Review Article

Exploring the Epidemiology, Transmission Dynamics and Public Health Interventions of Marburg Viral Disease: A Scoping Review of Global Evidence

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Abstract

Background
Marburg viral disease is a highly virulent pathogen with acute hemorrhagic fever outbreaks. It has generally received less attention despite its ability to cause explosive outbreaks in humans and poses a threat to public health. Marburg Virus Disease remains significantly under-researched, with a notable lack of comprehensive scientific evidence. This limited attention has resulted in gaps in understanding its epidemiology, clinical management, and prevention strategies.

Objective
This scoping review aims to explore the epidemiology, transmission dynamics, clinical manifestations, and public health interventions of Marburg viral disease.

Methods
A scoping review methodology was used to collate relevant studies from global electronic databases published between 1975 and 2024. Articles reporting up on epidemiological data, transmission routes, clinical features, interventions and control prevention of Marburg viral disease were selected. This review followed the PRISMA guidelines.

Results
Based on the review findings, Marburg viral disease outbreaks have been potentially occurring mainly in Sub-Saharan Africa. Marburg viral disease is zoonotically transmitted through direct contact of humans with infected bats and human-to-human through bodily fluids, greater risks for healthcare workers with inadequate infection control practices. Public health measures to combat it are case isolation, contact tracing, personal protective equipment, and community engagement.

Conclusions
The course of Marburg viral disease is still highly a public health problem. Enhancing healthcare systems, surveillance and research on vaccines and therapeutics are critical in boosting preparedness.

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Keywords: Marburg Viral Disease, Epidemiology, Transmission Dynamics, Clinical Manifestations, Public Health Interventions

Introduction

Marburg viral disease (MVD) is a highly fatal zoonotic disease caused by the Marburg virus, a member of the Filoviridae family. The virus belongs to the Ebola virus family and has very similar modes of transmission and presentation as with Ebola virus.[1] MVD is a severe hemorrhagic fever syndrome with high mortality, characterized by high fever, gastrointestinal (GI) bleeding and multi-organ failure. The virus was first discovered in 1967 during concurrent outbreaks in Marburg and Frankfurt, Germany, and in Belgrade, Serbia. Although the Marburg virus was first identified in Germany and the former Yugoslavia (now Serbia) in 1967, those outbreaks were linked to imported African green monkeys from Uganda used in laboratory research. Unlike Sub-Saharan Africa, these countries do not have the natural reservoir (Rousettus aegyptiacus, the Egyptian fruit bat), which thrives in tropical climates and specific ecological settings like caves and mines common in Africa. Therefore, Europe lacks the ecological conditions for endemic transmission, making future outbreaks highly unlikely without imported cases.[2]

Marburg virus is thought to be zoonotic; with Rousettus aegyptiacus (Egyptian fruit bat) identified as the natural reservoir. Human infections happen after direct exposure to infected bats or after contact with infected people's body fluids.[2] Variability in human-to-human transmissibility also complicates outbreak control, as has been seen in some healthcare settings with substandard infection control leading to nosocomial infections.[3-4]

Despite the severe consequences of MVD, it has garnered much less global attention than other members of the viral hemorrhagic fever family, such as Ebola.[4] This has led to a lack of awareness, as well as a lack of funding for research and public health activities, leaving large knowledge gaps in the epidemiology, transmission dynamics, and containment of MVD to inform effective response efforts. It has a case fatality rate of between 23% and 90%, depending on the outbreak.[5]

Marburg viral disease poses a significant public health risk, with worse consequences for resource-constrained countries with poorly developed healthcare systems with respect to fighting viral outbreaks. Combined with high mortality rates, sporadic and unpredictable outbreaks lead to risks associated with MVD.[6] Moreover, climate change and rising human-wildlife contact are creating opportunities for further zoonotic spillover events that increase the risk posed by the virus. With continued urbanization and deforestation, it is likely that the potential for human–wildlife encounters will increase, leading to a higher risk of future outbreaks.

This review identified important knowledge gaps relevant for public health prevention and research efforts in MVD. This review synthesizes the literature on epidemiology, transmission dynamics, and public health responses related to MVD, to establish a comprehensive overview for stakeholders, policy-makers, health care providers, and researchers contributing to the current management of outbreaks. The finding of this review will act as an instrument to improve the understanding about MVD and being prepared for future outbreaks especially in resource-limited settings, and for high case fatality rates associated with it. By identifying gaps in the literature that need to be addressed and moved forward, this review reinforces the overall aim of enhancing global health security and mitigating the public health threat of MVD.

Due to the severe nature and rapid transmissibility of Marburg virus, it is important to perform comprehensive reviews that synthesize knowledge and identify gaps. The purpose of this scoping review is to describe the existing literature related to MVD epidemiology, transmission dynamics, and public health interventions.

