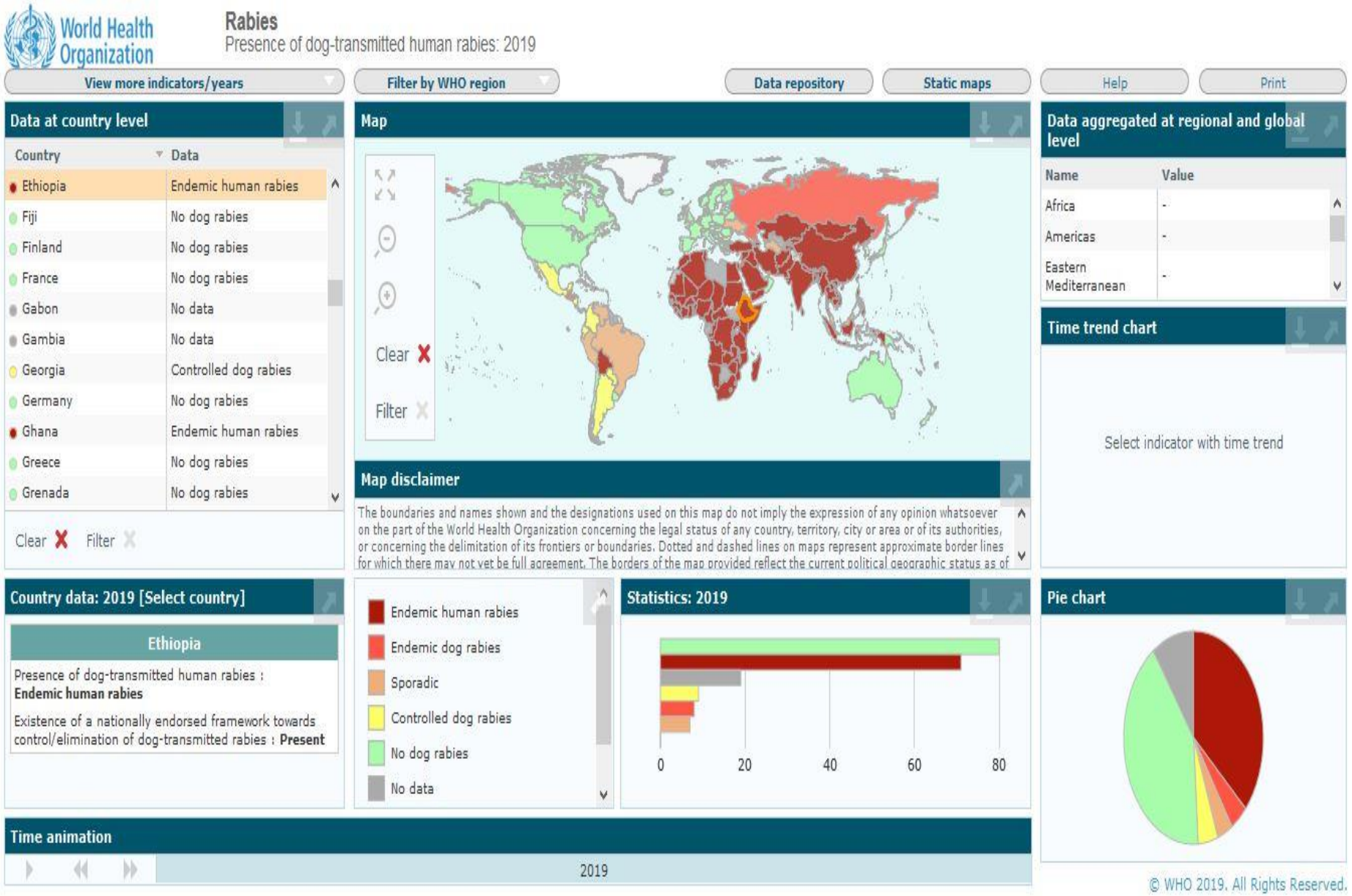
- The human risk for rabies is directly linked to the high rate in dogs

- The rabies vaccination coverage among dogs is very low in Ethiopia, far below the 70 percent needed to halt the transmission of canine rabies.

- This is partly due to lack of awareness about rabies vaccination among dog owners and high number of stray dogs in the country.

- The total number of animal rabies cases in Ethiopia is unknown, but with a rural and farming population of more than 80%, annual livestock losses caused by rabies place a large societal and economic burden on the country.

WHO REPORT ON HUMAN RABIES



	Reported number of human rabies deaths[i]							
Country	2017	2016	2015	2014	2013	2012	2011	2010
Equatorial Guinea	No data	No data	No data	No data	No data	No data	No data	No data
Eritrea	No data	No data	No data	No data	No data	No data	No data	No data
Estonia	0	0	0	0	0	0	0	0
Eswatini	0	0	0	No data	No data	No data	No data	No data
Ethiopia	17	24	15	No data	No data	No data	No data	No data
Fiji	No data	No data	No data	No data	No data	0	0	No data
Finland	0	0	0	0	0	0	0	0
France	1	0	0	0	0	0	0	0

Incidence of Rabies in Humans and Domestic Animals and People's Awareness in North Gondar Zone, Ethiopia

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Methodology/Principal Findings: The incidence of rabies in humans and domestic animals was prospectively followed up for one year period based on clinical observation. A questionnaire was also administered to 120 randomly selected dog owners and 5 traditional healers to assess the knowledge and practices about the disease. We found an annual estimated rabies incidence of 2.33 cases per 100,000 in humans, 412.83 cases per 100,000 in dogs, 19.89 cases per 100,000 in cattle, 67.68 cases per 100,000 in equines, and 14.45 cases per 100,000 in goats. Dog bite was the source of infection for all fatal rabies cases. Ninety eight percent of the questionnaire respondents were familiar with rabies and mentioned dog bite as a means of transmission. But discordant with current scientific knowledge, 84% and 32% of the respondents respectively mentioned any type of contact (irrespective of skin condition) with saliva, and inhalation as a means of transmission of rabies. Eighty four percent of the respondents relied on traditional healers for management of rabies.

Number of human and animal cases and death due to rabies in North Gondar

District	Species	Number exposed	Number died
Gondar town	Human	5	1
	Cattle	4	2
	Dog	1	1
Dabat	Human	27	2
	Cattle	10	5
	Horse	3	3
	Goat	3	2
	Dog	2	0
Total		**55**	**16**

❑ Etiology

- Virus of the family *Rhabdoviridae* and the genus *Lyssavirus*
- Virus sensitive to sunlight and ultraviolet radiation
- Vulnerable to disruption by detergents (soap solution)
- Acid disinfectants are best suited for decontamination
- Persist in infected brain tissue for up to 10 days at room temperature

Transmission

- Rabies virus affect all warm-blooded animals
- The source of infection is always an infected animals
- The method of spread is almost always by the bite of an infected animal

- Contamination of skin wounds by fresh saliva may also result in infection
- Saliva is usually infectious at the time of clinical sign
  - But it is possible for dogs and cats to shed the virus for several days before onset of clinical sign
- Inter-bat spread and spread from bats to other species is principally by bites
  - But infection by inhalation also occurs

Host range and susceptibility

- All mammals susceptible with a varying degree
- Rabies reservoir species are found among members of carnivores (dogs, foxes..) and bats
- Bats represent a serious threat of spread of rabies because of their migratory habits

- Domestic livestock like cattle are rarely a source of infection

- Spread of the rabies virus is often seasonal and, with the highest incidence in the late summer and autumn

  - Large scale movement of wild animals at mating time and in pursuit of food

RABIES: DIAGNOSIS

- **Sampling for diagnosis**
  - Secretions and biological fluids (saliva, spinal fluid..)
  - Brain tissue the preferred specimen for PME
  - The hippocampus, medulla oblongata, cerebellum

- **Diagnosis techniques**
  - PCR (for detecting viral RNA)
  - Direct fluorescent antibody test (detecting viral antigen)
  - Antigenic capture ELISA
  - Rapid immunodiagnostic test

RABIES: PREVENTION AND CONTROL

- The most rational approach to reducing human rabies is to reduce the prevalence and incidence of disease in carnivores
- Notification of suspected cases and destruction of dogs with clinical signs and dog bitten by a suspected rabid animals
- Mass immunization of dogs by campaigns and by continuing vaccination of young dogs

- Elimination of stray dogs and cats
- Dog registration
- Imposition of quarantine on imported dogs
- **In farm animals:**
  - Prevention of exposure, Controlling access of wildlife
    - Vaccination of wild animals

- Pre-exposure vaccination
- Community education
- Pre-exposure immunization of all vets and rabies lab workers
- If humans are bitten by healthy dog (but suspected):
  - The suspected dog should be kept in strict quarantine for at least 2 wks.
  - Post-exposure vaccination of the exposed subject

1.3 African horse sickness

- **Importance**
  - A serious, often fatal, viral disease of horses and mules
  - Mortality rate:
    - 70-95 % in horses
    - 50-70% in mules

❑ Etiology

- AHSV belongs to the genus *Orbivirus* and family *Reoviridae*.
- There are 9 immunologically distinct serotypes
  - Serotype 9 is widespread in endemic regions
  - Serotypes 1 to 8 found only in limited geographical areas.

Isolation and Identification of Circulating Serotypes of African Horse Sickness Virus in Ethiopia

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Intern J Appl Res Vet Med • Vol. 3, No. 1, 2005

different disease patterns.[2] Of the nine serotypes identified, type 9 is predominantly found through out the African continent, and it is the only serotype previously identified in Ethiopia.

In 2002–2003 Ethiopia faced serious and repeated outbreaks of AHS in different regions, including southern, western, central, and northern Ethiopia. The outbreak affected horses vaccinated with monovalent vaccines containing type 9 AHSV (AHS Vaccine, National Veterinary Institute, Debre Zeit, Ethiopia). It is well documented that in spite of its wide distribution, serotype 9 of AHSV has a lower virulence than other serotypes, killing few horses in enzootic areas.[2,3] The outbreak encountered

September 2003. Six hundred and fifty (650) equines of different species (horse, donkey, mule) were examined. Viral specimens were collected from 12 acutely sick and moribund animals. Clinical and necropsy findings distinguished two forms of the disease: a peracute pulmonary form and a subacute cardiac form. Laboratory investigation of tissue and whole blood specimens collected from sick and moribund animals identified two different serotypes of AHS viruses: serotype 9 and serotype 6. The identification of serotype 6 represents the first report of this serotype in Ethiopia.

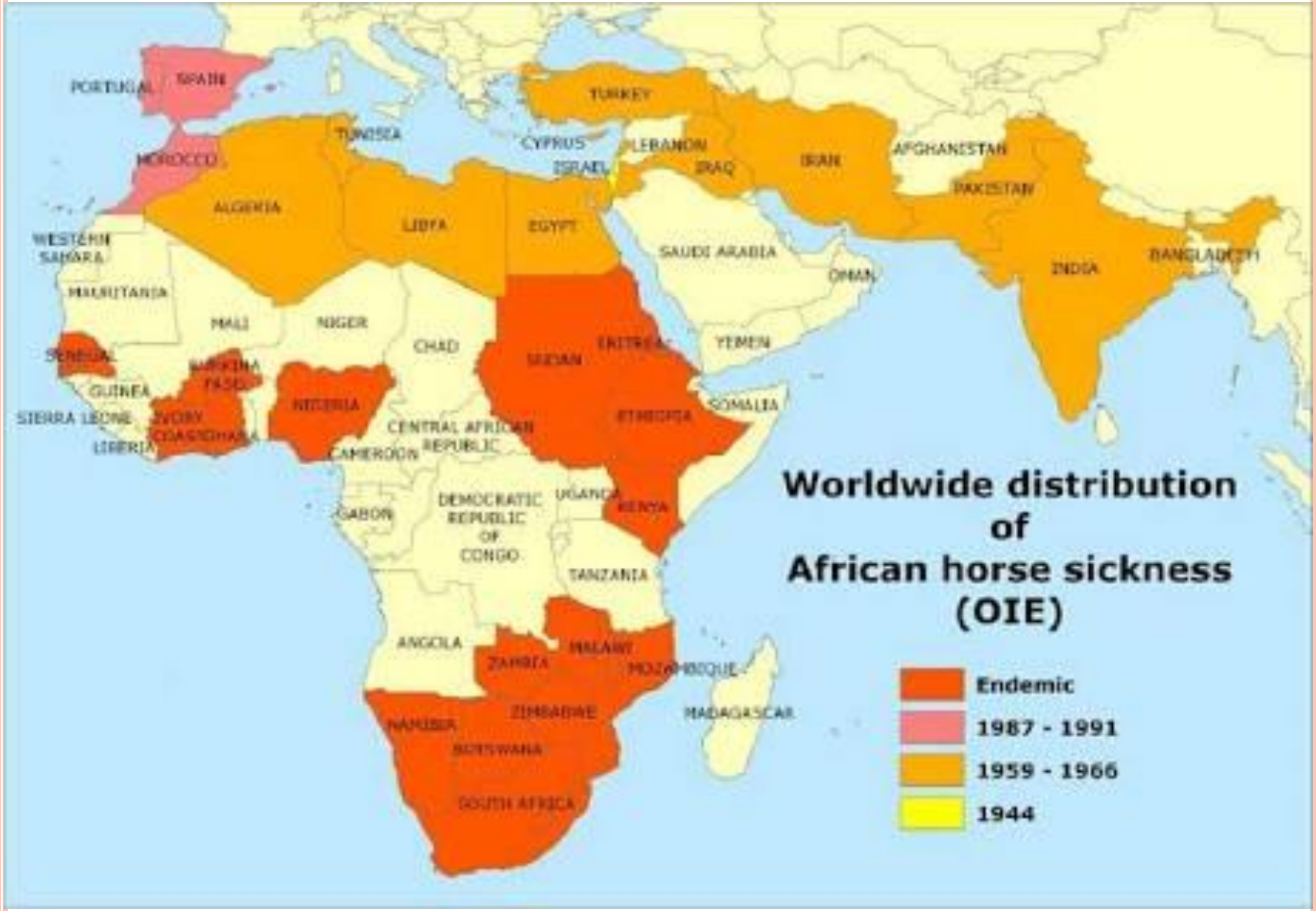
AHS: EPIDEMIOLOGY

- **Geographical distribution**
  - Endemic in sub-Saharan Central and East Africa
  - Sometimes in S. Africa and in N. Africa
  - Outside Africa: Outbreaks reported in the Middle East, Spain, Portugal, Pakistan and India
  - AHS is a very serious disease in Ethiopia
  - Ethiopia had a serious outbreaks in **2002–2003**

- **Species affected**
  - Horses, mules, donkeys, zebras, camels and dog
  - The most serious infections occur in horses and mules
  - Donkeys and zebras rarely develop serious clinical signs

- **Transmission:** Transmitted by midges in the genus *Culicoides*
  - ✓ Both *Culicoides imicola** and *C. bolitinos*

