MONTHLY SCIENTIFIC REVIEW ON FILOVIRUS
(Marburg & Ebola Sudan virus)

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Situation at a glance

- On January 14, 2025, an outbreak of Marburg virus disease was declared in Tanzania, with 10 reported cases (2 confirmed, 8 probable) and a case fatality rate of 100%. After 42 days without new cases, the Ministry of Health officially declared the end of the outbreak on March 13, 2025.
- On January 30, 2025, Uganda reported an outbreak of Sudan virus disease (SVD), with 14 cases (12 confirmed, 2 probable) and a case fatality rate of 29%. In response, an emergency vaccine trial (*TOKOMEZA SVD*) was launched to assess the efficacy of the *rVSV-SUDV* vaccine among identified contacts.
- On April 27, 2025, Uganda officially declared the end of its eighth outbreak of Sudan ebolavirus disease. The outbreak recorded 14 cases (including 12 laboratory-confirmed and 2 probable), with 4 deaths (2 confirmed and 2 probable). In total, 534 contacts were identified and closely monitored.

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Scientific articles

This section presents relevant articles published on peer-reviewed scientific journals or pre-print platforms.

This week, explore groundbreaking advancements in virology, pathogen characterization, physiopathology, treatments, and vaccines for Marburg and Sudan viruses.

Animal Virology

Modeling natural coinfection in a bat reservoir shows modulation of Marburg virus shedding and spillover potential. Schuh AJ, Amman BR, Guito JC, Graziano JC, Sealy TK, Towner JS.

Published in PLoS Pathog on March 2025.

This study examines how co-infections in Egyptian rousette bats (ERBs) affect Marburg virus (MARV) shedding and its potential to spill over to humans. Researchers experimentally infected bats with MARV alone or in combination with Sosuga virus (SOSV) or Kasokero virus (KASV). SOSV+MARV co-infection reduced MARV oral shedding duration and IgG responses, potentially allowing reinfection. In contrast, KASV+MARV co-infection increased MARV viremia, oral shedding, and IgG response, making bats more infectious. Four KASV+MARV bats were identified as "supershedders," responsible for 72.5% of total MARV shedding in that group. The study reveals that the specific co-infecting virus modulates MARV dynamics differently. This has major implications for understanding MARV transmission among bats and its spillover risk. Supershedders may significantly elevate the threat to human populations. The findings highlight the need to consider coinfections in zoonotic disease modeling.

Interaction Hotes-pathogenes

Jamaican fruit bats' competence for Ebola but not Marburg virus is driven by intrinsic differences. van Tol S, Port JR, Fischer RJ, Gallogly S, Bushmaker T, Griffin A, Schulz JE, Carmody A, Myers L, Crowley DE, Falvo CA, Riopelle JC, Wickenhagen A, Clancy C, Lovaglio J, Shaia C, Saturday G, Prado-Smith J, He Y, Lack J, Martens C, Anzick SL, Kendall LV, Schountz T, Plowright RK, Marzi A, Munster VJ.

Published in Nat Commun on March 2025.

This study investigates the susceptibility of the Jamaican fruit bat (Artibeus jamaicensis) to the filoviruses Ebola (EBOV) and Marburg (MARV). Through experimental infection via oral, nasal, and subcutaneous routes, researchers observed systemic and non-lethal replication of Ebola virus, with oral shedding, whereas MARV replication was localized and transient. In vitro, JFB cells supported more efficient entry and replication of EBOV, linked to the virus's stronger ability to antagonize type I interferon (IFN-I) signaling, unlike MARV, which strongly induced interferon-stimulated genes (ISGs). Methodologies included RT-qPCR, viral titrations, transcriptomic analysis, and immunoblotting. EBOV effectively suppresses IFN-I responses via its VP24 protein, while MARV fails to block this pathway, explaining its limited replication. This model highlights the significance of virus-host specific interactions in understanding viral complementarity and predicting potential reservoir species.