Understanding research gaps helps to guide future efforts that will contribute to fighting against MVD. Improved understanding of the disease's routes of transmission and risk factors, as well as effective interventions, can help guide policymakers and public health practitioners in designing targeted prevention and control strategies.

Reviewing Marburg viral disease (MVD) is important for the country of Rwanda, especially in the light of recent occurrences in the region. Marburg viral disease is an extremely infectious and lethal viral hemorrhagic fever that is a major public health challenge, particularly in regions with insufficient healthcare and surveillance resources. As Rwanda works to enhance its health infrastructure and response systems, it is crucial to understand the epidemiology, transmission dynamics, and clinical management of MVD to formulate an effective prevention and control plan. The knowledge gained from this review can be an important step in highlighting related risk factors, community sensitization, and response measures, which ultimately help in improving the readiness of the country to identify and manage future outbreaks. A holistic approach to tackling MVD enables Rwanda to protect public health, boost health security, and build its healthcare system's resilience against emerging infectious diseases.

The worry is that, as currently, there are only a few vaccines and therapeutics available for MVD, there is a requisite need for increased research and development in those areas to provide effective measures should outbreaks occur again. The challenges presented by MVD highlight the need for a coordinated global response, surveillance systems across a range of disciplines and a robust public health infrastructure capable of facing future zoonotic diseases. Until these challenges are addressed, stakeholders may continue to struggle with efforts to predict and limit the devastation of this deadly disease upon public health.

Methods

Scoping Review Framework

The scoping review methodology was implemented in accordance with the framework proposed by Arksey and O'Malley (2005), supplemented with guidelines from Levac 2010 for enhanced rigor.[6] We identified, selected and synthesized existing literature in a systematic process to map key concepts involved in epidemiology, transmission dynamics and public health interventions relevant to Marburg viral disease (MVD). This review followed the PRISMA guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews).

Marburg viral disease (MVD) is constantly evolving topic that warrants a scoping review as opposed to a systematic review so that epidemiology, transmission dynamics and public health interventions can be explored. Due to the somewhat erratic occurrence of MVD outbreaks, as well as the variability in study designs that are the basis for most evidence on MVD, a scoping review allows for broader sources of evidence and assists in synthesizing findings across several axes, including transmission routes and intervention approaches.

A scoping review is useful for identifying gaps in the literature and guiding future research and public health recommendations. MVD is still understudied and only scarce high-quality studies exist for meta-analysis, thereby a systematic review may be impracticable. In contrast, a scoping review identifies gaps in knowledge and offers an overview of current understanding that can guide public health officials, researchers, and policymakers in their efforts to enhance preparedness and response strategies for MVD outbreaks prevention of Marburg viral disease?

Review Question Development

The scoping review attempted to answer the following primary question: Which studies already exist regarding the epidemiology, transmission dynamics, clinical features and public health interventions for Marburg viral disease? Sub-questions included: What epidemiological patterns underlie MVD outbreaks? In the context of zoonosis and human-to-human transmission, how is the Marburg virus transmitted? Which public health measures have been implemented to control and prevent MVD outbreaks? What are the gaps in the literature related to the control and prevention of Marburg viral disease?

Search Strategy

A systematic search strategy was used to find studies published between 1975 and 2024. Older works were included to demonstrate the continuity of the research conducted on the topic, to showcase the development of evidence over time, to identify gaps, and to provide a historical perspective on the evolution of the MVD. A search was made through multiple electronic databases, grey literature and reports. Databases searched were: Pubmed, Scopus, Web of Science; CINAHL and EMBASE

A combination of Medical Subject Headings (MeSH) and keyword terms were derived and grouped using four meta-themes: Marburg virus disease (“Marburg virus,” “Marburg hemorrhagic fever,” “MARV”) Epidemiology (“incidence,” “prevalence,” “outbreaks”), Transmission dynamics (“zoonotic transmission,” “human-to-human transmission”), Public health interventions (“control strategies,” “contact tracing,” “isolation”). Search terms were combined using Boolean operators (“AND”, “OR”), and filters were applied to obtain studies published in English.

PCC (Population, Concept, Context) Framework

(PCC): Population, Concept, and Context is a useful tool to structure the review focus. Here is how it can be done for the scoping review on Marburg viral disease (MVD):

Population

People affected by MVD: These include patients diagnosed with Marburg viral disease (MVD), healthcare workers responsible for the management of MVD patients, and communities at-risk for outbreaks especially in endemic regions where MVD is found.

Concept

Epidemiology, Transmission Dynamics and Public Health Interventions: This includes the examination of the incidence of MVD, the modes of virus transmission (zoonotic and human–human) as well as the effectiveness of different public health interventions to stop and prevent outbreaks. The unexpected challenge of a local pandemic is that, it doesn’t just involve treatment of one disease after another; rather it’s about treating constant changes in how diseases are treated.

