Kilimanjaro Christian Medical Centre

Emerging Challenges

Trends and Threats

The 86th KCMC Post Graduate Seminar, 22nd – 24th Oct, 2014

Ebola: Epidemiology and Transmission

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Viral Hemorrhagic Fevers

- HF, caused mainly by deadly viruses.
- Cause severe & life-threatening diseases.
- All agents cause sporadic disease.
- Emerging & re-emerging infectious agents.

Hemorrhagic fever viruses

- All have RNA genome.
- With lipid envelopes.
- Viruses of four distinct families (VHFV)
  - Arenaviruses-LASV, LUJV
  - Bunyaviruses-RVFV, CCHV, HV
  - Flaviviruses-YFV, DV
  - Filoviruses-MDV, EDV

Ebola

“The Deadly African Virus”
“Hot virus”

WHO,.. 8th August, 2014 ….

International Health Regulations Emergency Committee
(GENEVA)

The World Health Organization declared the West African, 2014 Ebola epidemic an…

“International Public-Health Emergency”

And,…

The current outbreak is the deadliest since Ebola was discovered in 1976

Zaire-Democratic Republic of Congo(DRC)

Why Ebola is so dangerous,..?

- Extraordinary VIRULENT virus

Human to Human Trans;

- Most dangerous,…..

- Level 4 pathogen

- **Sudden** onset of fever, intense weakness, muscle pain and a sore throat (WHO).

- In some cases - **bleeding**.

No licensed drugs or vaccine

Epidemiology

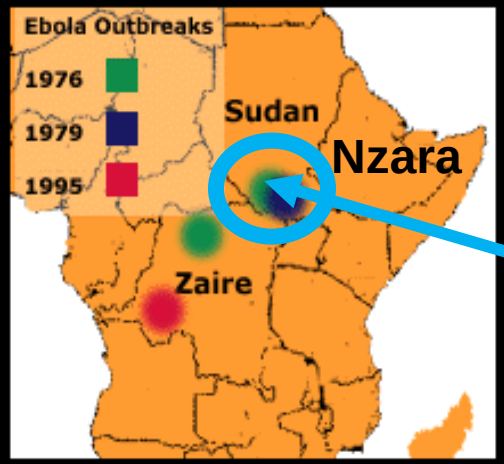
Epidemiology

- EHF was first found in 1976

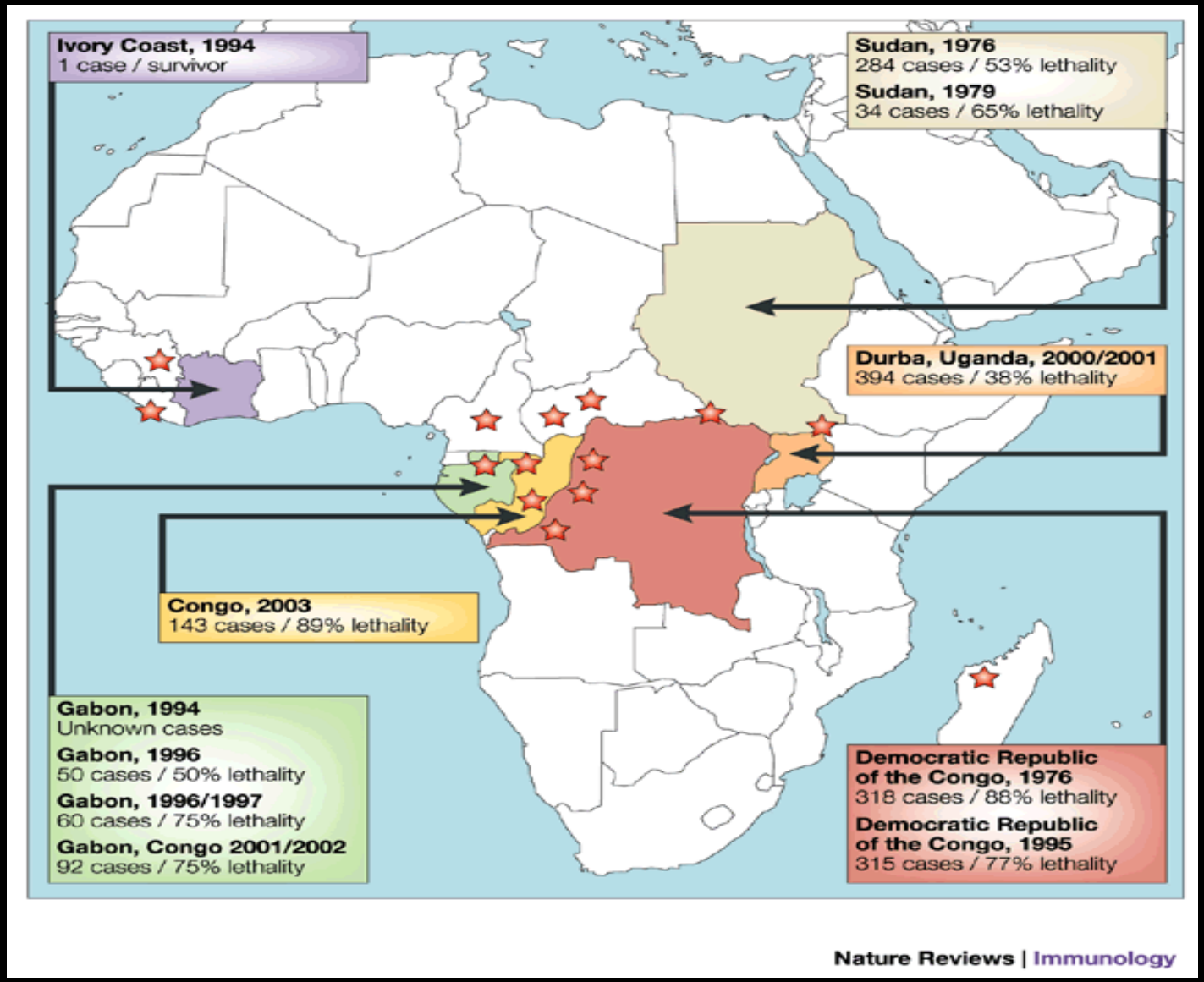
- It struck two countries,…Mortality Rate, 50 –90%
  - Sudan – in a town called N'zara
  - Zaire, now known as the DRC

- Ebola has hit Afr several times. The worst being in the yr 2000 in Uganda (about 400 people died).