Pathogen characterization

Structural insights into the RNA-dependent RNA polymerase complexes from highly pathogenic Marburg and Ebola viruses Li G, Du T, Wang J, Jie K, Ren Z, Zhang X, Zhang L, Wu S, Ru H.

Published in Nat Commun on March 2025.

In this study, the authors presented the cryo-EM structures of the polymerase complexes (two proteins: L and its cofactor VP35) for the Marburg virus and the Ebola virus at 2.7 Å and 3.1 Å resolutions respectively. Despite the similar assembly and overall structures between these two viruses, the authors identify virus-specific L–VP35 interactions. These findings show that

intergeneric exchange of VP35 would diminish these interactions and prevent the formation of a functional chimeric polymerase complex between L protein and heterologous VP35. Additionally, a contracted conformation of the Ebola virus polymerase structure was identified, revealing the structural dynamics of the polymerase during RNA synthesis.

Physiopathology

Sudan Virus Persistence in Immune-Privileged Organs of Nonhuman Primate Survivors Beavis BB, Liu J, Zumbrun EE, Bryan AV, Babka AM, Twenhafel NA, Alves DA, Pitt ML, Nalca A, Zeng X.

Published in Emerg Infect Dis on February 2025.

The authors studied Sudan virus (SUDV) persistence in nonhuman primates that had survived acute infection without therapeutic intervention. They identified SUDV persistence in the vitreous chamber as well as in the seminiferous tubules in the testes but not in common target organs typically infected during the acute phase of disease. Specifically, SUDV persists primarily in macrophages in the eyes and Sertoli cells in the testes. Ocular and testicular SUDV persistence in nonhuman primates is accompanied by tissue damage, including inflammatory cell invasion. The authors suggest that long-term follow-up efforts are needed to reduce possible recrudescent disease and reignition of outbreaks caused by virus persistence in human survivors of SUDV infection.

Dual roles of CXCR4 (C-X-C motif chemokine receptor 4) in promoting entry of ebolavirus and targeting excessive glycoprotein for reticulophagic degradation to facilitate viral fitness Huang H, Shi W, Yan H, Fan L, Lu J, Long Z, Li X, Li J, Wang J, Liu L, Qian J.

Published in Autophagy on April 2025.

In this study, the authors showed that CXCR4-induced macroautophagy/autophagy and was internalized to endosomes by interacting with glycoprotein (GP) on viral particles during Zaire Ebolavirus (EBOV) infection; this promoted the EBOV attachment and entry, which was reduced by CXCR4 antagonist and neutralizing antibody. Additionally, they found that CXCR4 increased EBOV replication by downregulating cytotoxic GP to promote viral fitness instead of influencing the assembly of viral factory. Mechanistically, excessive EBOV GP could hijack CXCR4 sorting and transporting pathways by their interactions with HGS, one of the key components of the ESCRT machinery; subsequently GP could be carried back to the endoplasmic reticulum by CXCR4, where the E3 ubiquitin ligase RNF185 was recruited to polyubiquitinate GP in a K27- and K63-linked manner. Finally, polyubiquitinated GP was degraded in lysosomes via reticulophagy by interacting with RETREG1 (reticulophagy regulator 1), in an ATG3- and ATG5-dependent manner. These findings revealed dual roles of CXCR4 in regulation of EBOV life cycle.

Treatments

The oral drug obeldesivir protects nonhuman primates against lethal Ebola virus infection Woolsey C, Cross RW, Chu VC, Prasad AN, Agans KN, Borisevich V, Deer DJ, Harrison MB, Martinez JK, Dobias NS, Fenton KA, Cihlar T, Nguyen AQ, Babusis D, Bannister R, Vermillion MS, Geisbert TW.

Published in Sci Adv on March 2025.