Context

Resource-limited settings: We focused on evidence at the global level as this is where MVD outbreaks have historically occurred. The review will take into account the challenges of poor healthcare infrastructure, limited healthcare resources and socio-cultural dynamics where public health interventions need to be implemented in these worldwide regions. It will also consider the role of climate change and rising human-wildlife interactions as likely contributors to outbreaks risks.

Inclusion and Exclusion Criteria

The selection of the studies was done according to the following eligibility criteria:

Inclusion Criteria

Studies identify MVD outbreaks, epidemiology or transmission dynamics; clinical features of MVD outbreaks or public health interventions implemented during MVD outbreaks; research from endemic settings in the world, or any reported MVD outbreak; health organization reports outlining strategies for MVD response and articles published in English from 1975 to 2024.

Exclusion Criteria
Laboratory research or virology articles with no public health relevance, non-peer-reviewed literature that lacked global health organization published articles or articles without full text available.

Study Selection
Following the search, records identified were imported into reference management software (Mendeley), where duplicates were removed. The remaining articles were screened in two steps: Title and Abstract Screening: Titles and abstracts were screened by two independent reviewers for relevance according to the inclusion criteria. In this stage, full-text review was conducted for articles that fulfilled initial screening. Disagreements among reviewers were resolved by consensus or involvement of a third reviewer.

Data Extraction
Data from eligible studies were extracted using a pre-defined data extraction form developed for the review. Study characteristics (author, year, location, design), epidemiologic characteristics (cases and mortality, geographic spread), modes of transmission (zoonotic, human–human), and public health interventions (e.g., isolation, community engagement), barriers to control and areas of missed opportunity in the literature or policy to address gaps. Data extraction was independently verified by 2 reviewers to guarantee consistency and completeness.

Data Analysis and Synthesis
Data from included studies were categorized and qualitatively synthesized thematically. Findings were summarized narratively across four domains: epidemiology, transmission dynamics, clinical features, and public health interventions. Comparative analysis of the studies allowed for the identification of key trends, patterns and gaps in the literature. Results were synthesized to provide an overview of the current evidence regarding MVD and to identify areas in which further research is needed.

Quality Appraisal
Although formal quality assessment was not the aim of this scoping review, the quality of included studies was assessed for the quality of included studies based on basic criteria including clear objectives, sound methodology, and completeness of reporting. Due to the importance of the reviewed data, we also included studies lower in methodological quality if they offered relevant information for the objectives of the review.

Results

Studies on Marburg viral disease (MVD) have been conducted extensively, and more than 6,500 research articles on this topic have been published around the world. It also includes a broad range of studies on the disease, including epidemiology, transmission dynamics, clinical management, and potential therapeutic agents. Even with such a large volume of literature, however, gaps exist especially in terms of vaccine development and long-term public health plans to address outbreaks. Of these, 125 peer-reviewed journals published between 1975 and 2024 were eligible to be cased as part of this scoping review. After eliminating duplicate entries, screening titles and abstracts for relevance and reading the full text, 19 studies were included in the final synthesis. The aim of this review was to discuss the resulting data from these articles which included epidemiology, transmission dynamics, clinical features, and public health interventions surrounding MVD.[Figure 1]

