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Lassa Fever in West Africa: The Emerging Role of Aerial Logistics in Epidemic Response

ZAKARI ISIAKA OSHEKU[1], NDIFREKE GODDEY UDOIDUNG[2], AISHA HASSAN TUKURA[3], AMINA NA'IYA AMINU[4], ILYAS BASHIR USMAN[5], HAFSAH SHUAIB MUHAMMAD[6], SHERIFAT TOLULOPE AKINDELE[7], EMMANUEL PIUS OIWOH[8], NUHU MOMOH ABDULLAHI[9], OMOBOLANLE ESTHER FATONA[10], SUMAYYA USMAN ABDULLAHI[11]

[1]Department of Public Health, Distance Learning Centre, Ahmadu Bello University, Zaria, Kaduna, Nigeria.
[2, 3]Zipline Nigeria, Abuja, Nigeria.
[4,5]Usman Danfodio University Teaching Hospital, Sokoto, Nigeria.
[6]Gombe State University, Gombe, Nigeria.
[7]Abraham Adesanya Polytechnic, Ijebu-Igbo, Ogun State, Nigeria.
[8]University of Uyo, Uyo, Nigeria.
[9]Federal Teaching Hospital Gombe, Gombe, Nigeria.
[10]Frimley Health NHS Foundation, Surrey, United Kingdom.
[11]Abubakar Tafawa Balewa University Teaching Hospital, Bauchi, Nigeria.

***Abstract:** Lassa fever remains one of the most significant and persistent viral hemorrhagic fevers in West Africa. Despite over five decades of research and the availability of ribavirin, an antiviral with proven benefit when administered early, case fatality remains unacceptably high. The disease continues to expand geographically, with outbreaks becoming larger and more frequent. These challenges are compounded by limited diagnostic capacity, slow sample transport, and weak health systems. This review synthesizes evidence on the epidemiological transitions and control strategies for Lassa fever across West Africa from 2000–2024, emphasizing the emerging role of aerial logistics such as unmanned aerial vehicles (UAVs) or drones in epidemic preparedness, diagnostics, and supply-chain innovation. A narrative review approach was adopted. Peer-reviewed articles and grey literature published between 2000 and 2024 were retrieved from PubMed, Scopus, Web of Science, WHO, AJOL and Africa CDC repositories. Data were thematically synthesized under three domains: epidemiological transitions, control and prevention strategies, and innovations in epidemic logistics. Evidence indicates increasing incidence, expanding endemic range, and persistent high case fatality across West Africa. Epidemiological transitions are driven by ecological changes, urbanization, improved surveillance and socio-economic vulnerabilities. Control strategies, spanning surveillance, therapeutics, community engagement and one health approaches, have yielded mixed success due to deep systemic constraints. Emerging technologies such as drone-based logistics demonstrate transformative potential in reducing diagnostic delays, improving access to life-saving therapeutics, and strengthening resilience of epidemic response systems. Lassa fever remains a growing challenge in West Africa, requiring enhanced, technology-integrated epidemic management. The integration of aerial logistics systems into national surveillance and response frameworks represents a promising frontier for accelerating diagnosis, treatment and public health interventions. Greater investment in genomics, vaccine research, health systems strengthening, and logistics innovation is urgently needed to mitigate the long-term burden of this re-emerging threat.*

***Keywords:** Lassa Fever, Epidemiology, West Africa, Control Strategies, Unmanned Aerial Vehicles, Drones, Aerial Logistics.*

I. INTRODUCTION

1.1 Background and Significance

Lassa fever is a disease of significant public health concern. It is an acute viral hemorrhagic disease endemic to some West African countries such as Nigeria, Liberia and Sierra Leone (Ogundele, Jolayemi, & Bello, 2025) and it is very infectious and has a case fatality rate of over 1 % affecting the most populated black race, which is, Nigeria and a region with the weakest health systems in the world. The pathogen indicated for lassa fever is a virus called Lassa Fever Virus which was named after the place it was first discovered in 1969, following a nosocomial disease outbreak that was responsible for the killing of two missionary nurses. The name of the village was Lassa in Borno State of Nigeria. (Besson, Pépin, & Metral, 2024). Since then, Lassa fever has spread, not just from the north-eastern part of Nigeria to the far southern parts of Nigeria but also to other West African countries. Now the West African region remains the epicentre, with countries like Nigeria, Sierra Leone and Liberia reporting the highest case burdens (Asogun, et al., 2025).