In the search for effective therapeutics against Ebola virus (EBOV) infection, the authors investigated the efficacy of Obeldesivir (ODV; GS-5245), an orally administered ester prodrug of the nucleoside analog GS-441524. ODV exhibits broad-spectrum antiviral activity by inhibiting viral RNA-dependent RNA polymerases. In cynomolgus macaques, ODV demonstrated protective efficacy against lethal Sudan virus infection when administered 24 hours post-parenteral exposure. Furthermore, once-daily ODV treatment for 10 days conferred 80% and 100% protection in cynomolgus and rhesus macaques, respectively, following mucosal (conjunctival) EBOV exposure. This treatment delayed viral replication and enhanced adaptive immune responses. These results highlight the potential of ODV as a broadly active oral post-exposure prophylactic, particularly valuable during filovirus outbreaks due to its ease of administration and storage.

Vaccines

Ebola virus vaccination elicits Ebola virus-specific immune responses without substantial cross-reactivity to other filoviruse

Mdluli T, Wollen-Roberts S, Merbah M, Beckman B, Li Y, Alrubayyi A, Curtis DJ, Shubin Z, Barrera MD, Boeckelman J, Duncan S, Thapa P, Kim D, Costanzo MC, Bai H, Dearlove BL, Hooper JW, Kwilas SA, Paquin-Proulx D, Eller MA, Eller LA, Kibuuka H, Mwesigwa B, Kosgei J, Sawe F, Oyieko J, Ntinginya N, Mwakisisile J, Jani I, Viegas E, Iroezindu M, Akintunde A, Paolino K, Robb ML, Ward L, McLean C, Luhn K, Robinson C, Ake JA, Rolland M.

Published in Sci Transl Med on April 2025.

velopment, the authors evaluated the Janssen Ebola virus (EBOV) vaccine, consisting of two components administered eight weeks apart: an adenovirus type 26 vector encoding the EBOV glycoprotein (Ad26.ZEBOV), and a modified vaccinia Ankara (MVA) vector encoding glycoproteins from EBOV, Sudan virus, and Marburg virus, along with the nucleoprotein from Tai Forest virus (MVA-BN-Filo). The immunogenicity of both vaccination sequences was assessed, revealing a strong EBOV GP-specific immune response, marked by high antibody binding, Fc effector function, and CD4 T cell involvement. Notably, antibody responses were similar in individuals regardless of HIV-1 status. Additionally, samples from 48 survivors and 121 contacts of the 2007 Bundibugyo virus outbreak showed limited cross-reactivity to other filovirus proteins, highlighting the need for broad-spectrum multivalent vaccines to ensure comprehensive protection.

Single-dose VSV-Sudan virus vaccine protects from lethal Sudan virus infection within one week: a challenge study in macaques [Preprint]

Fletcher P, O'Donnell KL, Feldmann F, Rhoderick JF, Clancy CS, Prator CA, Smith BJ, Gunn BM, Feldmann H, Marzi A.

March 2025

The authors developed a vesicular stomatitis virus (VSV)-based vaccine expressing the Sudan virus (SUDV) glycoprotein. Cynomolgus macaques were vaccinated intramuscularly with a single dose of VSV-SUDV either one month or one week prior to SUDV challenge. A third group was vaccinated with a single dose of VSV-EBOV one month prior to SUDV challenge to assess its cross-protective potential, and a control group received an unrelated VSV-based vaccine. All vaccinated nonhuman primates (NHPs) developed antigen-specific IgG within 2 weeks of vaccination, including cross-reactive responses. After challenge with a lethal dose of SUDV, all VSV-SUDV-vaccinated NHPs were uniformly protected from disease. In contrast, the VSV-EBOV-vaccinated and control NHPs succumbed to disease between day 5 and 7 after challenge. The authors conclude that a single dose of VSV-SUDV protected NHPs from lethal SUDV infection within one week.

Relevant news

This section presents official reports from health agencies, manufacturers and press releases with reliable sources.

Rwanda's Swift Response to the Marburg Virus Disease Outbreak: Exemplary Coordinated Partnerships in Action

Published by Afro WHO on 28 April 2025.