GEOGRAPHICAL DISTRIBUTION AHS



IJAVMS

Seroprevalence of African Horse Sickness at Central Highland of Ethiopia

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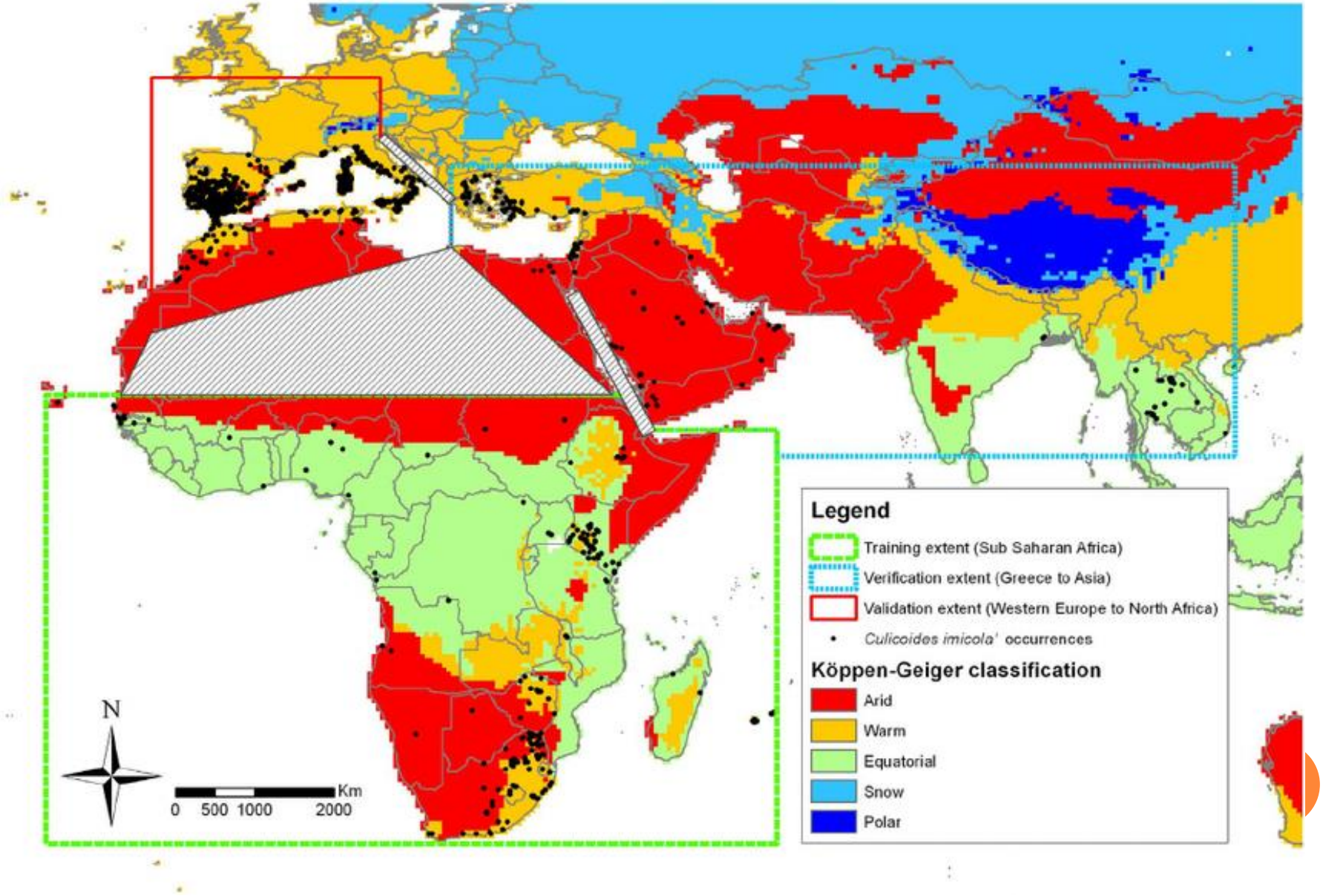
ABSTRACT

A cross-sectional study was undertaken to determine the seroprevalence of African Horse sickness virus (AHSV) antibodies and identify potential risk factors in equine population at selected areas of central high land of Ethiopia from November 2011 to April 2012. A total of 546 sera (506 horses, 18 mules and 22 donkeys) were collected randomly. Competitive Enzyme Linked Immuno Sorbent Assay (c-ELISA) configuration was employed to determine the presence of AHSV antibodies. The apparent prevalence of AHSV was found to be 46 % in horses,61.1 % in mules and 36.4 % in donkeys. The overall apparent seroprevalence of AHSV in three species equine was found to be 46.2 %. Statistical significant ($p<0.05$) difference in seroprevalence was observed at the different study areas confirming the existence of agro-ecology based variation in the occurrence of AHS. The highest seroprevalence of AHSV was documented

Distribution of *Culicoides imicola* and study area (Guichard, *et al.*, 2014, Plos one)



AHS: CLINICAL SIGNS

- **The pulmonary form:** The most serious
  - Characterized by fever, depression, severe respiratory distress and severe dyspnea, frothy nasal discharge, death
- **The cardiac form:** usually characterized by
  - Fever, edema of the head, neck, chest, and supraorbital fossae
  - Petechial hemorrhages in the eyes, on the tongue

- **The mixed form:**
  - Often the most common form
  - It is a combination of the cardiac and the pulmonary form
  - Also causes a high mortality rate, of app. 70%
  - Death usually occurring within 3 to 6 days after onset of fever

AHS: PREVENTION AND CONTROL

- Surviving Equidae develop solid immunity to the homologous serotype
- Vaccination
  - Live-attenuated multivalent vaccines in endemic regions; may not be safe in AHS-free countries
  - Inactivated vaccines: give two doses

- Vector control
- All Equidae should be stabled in insect-proof housing from dusk to down
- If AHS is detected in a country where it is not endemic:
  - A strict quarantine zone and movement controls should be established
  - Euthanasia of infected and exposed animals may be considered

Soil-borne diseases

OBJECTIVES

At the end of this chapter the students will be able to:

- Understand the **methods of SBD transmission**
- Know the **epidemiology of SBD**
- Recognize the **methods used for the prevention and control of SBD**

BRAINSTORMING

- What is meant by **SBD**?
- Mention some possible **methods of transmission** for **Anthrax** and **Clostridial** diseases?
- Mention the **possible prevention and control measures** for the aforementioned diseases?

2.1. ANTHRAX

- **Importance**
  - A serious zoonotic disease that can affect most mammals, but is particularly important in herbivores
  - In animals, the disease is characterized, in most instances, by sudden death

- **Etiology:** Caused by *Bacillus anthracis*
  - Exists in two forms: **Vegetative and Spore form**
  - Within an infected host, spores germinate to produce the vegetative forms which eventually kill the host
  - Anthrax spores are extremely resistant to disinfectants, heat and environmental factors.
    - Can remain viable for decades in the soil or animal products

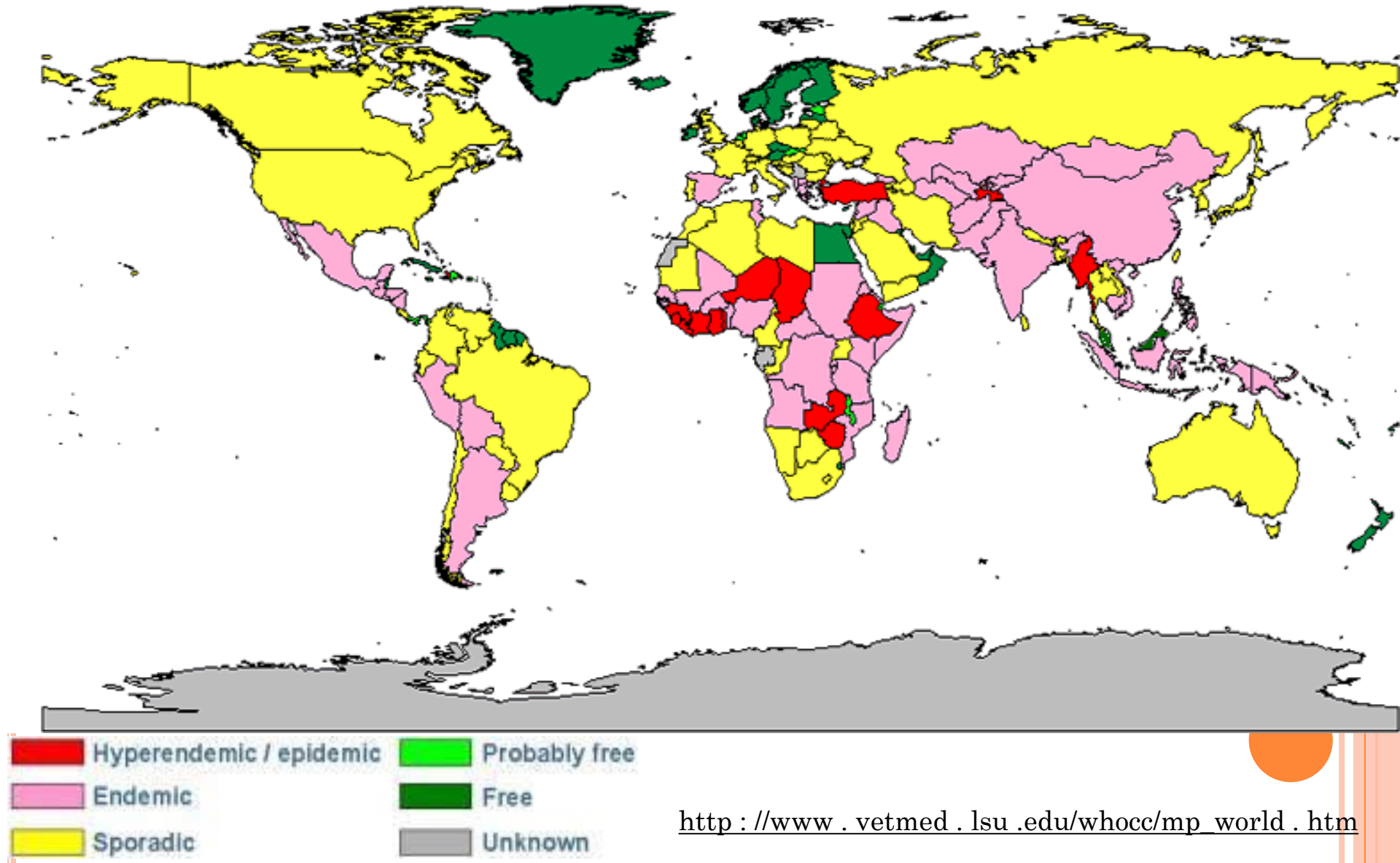
ANTHRAX: EPIDEMIOLOGY

Distribution

- Occurs worldwide specially in a warm environment
- Particularly common in parts of Africa, Asia and the Middle East
- Outbreaks occur in flooding and dry period

- **Species affected**
  - All mammals, as well as some birds and reptiles are susceptible
  - Primarily a disease of herbivores especially cattle, sheep and goats
  - Buffaloes and camels, equines are also susceptible
  - Nonexistent in poultry

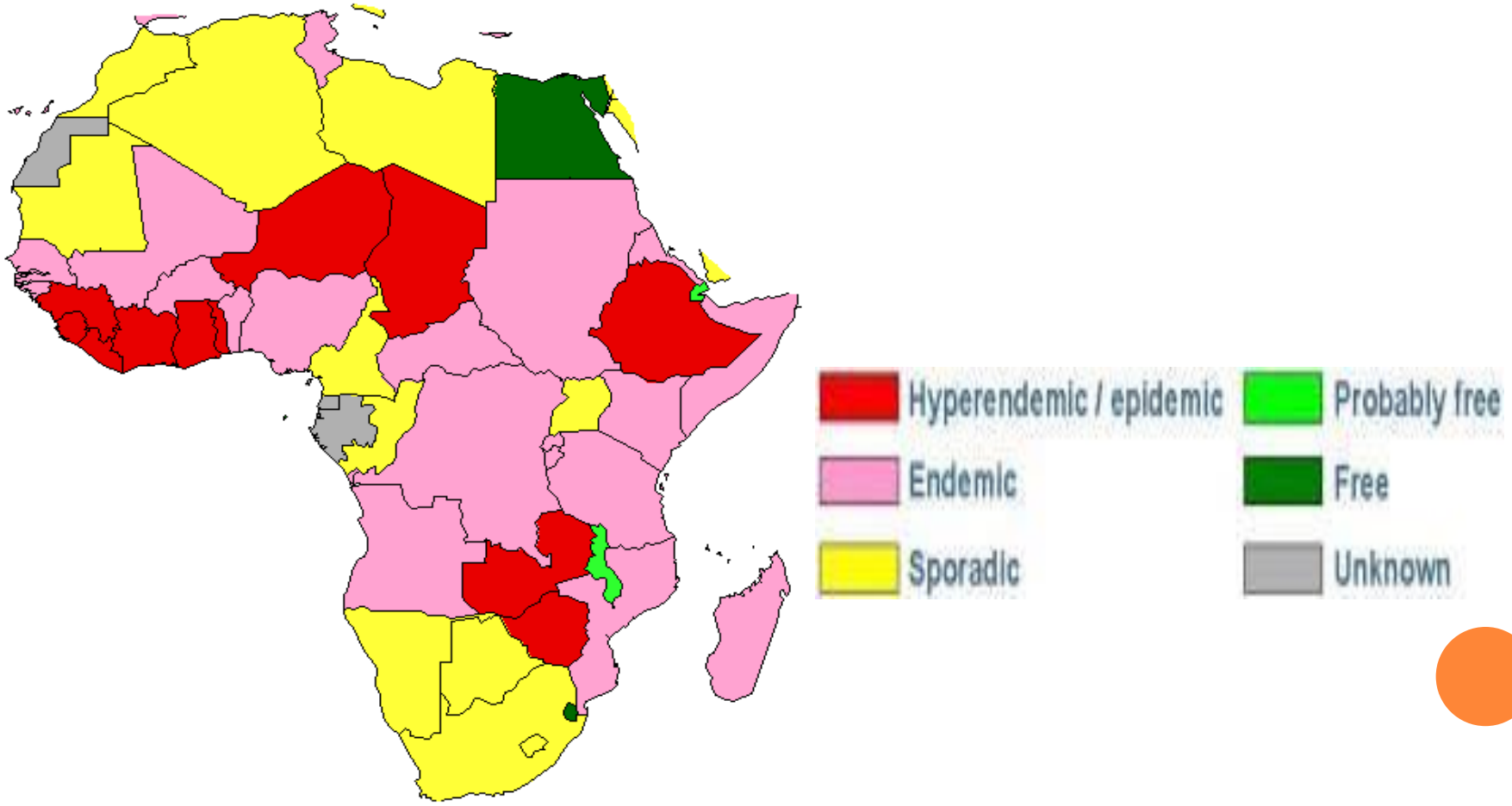
Geographical distribution of anthrax



http : //www . vetmed . lsu .edu/whocc/mp_world . htm

ANTHRAX IN AFRICA

- In Africa anthrax is wide spread and reported in most countries
- In Ethiopia, anthrax is hyperendemic/epidemic in most species of domestic animals and also cases have been reported in humans



Anthrax in Ethiopian livestock

- But very few studies at a national level

Vet Rec. 2002 Mar 9;150(10):318-20.

Anthrax outbreak in Mago National Park, southern Ethiopia.

Shiferaw F, Abditcho S, Gopilo A, Laurenson MK.

Source

Ethiopian Wildlife Conservation Organisation, Ministry of Agriculture, Addis Ababa.

PMID: 11913590

[PubMed - indexed for MEDLINE]

Rev. sci. tech. Off. int. Epiz., 2004, 23 (3), 951-956

Anthrax in Wabessa village in the Dessie Zuria district of Ethiopia

G. Shiferaw

Department of Microbiology, Kombolcha Regional Veterinary Laboratory, P.O. Box 9, Kombolcha, Ethiopia

Submitted for publication: 26 February 2004
Accepted for publication: 7 September 2004

Summary

In 2002 an investigation of sudden death in a goat in Wabessa village in the Dessie Zuria district of Ethiopia was undertaken using fresh blood brought to the Kombolcha Regional Veterinary Laboratory. The sample was examined using standard bacteriological techniques and animal pathogenicity tests were also performed. The laboratory investigation revealed *Bacillus anthracis* as the cause of sudden death. Information gathered from stockowners in the same village revealed other similar recent cases and deaths, both in animals and humans, with farmers clearly describing the clinical signs and necropsy findings of anthrax. The disease occurs annually in this area in May and June, and in the 2002 outbreak mortality rates of 7.7 %, 32.7 % and 47.1 % were observed in cattle, goats and donkeys, respectively. This study indicates that the community of this particular village neither knows of, nor practises, any of the conventional methods for anthrax control. The cutaneous form of the disease in humans and the environmental contamination associated with the practise of opening iscussed with reference to ewhere. Control strategies

Anthrax – Bacillus anthracis – Ethiopia – Goat – Outbreak.

Tropical and Geographical Medicine [1989, 41(2):108-112]

Seboxa T, Goldhagen J

Gondar College of Medical Sciences, Department of Internal Medicine, Ethiopia.

Anthrax in Ethiopia. PMID:2763354)

Abstract

Twenty-seven patients with cutaneous anthrax were identified over a three-year period at Gondar College of Medical Sciences in North Central Ethiopia. Nine patients who delayed seeking medical care presented with severe symptoms and three patients died. Eighteen patients were clustered within four families in which an attack rate of 32% occurred. Ninety-three percent of patients could trace their disease to exposure to the products of a specific diseased animal. Characteristics of anthrax in Ethiopia include a known exposure to diseased animals, occurrence within families, frequent treatment by local healers, and high morbidity and mortality.

Anthrax: transmissions

- Grazing animals become infected through ingestion of spores in the soil and possibly inhalation of spore
- Carnivores ingestion of contaminated meat
- Animal to animal or human to human transmission is rare (not contagious)

- Bacteria present in hemorrhagic exudate from mouth, nose, anus contaminate the environment

- Other source of contaminations

  - Biting flies
  - Vultures
  - Contaminated surface water pool

Anthrax: clinical signs

- Depends on the route of infection and host factors
- The anthrax bacillus produces a lethal toxin
- In very severe forms:
  - Cattle, sheep and goats
  - High fever, difficult breathing followed by convulsion, collapse and death.