As a result of the product of a weak health system plus the absence of a coordinated surveillance system, case fatality rates still remain high. Some of the factors for this weakness were due to poor diagnostic capacity, slow sample transport across vast rural regions and delayed presentation (John-Ugwuanya et al., 2021). During the earlier stages of Lassa fever, the symptoms resembled that of malaria, leading to misdiagnosis and delayed care. Beyond its health impact, Lassa fever imposes heavy socio-economic burdens, straining fragile health systems and perpetuating poverty cycles in affected communities (Eneh, et al., 2025).

1.2 Rationale for the Review

Despite over 50 years of emergence, major gaps remain in understanding Lassa fever's epidemiological evolution. Over the years, the Lassa fever disease landscape has significantly and rapidly changed due to several factors such as demographic transitions, intensified human–animal interactions and environmental shifts (Ogundele, Jolayemi, & Bello, 2025). Spreading quickly, Lassa fever has expanded to Ghana, Togo, Benin, Mali and Côte d'Ivoire. These countries were previously non-endemic, unknown to have any traces of Lassa fever (Garry, 2023).

Surveillance remains fragmented, with limited regional synthesis of key indicators such as incidence, attack rate, seasonality, and case fatality (Ogundele et al., 2025). Critical challenges persist: underreporting, lack of rapid diagnostics, weak laboratory networks, and insufficient capacity for genomic surveillance (Asogun et al., 2025; Happi et al., 2019).

Unmanned aerial vehicles (UAV), also known as drones, can play a critical role in delivering health care. At the same time, technological innovations such like UAV are transforming healthcare delivery in remote regions. Drone delivery systems have reduced turnaround time for diagnostics, improved emergency supply distribution, and enhanced outbreak response in several African countries by speedy delivery of health commodities to hard to reach communities. But their potential for Lassa fever diagnostics and logistics remains largely to be studied further (Nyaaba & Ayamga, 2021).

This review synthesizes the evolving epidemiology of Lassa fever in West Africa between 2000 and 2025 and to determine how existing control measures along with emerging aerial logistics technologies contribute to improved diagnostics, surveillance, and overall epidemic response efficiency in the region. The specific objectives are as follows:

1.3 Objectives

1. To describe the epidemiological transitions of Lassa fever in West Africa from 2000–2025.
2. To evaluate the control and prevention strategies implemented in the region.
3. To assess the emerging role of aerial logistics systems in enhancing diagnostics, surveillance, and supply-chain efficiency in epidemic response.

1.4 Scope and Definitions

The review focuses on West African countries within Nigeria, Sierra Leone, Liberia, Guinea, Benin and the expansion of Lassa fever to more West African countries of Togo, Mali, Ghana and Côte d'Ivoire. This review examines literature published between 2000 and 2025 addressing epidemiology, control initiatives, and logistics innovations.

II. METHODS

2.1 Design

A narrative review approach was employed to synthesize current evidence on epidemiological patterns and control strategies for Lassa fever.

2.2 Search Strategy

Databases searched included PubMed, Scopus, Web of Science, Science Direct, AJOL, Google Scholar, WHO and Africa CDC repositories. Studies on Lassa fever epidemiology published from 1969–2025 were reviewed, with emphasis on the years 2000–2024. The following keywords: Lassa fever, epidemiology, West Africa, control strategies, aerial logistics, drone delivery and viral hemorrhagic fever were combined

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for search.

2.3 Inclusion and Exclusion Criteria

Carrying out this review, we focused on peer-reviewed literature and grey literatures. Our inclusion criteria were: West Africa published studies on Lassa between 2000–2024: focus on epidemiology, surveillance, clinical management, prevention, or logistics innovations; and quantitative, qualitative, modeling, or genomic surveillance studies. However, our exclusion criteria: studies outside West Africa; case reports lacking epidemiologic detail and commentaries without methodological clarity.

2.4 Data Extraction and Synthesis

This study fundamentally canters on data extracted on incidence, case fatality, geographic distribution, seasonality, transmission patterns, control measures, and logistics innovations. Thematic synthesis was applied across three domains: epidemiological transitions, control and prevention strategies, and innovations in epidemic logistics. This is summarized in (Table 1).