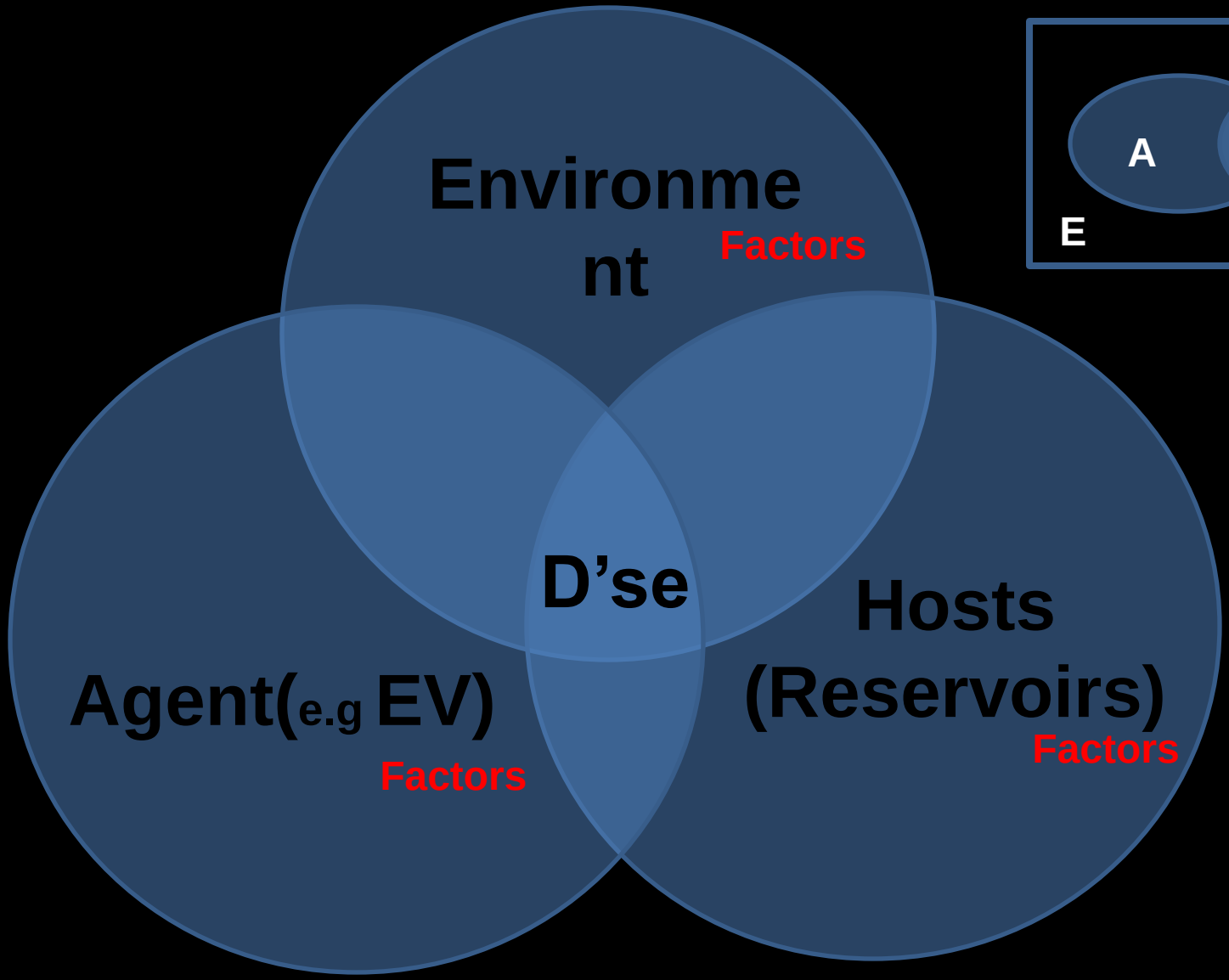
Zaire =DRC in 1976

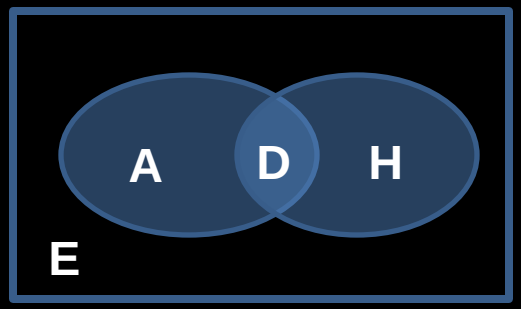


The Deadly African Virus

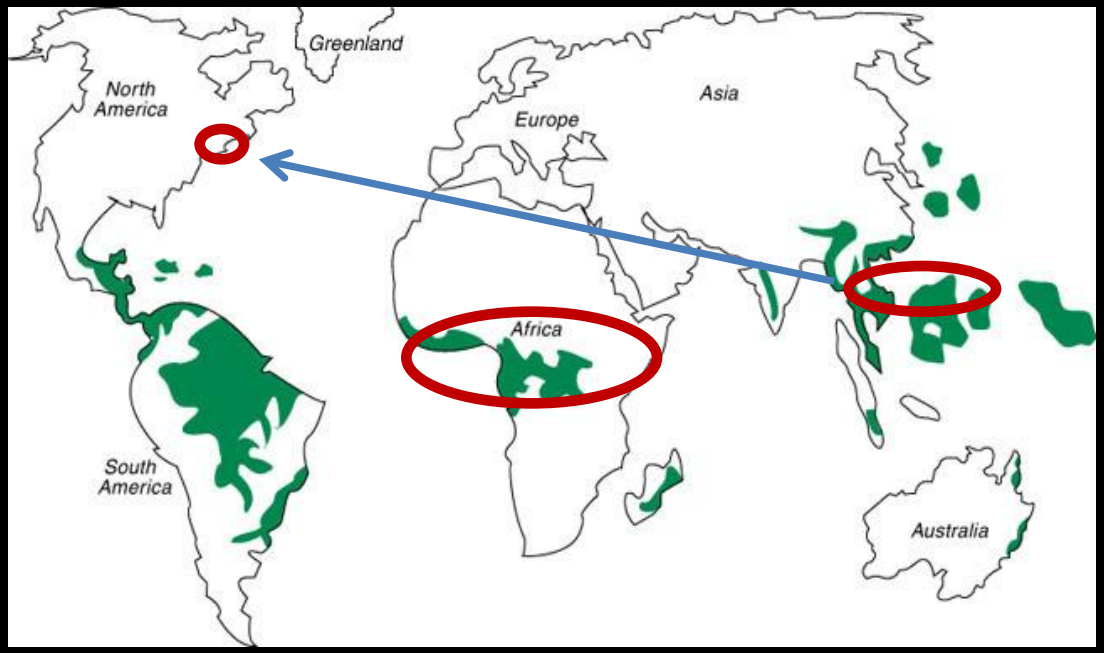


Triad of causal factors: Ebola





The Tropical rain forests: Ebola



The disease has just hit countries with Tropical rain forests

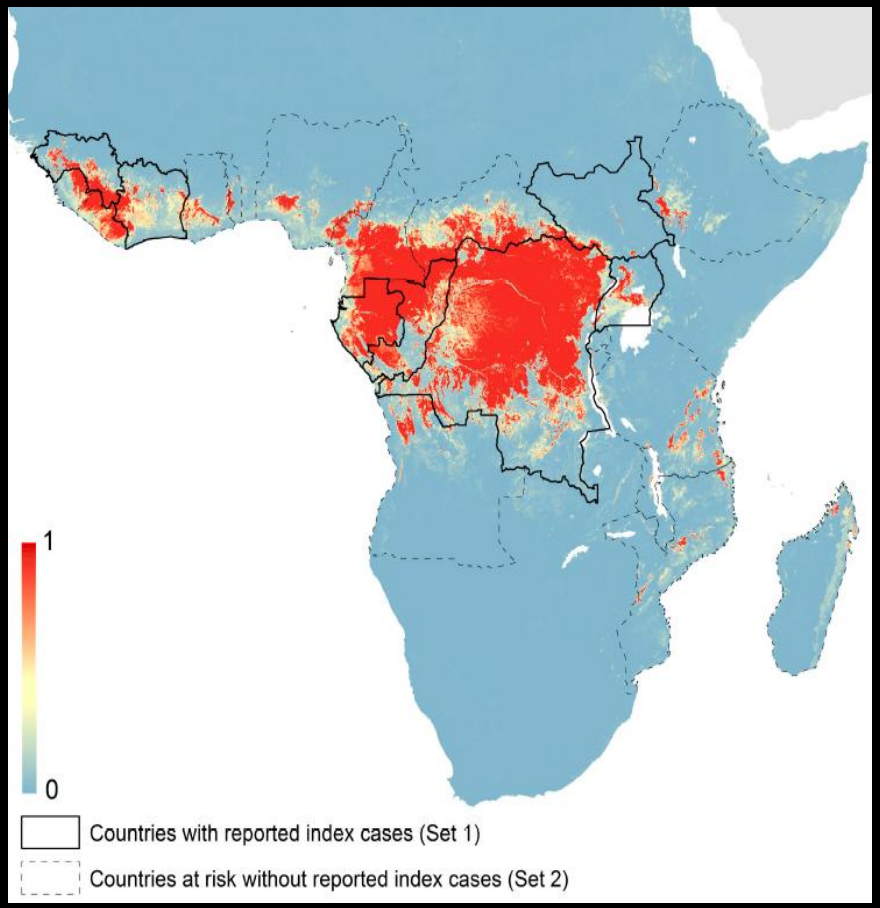
About 40 to 100 different species in a hectare of a tropical rain forest.

Estimate is 50 million animals are living TRFs

Environ Suitability: Zoonotic Trans

Presence of reservoir animals species,….

- Record of human index case(Set 1)
- Set 2, no report of index case, presence of reservoirs



Mapping the zoonotic niche of Ebola virus disease in Africa (Pigott *et al*., 2014)

The virus