- In dead animal or before death
  - ✓ Bloody discharges from body openings
  - ✓ Rigor mortis is often absent or incomplete
  - ✓ The blood is dark and thickened and fails to clot readily

- In less severe cases:
  - Some animals may survive for 1 week and others will recover
  - Dogs, humans, horses and pigs

Dead zebra with sign of anthrax

DECEASED ZEBRA WITH SIGNS OF ANTHRAX

ANTHRAX: PREVENTION AND CONTROL

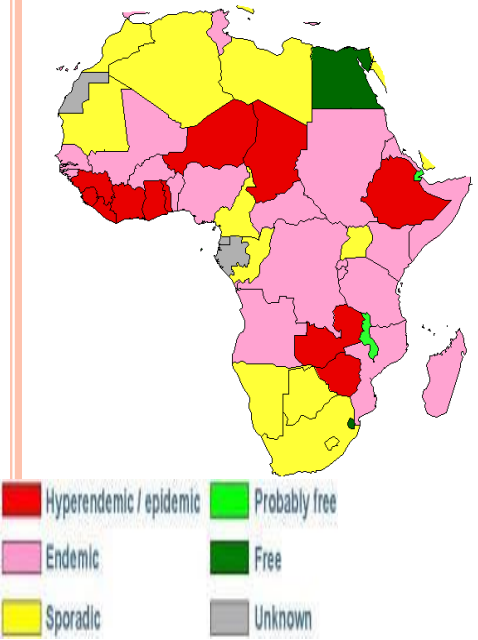
- Anthrax is a notifiable disease-report to authorities
- Early treatment with high doses of penicillin
- Annual vaccination of livestock with modified live vaccines in endemic areas
- Prophylactic antibiotics to exposed and at risk animals during an outbreak
- Sick animals should be isolated

- Movement of animals controlled
- Prompt disposal of dead animals by incineration /burning and burying
- Decontamination of premises and equipment
- Carcasses of dead animals should not be opened and
- Scavengers should be prevented from accessing the carcass

Zoonotic anthrax in Ethiopia

Human Cases

- *Bacillus anthracis* is found worldwide with an estimated 20,000-100,000 human cases each year
- In Ethiopia, anthrax is hyperendemic/epidemic in most species of domestic animals and also cases have been reported in humans



News Report: "Ethiopia: Anthrax Infects 10 People in Oromiya Region"

Immunization Newsbriefs (c) Copyright Information Inc., Bethesda, MD. Brought to you by the National Network for Immunization Information (NNii). Visit NNii's new website at http://www.immunizationinfo.org.
July 15, 2002

INTERNATIONAL IMMUNIZATION NEWS

"Ethiopia: Anthrax Infects 10 People in Oromiya Region"
Africa News Service (www.allafrica.com) (07/12/02)

An outbreak of anthrax has sickened at least 10 people in the eastern Ethiopia. The disease first infected and killed 15 head of cattle in the Fentale district of Oromiya Region. Dr. Yilma Jobre of the International Livestock Research Institute in Addis Ababa, noted that although it is transmittable to humans, it is still rare for humans to contract anthrax from cattle. He suggested that farmers burn or bury the carcasses of diseased cattle rather than slaughtering them, adding that anthrax spores are found naturally in soil and can be released into the atmosphere by rainfall.

ETHIOPIA: Suspected anthrax epidemic in Afar Region

2000 - Anthrax in Ethiopia

World Health Organization

WHO has received reports of clusters of cases of suspected anthrax in the Afar region of Ethiopia. This area is inhabited by pastoralists who depend on livestock and cases of anthrax are known to occur. Reports from organizations (e.g. United Nations Development Programme, Médecins Sans Frontières) working in the area indicate clusters of cases and increased numbers of cases of a clinical syndrome consistent with anthrax. No systematic epidemiological investigation has been carried out thus far.

Biological terrorism and anthrax

History

- **Sverdlovsk, Russia, 1979**
  - 94 people sick – 64 died
  - Outbreak was related to military facility

- **South Africa, 1978-1980**
  - Anthrax used by Rhodesian and South African apartheid forces on black tribal lands
  - Thousands of cattle died, 10,738 human cases, 182 known deaths

- **Tokyo, 1993**

  - Aum Shinrikyo – Japanese religious cult – “Supreme truth”
  - Attempt at biological terrorism
  - Released anthrax from office building
  - Vaccine strain used, No human injuries

Biological terrorism and anthrax…

- **U.S., 2001**
  - Using anthrax-contaminated letters
  - 22 cases – 11 cutaneous and 11 inhalational, 5 deaths
- Previous acts of biological terrorism have been small in scale
  - Clouds of spores of Anthrax bacilli
  - Aerosol (war heads filled with anthrax spores)
  - Through dried spores in envelops

- Postal workers affected–Inhalation anthrax (40% mortality)

- Release of 50 kg of spores

  - Urban area of 5 million (10 km upwind and 2 km wide)

    - Estimated impact
      - 250,000 cases of anthrax
      - 100,000 deaths

2.2. Clostridial diseases

- Clostridia are widespread in the environment and are normally found in soil and feces
- They form highly resistant spores that can survive in the environment for very long periods
- Not all species of clostridia cause disease, but those that do are usually fatal
- Disease occurs when these bacteria enter the body and multiply and/or produce toxin
- Clostridial diseases are typically infectious but not contagious

DISEASE CAUSING CLOSTRIDIUM SPECIES

Clostridium	Disease caused
C. tetani	Tetanus
C. septicum	Malignant edema
C. chauvoei	Blackleg
C. perfringens type D	Enterotoxaemia
C. novyi	Black disease
C. botulinum	Botulism

I. BLACKLEG

Importance

- A peracute, non-contagious, and highly fatal (nearly 100%) disease of cattle and sheep
- Clostridial myositis of skeletal and/or heart muscle tissue

- **Etiology:** *Clostridium chauvoei*
  - Spore forming, rod shaped, anaerobic gas producing bacterium
  - Spores are resistant to environmental changes and disinfectants
  - Transmission is by ingestion of the spores
  - Enter through small punctures in the mucus membrane of the GIT and via wound during **shearing, docking, castration, lambing**

Blackleg: epidemiology

Distribution

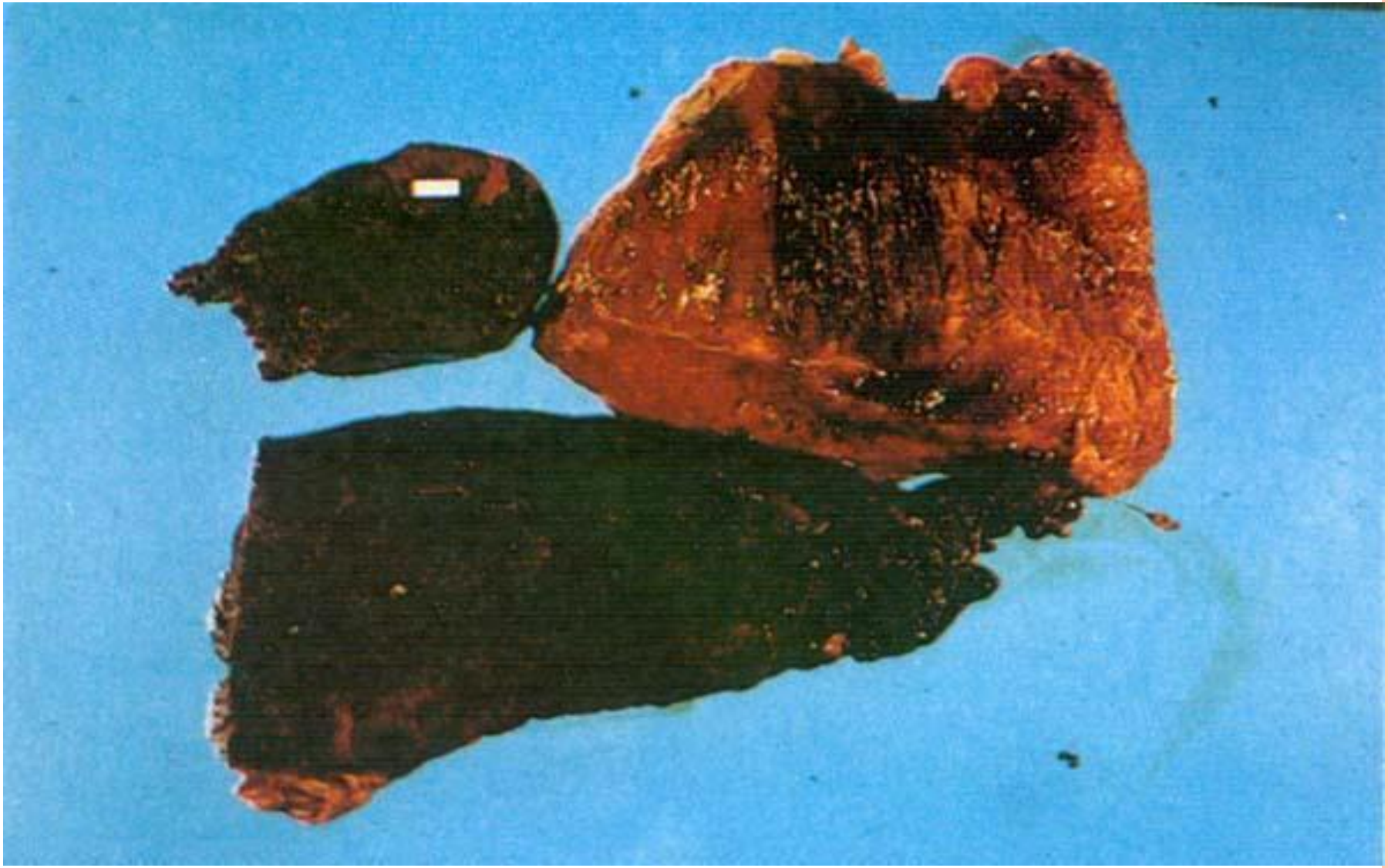
- Occurs on all continents
- Common in areas subject to flooding
- In cattle it has a seasonal incidence (warm months)
- It may also occur during times of drought
- Excavation of soil is also a risk factor

- **Species affected**
  - Usually a disease of cattle and occasionally sheep
  - Young cattle (6 months - 2 yrs) on a high plane of nutrition are most susceptible
  - In sheep there is no restriction to age group

Blackleg: Clinical signs and lesions

- Usually, onset is sudden, and a few cattle may be found dead without premonitory signs
- Acute, severe lameness and marked depression are common
- Fever initially, normal or subnormal later
- Discolored, dry or cracked skin
- Characteristic edematous and creping sound swelling in hip, shoulder and back
- Death within 12–48 hours

DARK-RED SKELETAL MUSCLE SHOWING HAEMORRHAGE, NECROSIS, EDEMA.



BLACKLEG: TREATMENT AND CONTROL

- **Prevention and control**

  - Vaccination

    - Calves between 3 and 6 months with two vaccinations given 4 weeks apart, followed by annual boosters prior to anticipated danger period (usually spring or early summer)

    - Naive ewes should be vaccinated twice a month before lambing and then with yearly boosters

  - In outbreak, all susceptible animals should be vaccinated and treated prophylactically with penicillin

II. BOTULISM

- A non-febrile, highly fatal and ***neuroparalytic intoxication***
- **Etiology**
  - Ingestion of ***Clostridium botulinum*** toxins with feed
  - There are 7 types of *Cl. botulinum* (A-G)
    - Types A, B, E and F cause illness in humans
    - C1 in most animal species
    - D in cattle
  - The usual source of the toxin is decaying carcasses, bones, dead tortoise, or vegetable materials such as decaying grass, hay, grain, or spoiled silage.

BOTULISM: TOXINS

1895, TYPE B
Ham, Belgium

1904, TYPE A
Canned beans, Germany

1922, TYPE C
Chickens in the U.S., cattle in Australia

1928, TYPE D
Cattle, South Africa

1936–37, TYPE E
Fish in New York and Ukraine

1958, TYPE F
Homemade liver paste, Denmark

1970, TYPE G
Soil, Argentina

2013, TYPE H?
Infant with botulism, residence unknown

Table 16.3 **Toxins of *Clostridium botulinum*.**

Toxin	Source	Susceptible species
Type A	Meat, canned products	Humans
	Toxico-infection	Infants
	Meat, carcases	Mink, dogs, pigs
Type B	Meat, canned products	Humans
	Toxico-infection	Infants
	Toxico-infection	Foals (up to two months of age)
Type C	Dead invertebrates, maggots, rotting vegetation and carcases of poultry	Waterfowl, poultry
	Ensiled poultry litter, baled silage (poor quality), hay or silage contaminated with rodent carcases	Cattle, sheep, horses
	Meat, especially chicken carcases	Dogs, mink, lions, monkeys
Type D	Carcases, bones	Cattle, sheep
	Feed contaminated with carcases	Horses
Type E	Dead invertebrates, sludge in earth-bottomed ponds	Farmed fish
	Fish	Fish-eating birds, humans
Type F	Meat, fish	Humans
Type G	Soil-contaminated food	Humans (in Argentina)

BOTULISM: EPIDEMIOLOGY

- **Species affected**
  - It has been reported in a variety of vertebrates including mammals, birds, reptiles and fish
  - Mainly affects cattle, sheep, goats, horses, mules, donkeys and camels
  - Pigs are relatively resistant to the ingestion of this toxin

Distribution

- Has no geographical limitations
- A classical disease of the arid and semi-arid pasture ranges of the tropics due to phosphorus deficiency
  - ✓ Outbreaks are most likely to occur during drought periods
  - ✓ Feed is sparse (grazing close to soil)
  - ✓ Phosphorous deficiency (lead to pica)

BOTULISM: EPIDEMIOLOGY…..

- **Transmission**
  - By ingestion of preformed toxins in a variety of sources including decaying vegetable matter, meat and fish, carcasses, bones, dead tortuous invertebrates and contaminated water
- **Public health significance**
  - Botulinum toxins are considered the most lethal toxic substances known to man
  - The milk and meat from cattle that have botulism should not be used for human consumption

Botulism in Ethiopia

***Trop Anim Health Prod*. 1990 Aug;22(3):195-6.**

Mengiste B, Mesfin T, Egziabher BG, Duarte CL

Cattle poisoning and mortality associated with tortoise clostridial toxicity in the Beletu District of Ethiopia.

BOTULISM: CLINICAL SIGNS

- **Clinical signs in animals**

  - Botulism is characterized by progressive motor paralysis
  - In animals, botulism usually affects the hind legs first and ascends
  - Difficulty in chewing and swallowing
  - Visual disturbances
  - Death usually results from paralysis of the respiratory muscles
  - Mildly affected animals may recover with minimal treatment

Botulism: treatment, prevention and control

- **Treatment**
  - Early administration of antitoxin + intensive fluid therapy
  - Hyper-immune serum IV for valuable animals
- **Prevention and control**
  - Appropriate management & feeding of animals
  - Adequate provision of phosphorous to the animals
  - Hygienic disposal of carcasses
  - Vaccination in areas where botulism is relatively common
    - There is no cross-protection between toxin types

III. TETANUS

- It is a toxemia caused by a specific neurotoxin of *Clostridium tetani*
- The organism is found in the soil & intestinal contents (manure)
- The toxin produced after parenteral infection of the target animal with the pathogen
- Occurs worldwide, but is more common on manured land, in closely settled areas under intensive cultivation, or associated with surgical procedures
- Outbreaks occur occasionally in young cattle, colts, pigs and lambs as a result of infection through operation wounds or via the naval cord

TETANUS: THE AGENT AND ITS TOXINS

- ***Clostridium tetani***
  - Gram positive, straight, slender rod with rounded ends
  - All species form endospore (drumstick with a large round end)
  - Spores are highly resistant to adverse conditions (heat, chemical agents…)

- **Produces two types of toxins:**
  - Tetanolysin, which causes lysis of RBCs
  - Tetanospasmin is neurotoxin and essential pathogenic product

TETANUS: SPECIES AFFECTED

- Almost all mammals are susceptible to Tetanus, including humans
- Horses are the most sensitive of all species followed by sheep & goats
- Cattle and dogs are relatively resistant
- Infection occurs through a deep wound caused by a puncture contaminated with soil or dung
- Unable to multiply in healthy tissue which contains oxygen – also in open and bleeding wounds