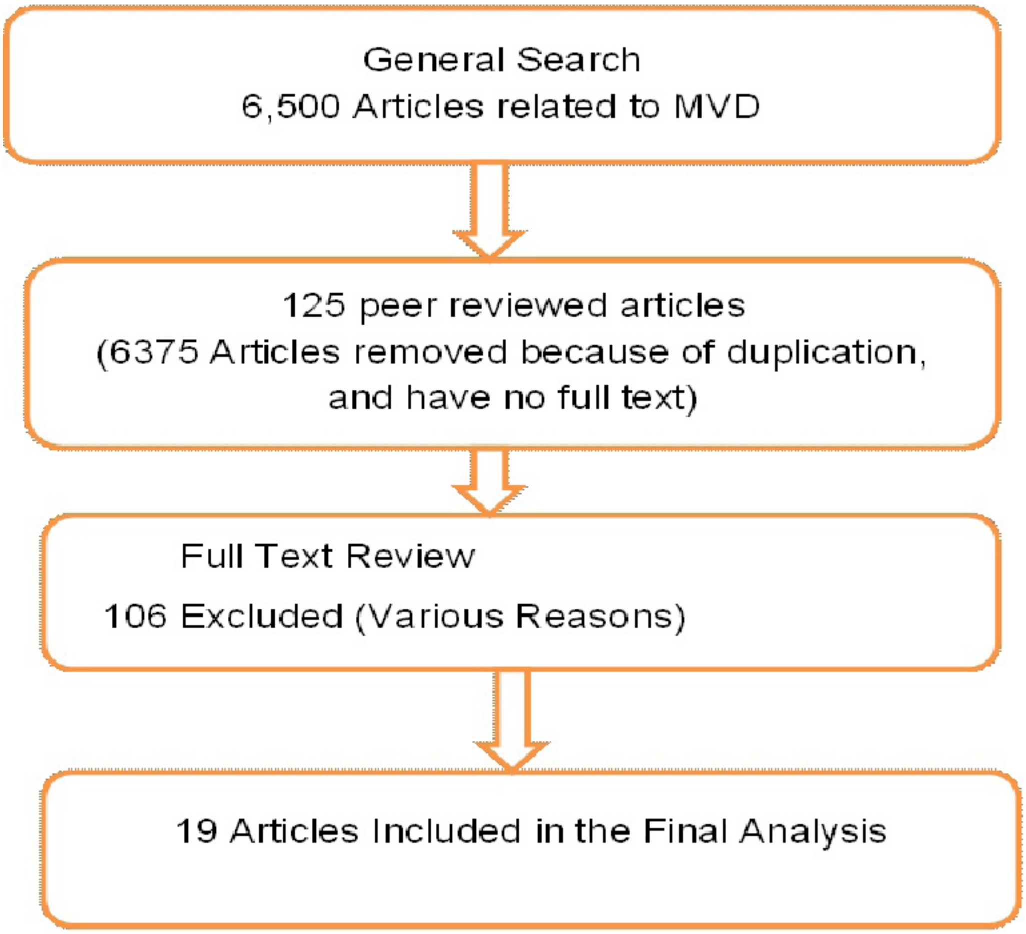

Figure 1. The PRISMA flow Diagram Depicting the Study Selection Process

Summary of Reviewed Articles

Understanding Marburg virus, its transmission, and treatments is critical, and the studies highlighted in the table below offer important insights. Studies in Egypt, Uganda, and South Africa have shown the role of bats as a natural reservoir, and strong evidence for zoonotic transmission has been found on a small scale. Initial outbreaks and clinical symptoms of this disease are documented by early case reports from Germany and Angola that have informed the epidemiologic understanding of this disease. Pharmaceutical comparisons and experimental reports (reviews about medical countermeasures, Remdesivir), demonstrate its efficacy against Marburg and other viruses, especially when tested in animal/human trials.

Moreover, methodological articles pertaining to scoping reviews provide relevant frameworks for current research structuring. These studies together inform the ongoing review by focusing on epidemiology, transmission dynamics, and treatment options for Marburg virus. [Table 1]

Table 1. Summary of Reviewed Articles on Exploring the Epidemiology, Transmission Dynamics and Public Health Interventions of Marburg Viral Disease: A Scoping Review of Global Evidence

No.	Author(s)	Year	Title of the Study	Country /Region	Study Design	Key Findings	Relevance to the Current Review
1	Bente D, et al.	2009	Disease modelling for Ebola and Marburg viruses	USA	Experimental	Developed disease models for filoviruses in animal studies.	Important for understanding the mechanisms of the Marburg virus and model development.
2	Smith DH, et al.	1967	Marburg virus disease in Germany	Germany	Case Report	First detailed report of the Marburg virus outbreak in Germany.	Key historical reference for initial identification of the Marburg virus.
3	Towner JS, et al.	2009	Isolation of genetically diverse Marburg viruses from bats	Egypt	Laboratory Study	Identified bats as a reservoir for genetically diverse Marburg strains.	Highlights the zoonotic transmission pathway of the Marburg virus.
4	Swanepoel R, et al.	2007	Studies of reservoir hosts for Marburg virus	South Africa	Field Study	Bats identified as reservoir hosts for Marburg virus.	Confirms the natural reservoir of Marburg virus, linking to human outbreaks.
5	Feldmann H, Geisbert TW	2011	Ebola haemorrhagic fever	Global	Review	Comprehensive review on Ebola and Marburg virus similarities.	Provides comparative insights into hemorrhagic fevers caused by filoviruses.
6	Arksey H, O'Malley L	2005	Scoping studies: Towards a methodological framework	UK	Methodological Paper	Proposes a framework for conducting scoping studies.	Methodological framework relevant to structuring scoping reviews in this manuscript.
7	Amman BR, et al.	2012	Seasonal pulses of Marburg virus circulation in bats	Uganda	Field Study	Seasonal virus pulses in bats linked to increased human risk.	Offers insights on Marburg virus transmission patterns and timing.
8	Towner JS, et al.	2009	Marburg virus infection in a common African bat	Uganda	Laboratory Study	Detected Marburg virus infection in African bats.	Identifies common bat species as a virus reservoir.