RNA virus (Ebola Virus):

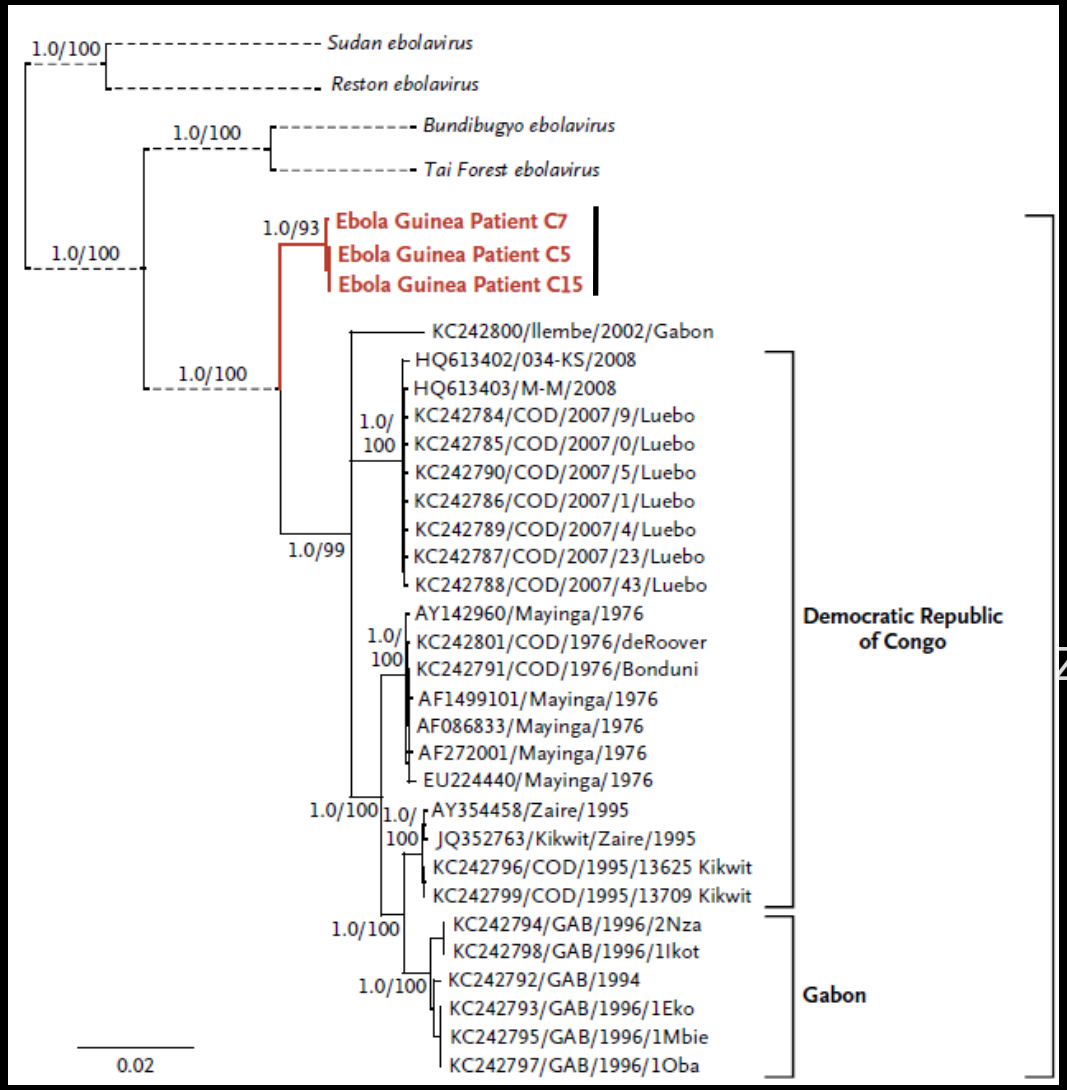
- Neg sense, ssRNA, linear, non segmented)
- Approx. 19 kb in length
- Filamentous, Enveloped virus
- Survival depends on an animal or human host and **natural reservoir.**

The Virus

- Genus Ebolavirus is 1 of 3 members of the *Filoviridae* family.

- Genus Ebolavirus comprises 6? Species,..
  - -Bundibugyo ebolavirus (BDBV)
  - -Zaire ebolavirus (EBOV)
  - -Sudan ebolavirus (SUDV)
  - -Ebola Ivory-Coast (ICEBOV)
  - -Reston ebolavirus (RESTV)
  - -**West Afr ebola virus (WAEV),….?????**

PA of the Genus Ebolavirus



Zaire ebolavirus
Topotype

Emergence of Zaire Ebola Virus Disease in Guinea — Preliminary Report (Baize *et al*., 2014)

Where does EV hide?