Tetanus: clinical signs

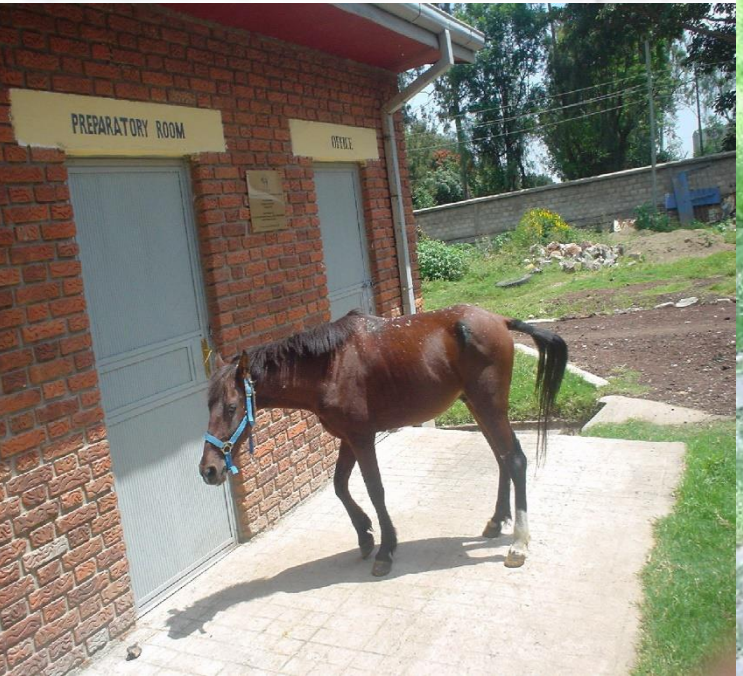
- Once the organism has entered the body, it releases an exotoxin that binds to nerve fibers and results in muscle rigidity

- Clinical signs noted secondary to the muscle rigidity include:

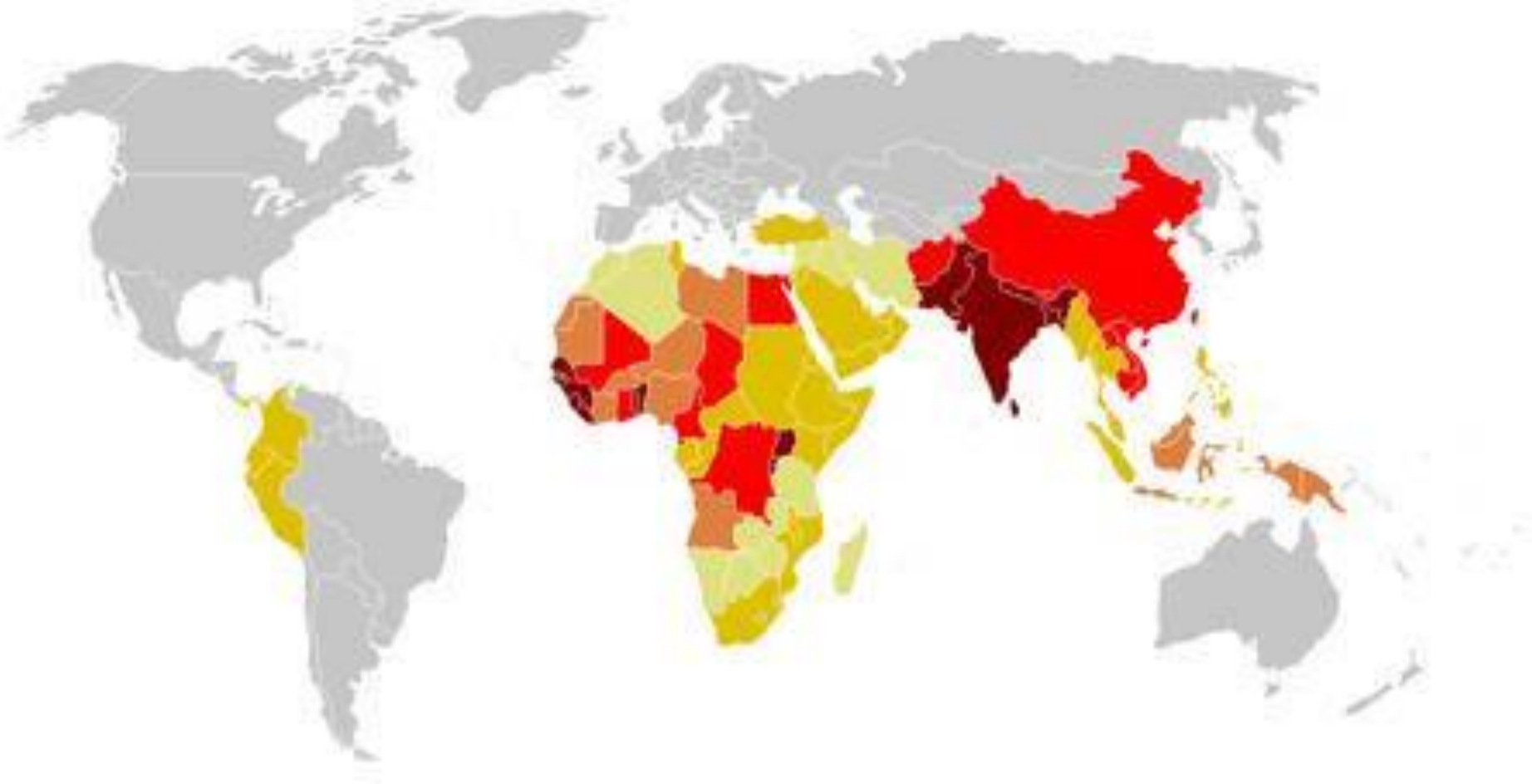
  - a “sawhorse appearance”
  - erect ears
  - a reluctance to eat or drink due to a “locked jaw”
  - an elevated tail
  - flared nostrils
  - a protruding third eyelid
  - even with treatment at this point, death is usually imminent

Advanced clinical case (donkey)

Dead sheep with sign of tetanus; posture at grazing



Human tetanus in Ethiopia



Tetanus cases reported worldwide (1990-2016). Ranging from **strongly prevalent (in dark red)** to **very few cases (in light yellow) (grey, no data).**

http://en.wikipedia.org/wiki/Tetanus

BACKGROUND INFORMATION

MATERNAL AND NEONATAL TETANUS

THE SITUATION IN ETHIOPIA

Ethiopia was ranked as having the 4th highest number of deaths due to neonatal tetanus in the world, with over 14,000 estimated infants killed. This is understandable with almost 90% of deliveries done at home or in the community by untrained birth attendants, community members, or family members, with only about 30% of women receiving enough protection through vaccination. As a result of this, about 17,900 NT cases with 13,400 Neonatal deaths occur every year. It is estimated that some 2,000 mothers die every year due to maternal tetanus infection. A community based study in 1989 in the southern parts of Ethiopia, now North and South Omo zones showed a mortality rate of 6.7 per 1000 live births accounting for 40% of all neonatal deaths in the community. It may not be much different in the other parts of the country.

Case-fatality of adult Tetanus at Jimma University Teaching Hospital, Southwest Ethiopia

*Amare A[1], Yami A[2]

1. Addis Ababa University, Medical Faculty, Department of Neurology, Addis Ababa, Ethiopia
2. Jimma University, Department of Internal Medicine, Jimma, Ethiopia

Abstract

Background: Tetanus remains a major health problem in Ethiopia like in most other developing countries.

Objectives: To assess the clinical presentation, complications and outcome of tetanus patients.

Methods: In this retrospective study, patients (age ≥ 13 years) who were admitted to Jimma University Teaching Hospital from 1996 to 2009 were included.

Results: Data from 171 patients were analyzed (129 males, 42 females, mean age 33 years). The mean hospital stay for patients discharged cured and deceased was 21.5±12 and 6.5±6.7 days, respectively. None of our patients was immunized for tetanus. Tracheostomy and mechanical ventilation (MV) was done in 10.5% and 11 %, respectively. The case-fatality was 38%. The mean annual admission and case-fatality increased over the study period from 9 to 20.5 and from 21 % to 51%, respectively. Establishment of intensive care unit (ICU) did not improve mortality due to infrequent tracheostomy and MV.

Conclusions: The case-fatality was high like in most other studies and the majority of patients died in the first few days indicating that adequate respiratory support was not given. Establishment of ICU did not improve mortality. Tetanus can be prevented by vaccination and if it occurs it needs well equipped ICU.

Key words: Tetanus, case-fatality, complication, vaccination, Africa

African Health Sciences 2011; 11(1): 36 - 40

Tetanus: prevention and control

- Proper treatment of all wounds is of primary importance
- The persistence of pus, dead tissue, dirt or foreign bodies within the wound must be avoided
- After any surgical procedure, such as docking or castration, animals must be turned out onto clean ground, preferably grass pastures

- If symptoms have occurred:
  - Place the animal in a quiet, comfortable place, not to disturb it
  - It should receive soft, easily digestible food
  - Plenty of fresh water should be placed
  - Any wounds should be drained and cleaned
  - Give large doses of penicillin IV
- Tetanus antitoxin (TAT) may be injected but is of little use once symptoms have appeared.
- Can be prevented efficiently through active immunization

IV. Enterotoxaemia

- **Etiology**
  - Caused singularly or in a combination by the different types of *Clostridium perfringens*
  - Five types of *C. perfringens* (A, B, C, D, and E) depending on their ability to produce toxins
  - The organism occurs widely in the environment and in the GIT of most mammals

ENTEROTOXAEMIA: EPIDEMIOLOGY

- **Distribution -** world wide

- **Species affected**

  - Many species of domestic animals are affected

  - Particularly important in sheep and cattle feedlot farms

Risk factors

- Triggered by mistakes in feed management
  - Intake of feed high in soluble carbohydrate and protein
  - When the diet is changed suddenly
  - Organisms multiply rapidly & produce harmful levels of toxin
- Influences of the weather
- Rapidly growing, well fed animals are most susceptible to the disease
- A problem of both intensive & extensive production system

ENTEROTOXAEMIA: EPIDEMIOLOGY….

Risk factors

- Sudden changes in diet
- Grazing lush, fresh young grass
- An irregular supply of supplementary feed such as Molasses
- High percentage of dry matter and a low proportion of crude fiber
- Mistakes in the use of milk replacer or excessive supplementary feeding in young animals

Enterotoxaemia: treatment and control

- **Treatment**
  - High doses of oxytetracycline

- **Control measures**
  - Preventing sudden changes of pasture
  - Provision of feed containing structurally crude fiber
  - Gradual adaptation of animals to new feed which is rich in nutrients
  - General sanitation of the feed and environment

CONTACT DISEASES

OBJECTIVES

At the end of this chapter the students will be able to:

- Understand the **methods of CD transmission**
- Know the epidemiology of **CD**
- Recognize the **methods used for the prevention and control of CD**

BRAINSTORMING

- What is meant by **CD**?
- Mention some possible **methods of transmission** for TB, CBPP, CCPP, Brucellosis, FMD?
- Mention the **possible prevention and control measures** for the aforementioned diseases?

3. Contact diseases

- Transmitted by direct or indirect contact from an infected to a susceptible organism
  - Coitus
  - Licking
  - Cutaneous contact
  - Aerosol
  - Animate objects
  - Inanimate objects

- Most of the time, animals recovered confer sterile immunity

- The widespread presence such diseases in tropics associated with poor infrastructure and underdeveloped economy

3.1. CONTAGIOUS BOVINE PLEUROPNEUMONIA (CBPP)

- The most economically important disease of cattle in Africa
  - Direct losses from mortality, ↓milk yield, vaccination costs, disease surveillance & research programs
- Naïve herds can experience losses up to 80%
- Many cattle that survive remain chronic carriers
- The only bacterial disease of the list A of OIE
- Caused by *Mycoplasma mycoides* subsp. *mycoides* Small Colony- bovine biotype (M*mm*SC)
  - The organism does not survive for long in the environment and transmission requires close contact

CBPP: GEOGRAPHICAL DISTRIBUTION

- Has occurred throughout the world at some time or another (except S. America & Madagascar)
- Eradicated from the US, Australia, Europe, South Africa
- Endemic in most of Africa, Occurs in some Asian country
- Sporadic outbreaks are also reported in the Middle East

Susceptibility:

- Cattle exotic breeds are more susceptible
- Sheep and goats can also be naturally infected, but with no clear associated pathology
- Wild animals do not play a role in the epidemiology of the disease.
- **Transmission is by inhalation of droplets from infected coughing animals**

CBPP: CLINICAL SYMPTOMS

- **Acute forms**

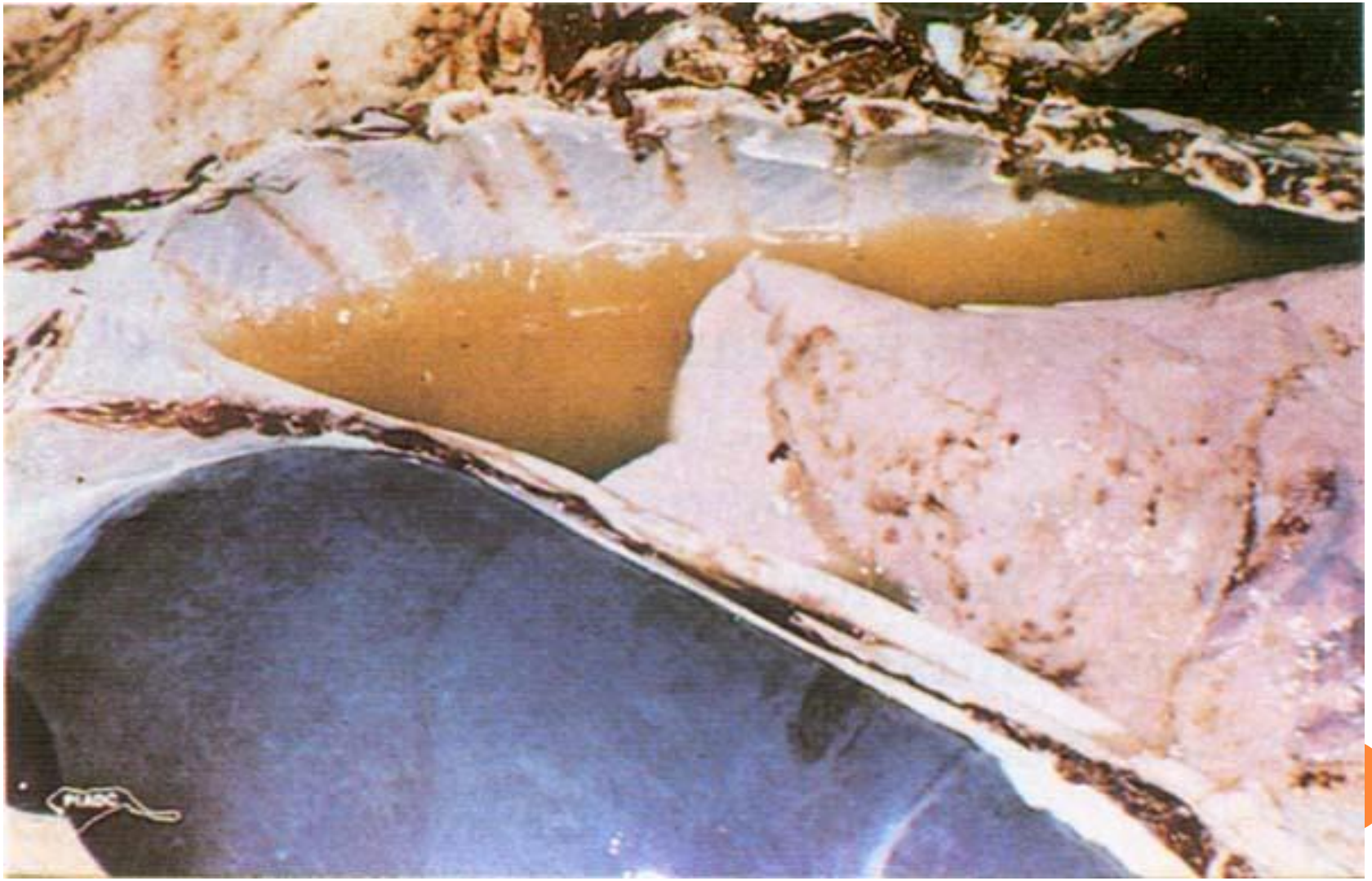
  - Animals show dullness, anorexia, irregular rumination, moderate fever, polypnea, characteristic attitude (elbows abducted, head extended, arched back), cough

