

FILOVIRIDAE

FILOVIRUS

1. MARBURG-LIKE VIRUSES

(1967) 20-50% MORTALITY

2. EBOLA-LIKE VIRUSES

A. EBOLA ZAIRE (1976) 77-100%
MORTALITY

B. EBOLA SUDAN (1976) 53-65%
MORTALITY

C. EBOLA RESTON (1989) NO MORTALITY

FILOVIRUSES

- FILO = THREAD-LIKE VIRUSES
- THEY ALL CAUSE SEVERE HEMORRHAGIC FEVERS
- THE NATURAL HOST IS UNKNOWN.

- MARBERG VIRUS. THE NAME COMES FROM MARBURG, GERMANY.
- IN 1967 THERE WAS AN OUTBREAK OF HEMORRHAGIC FEVER IN MARBURG AND FRANKFURT, GERMANY AND BELGRADE, YUGOSLAVIA.
- IT WAS ASSOCIATED WITH AFRICAN GREEN MONKEYS IMPORTED FROM UGANDA INTO EUROPE FOR USE IN KIDNEY CELL CULTURE.
- 31 PEOPLE BECAME INFECTED AND 7 DIED (23%).

MARBURG-LIKE VIRUS

YEAR	COUNTRY	CASES/ %MORTALITY
1975	ZIMBABWE	3 (33%)
1980	KENYA	2 (50%)
1987	KENYA	1 (0%)
1998-2000	ZAIRE	99 (80%)

- EBOLA VIRUS WAS NAMED AFTER A RIVER IN THE DEMOCRATIC REPUBLIC OF CONGO, FORMERLY ZAIRE.
- TRANSMISSION IS PERSON TO PERSON VIA BLOOD AND OTHER BODY FLUIDS.
- IN 1976, THERE WAS A SEVERE EPIDEMIC OF HEMORRHAGIC FEVER IN ZAIRE AND SUDAN.
OVER 600 PEOPLE WERE INFECTED AND 430 DIED.

YEAR	COUNTRY	CASES/ % MORTALITY
1976	SUDAN	284 (53%)
1976	ZAIRE	318 (88%)
1977	ZAIRE	1 (100%)
1979	SUDAN	34 (65%)
1994	GABON	44 (64%)
1994	IVORY COAST	1 (0%)
1995	ZAIRE (KIKWIT)	315 (77%)
1996	GABON	37 (57%)
1997	GABON	60 (75%)
2000	UGANDA	425 (53%)

YEAR	COUNTRY	CASES/% MORTALITY
2001	GABON	65 (82%)
2002	REPUBLIC OF CONGO	8 (83%)
2003	REPUBLIC OF CONGO	143 (90%)
2003	REPUBLIC OF CONGO	42 (69%)

EBOLA ZAIRE





SYMPTOMS OF EBOLA HEMORRHAGIC FEVER

- FEVER BEGINS 4 TO 16 DAYS AFTER INFECTION.
- PERSONS DEVELOP FEVER, CHILLS, HEADACHES, MUSCLE ACHES, AND LOSS OF APPETITE.
- LATER THERE IS VOMITING, DIARRHEA, ABDOMINAL PAIN, SORE THROAT AND CHEST PAIN.

- Symptoms of Ebola start out mild, with flu-like symptoms. Headache, body pains, and fatigue are likely to occur. However, the virus starts to work quickly....
- Your bloodstream starts to fill with small blood clots, which slows the blood. Some of these clots stick to blood vessels' sides. (This is called paving, because the clots resemble a mosaic).

- These clots are very dangerous; they clog up capillaries, which shuts off blood supply to various parts of the body, such as the kidneys, lungs, intestines, liver, brain, and throughout the skin.
- Your skin starts to get these little red dots all over it, which are hemorrhages under the skin (petechiae). It attacks connective tissues that hold your organs together, destroys collagen, and liquefies the under layers of skin. White blisters appear alongside the red dots (called a maculopapular rash, and looks like tapioca pudding). Rips easily occur in the skin, and hemorrhagic blood spills out. The rash develops into bruises, and the skin becomes pulpy and soft.

- Your connective face tissues are destroyed, and your face takes on hollow, mask-type look. Your eyes also turn bright red, and may be fixed in one position.
- Your gums, mouth linings, and salivary glands start hemorrhaging. The surface of the tongue turns bright red, and dissolves. The lining of your throat also dissolves. Then the black vomit starts.....
- Your heart starts bleeding in itself, and blood starts to fill the chest cavity. Blood clots in the brain kill brain cells, which is known as sludging of the brain. The linings of the eyeballs may fill with blood, and you could go blind. You may even weep blood.
- You could possibly have a hemispherical stroke, in which parts of your body may become paralyzed, or could be fatal.