ENDANGERED APES: RAINFOREST CHIMPANZEE

- Large numbers of Chimpanzee have been killed in recent years by human diseases.
- Most notably the dreaded and incurable EDV/MV.

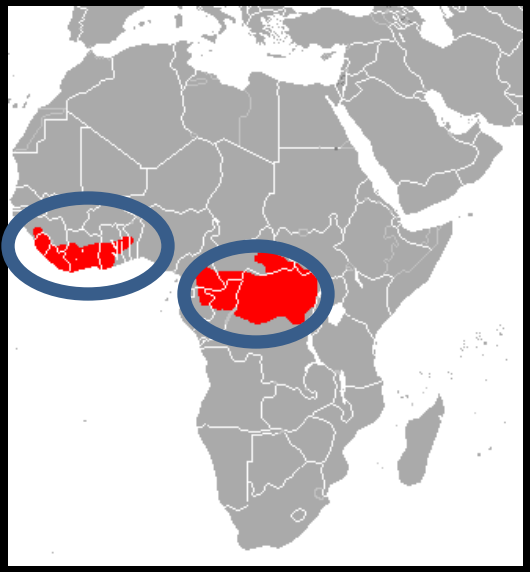
Endangered Apes: Chimpanzee (*Pan troglodytes*)

DEAD END HOSTS

http://www.allaboutwildlife.com/endangered-species-rainforest-gorillas 13th Sept, 2014

Where does EV hide?

FOREST ANTELOPES: *TRAGELAPHUS EURYCERUS*



DEAD END HOSTS,..?

Populations have been greatly reduced by hunting, poaching, and animal trapping

Under intense pressure from illegal market hunting- **”bush meat”.**

Where does EV hide?

- **2002- Fruit Bats**
- Ebola Gene sequences in liver and spleen
- Fruit bats do not show any symptoms
- Best candidate to be the reservoir
  - More research needs to be done

Natural host of the virus

Vol 438|1 December 2005 nature

BRIEF COMMUNICATIONS

Fruit bats as reservoirs of Ebola virus

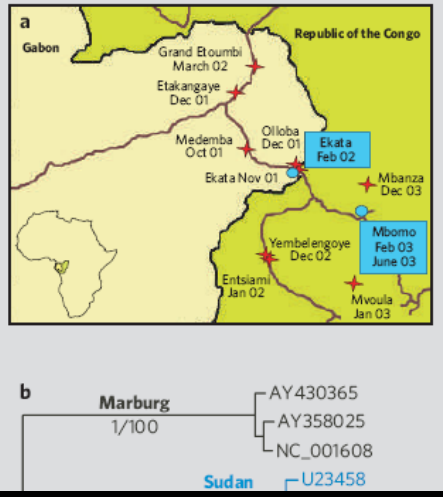
Bat species eaten by people in central Africa show evidence of symptomless Ebola infection.

The first recorded human outbreak of Ebola virus was in 1976, but the wild reservoir of this virus is still unknown[1]. Here we test for Ebola in more than a thousand small vertebrates that were collected during Ebola outbreaks in humans and great apes between 2001 and 2003 in Gabon and the Republic of the Congo. We find evidence of asymptomatic infection by Ebola virus in three species of fruit bat, indicating that these animals may be acting as a reservoir for this deadly virus.

Human Ebola outbreaks that occurred between 2001 and 2005 in Gabon and the Republic of the Congo were linked to concurrent outbreaks that devastated local gorilla and chimpanzee populations[2,3]. To identify the viral reservoir, we undertook three trapping expeditions in areas close to infected gorilla

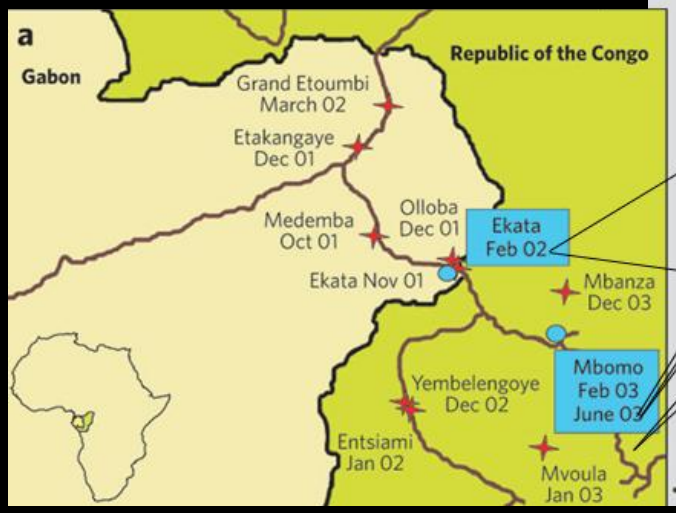
be because PCR-positive bats were recently infected and were tested before they developed a detectable immune response. Alternatively, it could be that differences in the virulence of Ebola virus strains led to different immunological responsiveness and viral replication patterns. Of the bat species collected at Mbomo in February 2003, 7 of 31 (22.6%) and 0 of 10 (0%) were PCR-positive and IgG-positive, respectively, but five months later the corresponding results were 4 of 184 (2.2%) and 12 of 160 (7.5%). These opposite trends in the PCR and serological results are consistent with the first hypothesis.