  - At percussion, dull sounds can be noticed in the low areas of the thorax

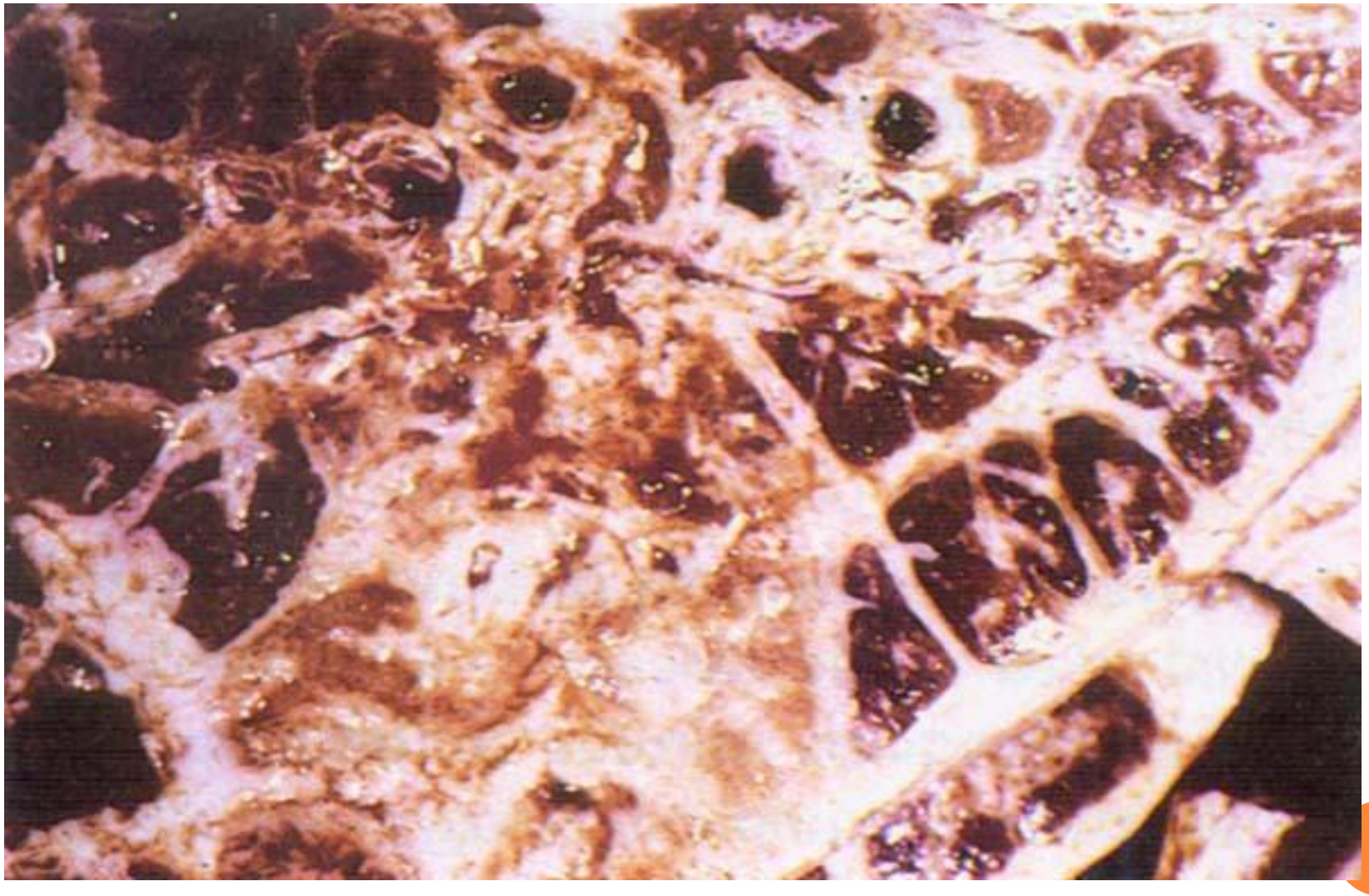
  - Polyarthritis in young animals.

- **Hyper acute forms**
  - The clinical signs observed are much accelerated.
  - Affected animals may die within a week exhibiting classical respiratory signs.
- **Sub acute/Chronic forms**
  - Slight cough only noticeable when animal is exercised
  - Recurrent low-grade fever
- **Lesions** Abundant yellow or turbid exudate in pleural cavity, and Marbled appearance of lung

STRAW COLOURED FLUID IN THE THORAX AND PARTIAL LUNG HEPATIZATION



HEPATIZATION AND MARBLED APPEARANCE OF LUNG LOBULES



CBPP: PREVENTION AND CONTROL

- **In disease-free areas - Sanitary prophylaxis:**
  - Quarantine
  - Movement controls
  - Serological screening and slaughtering of all positive and in-contact animals
- **Vaccination in enzootic areas like Africa**
  - Attenuated strains
  - Attenuated live vaccine available in Ethiopia

3.2. CONTAGIOUS CAPRINE PLEUROPNEUMONIA (CCPP)

- A severe disease of goats caused by *Mycoplasma capricolum* subspecies *capripneumoniae* (Mccp)
- Causes major economic losses in Africa, Asia and the Middle East, where it is endemic
- Under natural conditions CCPP affects only goats
- Readily transmitted by inhalation
- Morbidity reaches 100% and mortality as high as 80%.

Clinical signs:

- Very high fever (41-43°C), lethargy and anorexia, followed within 2 to 3 days by coughing and labored respirations.
- Goat may not be able to move and stands with its front legs wide apart, and its neck stiff and extended.
- Saliva dripping continuously, animal may grunt or bleat
- Pregnant goats can abort.
- Acutely affected goats generally die within seven to 10 days.
- Chronic CCPP is characterized by a chronic cough, nasal discharge and debilitation

CCPP: PREVENTION AND CONTROL

- Oxytetracycline (15 mg/kg/d) is highly successful
  - Severity of the disease reduced but still sources of infection
- Herd biosecurity
- Vaccination with an inactivated mycoplasma F38 vaccine
  - A booster dose 1 month after the first vaccination
  - Vaccine produced in Ethiopia

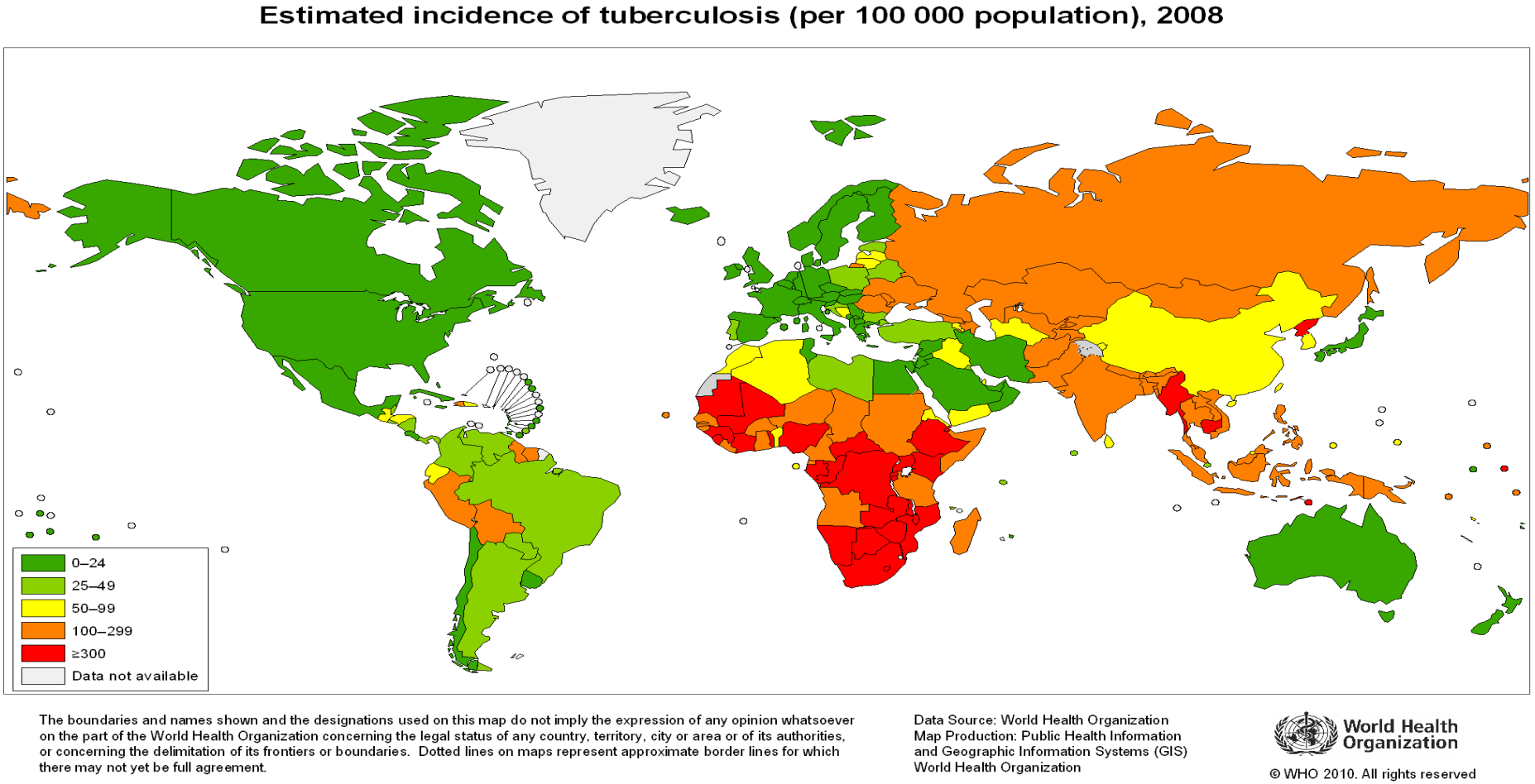
3.3. TUBERCULOSIS

- TB in animals and humans are caused by:

  - **Mycobacterium bovis:**
    - ✓ Pathogenic for cattle, humans, dogs, pigs, goats and horses

  - **Mycobacterium tuberculosis:**
    - ✓ Pathogenic for humans and carnivores
    - ✓ Only latent infection in pigs and cattle

  - **Mycobacterium avium:**
    - ✓ Pathogenic for poultry and pigs
    - ✓ only as an exception for humans, cattle and horses



Epidemiology of TB

Globally:

- One third (nearly 2 billion) of world's population infected
- 100 million people infected every year
- 9.27 million new cases of tuberculosis
- Nearly 2 million people die of TB each year (WHO, 2009)

Bovine tuberculosis

- A chronic infectious and contagious disease of livestock, wildlife and humans
- It is usually characterized by formation of nodular granulomas known as tubercles in lung and associated lymph nodes
- It is a significant zoonosis that can spread to humans, by the inhalation of aerosols or ingestion of unpasteurized milk.

BTB: OCCURRENCE

- Eliminated or nearly eliminated from many industrialized countries
- Still widespread in Africa, parts of Asia and some Middle Eastern countries
- Occurs in extensive as well as in intensive production systems of the tropics
  - pulmonary tuberculosis in intensive dairy production systems
  - gastrointestinal tuberculosis in the extensive as well as nomadic animal production systems
  - Transmitted by Inhalation and Ingestion

BOVINE TUBERCULOSIS……

Why bovine TB is a hidden threat

- Global distribution
- Chronic disease that has effect on animal population and productivity
- Wide host range, including ruminants, predators, scavengers, small mammals
- Annual worldwide losses~$3 billion (trade)
- Difficult to eradicate due to the large disease reservoir apparent in wild life

Bovine tuberculosis in Africa-in cattle and wildlife-1996-2011

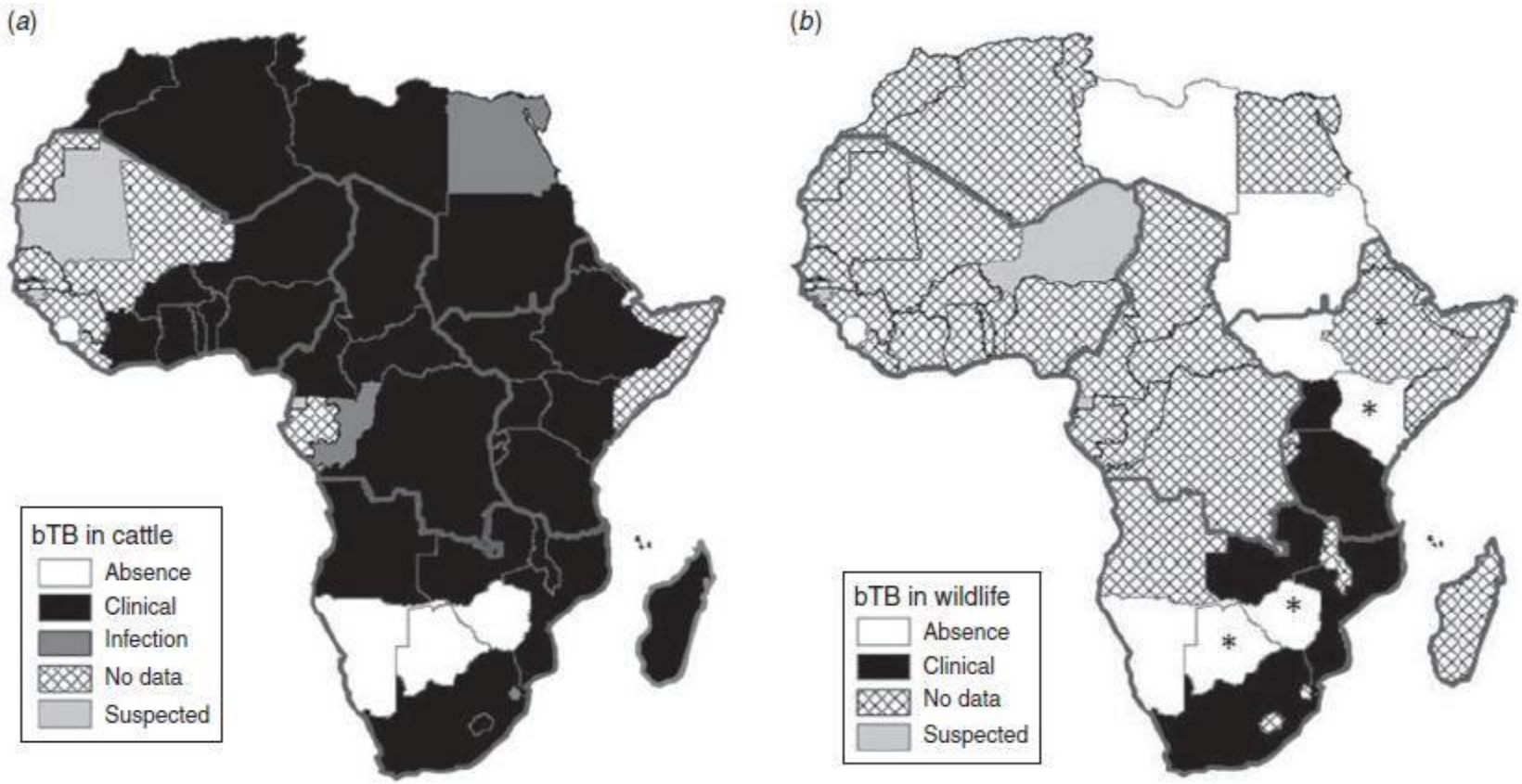


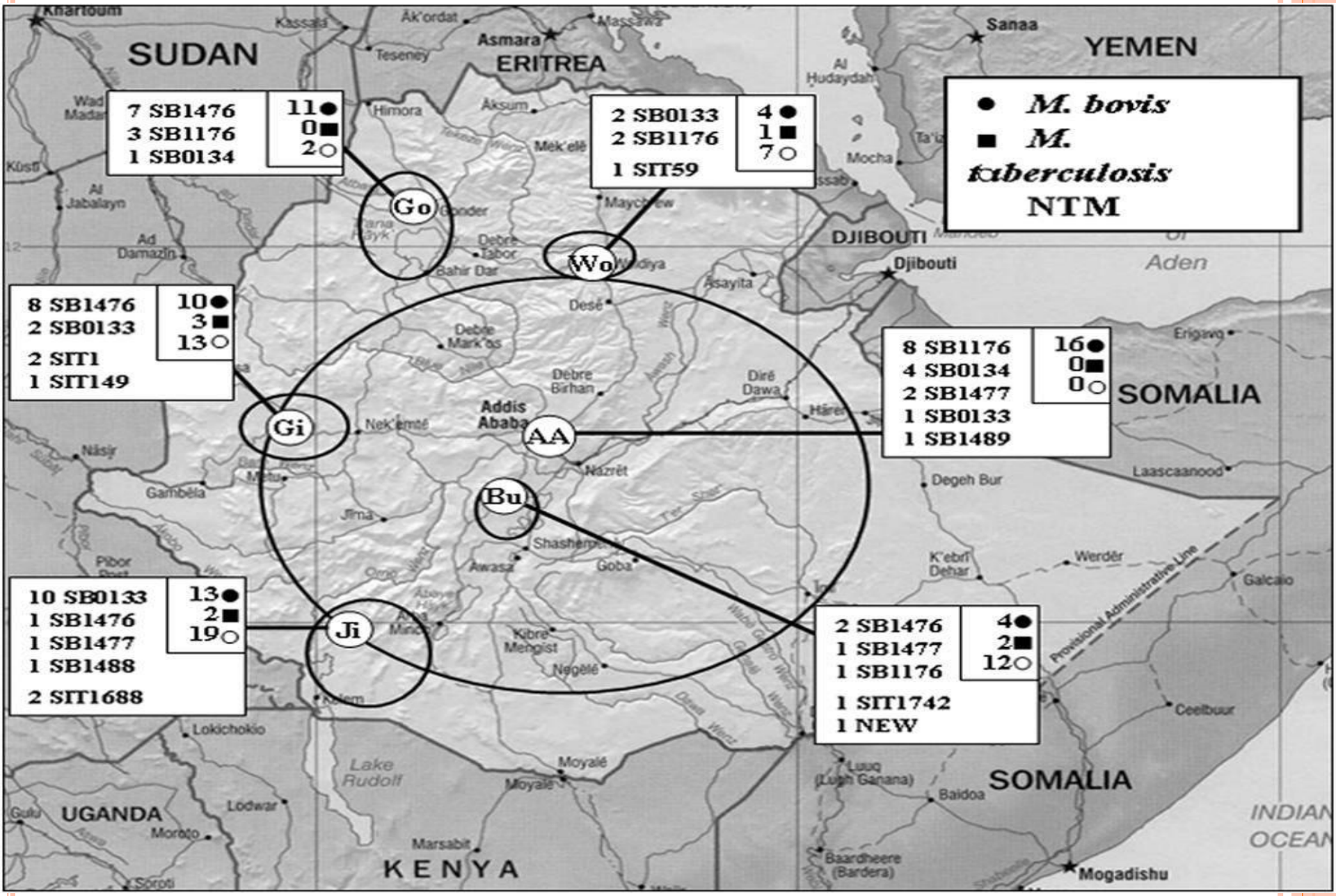
Fig. 1. Distribution map of bovine tuberculosis in Africa during 1996–2011 (large grey lines indicate the African subregions as referred to in the text: West, Central, East and Southern Africa). (*a*) Cattle status at country level; (*b*) wildlife status at country level. Asterisk (*) indicates countries (i.e. Botswana, Ethiopia, Kenya, Zimbabwe) where suspected and confirmed cases have been detected but not yet reported to OIE [37, 38, 50, 59, 60]. No additional information (e.g. species) was available for suspected cases reported in wildlife for Niger, Equatorial Guinea and Guinea–Bissau and confirmed cases in wildlife in Mozambique. Data compiled from World Animal Health Information databases/OIE [30, 31, 42] and [37, 38, 50, 59, 60].