Table 1. Continued

No.	Author(s)	Year	Title of the Study	Country /Region	Study Design	Key Findings	Relevance to the Current Review
9	WHO	2005	Marburg virus outbreak in Angola - Update 12	Angola	Epidemiological Report	Details the Marburg outbreak in Angola.	Provides data on the epidemiology of Marburg virus outbreaks.
10	Kortepeter MG, et al.	2011	Marburg virus: Medical countermeasures	Global	Review	Overview of medical countermeasures for Marburg virus.	Summarizes available treatments and preventive measures for the Marburg virus.
11	Gear JH	1975	Clinical aspects of African viral hemorrhagic fevers	Africa	Clinical Review	Early description of clinical symptoms of African hemorrhagic fevers.	Early clinical understanding of hemorrhagic fevers, including the Marburg virus.
12	Kuhn JH	2008	Filoviruses: A compendium of 40 years of studies	Global	Review	Comprehensive review on filoviruses' epidemiology and clinical data.	Key reference for the historical and epidemiological context of the Marburg virus.
13	WHO	2012	Marburg virus disease	Global	Fact Sheet	Summary of Marburg virus disease epidemiology and prevention.	Official WHO information relevant to the current epidemiological context.
14	Warren TK, et al.	2016	Therapeutic efficacy of GS-5734 against Ebola in monkeys	USA	Animal Study	GS-5734 (Remdesivir) shows efficacy against Ebola in monkeys.	Important for understanding potential treatments, including for the Marburg virus.
15	Sheahan TP, et al.	2017	GS-5734 inhibits epidemic and zoonotic coronaviruses	USA	Experimental	GS-5734 (Remdesivir) is effective against multiple viruses.	Highlights the broad-spectrum antiviral potential of Remdesivir, including Marburg.
16	Cross RW, et al.	2018	Marburg virus disease in nonhuman primates: Remdesivir treatment	USA	Animal Study	Remdesivir is effective in treating Marburg in primates.	Critical evidence supporting Remdesivir as a therapeutic option for Marburg virus.
17	Spinner CD, et al.	2020	Effect of Remdesivir vs Standard Care on COVID-19	Global	Clinical Trial	Remdesivir has been shown to improve clinical status in COVID-19 patients.	Demonstrates clinical application of Remdesivir, with implications for Marburg virus.
18	Beigel JH, et al.	2020	Remdesivir for the treatment of COVID-19 — final report	Global	Clinical Trial	Final results showing Remdesivir's efficacy for COVID-19 treatment.	Further establishes efficacy of Remdesivir for viral infections, relevant for Marburg.
19	NIH	2019	Remdesivir and Marburg Virus	USA	Fact Sheet	Describes potential use of Remdesivir for Marburg virus.	Current guidance on therapeutic use of Remdesivir for Marburg virus treatment.

Marburg Viral Disease: Epidemiology

The outbreaks of Marburg viral disease have almost exclusively been reported in Sub-Saharan Africa, especially in Uganda, Angola and Democratic Republic of Congo. Isolated cases have also occurred in Kenya and South Africa, usually after people were exposed to caves where Rousettus aegyptiacus, a species of fruit bat identified as the natural reservoir of the virus' lives.[7,8] This zoonotic reservoir is crucial in the early transmission of the virus to humans.

The largest documented outbreak of MVD to date occurred in Angola in 2005, resulting in more than 252 confirmed cases and a case fatality rate of 90%.[7] This epidemic underscored the brutal pathogenicity of the virus, especially in low-resource settings.[8] The disease usually is found among rural groups living close to bat roosts, or people who mine caves and are thus exposed to the virus.[9,10]

Other outbreaks include: Uganda (2007), which had several human cases linked to exposure to bats in caves.[8] Democratic Republic of Congo (1998–2000), where many cases are thought to result from inter-species transmission from bats to humans.[11-12] Episodic nature of outbreaks coupled with high mortality rates highlights the need of enhanced surveillance and early warning systems in the regions which potentially at risk of future outbreaks. Enhanced preparedness in regions of human–bat interactions could curtail the impact of future epidemics.[10]

Transmission Dynamics of MVD

Marburg virus is transmitted via zoonosis and human to human. Zoonotic transmission occurs when humans have direct contact with infected fruit bats or their excreta. Transmission between humans occurs through contact with body fluids, including blood, vomit, and bodily secretions, from infected patients, particularly during the later stages of the disease when viral load is highest.[8] Healthcare workers and family members caring for infected patients are at increased risk during outbreaks, particularly in settings with insufficient or inadequately used personal protective equipment (PPE). Transmission risk in healthcare settings is compounded by poor infection control measures especially in settings with scarce resources.[10] Transmission in health care settings has been a prominent feature of MVD, helping to sustain larger outbreaks. For example, nosocomial transmission was an important driver of disease spread during the 1998–2000 outbreak in the Democratic Republic of Congo, due to inadequate infection control measures and limited availability of personal protective equipment (PPE) in hospitals.[13] Meeting these infection control challenges is an important step towards mitigating secondary transmission during epidemics.