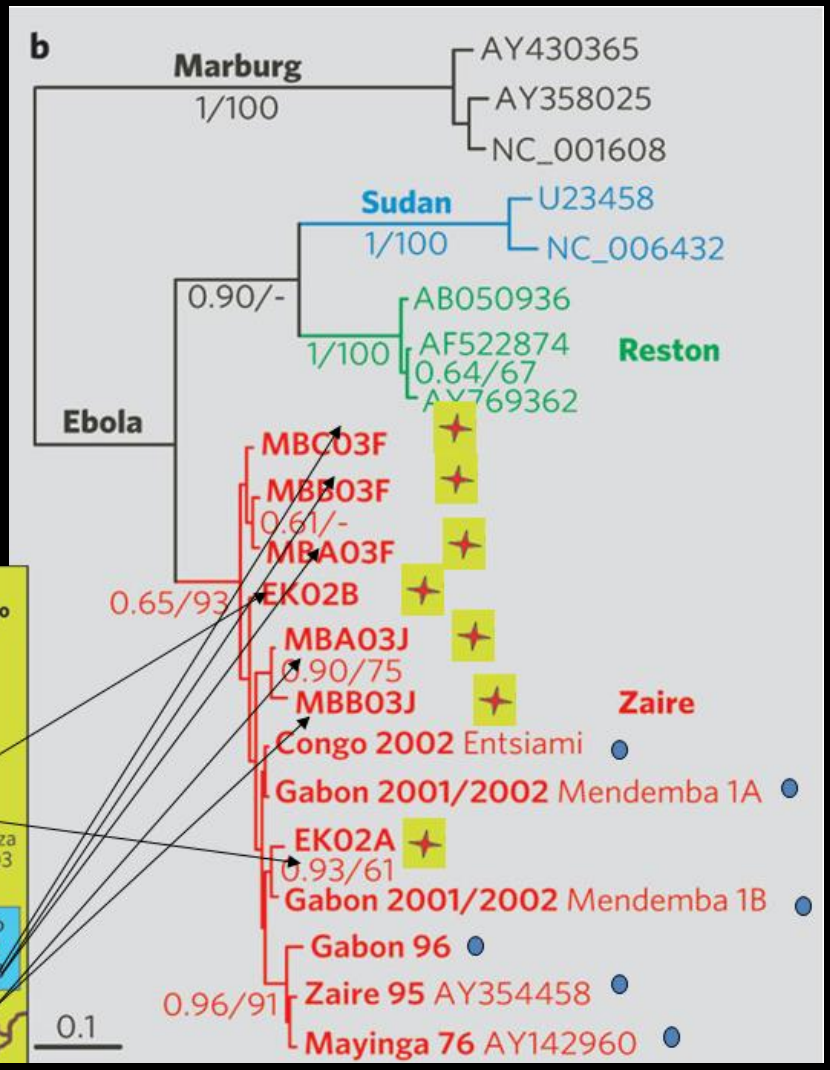
Each of the three bat species has a broad geographical range that includes regions of Africa where human Ebola outbreaks occur[5] (Fig. 1c). Our findings support results of



The genetic relationship

- MP analysis supported the viruses are closely related.
- Viral nucleotides were discovered in 3 species of bats.