De Garine-Wichatitsky et al., 2013- Epidemiol Infect 141: 1342-1356

Status of BTB in Ethiopia

- Endemic (known since 1967)
- From 1996-2011 extensive researches has been carried out- eg. researches by Prof. Gobena Ameni and his team (AAU) has helped to establish the status of BTB in livestock of Ethiopia.
- Detection of BTB: most commonly on the basis of TST, abattoir meat inspection, bacteriological examination and molecular characterization of the agents
- Prevalence ranging from 0.9% in extensive to 87% in intensive production system using TST and a range of 0.78% to 15.9% in abattoir based study in various part of the country
- Intensification has contributed for increase of BTB

Molecular epidemiology of Bovine Tuberculosis in Ethiopia



Berg et al., 2009- PLoS One 4 (4): e5068

Zoonotic tuberculosis

- Zoonotic tuberculosis is human tuberculosis caused by *Mycobacterium bovis* which originated from animals.

- **Why is zoonotic TB so serious**

  - Cause extra-pulmonary manifestation (9.4% of global TB)

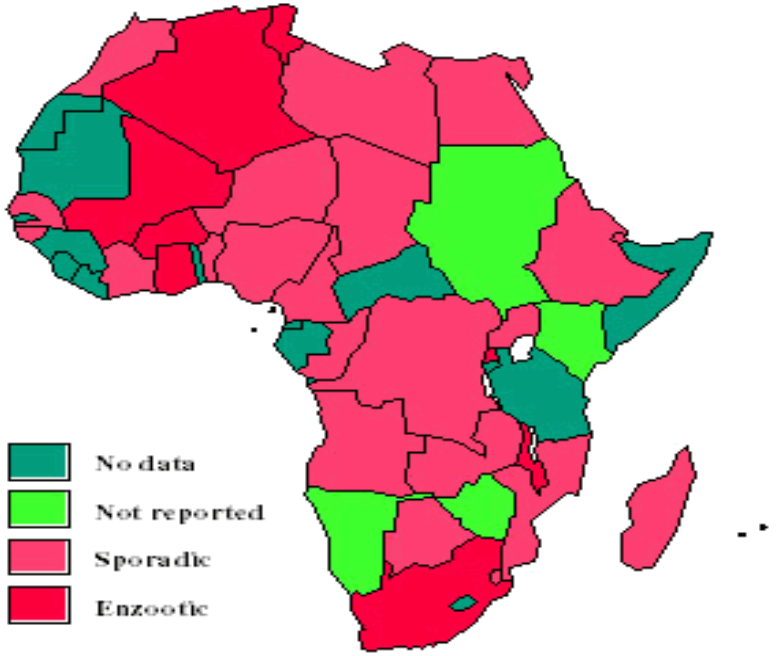
  - Slow to develop and infects many organs, which make treatment difficult

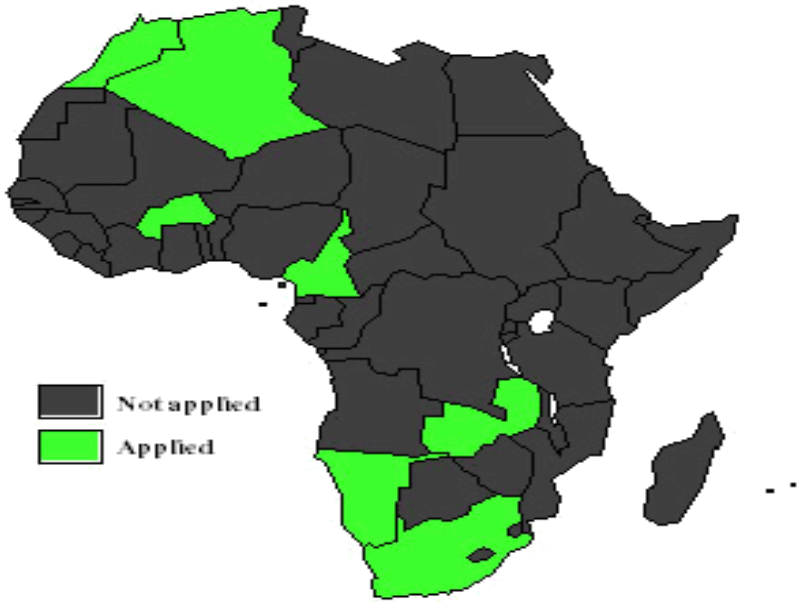
  - Multi-drug resistant to the top 10 frontline drugs. This increase the duration and cost (10X) of treatment

- **Why should we be concerned?**
  - In Africa 80% of the population is rural and depends solely on livestock for food and wealth
  - 85% cattle and 82% people live where BTB is only partially controlled
  - 90% of the total milk produced in Africa is consumed raw

ZOONOTIC TUBERCULOSIS……

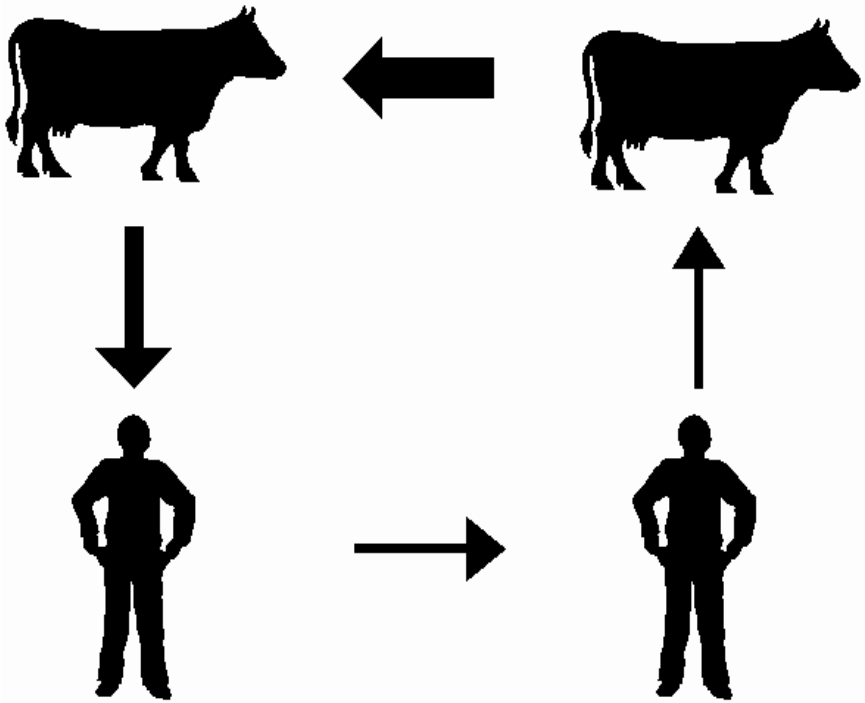
- In Africa, nearly 85% of livestock and 82% of the human population live in areas where the disease is endemic or partially controlled
- Human disease caused by *M. bovis has been* confirmed in African countries.
  - Egypt (6.4%), Nigeria (3.9%), Tanzania (36% from Lymph node biopsy-LNB)- Cosivi *et al.*, 1998
  - Ethiopia (17% (6/35) - Kidane *et al.*, 2002 from LNB in Butajira) controversial
  - Recently, Gumi *et al.*, 2012-1.73%- Borena from PTB, Mamo, 2014 (PhD research)-1.3%-Afar from PTB cases





ZOONOTIC TB TRANSMISSIONS

- Foodborne: ingestion of contaminated unpasteurized dairy products
- Airborne: Inhalation of aerosol droplets
- Direct inoculation (cutaneous)– Butcher's wart in Hunters



Cycle of *Mycobacterium bovis* transmission between cattle and humans.
Adapted from *Collins and Grange* (1987).

Risk factors for transmission

Watering point (Afar-Halidage)
Photo: Gezahegne M.

Ape drinking from tapwater
(Photo: Gezahegne M-Afar)

HUMAN

DOMESTIC ANIMALS

WILD ANIMALS

Reverse zoonosis (Anthroponosis) of TB in Ethiopia

The Veterinary Journal xxx (2010) xxx–xxx

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Short Communication

Mycobacterium tuberculosis infection in grazing cattle in central Ethiopia

Gobena Ameni [a,c,*], Martin Vordermeier [b], Rebuma Firdessa [c], Abraham Aseffa [c], Glyn Hewinson [b], Stephen V. Gordon [b,d,e], Stefan Berg [b]

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ABSTRACT

A preliminary study to characterise mycobacteria infecting tuberculous cattle from two different management systems in central Ethiopia was carried out. Approximately 27% of isolates from grazing cattle were *Mycobacterium tuberculosis*, while cattle in a more intensive-production system were exclusively infected with *M. bovis*. The practice of local farmers discharging chewed tobacco directly into the mouths of pastured cattle was identified as a potential route of human-to-cattle transmission of *M. tuberculosis*.

REVERSE ZOONOSIS….

Fig. 1. A farmer in central Ethiopia discharging tobacco juice directly into the oral cavity of his cattle, a common practice in this region and a possible route of transmission of *Mycobacterium tuberculosis* from humans to cattle.

In conclusion, this study highlights the possible risk of human-to-cattle transmission of *M. tuberculosis* through the practice of mouth-to-mouth feeding of tobacco juice and/or where animals live in close contact with tuberculous humans. Epidemiological studies are ongoing to determine the impact of tobacco juice feeding on cattle health and on the potential for transmitting *M. tuberculosis* to cattle.

REVERSE ZOONOSIS….

Hindawi Publishing Corporation
Veterinary Medicine International
Volume 2012, Article ID 869146, 8 pages
doi:10.1155/2012/869146

Research Article

Tuberculosis in Goats and Sheep in Afar Pastoral Region of Ethiopia and Isolation of *Mycobacterium tuberculosis* from Goat

Gezahegne Mamo Kassa,[1,2,3] Fekadu Abebe,[3] Yalelet Worku,[2,4] Mengistu Legesse,[1,3] Girmay Medhin,[1] Gunnar Bjune,[3] and Gobena Ameni[1]

A cross sectional study was conducted on 2231 small ruminants in four districts of the Afar Pastoral Region of Ethiopia to investigate the epidemiology of tuberculosis in goats and sheep using comparative intradermal tuberculin skin test, postmortem examination, mycobacteriological culture and molecular typing methods. The overall animal prevalence of TB in small ruminants was 0.5% (95% CI: 0.2%–0.7%) at ≥4 mm and 3.8% (95% CI: 3%–4.7%) at cutoff ≥2 mm. The herd prevalence was 20% (95% CI: 12–28%) and 47% (95% CI: 37–56%) at ≥4 mm and ≥2 mm cut-off points, respectively. The overall animal prevalence of Mycobacterium avium complex infection was 2.8% (95% CI: 2.1–3.5%) and 6.8% (95% CI: 5.8–7.9%) at ≥4 mm and ≥2 mm cut-off points, respectively. Mycobacteriological culture and molecular characterization of isolates from tissue lesions of tuberculin reactor goats resulted in isolation of *Mycobacterium tuberculosis* (SIT149) and non-tuberculosis mycobacteria as causative agents of tuberculosis and tuberculosis-like diseases in goats, respectively. The isolation of *Mycobacterium tuberculosis* in goat suggests a potential transmission of the causative agent from human and warrants further investigation in the role of small ruminants in epidemiology of human tuberculosis in the region.

BTB: CLINICAL SIGNS

- Early infections are often asymptomatic.

- In the late stages, common symptoms include:
  - progressive emaciation
  - a low-grade fluctuating fever,
  - Weakness, inappetence

- Animals with pulmonary involvement usually have a moist cough that is worse in the morning, during cold weather or exercise

- In the terminal stages, animals may become extremely emaciated and develop acute respiratory distress

LESION OF TUBERCULOSIS IN THE LUNGS

BTB: PREVENTION AND CONTROL

- Antimicrobial Rx is controversial (costly)
- Test-and-slaughter is the most efficient and practical method
- This control strategy is not feasible to apply in most developing countries
- In Ethiopia, this measure can not be adopted in practice due to:
  - Lack of knowledge on the actual prevalence
  - The existing technical and financial limitations
  - Cultural and traditional beliefs
- No effective vaccine for cattle

3.4 BRUCELLOSIS

- It is a contagious disease of livestock with significant economic and public health importance
- Distributed throughout the world, eradicated from several countries
- It is usually manifested by abortion, with excretion of the organisms in uterine discharges and in milk.
- An important zoonosis causing undulant fever in humans
- Caused by various bacteria of the family Brucella

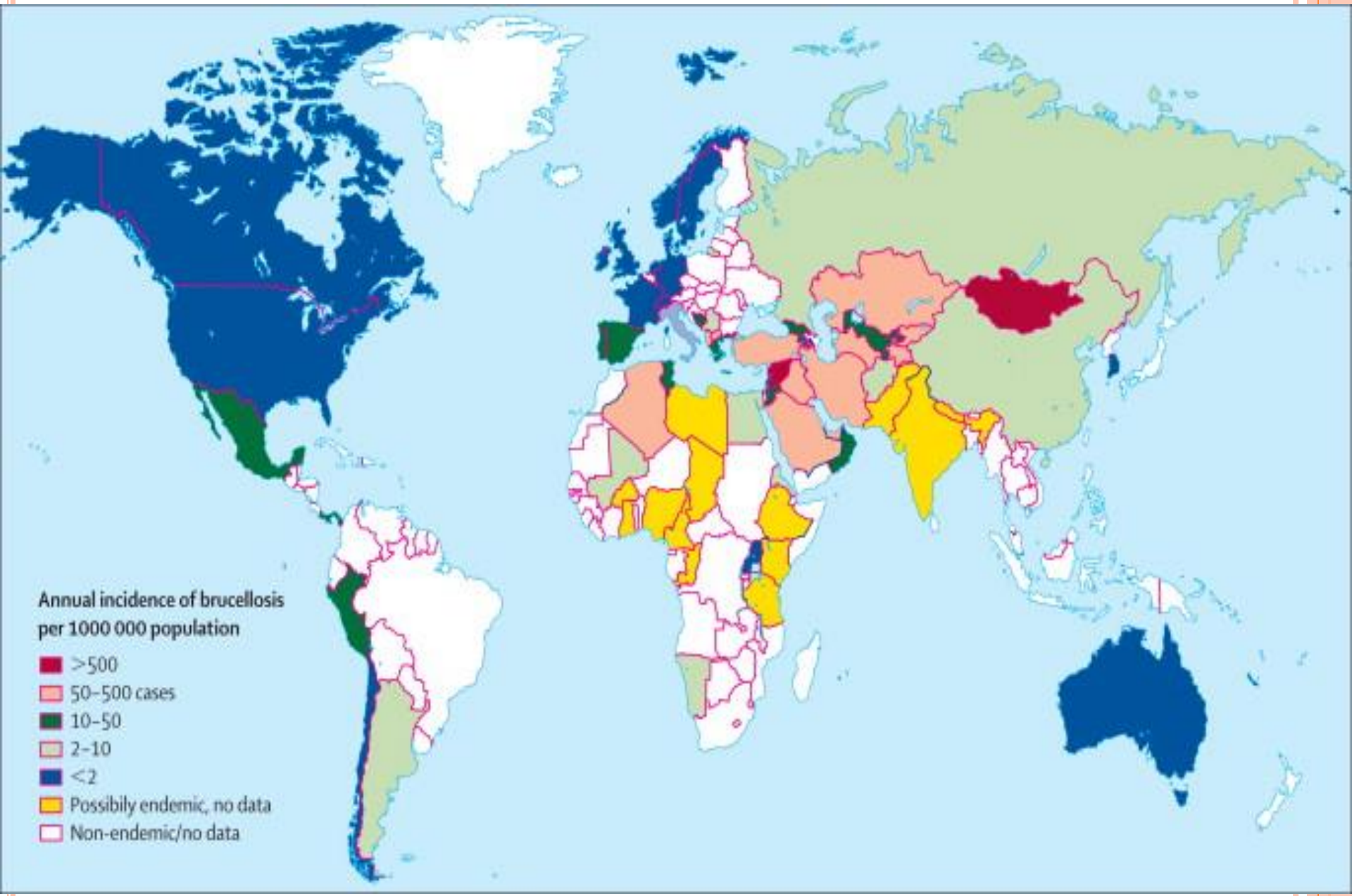
BRUCELLA SPECIES AND THEIR HOST

Brucella species	Usual host/clinical significance	Species occasionally infected/ clinical significance
B. abortus	Cattle/abortion, orchitis	Sheep, goats, pigs/sporadic abortion Horses/bursitis Humans/intermittent fever, systemic disease
B. melitensis	Goats, sheep/ abortion, orchitis, arthritis	Cattle/sporadic abortion, brucellae in milk Humans/Malta fever, severe systemic disease
B. suis	Pigs/abortion, orchitis, arthritis, spondylitis, infertility	Humans/intermittent fever, systemic disease
B. ovis	Sheep/epididymitis in rams, sporadic abortion in ewes	
B. canis	Dogs/abortion, epididymitis, disco-spondylitis, sterility in male dogs	Humans/mild systemic disease
B. neotomae	Desert wood rat/not isolated from domestic animals	