Rwanda's successful containment of the Marburg Virus Disease outbreak, achieving the lowest case fatality rate of 22.7% among Marburg outbreaks in Africa, is a testament to the power of strong, coordinated partnerships. The collaborative response—led by the Ministry of Health and supported by WHO, ECHO, FCDO and other partners—demonstrated how strategic collaboration can transform a potential crisis into a controlled and timely response.

Africa CDC Commends Uganda's Leadership in Ending Eighth Ebola Outbreak

Published by Afro CDC on 27 April 2025.

The Africa Centres for Disease Control and Prevention (Africa CDC) commends the Republic of Uganda for officially declaring the end of its eighth outbreak of Sudan Ebola Virus Disease (SVD). During this outbreak, 14 cases, 12 confirmed and two not confirmed through laboratory tests (probable), were reported. Four deaths, two confirmed and two probable, occurred. Ten people recovered from the infection. A total of 534 people were identified as having been in contact with the confirmed and probable cases and were closely monitored.

The end of Ebola outbreak in Uganda demonstrates WHO's value in controlling and stopping diseases

Published by Afro WHO on 27 April 2025.

As the situation in Uganda stabilizes, this outbreak highlights three clear lessons: early preparedness saves lives, rapid response is critical, and WHO's support remains vital, not only for Uganda, but for global health security.

Sabin Begins Marburg Vaccine Trial in U.S.

Published by SABIN Vaccine Institute on 16 April 2025.

The Sabin Vaccine Institute has launched a multi-site Phase 2 clinical trial in the U.S. for its Marburg vaccine candidate, administering doses to the first participants in Melbourne, Florida. This trial builds on ongoing Phase 2 testing in Kenya and Uganda, with initial findings from that research expected in the coming months.

Guidelines and practical information

This section lists official manuals of recommendations for clinical practice or public health policy published by leading health organizations.

WHO	Diagnostic testing for Ebola and Marburg virus diseases (December 2024)
WHO	Risk communication and community engagement for Marburg virus disease outbreaks (November 2024)
WHO	Ebola and Marburg virus disease epidemics: preparedness, alert, control, and evaluation (August 2024)
CDC	Public Health Management of People with Suspected or Confirmed VHF or High-Risk Exposures (May 2024)
WHO	Contact Tracing During an Outbreak of Ebola Virus Disease (January 2024)
WHO	Country Readiness Strengthening workshop on infection prevention and control for Ebola and Marburg disease outbreaks (December 2023)
WHO	Infection prevention and control guideline for Ebola and Marburg disease (August 2023)
WHO	Clinical management of patients with viral haemorrhagic fever: A pocket guide for front-line health workers (January 2016)
WHO	Case definition recommendations for Ebola or Marburg virus diseases: interim guideline (August 2014)

Fact sheet on Marburg virus

Phylogeny

The Marburg virus (MARV) belongs to the Filoviridae family and is responsible for Marburg virus disease (MVD). Since its identification in 1967, it has caused 14 outbreaks over 50 years, primarily in Africa. The most severe outbreak occurred in Angola in 2005, with 252 cases and a case fatality rate (CFR) of 90%.

Transmission

MARV is a zoonotic hemorrhagic fever transmitted by *Rousettus aegyptiacus* fruit bats. Other bat species and certain non-human primates can also be infected, acting as intermediate hosts. Human-to-human transmission occurs through direct contact with bodily fluids from infected individuals or contaminated surfaces. Healthcare workers and close contacts, especially during funeral rites, are at high risk. Vertical transmission has not been demonstrated, but the virus can persist in semen for up to three months after recovery.

Diagnosis

The incubation period ranges from 2 to 21 days. Initial symptoms include fever, headache, and muscle pain, followed by skin rashes around day 7. The disease often leads to rapid multi-organ failure, with death occurring between days 8 and 9. Due to symptom overlap with other viral hemorrhagic fevers like Ebola, clinical diagnosis is challenging and requires confirmation by RT-PCR. IgG testing is used for late-stage confirmation. Samples must be handled in biosafety level 4 (BSL-4) laboratories.