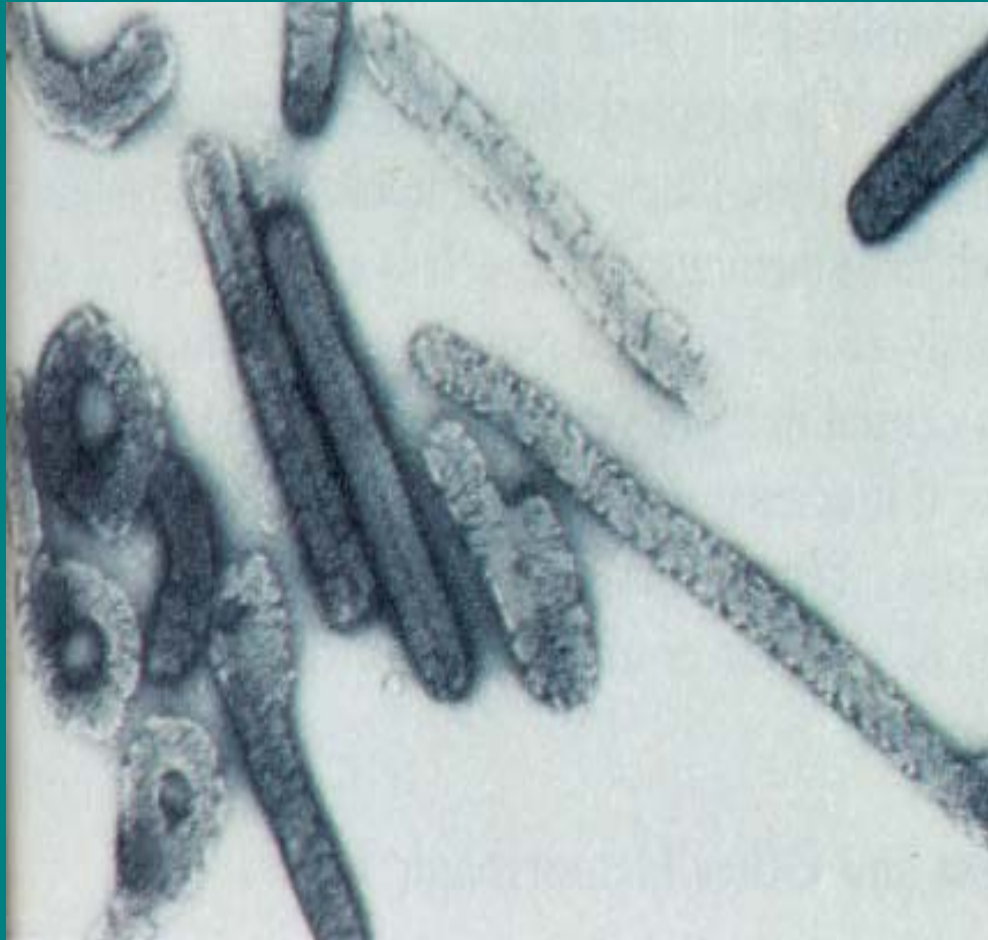
- Since your organs are clogged with coagulated blood, the blood that you bleed does not clog. In this blood, the red blood cells have been destroyed. Ebola kills many tissues while you are still alive...
- The liver turns yellow, bulges, and may start to dissolve. The kidneys may fail, the spleen hardens, and the intestines fill with blood. If the victim is pregnant, she will abort her baby, which is filled with Ebola virus particles and has red eyes.

- Ebola destroys the brain thoroughly, and you would probably have epileptic convulsions, or grand mal seizures. The entire body violently shakes. If you don't die from a stroke or organ failure, then you will have to suffer from "crash and bleed"....
- You hemorrhage through almost every opening of your body. Your body, already damaged from shock, heated by fever, and slowly being destroyed tissue by tissue, quickly "crashes" from blood loss.
- After the body is clinically dead, body tissues (skin, organs, etc.) liquefy, and the fluids are filled with Ebola virus particles.

EBOLA SUDAN

- Beginning in late 2002 and continuing in 2003, Ebola virus has been causing devastating mortalities in humans and wildlife in the northwest section in the Republic of Congo. As of mid-March, close to 200 people have died in the villages of Kelle and Mbomo. In a village-created protected area (the Lossi Sanctuary) located between these two villages, the death of hundreds of gorillas and chimpanzees is now being discovered. To date, gorilla mortality appears to be about half of the previously estimated population of 1200 living in and around the sanctuary.

EBOLA VIRUS (FILOVIRUS)



- Colorized transmission electron micrograph of Ebola virus.