Kumulungui., 2013

Pteropodidae family

Hypsignathus monstrosus

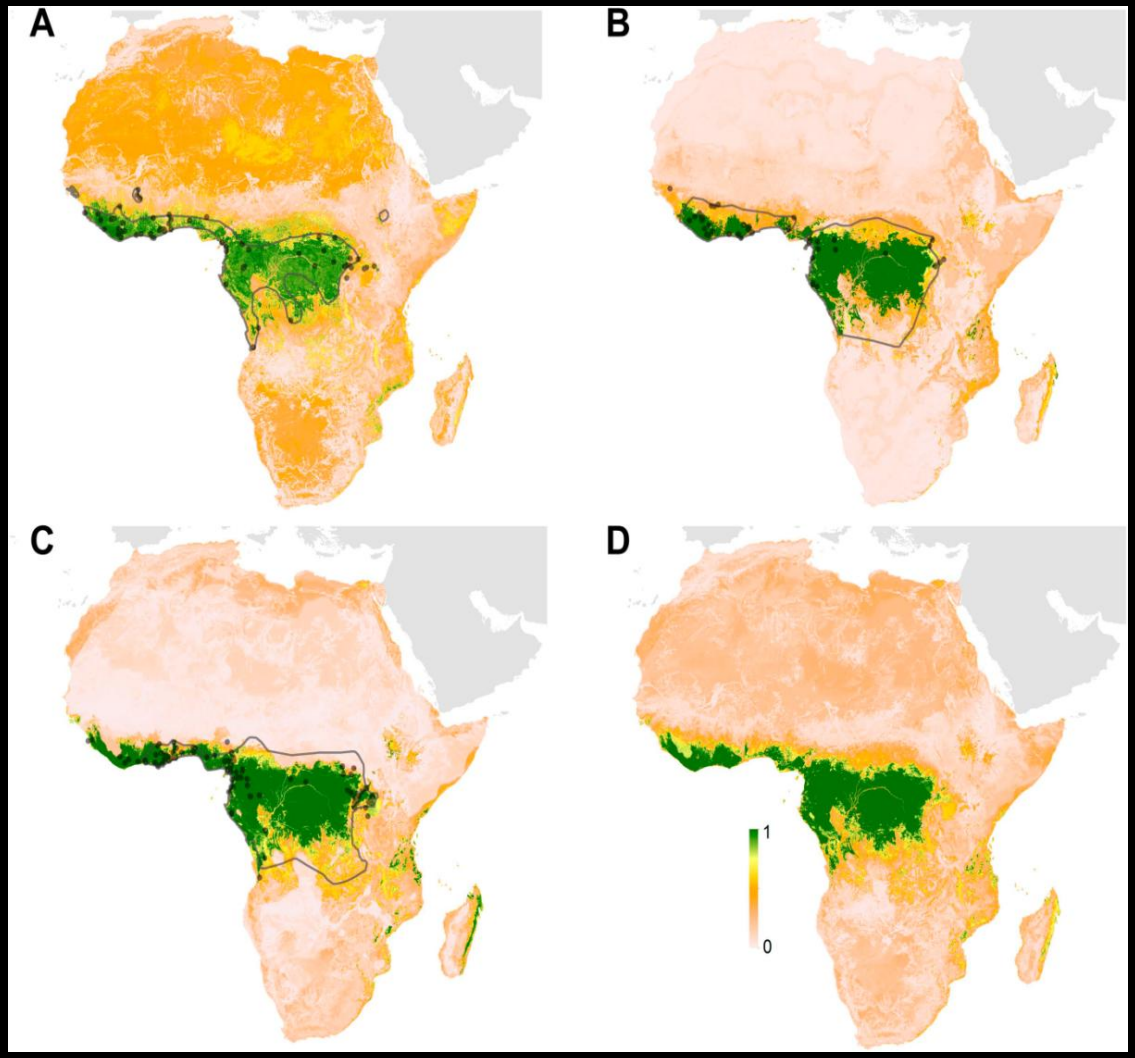
The hammer-headed bat

Epomops franqueti

Myonicteris torquata

The Little Collared Fruit Bat

Geographical distribution of FBs

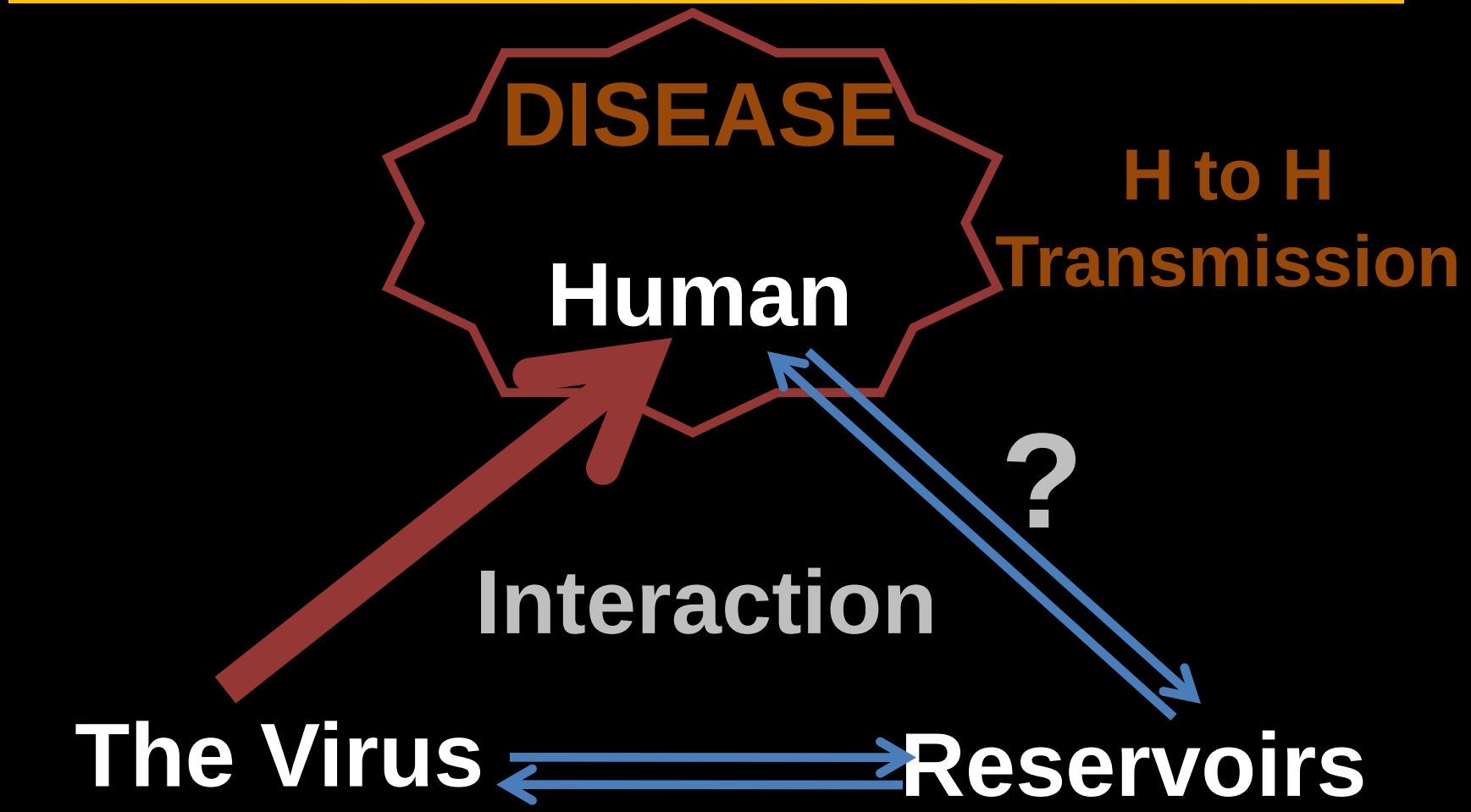


A. *Hypsignathus monstrosus* ***B.*** *Myonycteris torquata)* ***C.*** *Epomops franqueti* ***D.*** Mean from (A–C). Mapping the zoonotic niche of Ebola virus disease in Africa (Pigott *et al*., 2014)