Public Health Interventions of MVD

The public health response to MVD outbreaks has paralleled the strategies for control of Ebola virus disease outbreaks. Some of the key interventions include: Isolation of confirmed and suspected cases to prevent further transmission; Contact tracing to identify and monitor individuals who have been exposed to the virus; Ensuring the use of PPE by healthcare workers caring for infected individual, Community engagement efforts to educate the public on the disease dispelling myths and addressing fears which is critical for compliance with public health measures.[13]

While these measures have been put in place, challenges indeed still exist, especially within resource-limited settings, as healthcare infrastructure is inadequate. The absence of point-of-care diagnostic tools, lack of adequate personal protective equipment, and challenges in mobilizing the full community response has made it difficult to contain outbreaks.[12] For example, the 2005 outbreak in Angola exceeded the capacity of the health care system to respond appropriately due to the rapid spread of the disease.[9] The major vaccine breakthrough came with the development of vaccines against MVD.

Although some experimental vaccines have shown promise in animal models, none have yet been licensed for use in large numbers of people.[10] Like the MVD, therapeutics for MVD are limited with supportive care as the principal treatment option during outbreaks.

Gaps and Challenges in Resource Limited Settings

There are still significant gaps in our knowledge of the ecology of Marburg virus - especially in terms of how this virus spills over from bats to humans. By studying how bats and humans interact on a public health front, we could gain insight into how to stop zoonotic transmission before any contact that may infect these new hosts has occurred. Furthermore, despite promising advances in vaccine and therapeutic development, no licensed therapies are available and health care workers must fall back on supportive care.[5] Better diagnostic tools, stronger health-care infrastructure, and further investment in public health preparedness in areas where MVD is endemic are critical for mitigating the severity of future outbreaks. However, to respond effectively, models should include not only medical responses but should also incorporate community-based ones that can ensure compliance with public health interventions during outbreaks.[14]

Discussion

The finding of this scoping review highlights the need for continued response to Marburg viral disease (MVD), especially in resource-limited settings with healthcare systems that cannot adequately respond to outbreaks. The mortality rate of MVD is high, with some outbreaks reaching fatality rates as high as 90% in combination with the potential of the virus to spread quickly, raises the concern for global surveillance and outbreak readiness.[9] Despite significant advances in understanding the transmission dynamics and clinical management of the disease, challenges remain, particularly in regard to developing effective vaccines and treatments for MVD.

Transmission dynamics of MVD

Because MVD is zoonotic in nature, with Rousettus aegyptiacus (a species of fruit bat) recognized as the natural reservoir of the virus, addressing animal-human cultural interaction is crucial as the primary mode of transmission. Marburg viral disease spills over to humans in close encounters with bats or their bodily fluids, and it is human-to-human transmissible by contact with sick individuals' bodily fluids.[8] However, this dual transmission pathway presents a challenge for control, requiring interventions in both wildlife and human populations.

The multifactorial nature of transmission; therefore, a One Health strategy combining approaches at the human, animal, and environment levels is viewed as the most effective way to curtail future outbreaks. This is part of the One Health concept, which brings together the health of people, animals and the environment, conducting coordinated interventions to minimize the risk of zoonotic spillover.[7] For MVD, this strategy would entail surveillance of bat populations for indicators of viral activity, enhancing public health messaging around risks of bat exposure, and ecosystem-based management strategies to reduce human interface with bat habitation areas.

Challenges in Resource-limited Environments

These healthcare providers would be ill-equipped to mitigate adverse impacts caused by MVD outbreaks, especially in areas where outbreaks are common in Sub-Saharan Africa. The disease spread is aggravated by poor access to personal protective equipment (PPE) and limited healthcare infrastructure and the use of inadequate infection control practices, especially in healthcare settings. Such conditions lead to elevated transmission among health professionals and communities if timely and robust public health interventions are lacking.[10]

Such regions face significant challenges in accessing rapid diagnostic tools, which may allow cases to go undetected and let the virus spread before containment can be initiated. Conversely, outbreaks such as those of Angola (2005) and the Democratic Republic of Congo (1998–2000) showed that, without adequate and rapid intervention, MVD can rapidly be beyond the capacity of local health systems, with heavy human tolls.[11] Therefore, it is critical to bolster health systems in these high-risk parts of the world in order to enhance the response capabilities to future outbreaks.

Public Health Interventions of MVD

A lack of on-going surveillance systems in MVD endemic regions, or inadequate funding may contain gaps in outbreaks detection or response. Investing in robust surveillance systems including; wildlife surveillance to monitor bat populations would greatly improve the ability to detect outbreaks before they spill over into human populations. [9] Surveillance measures should also extend to humans, where rapid case detection and tracking, especially in high-risk communities with close interactions with bats or other wildlife, are particularly important.