Brucellosis: Epidemiology

- Clinical disease is still common in the Middle East, Asia, Africa and South and Central America.
- It has major economic importance in developing countries that don't have a national brucellosis eradication program
- The prevalence of infection varies considerably among herds, areas and countries.

Incidence of human brucellosis



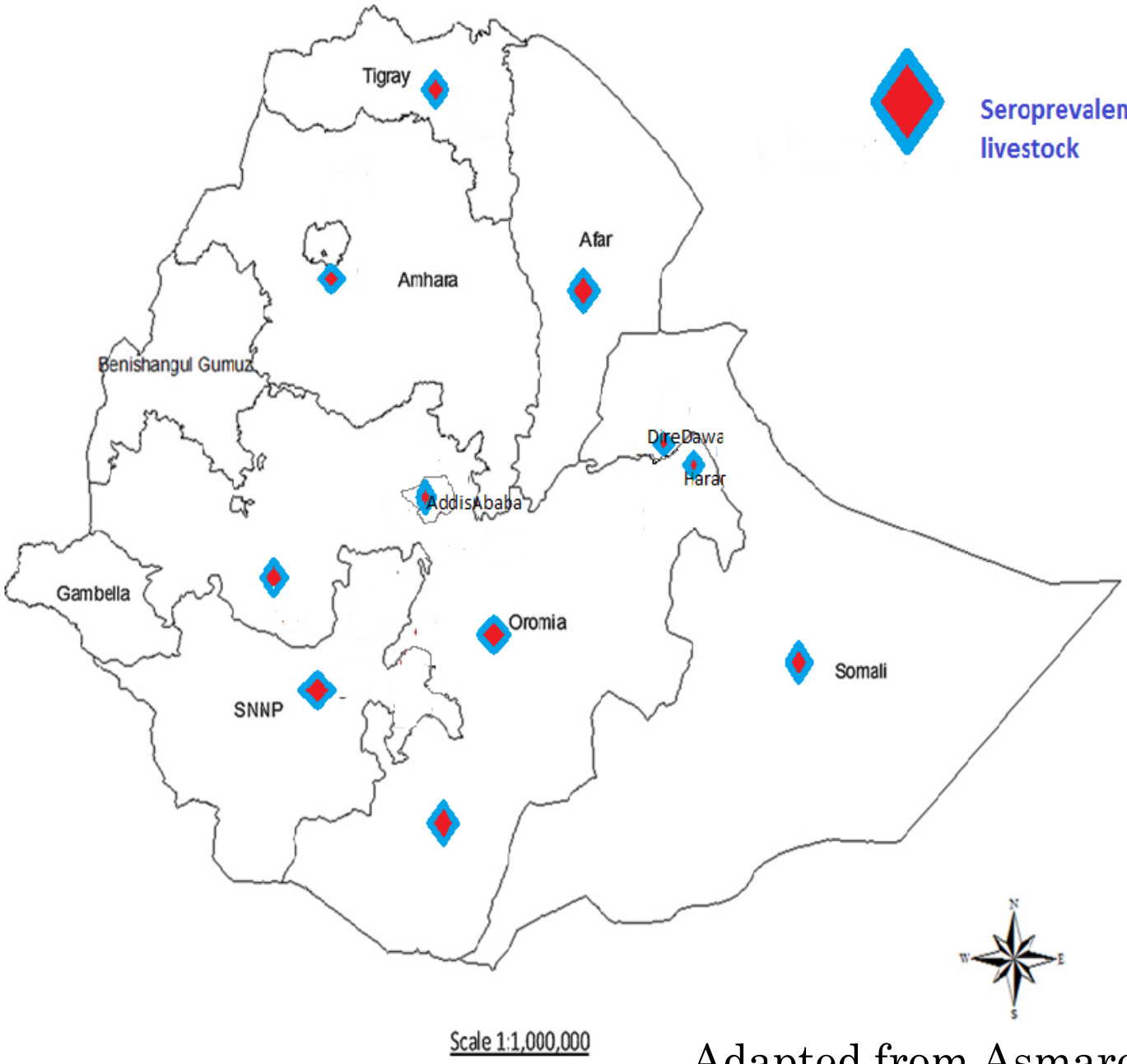
Brucellosis epidemiology in Ethiopia

- In **Ethiopia, brucellosis is known to be endemic** since first reported in 1970s (Domenech, 1977; Meyer, 1980) and is **still a major disease of both socio-economic and public health importance**

- Brucellosis has been reported in animals and humans in different localities of the country

Bovine brucellosis

- Extensive seroprevalence has been done
  - Intensive production system: **ranges from 0 to 50%**
  - Extensive production system including pastoral area: **ranges from 0.77% to 18.6%**
  - **No isolation of the *Brucella species* reported**



Adapted from Asmare et al. 2013

Brucellosis epidemiology in Ethiopia

Caprine and ovine brucellosis

- Seroprevalence ranging from 1.6% to 9.4% in lowland pastoral regions of Ethiopia and highland ranges from 1.6 to 4.9%

- **No isolation of the *Brucella species* reported (This year we are attempting to isolate from Afar, Konso and Woliata, Fentale area)**

Camel brucellosis

- Brucellosis in camel is largely understudied.
- Few studies carried out so far indicated that the prevalence ranges from **1.8% to 5.7%** in camels of Borena, Somali and Afar lowland areas of Ethiopia
- **No isolation of the organism** (This year we are attempting to isolate from Afar Camel)

Zoonotic Brucellosis in Ethiopia

Human brucellosis

- In Ethiopia, few studies carried out on exposed individuals revealed a **prevalence ranging from 3% to 34.1%** with the **highest prevalence being recorded in pastoralist communities of Borena, Somali and Afar Region**

- **No record of isolation of the organism human cases in Ethiopia so far except one report indicating *B. melitensis* Biovar 1 isolated in UK from human (Ethiopian origin) (Adrian *et al., 2006, J Clin Microbiol, 44: 1982-93)***

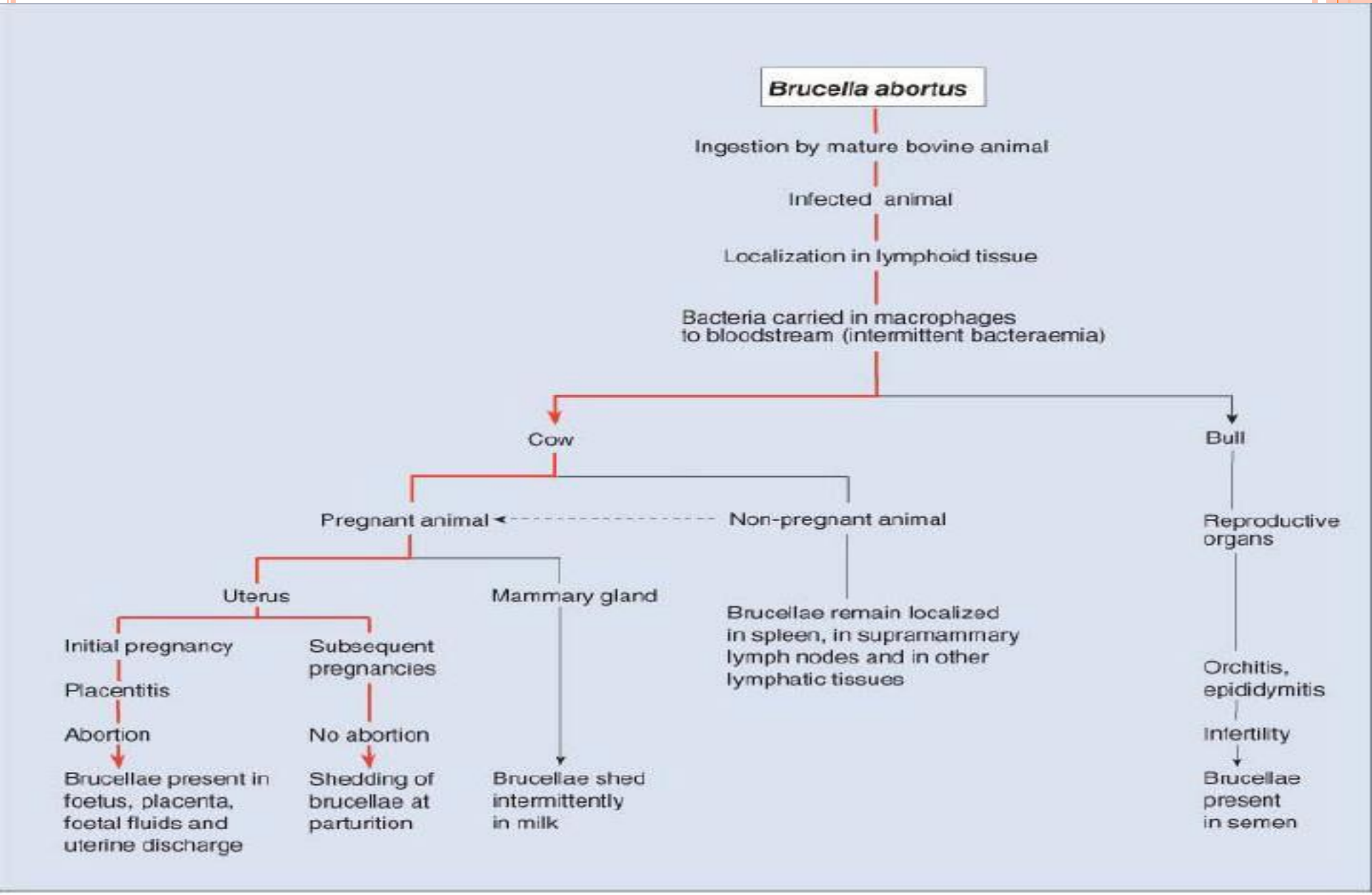
Bovine brucellosis

- Usually caused by *Brucella abortus*, less frequently by *B. melitensis*, and rarely by *B. suis*.

- Most cases in human are the result of occupational exposure to infected animals (inhalation & contact), but infections can occur from ingesting contaminated dairy products

- **Species affected**
  - Maintenance hosts for *Brucella abortus* include
    - **Cattle, buffalo, Elk, Camels**
  - Occasional infections in horses and dogs have also been reported
  - Sexually mature, pregnant cattle are more susceptible

The progression of infection with *B. abortus* in mature susceptible cattle



BOVINE BRUCELLOSIS……

- **Transmission**
  - Usually transmitted by contact with the placenta, fetus, fetal fluids and vaginal discharges from infected animals
  - Infection usually occurs by ingestion and through mucous membranes
  - Can be transmitted through broken skin
  - *In utero* infections also occur
  - Transmission by AI is reported, but venereal transmission is uncommon

- **Clinical signs**
  - In cattle, B. abortus causes abortions and still births; abortions usually occur during the second half of gestation.
  - The placenta may be retained and secondary metritis can occur.
  - Epididymitis, seminal vesiculitis, orchitis or testicular abscesses are sometimes seen in bulls.
  - Infertility occurs occasionally in both sexes due to metritis or orchitis/epididymitis.
  - Hygromas particularly on the leg joints, are a common symptom in some tropical countries.

Brucellosis, Hygromas on the knee joints. This condition may be a sequel to Brucella abortus infection

BRUCELLOSIS: CONTROL AND ERADICATIONS

- Control and eradication
  - Test and removal procedures or depopulation
  - Quarantine of infected herds
  - Cleaning and disinfection of the infected area
  - Culling affected animals advisable.

- Vaccination (in endemic areas)
  - Live attenuated vaccines are available
  - Strain 19 and RB51 are the most commonly used
  - The optimum age for vaccination is between 4 and 8 months.
  - Modified live *B. melitensis Rev. 1* strain for small ruminants
- Brucella infections are known to be persistent, so treatment with antibiotic is not recommended.

3.6 Foot and mouth disease

- It is a highly contagious viral disease that primarily affects cloven-hooved livestock and wildlife.

- It is economically significant disease:
  - Production losses, particularly to the dairy and pig industries
  - A major constraint to international trade in live animals and their products

- FMD virus is a member of the genus *Aphthovirus* in the family Picornaviridae

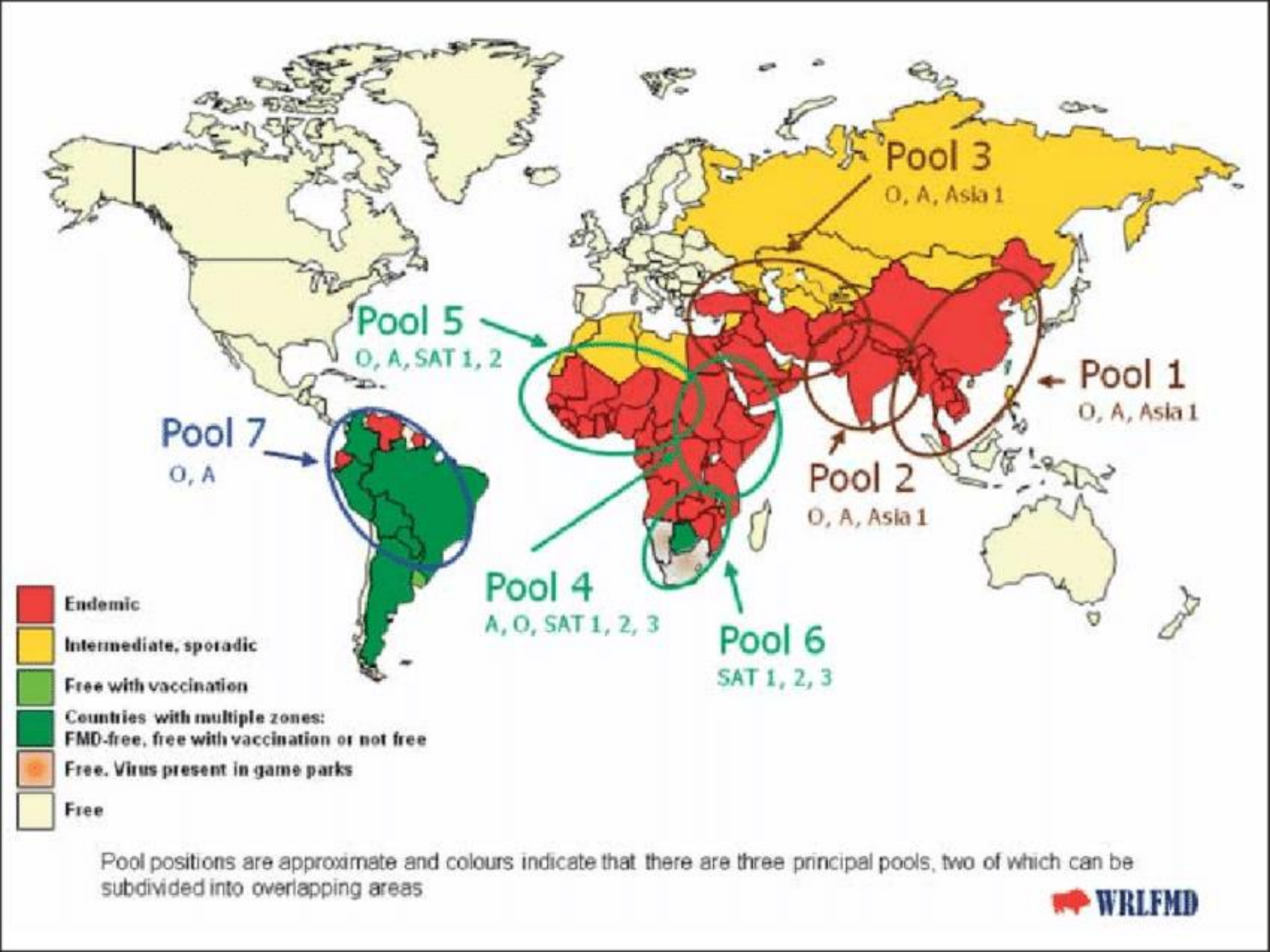
- There are seven immunologically distinct serotypes