Symptoms

The disease begins with fever, headache, and muscle pain. Around day 7, patients develop skin rashes, followed by multi-organ failure, which frequently leads to death between days 8 and 9. The CFR ranges from 24% to 90%, depending on the quality of supportive care.

Treatment

There is currently no specific antiviral treatment for MVD. Management is primarily supportive. Research is ongoing on several antiviral agents, including galidesivir, favipiravir, and remdesivir, which have shown promising results in animal models. The monoclonal antibody MBP091 demonstrated 100% efficacy in non-human primates and successfully completed a phase 1 clinical trial confirming its safety. The WHO has launched the SOLIDARITY PARTNERS clinical trial to assess these treatments during successive outbreaks.

Vaccination

Currently, 28 vaccine candidates are under development. The MARVAC consortium has prioritized four vaccines, focusing on two main platforms:

• rVSV-MARV: The VSVΔG-MARV-GP (Musoke) vaccine, developed since 2005, has shown 100% protection in non-human primates after a single intramuscular injection, with durable neutralizing antibody responses lasting up to 14 months. The rVSVΔG-MARV-GP (Angola) or PHV01 vaccine has demonstrated rapid protection within three days post-vaccination, making it a potential candidate for post-exposure prophylaxis.

• ChAdV: The ChAd3-Marburg vaccine, developed by the Sabin Vaccine Institute, has shown rapid and long-lasting protection in non-human primates and was deployed during the 2024 Marburg outbreak in Rwanda. The ChAdOx1 Marburg vaccine, developed by the Oxford Vaccine Group, entered a phase 1 clinical trial in July 2024 to assess its safety and immunogenicity.

The WHO has rapidly implemented a ring vaccination protocol in Tanzania to evaluate these vaccines in an emergency setting.

Fact sheet on Sudan virus

Phylogeny

The Sudan virus (SUDV) belongs to the *Orthoebolavirus* genus and causes Sudan virus disease (SVD). Since its identification in 1976, eight outbreaks have been attributed to SUDV, with a total of 956 cases and 503 deaths (case fatality rate of 53%). Unlike Zaire ebolavirus (EBOV), which accounts for most Ebola outbreaks, no specific vaccines or treatments have been approved for SUDV.

Transmission

SUDV is a zoonotic disease whose natural reservoir is the fruit bat of the *Pteropodidae* family. Transmission to humans occurs through contact with infected animals, either alive or dead. Human-to-human transmission is also possible through bodily fluids, contaminated objects, or unsafe medical practices. Sexual transmission has been observed but remains rare. The lack of herd immunity and the persistence of the virus in its animal reservoir make control measures challenging.

Diagnosis

Diagnosis primarily relies on RT-PCR and serological tests (ELISA). Rapid diagnostic tests exist but do not differentiate SUDV from EBOV. Biological samples must be handled with extreme caution due to the high risk of infection.

Symptoms

After an incubation period of 2 to 21 days, the disease progresses in two phases. The dry phase includes fever, severe fatigue, muscle pain, and headaches. The wet phase is characterized by vomiting, diarrhea, internal and external hemorrhages, and multi-organ failure. Contagiousness is highest during this stage.

Treatment

There is no specific treatment approved for SVD. Management is based on supportive care, including rehydration and symptomatic treatment. Several antivirals, such as galidesivir and obeldesivir, have shown efficacy in preclinical studies. Monoclonal antibodies, including Inmazeb and Ebanga—both approved for EBOV—are being evaluated for SUDV.

Vaccination

Two EBOV vaccines, Erbevo® and Zabdeno®/Mvabea®, are approved but provide limited cross-protection against SUDV. Specific vaccine candidates, such as *rVSV-SUDV* and *ChAd3-SUDV*, have shown promising immune responses in clinical trials. The *TOKOMEZA SVD* vaccine trial was launched in Uganda to evaluate the efficacy of *rVSV-SUDV* during an ongoing outbreak