MORPHOLOGY OF AN ENVELOPED HELICAL VIRUS



- Colorized transmission electron micrograph of Ebola virus, a filovirus showing helical rods.

EBOLA RESTON

- IN LATE 1989 A NOVEL EBOLA VIRUS INFECTED A COLONY OF CYNOMOLGUS MACAQUES THAT HAD BEEN IMPORTED FROM THE PHILIPPINES TO WESTON, VIRGINIA. THE VIRUS WAS TRANSMITTED FROM MONKEY TO MONKEY VIA RESPIRATORY DROPLETS. AS A RESULT ALL OF THE MONKEYS DIED QUICKLY.



- **Ferlite Farms**

Ferlite Farms is located in a 2.5 to 3-hectare area in Calamba, Laguna, Philippines, which is approximately 40 km South of Manila. Ferlite uses open cages as their holding facilities. Individual cages are used in their quarantine facility. Until 1996, Ferlite exported 1500 monkeys annually to the United States. The monkeys used for breeding come from Zamboanga and Iligan City. Supposedly, Ferlite quarantines the monkeys 30 days prior to shipping. All of the monkeys at Ferlite were killed after this outbreak of EBO-R in 1989

- FOUR MEN WHO WORKED IN THE MONKEY HOUSE EVENTUALLY TESTED POSITIVE FOR THE VIRUS. THEY BECAME INFECTED WITH THE VIRUS BUT NONE BECAME ILL.
- IN 1992 A REPEAT OF THE RESTON EPISODE OCCURRED IN SIENA, ITALY WHEN MACAQUES WERE IMPORTED FROM THE SAME SUPPLIER IN THE PHILIPPINES.

EBOLA Cote d'Ivoire

- A GENETICALLY DISTINCT EBOLA VIRUS WAS DISCOVERED IN 1994. A SWISS ZOOLOGIST (ETHOLOGIST) PERFORMED AN AUTOPSY ON AN INFECTED CHIMP AND BECAME ILL BUT DID NOT DIE.

- **The Infected Ethologist**

A 34-year-old female Swiss ethologist, one of the three scientists performing the necropsy on the chimpanzee found on November 16, 1994, contracted Ebola, presumably from the necropsy. During the necropsy of the chimpanzee, she wore household latex gloves that were in poor condition. During the necropsy, she noted no wounds or punctures. Transmission of Ebola to the ethologist probably occurred as a result of contact with the chimpanzee blood either by the projection of droplets onto the face, particularly mucous membranes, or on the hand.

- She developed a "dengue-like" syndrome on November 24th (eight days after performing the necropsy) that was later diagnosed as EHF. After checking herself into the Abidjan hospital, she was transported to Switzerland for treatment. She received a rigorous treatment of fluid and electrolyte replacement therapy. Despite the lack of strict containment measures, no secondary transmission occurred.

- The lack of secondary transmission even though strict containment measures were not taken supports the theory that Ebola is not respiratory/aerosol transmitted and transmission requires direct contact with the patient or the patient's bodily secretions/fluids. On day 15 of her hospitalization, she was discharged from the hospital. She did not fully recover until 6 weeks after her infection.



- **Background on Tai National Park**

The Tai National Park (436,000ha) is the last and largest of the tropical rain forest belt in West Africa and is located in the southwest Cote d'Ivoire near the Liberian border. It's classified as a Biosphere Reserve and is unique for its biological diversity and numerous endemic species.

- Hundreds of chimpanzees and Western Red Colobus monkeys (*Colobus badius*) live in the Tai Forest. Emergent trees 40-60 meters tall tower over canopy trees 30 meters tall. Average temperature is 25°C with constant humidity. Average rainfall is 1900mm per year. There are two periods of light rainfall: December to February (<70 mm/month) and August (140 mm).

- 1995. Liberia transported to Cote d'Ivoire. A chief of a troupe of 17 warriors, who was fighting in the Liberian civil war, contracted Ebola in Liberia. He came from the town of Plibo, Liberia. He and his troop primarily lived in the bush. Surveillance around his town did not reveal any additional cases. He took refuge from the civil war in Cote d'Ivoire. On November 15, 1995, he complained of fever, nausea, and diarrhea. He was moved to a cholera camp organized by *Médecins sans Frontières* (MSF) in Cote d'Ivoire.

- Once in MSF, his symptoms had progressed, and he presented with hematuria (bloody urine). At the end of November, he was suspected of having yellow fever. On November 29, a blood sample was sent to the Pasteur Institute and was found positive for IgM and IgG against Ebola. The PCR analysis of the viral isolates were negative for Ebola. These lab results are consistent with him being in the convalescent stage of the EHF; the date of specimen collection being 14 days after the first presentation of disease.