  ~ O, A, C, SAT1, SAT2, SAT3 and Asia1

FMD: EPIDEMIOLOGY

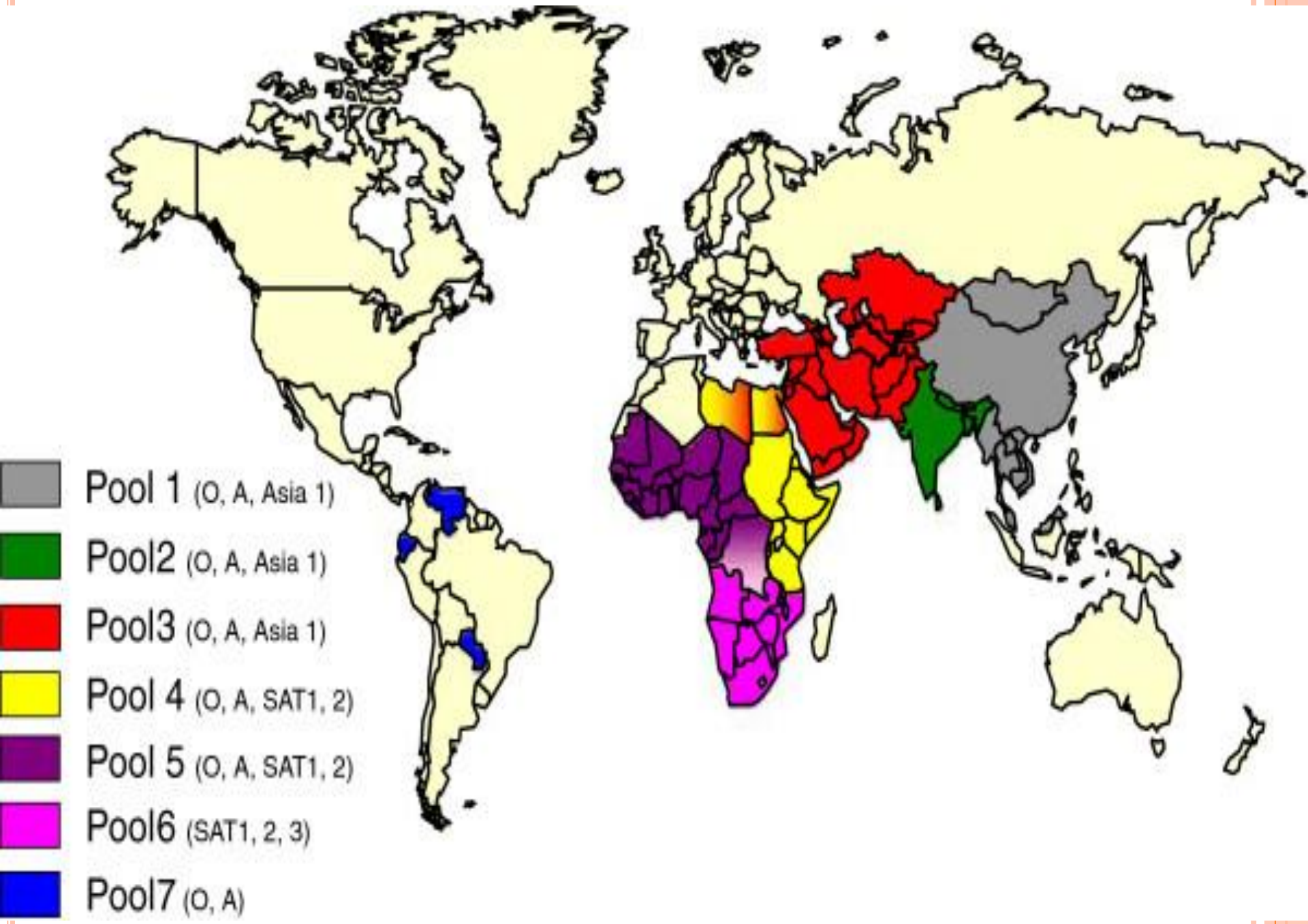
Distribution

- Endemic in parts of Asia, Africa, the Middle East and South America
- North America, New Zealand, Australia, Greenland, Iceland and most of Europe are free of this disease
- Serotype O, A and C virus are the widest distribution and have been responsible for outbreak in Europe, America and Asia.
  - The last reported outbreak due to serotype C FMDV was in Ethiopia during 2005
- SAT 1, 2, & 3 types are restricted to sub-Saharan Africa.



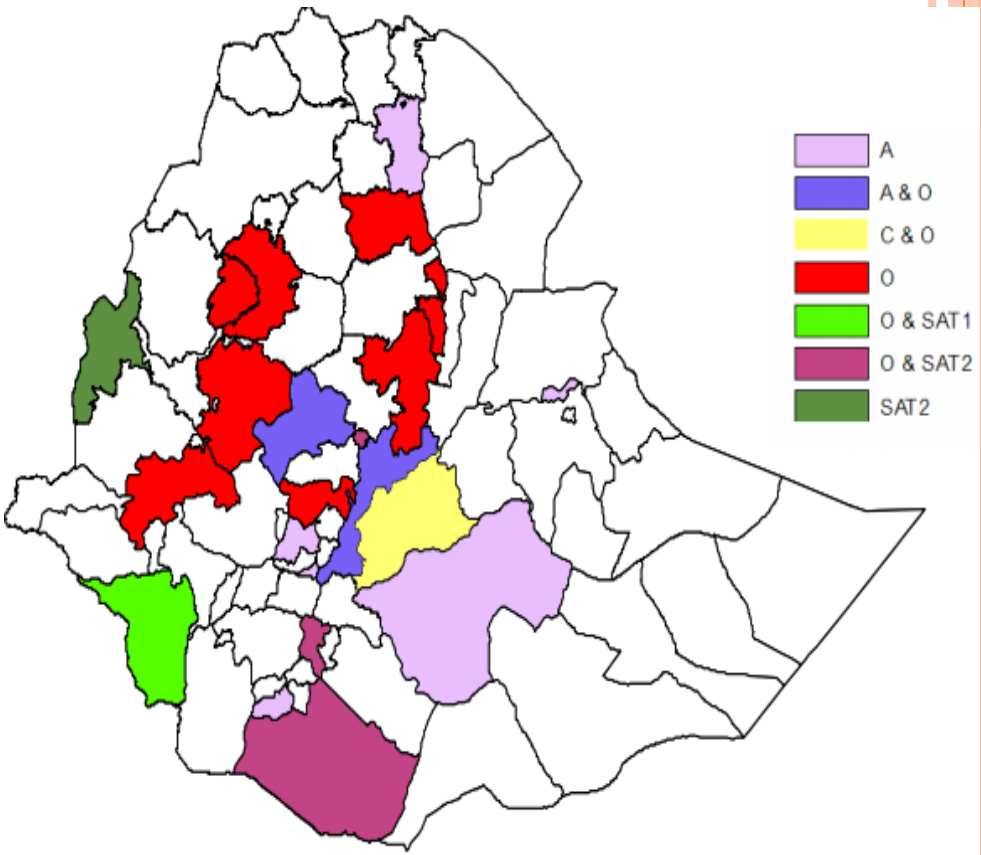
Pool positions are approximate and colours indicate that there are three principal pools, two of which can be subdivided into overlapping areas

WRLFMD


Pool 1 (O, A, Asia 1)
Pool2 (O, A, Asia 1)
Pool3 (O, A, Asia 1)
Pool 4 (O, A, SAT1, 2)
Pool 5 (O, A, SAT1, 2)
Pool6 (SAT1, 2, 3)
Pool7 (O, A)

In Ethiopia

- Serotype O and C was first reported in 1957
- Type C not recognized after 2005
- Serotype A in 1969
- Serotype SAT 2 in 1989
- Serotype SAT 1 in 2007



SEROTYPE OF FMDV ISOLATED IN ETHIOPIA DURING 1981-2008

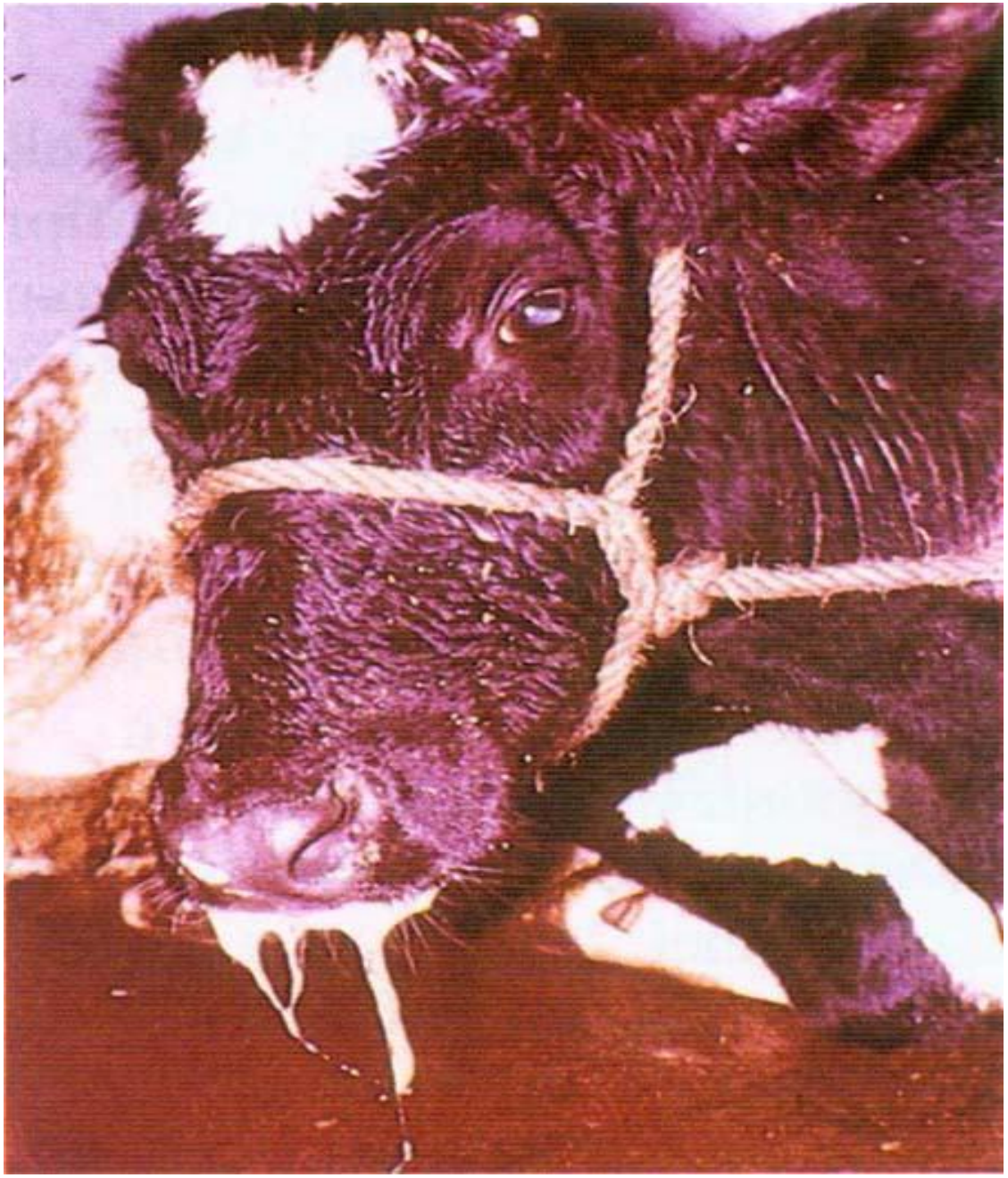
Gelagay Ayelet , 2008

FMD: EPIDEMIOLOGY…..

- ***Species affected***
  - Cattle, pigs, sheep, goats and buffalo are susceptible to FMD
  - Cattle and African buffalo (SAT type2) are the usual maintenance hosts for FMDV in Africa
- **Transmission**
  - Inhalation of aerosolized virus
  - Ingestion of contaminated feed
  - Entry through skin abrasions or mucous membranes
  - Morbidity is high in naïve and young population

FMD: CLINICAL SIGNS

- **Sheep**
  - Tendency to lie down and reluctance to move
  - Blisters in the mouth, on the tongue and on the hoof
- **Cattle**
  - Fever
  - Blisters/lesions in the mouth, on the tongue and hooves
  - Profuse salivation , drooling and nasal discharge
  - Lameness
  - Reduced milk yield



Excessive salivation in a cow affected with FMD

Extensive areas of eroded epithelium on a bovine tongue

FMD: PREVENTION AND CONTROL

- Restrictions on importation of animals and animal products from endemic areas
- Quarantine measures and animal movement restriction in case of outbreaks
- Euthanasia of infected, recovered, and susceptible contact animals
- Cleaning and disinfection of affected premises, equipment and vehicles

- Infected carcasses must be disposed safely by incineration or burial
- Good biosecurity measures on uninfected farms
- Vaccination
  - Inactivated virus vaccines are highly recommended
  - Live virus vaccines are not acceptable due to the danger of reversion to virulence

3.7. PESTE DES PETITS RUMINANTS (PPR)

- A highly contagious viral disease of sheep and goats
- Goats are usually more severely affected than sheep

Etiology

- PPRV is a member of the genus *Morbillivirus* in the family Paramyxoviridae
- PPRV is closely related antigenically to rinderpest virus

Geographic distribution

- Endemic in Sub-Saharan Africa, especially in countries between the Sahara and Equator
- Middle East, The Indian subcontinent
- Four genetic lineages (lineages 1-4) have been identified
- Lineages 1&2 occur in west of Africa
- Lineage 3 has been reported from East Africa, the Middle East, and southern India
- Lineage 4 has been found in the Middle East and the Indian subcontinent and recently in Africa

EPIDEMIOLOGY

- ***Species affected***

  - Primarily a disease of goats and sheep

  - Cattle and pigs are susceptible but do not exhibit clinical signs and are not known to transmit the disease to other animals

  - Country wide epizootic in Ethiopia (1995-1996) among small ruminant camels with high morbidity and mortality

- ***Transmission***

  - Mainly occurs during close contact.
  - Inhalation is thought to be an important route of spread
  - Morbidity and mortality rates can reach 100%, particularly in naïve herds
  - Mortality as low as 20% in endemic areas
  - No evidence of human infection

- **Clinical Signs Include:**

  - Sudden high fever, inappetence, marked depression and somnolence (sleepy) are initial signs

  - Serous nasal and ocular discharges, which progressively become mucopurulent appear

  - The gums become hyperemic, and small, gray, necrotic foci, covering shallow erosions, appear in the mouth.

- Most animals manifest severe diarrhea, often profuse but not hemorrhagic
- Severe dehydration, emaciation, and dyspnea followed by hypothermia
- Death usually occurs after a course of 5 to 10 days
- Brochopneumonia (coughing) in the later stages of PPR.
- Pregnant animals may abort

Depression, hemorrhage, diarrhea

DISCHARGE FROM THE EYES, NOSE, MOUTH AND EROSION IN THE MOUTH

CLOSE UP VIEW OF MOUTH LESIONS

CONTROL

- **Can be eradicated by:**
  - Quarantines
  - Movement controls
  - Euthanasia of infected and exposed animals
  - Cleaning and disinfection of infected premises

- **In endemic areas**
  - Vaccination
  - Good nursing and treatment for bacterial and parasitic complications
  - PPR vaccine is available in Ethiopia