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## **Marburg Virus Outbreak: A Comprehensive Review of Epidemiology, Clinical Presentation, Transmission, and Outcomes**

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### **Abstract**

Marburg virus disease (MVD) is a severe, often fatal hemorrhagic fever caused by Marburg virus (MARV), a filovirus with significant epidemic potential. This comprehensive review synthesizes current evidence on MVD outbreaks, focusing on epidemiology, clinical features, transmission dynamics, and patient outcomes. The virus originates from Egyptian fruit bat reservoirs (*Rousettus*

*aegyptiacus*), with spillover events typically occurring through exposure to bat-inhabited environments. Human-to-human transmission follows via direct contact with infected bodily fluids, leading to outbreaks characterized by rapid spread, high mortality (case fatality rates: 24-90%, average ~83%), and frequent nosocomial amplification. Clinical presentation progresses from non-specific febrile illness to severe gastrointestinal symptoms and potentially fatal hemorrhagic manifestations. Diagnosis relies on RT-PCR and antigen-detection tests, while management remains primarily

supportive. Recent outbreaks in Ghana (2022), Equatorial Guinea, and Tanzania (2023) underscore the expanding geographic threat. Effective outbreak control depends on rapid case identification, strict infection prevention, contact tracing, safe burials, and community engagement. Despite promising vaccine and therapeutic candidates in development, MVD continues to present substantial global health challenges, necessitating enhanced surveillance, international collaboration, and investment in countermeasures.

## 1. Introduction

Marburg virus (MARV), belonging to the *Filoviridae* family alongside Ebola viruses, causes Marburg virus disease (MVD), a severe hemorrhagic fever with high mortality rates (1). First identified in 1967 during outbreaks in Germany and Serbia linked to African green monkeys imported from Uganda, MARV has since caused sporadic but devastating outbreaks primarily in Africa (2). The recent emergence of cases in West Africa (Ghana, Guinea) and new territories (Equatorial Guinea, Tanzania) marks a concerning expansion beyond its historical Central and East African foci, highlighting gaps in surveillance and understanding of viral ecology (3, 4). This review aims to consolidate current knowledge on MVD epidemiology, clinical progression, transmission pathways, and outcomes to inform public health preparedness and clinical response strategies for this high-consequence pathogen.

## 2. Epidemiology and Outbreak Patterns

### 2.1 Reservoir and Spillover

The primary reservoir of MARV is the Egyptian fruit bat (*Rousettus aegyptiacus*). Viral RNA and antibodies have been consistently detected in these bats across Africa, confirming their role as a natural host (5). Spillover events to humans typically occur through direct exposure to bat excretions (urine, feces) or aerosols in confined environments such as mines, caves, or potentially bat-roosting sites (6). The 2007 outbreak among miners in Kamwenge District, Uganda, provided strong epidemiological evidence linking cave exposure to index cases (7).

### 2.2 Historical and Recent Outbreaks

Since 1967, notable outbreaks have occurred in:

- **1967:** Germany and Serbia (31 cases, 7 deaths) - initial identification (2).

- **1998-2000:** Democratic Republic of the Congo (DRC) - a large, protracted outbreak with significant nosocomial transmission (8).
- **2004-2005:** Angola - the largest recorded outbreak (252 cases, 227 deaths, CFR 90%), driven extensively by hospital-based amplification (9).
- **2007, 2012, 2014, 2017:** Uganda - multiple outbreaks often linked to cave exposure (10).
- **2021-2023:** Emergence in West Africa (Guinea, 2021; Ghana, 2022) and first-time reports in Equatorial Guinea and Tanzania (2023), indicating potential wider ecological distribution of the virus or increased detection (3, 4, 11).

## 2.3 Risk Factors for Transmission

Key risk factors include:

- **Occupational:** Mining, cave tourism, and healthcare work without adequate personal protective equipment (PPE) (12).
- **Cultural Practices:** Traditional burial ceremonies involving direct contact with deceased bodies (13).
- **Household:** Caring for sick family members in the community (14).
- **Nosocomial:** Inadequate infection prevention and control (IPC) in healthcare settings remains a major amplifier (9).

## 3. Clinical Presentation and Diagnosis

### 3.1 Clinical Course

The incubation period is 2-21 days (average 5-9). Illness progresses in phases (15):

- **Initial Phase (Days 1-4):** Abrupt onset of high fever, severe headache, myalgia, and malaise. Sore throat and conjunctival injection may be present.
- **Gastrointestinal Phase (Days 5-7):** Profuse watery diarrhea, abdominal pain, nausea, and vomiting leading to significant dehydration and electrolyte imbalances.