Community engagement is also essential for surveillance and outbreak control.[4,7] Signs of such communication campaigns can go a long way to educate communities about exposure risks and hygiene practices, and encourage early reporting of symptoms, which will greatly decrease the potential for human-to-human transmission. Such communication strategies are particularly critical in rural settings where traditional beliefs and misinformation about the disease can impact compliance with public health interventions.[12]

Upgrade the Public Health Infrastructure

MVDers are here to stay, and the answer to the challenges they present will come from public health and public nutrition long-term solutions involving investment in these systems. These contain strengthening wellbeing services, guaranteeing PPE availability, preparing wellbeing employees in infection prevention and control actions and devising fast diagnostic instruments for early detection. To increase their capacity to respond to future outbreaks and decrease the effect of MVD on at risk populations, endemic regions need their health systems strengthened.[10]

In addition to this training, improving global preparedness for MVD requires concerted efforts to build up laboratory and diagnostic capacity for early detection, establish logistical support for outbreak response and facilitate global collaboration. Additionally, a multi-faceted approach involving cooperative interplay among governments, global health organizations and local communities will be crucial in developing sustainable solutions for the management and prevention of MVD outbreaks.

The Need of Vaccines and Treatments

Although progress has been made in the development of vaccines and researches on therapeutics, there is no licensed vaccine or specific antiviral (AV) treatment available for use in humans.[5] Experimental vaccines have been shown to be effective in animal models but have limited clinical use in human populations. Acute respiratory distress syndrome is managed primarily with supportive care, which is often not effective enough to lower the high mortality rates seen in disease.[10]

An early alert and confirming tests are now available as one of the new measures to tackle the disease, but the development of an effective vaccine and antiviral therapies remains a critical area that needs to be addressed. Because of the potential global spread of the virus, particularly in our interdependent world, all research into vaccines must be expedited. In the absence of treatment options, a vaccine would be the best to reduce the consequences of future outbreaks.

Remdesivir Infusion for Five Days in Treating MVD and its Effects

With no approved antiviral therapies specific to Marburg virus, some of the experimental therapeutics, like Remdesivir, has been receiving attention. Originally used as a potential treatment for Ebola virus and subsequently, for COVID-19, Remdesivir has been shown to act as a potential antiviral therapy against MVD. Remdesivir is a nucleotide analog prodrug that disrupts the replication of viral RNA. It inhibits the Marburg RNA-dependent RNA polymerase, which is crucial for Marburg virus replication.[14,15] Remdesivir is delivered intravenously via a five-day infusion regimen to provide therapeutic levels of the drug in the blood to limit viral replication and reduce disease severity.

Although clinical data in Remdesivir's therapeutic role in MVD is limited, preclinical studies using animal models demonstrate some efficacy. In non-human primates, Remdesivir has been shown to decrease viral load and improve survival following infection with the Marburg virus.[16] These results indicate possible effectiveness in controlling viral replication and reducing mortality when started early in the disease process.

The Acute Impact of a 5-day Infusion

Common reported side effects of Remdesivir in patients being treated for other viral infections such as COVID-19 include: nausea, increased liver enzymes and rarely renal.[17] The safety profile of Remdesivir is presumed similar in the MVD, and strict monitoring of liver and kidney functions during the treatment course is essential.[18] Its five-day infusion regimen facilitates prolonged viral suppression, which may help save lives during the early critical period of MVD, when viral replication is maximized.[19]

Strength and limitation

Key strengths of this review include its exhaustive synthesis of existing literature on MVD, which is relevant for summarizing the epidemiology, transmission dynamics, and public health interventions for this fatal virus. Despite the potential application of these findings, the novelty of such an extensive review is the ability to be used as a roadmap for future studies and public health strategies to enhance preparedness before the next outbreak. This also re-enforces the need for the One Health approach to mitigating MVD, as it highlights the potential for both zoonotic and human-to-human transmission pathways.

The review limitations include; the potential for publication bias, as it primarily includes studies published in English, many that are published in other languages or as grey literature may be missed. Infectious disease research is evolving quickly than the date of access, therefore, due to this some of couple of studies might not be captured, which could affect the findings comprehensiveness. These constraints imply the necessity of evolving research to allow for the updating and expanding of what is known about MVD in a contemporary world.

Conclusion

This scoping review highlights that Marburg viral disease represents a major public health threat, especially in Sub-Saharan Africa where ecological, social and healthcare system factors coalesce to facilitate recurrent outbreaks. While significant progress has been made in understanding Marburg viral disease, particularly its transmission dynamics and clinical management, major challenges remain in preventing and controlling future outbreaks. While there is a lot of research ongoing in the world and encouraging developments in the areas of diagnostics and experimental therapeutics (such as Remdesivir), outstanding gaps still remain including: the absence of licensed vaccines or specifically targeted antiviral treatments.

Recommendations

Based on the review findings, the following reconditions were suggested; Support vaccine and antiviral development, improve surveillance and early detection systems, strengthen healthcare infrastructure and capacity, adopt a one health approach, encourage social engagement and risk communication and join forces to advance global readiness and response.