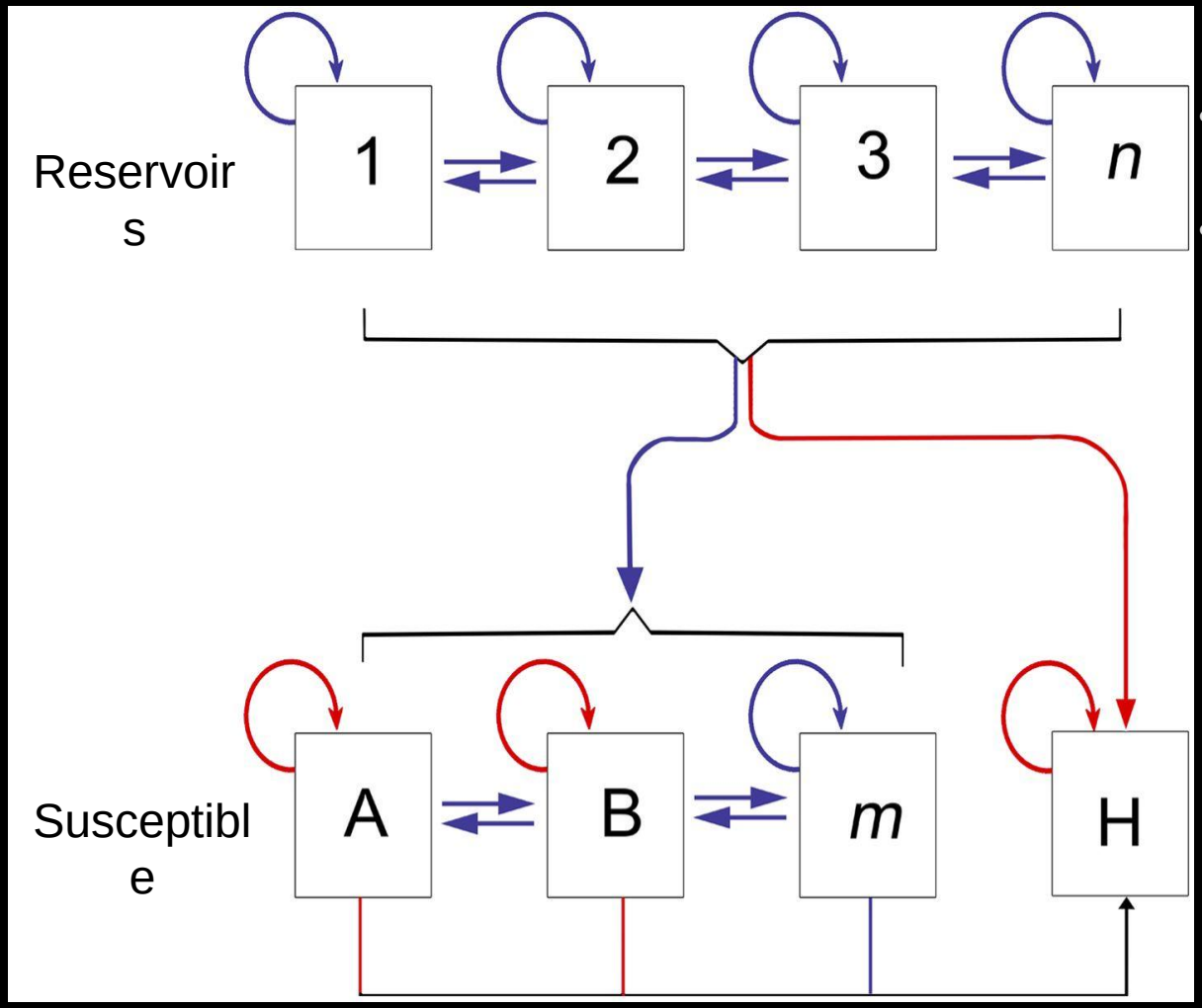
Humans-Dead end hosts

Transmission

Inter play of three factors



Transmission



- 1,2 & 3-Fruit bat ssp
- n – Unknown ssp

A & B – Gorilla and Chimpanzee

m – Unknown ssp

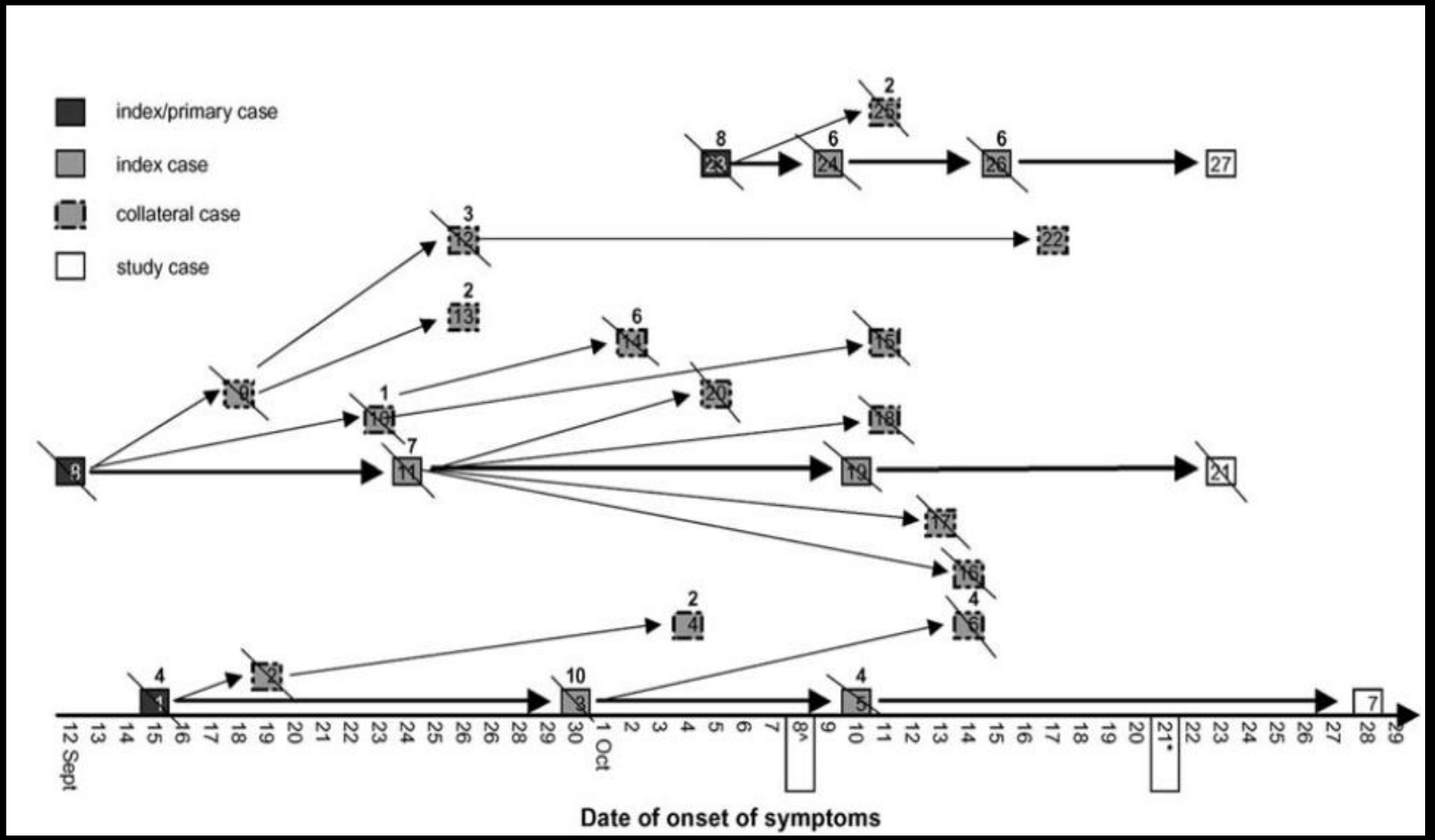
H – Human

Mapping the zoonotic niche of Ebola virus disease in Africa (Pigott et al., 2014)

Transmission

- **Contact with infected person or cadaver.**
  - **Direct contact with:**
    - Blood or body fluids (such as saliva, sweat, semen, breast milk, stool or urine).
    - Infected animal products (bush meat).
  - **Indirect contact with:**
    - Contaminated environments (hospital, burial areas).
    - Contaminated objects (hospital, house hold,

Chains of transmission



Chains of transmission relative to 27 Ebola cases, Gulu District, Uganda (September–October 2000). Francesconi et al., 2003

International travel,…

- Human to Human Transmission
- The world wide threat,….

Kenya Airways - The Pride of Africa

Bajaj – Pride of Dar

July, 2014: **Ebola in Nigeria**

Mr. Sawyer had flown in from Liberia, and collapsing at the airport in Lagos.

Flown in Nigeria on 20th July, and died 25th July, In Lagos.

One Dr and **70 other people** who were in contact with him, kept in **ISOLATION**.

Sept, 2014:Ebola in Dallas, USA

Thomas Eric Duncan

Passenger Health Screening Form — **Roberts International Airport, LIBERIA**

Visual Assessment ☑ Clear ☐ Secondary — Temperature (°C) 36.3 AFC

FOR OFFICIAL USE ONLY ABOVE LINE

Dear Traveler: Due to an outbreak of Ebola, public health officials are asking travelers to complete the following health declaration form. We need your help to prevent the spread of this disease.

(*Name as it appears on your travel and boarding documents*) DATE (DD/MM/YY) 19/09/2014

Surname: DUNCAN First name: THOMAS

Other name(s): ERIC

Phone number(s) with country code: 1) +231 880265145 2) +231 -

Country Issuing Passport: LIBERIA

Airline and Flight Number BRUSSELS SN1241 Final Destination: DALLAS

Have you had any of the following symptoms today OR within the past 2 days?	Yes	No
Fever of 37.5°C or feeling feverish		✓
Headache		✓
Vomiting		✓
Diarrhea		✓
Exhaustion/intense fatigue		✓
Loss of appetite		✓
Stomach or abdominal pain		✓
Muscle or joint pain		✓
Red eyes (conjunctivitis)		✓
Unexplained bleeding (bleeding from mouth, nosebleed, bloody vomit, bloody/black diarrhea, coughing blood)		✓
In the last 21 days, have you experienced any of the following?	**Yes**	**No**
Have you been stuck with a needle used on an Ebola patient?		✓
Have you had body fluids of an Ebola patient in your eyes, nose or mouth?		✓
Have you taken part in a burial or funeral rites, or touched the body of someone who died in an area where there is Ebola?		✓
Did you stay in a house with or have other casual contact with an Ebola patient?		✓
Have you taken care of an Ebola patient or come into contact with body fluids of an Ebola patient?		✓
If your answer was yes, did you ***always*** use a mask and gloves, and other protection?		N/A
Have you worked in a laboratory that processes body fluids of confirmed Ebola cases?		✓
If your answer was yes, did you ***always*** use personal protective equipment?		N/A

Ebola patient dies at Dallas hospital

The first Ebola patient diagnosed in the United States died in a Dallas hospital, a little more than a week after his diagnosis exposed gaps in the nation's defenses against the disease.