- **Hemorrhagic Phase (Days 7+):** May develop in severe cases, manifesting as petechiae, ecchymoses, mucosal bleeding (e.g., gingival), and hemorrhage from gastrointestinal tract or venipuncture sites. A non-pruritic maculopapular rash often appears around day 5.
- **Critical Phase:** Multi-organ dysfunction, including hepatic involvement, pancreatitis, encephalitis, and hypovolemic shock, typically occurs in the second week.

### 3.2 Diagnosis

Early diagnosis is challenging due to non-specific symptoms. Definitive diagnosis requires laboratory testing (16):

- **Reverse Transcription-Polymerase Chain Reaction (RT-PCR):** Detects viral RNA in blood, serum, or oral swabs; most common and sensitive method during acute illness.
- **Antigen-Capture Enzyme-Linked Immunosorbent Assay (ELISA):** Useful for rapid detection.
- **Virus Isolation:** Performed in BSL-4 laboratories.
- **Serology:** IgM and IgG ELISA can indicate recent or past infection but are less useful for acute diagnosis.
- **Post-mortem:** Immunohistochemistry on tissue samples.

## 4. Transmission Dynamics

### 4.1 Human-to-Human Transmission

Transmission requires direct contact with infectious blood, secretions, organs, or other bodily fluids of infected people, or with contaminated surfaces and materials (e.g., bedding, clothing) (17). Patients become contagious upon symptom onset, with viral load and infectiousness increasing as disease progresses.

### 4.2 Special Transmission Considerations

- **Nosocomial Transmission:** A hallmark of major outbreaks. The Angola outbreak demonstrated how inadequate IPC can fuel epidemic spread within healthcare facilities (9).

- **Funeral Practices:** As with other filoviruses, rituals involving washing and touching the body pose extreme risk and have been major transmission events (13).
- **Persistence in Body Fluids:** MARV can persist in immune-privileged sites. Viral RNA has been detected in semen for months after recovery, indicating risk of sexual transmission, similar to Ebola virus disease (18). Guidance recommends safe sex practices for at least 12 months post-recovery or until semen tests negative twice by RT-PCR (19).

## 5. Outcomes, Management, and Control

### 5.1 Case Fatality and Survivorship

Case fatality rates (CFR) vary widely (24-90%) but average ~83%, influenced by viral strain, quality of supportive care, and outbreak setting (20). Survivors face a prolonged convalescence with potential sequelae: arthralgia, uveitis, hearing loss, orchitis, and psychosocial challenges (21).

### 5.2 Clinical Management

No licensed antiviral therapy exists. Management is supportive and includes (22):

- Aggressive fluid and electrolyte resuscitation.
- Maintenance of oxygenation and blood pressure.
- Treatment of secondary bacterial infections.
- Pain and symptom management.
- Experimental therapeutics (e.g., monoclonal antibodies, antivirals like remdesivir) have been used under Monitored Emergency Use of Unregistered and Investigational Interventions (MEURI) protocols in recent outbreaks (23).

### 5.3 Outbreak Control Measures

Effective control relies on core public health interventions (24):

1. **Rapid Case Detection and Isolation** in dedicated treatment units.
2. **Contact Tracing and Monitoring** for 21 days.

3. **Strict IPC:** Including appropriate PPE, hand hygiene, sterilization, and waste management.
4. **Safe and Dignified Burials** conducted by trained teams.
5. **Social Mobilization and Risk Communication** to promote community acceptance of interventions.
6. **Surveillance and Laboratory Strengthening.**

#### 5.4 Vaccine Development

While no licensed vaccine exists, several platforms (e.g., vesicular stomatitis virus-based, chimpanzee adenovirus-based) have shown efficacy in non-human primate models and are in advanced preclinical or early clinical development (25).

#### 6. Conclusion and Future Directions

Marburg virus disease remains a potent global health threat due to its high mortality, epidemic potential, and recent emergence in new regions. The expansion into West Africa suggests a broader at-risk area than previously recognized, demanding enhanced "One Health" surveillance at the human-animal-environment interface. Controlling outbreaks will continue to depend on the rapid implementation of traditional public health measures. However, the high CFR underscores the critical need for accelerated research and development of effective vaccines, therapeutics, and rapid diagnostics. Global health security requires sustained investment in preparedness in all regions at potential risk, ensuring equitable access to countermeasures when they become available.

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