Consent for publication
Not applicable

Ethical Considerations
No ethical approval was required as we conducted a review of publicly available literature. In order to adequately and ethically represent the work of the original authors, all sources were cited so as not to misrepresent the results of the original authors or work.

Authors' contribution
The study was developed and conducted by all authors within this Scoping review. GT, TK, PU, DK drafted the review, developed the search strategy and supervised the extraction and analysis of data. AM, RJ, MD and MJP were significantly involved in conducting the literature search, screening articles for inclusion and assisting with the interpretation of data. All authors critically reviewed the manuscript and approved the final submission. All authors worked closely together during the review process and approved the final version of the paper for submission.

Data and materials availability
Any additional data are available from the corresponding author on reasonable request and the raw data for inputs and for processing are available with the submitted paper, Table and Figure.

Conflict of interests
The authors have no conflicts of interests in this review.

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References

1. Bente D, Gren J & Strong E. Disease modeling for Ebola and Marburg viruses. *Dis Models Mech.* 2009; 2 (1–2):12–17. https://doi.org/10.1242/dmm.000471
2. Smith D. Marburg virus disease in Germany. *Lancet.* 1967; 290(7551), 689-693. https://doi.org/10.1080/21505594.2022.2054760
3. Towner J, Amman B & Sealy T. Isolation of genetically diverse Marburg viruses from Egyptian fruit bats. *PLoS Pathog.* 2009; 5(7):e1000536. https://doi.org/10.1371/ journal.ppat.1000536
4. Swanepoel R, Smit S & Rollin E. Studies of reservoir hosts for Marburg virus. *Emerg Infect Dis J.* 2007; 13 (12):1847. https://doi.org/10.3201/eid1312.071115
5. Feldmann, H. & Geisbert, T. Ebola haemorrhagic fever. *Lancet.* 2011; 377(9768), 849-862, https://doi.org/10.1016/s0140-6736(10)60667-8
6. Arksey H & O'Malley L. "Scoping studies: Towards a methodological framework." *International Journal of Social Research Methodology.* 2005; 8(1), 19-32. https://doi.org/10.1080/1364557032000119616
7. Amman R. Seasonal pulses of Marburg virus circulation in juvenile Rousettus aegyptiacus bats coincide with periods of increased risk of human infection. *PLoS Pathogens.* 2012; 8(10), https://doi.org/10.1371/journal.ppat.1002877
8. Towner J. Marburg virus infection detected in a common African bat. *PLoS ONE.* 2009; 4(7), e7647. https://doi.org/10.1371/journal.pone.0000764
9. WHO. Marburg virus outbreak in Angola - Update 12. *WHO.* 2005. www.who.int, accessed on December 20/2024
10. Kortepeter M. Marburg virus: Medical countermeasures. *Viruses.* 2011 ; 3(9), 1723-1752., https://doi.org/10.1016/j.ijid.2020.07.042
11. Gear H. Clinical aspects of African viral hemorrhagic fevers. *Rev Infect Dis.* 1975; 7(2), 148-158. https://doi.org/10.1093/clinids/11.supplement_4.s777

12. Kuhn J. Filoviruses: A compendium of 40 years of epidemiological, clinical, and laboratory studies. *Arch Virol.* 2008.
13. World Health Organization. Marburg virus disease. *Who.* 2012; https://www.who.int/news-room/fact-sheets/detail/marburg-virus-disease. Accessed on December 23/2024
14. Warren T. Therapeutic efficacy of the small molecule GS-5734 against Ebola virus in rhesus monkeys. *Nature.* 2016; 531(7594), 381-385. https://doi.org/10.1038/nature17180
15. Sheahan P. Broad-spectrum antiviral GS-5734 inhibits both epidemic and zoonotic coronaviruses. *Science Translational Medicine.* 2017;9(396), eaal3653. https://doi.org/10.1126/scitranslmed.aal3653
16. Cross R. Marburg virus disease in nonhuman primates: Therapeutic treatment with Remdesivir. *Journal of Infectious Diseases.* 2018; 218(S5), S612-S621. https://doi.org/10.1126/scitranslmed.3009706
17. Spinner C. Effect of Remdesivir vs Standard Care on Clinical Status at 11 Days in Patients with Moderate COVID-19: A Randomized Clinical Trial. *JAMA.* 2020; 324(11), 1048-1057. https://doi.org/10.1001/jama.2020.16349
18. Beigel H. Remdesivir for the treatment of COVID-19 — final report. *New England Journal of Medicine.* 2020; 383(19), 1813-1826. https://doi.org/10.1056/nejmoa2007764
19. National Institutes of Health (NIH). Remdesivir and Marburg Virus. *NIH.*2019. https://www.nih.gov Accessed on December 23/2024.