TIMELINE OF THE EBOLA-INFECTED PATIENT

Sept. 19: Thomas Eric Duncan departs from Liberia.

Sept. 20: Arrives in Dallas to visit relatives

Sept. 24: Feels ill and begins displaying symptoms associated with Ebola.

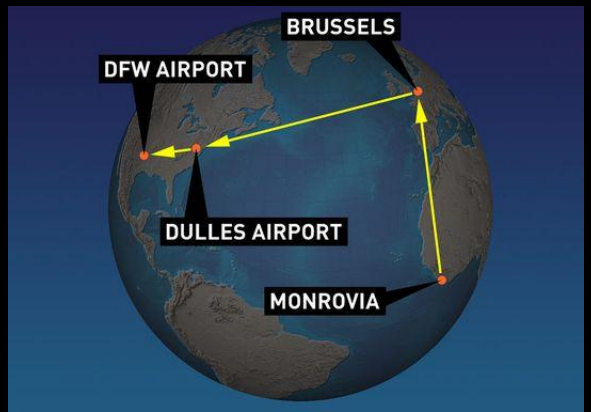
Sept. 25: Seeks medical care from Texas Health Presbyterian Hospital but is released.

Sept. 28: Returns to the hospital after his condition worsens. Hospital staff discover the West Africa connection and admit him under strict isolation.

Sept. 30: Blood tests confirm his Ebola diagnosis. Authorities begin tracking down anyone who may have come in close contact with Duncan.

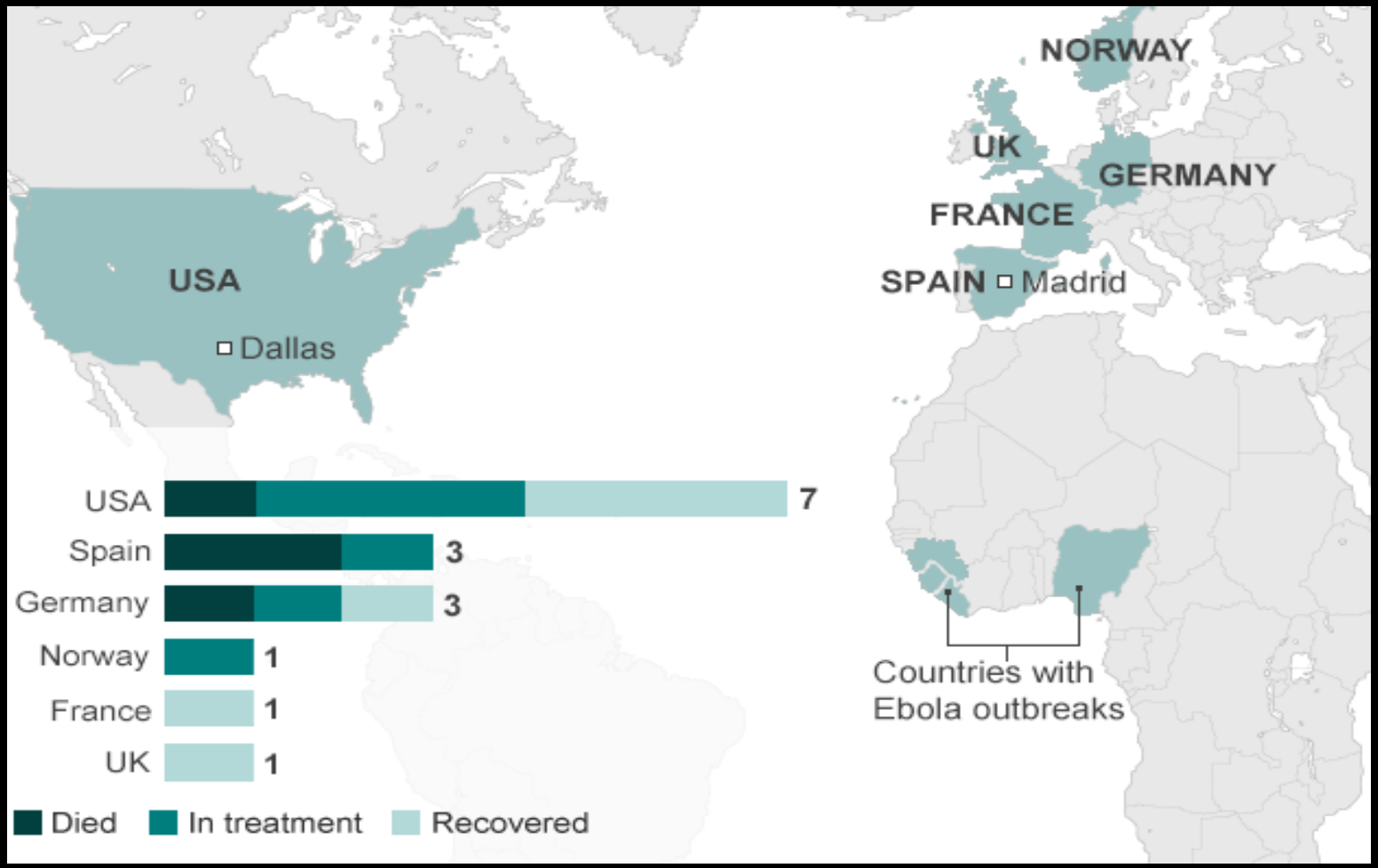
Oct. 8: Duncan is pronounced dead at 7:51 a.m. His condition had been downgraded from serious to critical on Oct. 4.

SOURCE: World Health Organization AP



2 cases of H to H transmission,
about 152 being monitored

The transmission-world status



15th October, 2014, BBC

Discussion

- Urbanization and population growth.
- International travel.
- Deforestation and climate change.
- Political unrest.
- Breakdown of public health measures.

"The up-rise incidences of VHFs are mostly due to human activities".

Conclusion

- The nature of the EID poses a continuing challenge, which is volatile & ever-changing.

- Includes a need for;
  - Early detection.
  - Rapid response.
  - Close surveillance activities.
  - Outbreak control, by multi-disciplinary teams

"one-health" approach is key to public health.

SACIDS, 2014

References

Francesconi *et al*. (2003). Hemorrhagic Fever Transmission and Risk Factors of Contacts, Uganda. *Emerging Infectious Diseases*; 9(11): 1430–1437

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SACIDS: What are the lessons learned from a coordinated network response in east africa? http://www.sacids.org 26th Sept, 2014

Acknowledgement

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Gerald Misinzo Ph.D (Virologist)
SUA & SACIDS

The End,...Thanks