III. EPIDEMIOLOGICAL TRANSITIONS OF LASSA FEVER (2000–2025)

Table 1. Summary of Key Themes Synthesized from the Review on Lassa Fever Epidemiology, Control and aerial logistics in West Africa (2000–2025)

Theme	Summary of Findings	Key Evidence / Citations
1. Epidemiological Transitions	• Prevalence of LASV in *Mastomys* spp. and human varied from 0.7% to 24.00% and 5.3% to 40.3% respectively. • Incidence has increased sharply since 2015, with Nigeria experiencing record outbreaks (e.g., 1,270 confirmed cases and 227 deaths in 2023). • Case fatality rates remain high (15–50% among hospitalized cases).	(Mandi H, et al., 2025); Besson et al., 2024; (Ezenwa-Ahanene, Salawu, & Adebowale, 2024); (John-Ugwuanya A., et al., 2021); Garry, 2023; (Balogun et al., 2020); (Yessinou, et al., 2020)
Theme	Summary of Findings	Key Evidence / Citations
	• Expansion of endemic areas to Benin, Togo, Ghana, Mali, and Côte d'Ivoire. • Increasing age range affected, with most cases in 21–40-year-olds. • Strong seasonality but emerging year-round transmission in some countries.	
2. Drivers of Transmission	• Ecological changes—deforestation, urban expansion, and climate variation—expand rodent reservoir habitats. • Socio-cultural behaviors (rodent hunting, poor food storage, unsafe burials) sustain transmission. • Conflict-related displacement contributes to spread across borders.	(Fichet-Calvet & Rogers, 2009); Isiguzo & Iroezindu, 2019; Besson et al., 2024; (Yun & Walker, 2012)

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3. Surveillance and Early Warning Systems	• IDSR adoption improves reporting, but underreporting persists. • Non-specific symptoms delay diagnosis. • Expanded PCR capacity and digital tools (SORMAS) strengthen surveillance but remain unevenly distributed. • Genomic surveillance capable of tracking viral evolution is expanding regionally.	Asogun et al., 2025; Happi et al., 2019; Balogun et al., 2020; Ezenwa-Ahanene et al., 2024
4. Clinical Management	• Ribavirin is effective only when given early—often missed due to late presentation. • Supportive care limited by inadequate health infrastructure. • New therapeutics (favipiravir, monoclonal antibodies) under evaluation.	Garry, 2023; Besson et al., 2024; Yun & Walker, 2012; Mandi et al., 2025
5. Community Engagement and Public Awareness	• High awareness but uneven knowledge of prevention methods. • Misinformation, distrust of health systems, and cultural practices impede behavior change. • Rural communities rely on local leaders and informal communication channels.	(Al-Mustapha, et al., 2025); Besson et al., 2024; Isiguzo & Iroezindu, 2019
6. One Health and Multisectoral Collaboration	• Integrated human, animal, and environmental surveillance essential for addressing zoonotic spillover.	Besson et al., 2024; Garry, 2023

Theme	Summary of Findings	Key Evidence / Citations
7. Aerial Logistics and Innovations	• Regional coordination improving but under-resourced. • UAVs/drones can drastically reduce sample transport times and enable rapid ribavirin delivery. • Evidence from Rwanda and Ghana shows large-scale improvements in emergency supply transport. • Pilot programs in Nigeria demonstrate feasibility for Lassa fever hotspots. • Potential uses include sample transport, PPE distribution, and environmental surveillance.	(Kremer, et al., 2023); (Mechan, Malone, & Lees, 2023); (Lammers, et al., 2023)
8. Challenges to UAV Scale-Up	• Regulatory restrictions and airspace management issues. • High initial cost and sustainability concerns. • Community acceptance and data governance remain barriers.	(Mechan, Malone, & Lees, 2023); Kremer et al., 2023
	• Strengthen genomic surveillance and diagnostic decentralization.	

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9. Policy Priorities and Future Directions	• Integrate UAVs into national emergency logistics plans. • Invest in vaccine R&D and new therapeutics. • Expand community-owned risk communication strategies.	Garry, 2023; Besson et al., 2024; Kremer et al., 2023; Asogun et al., 2025

3.1 Historical Overview
Lassa fever is caused by the Lassa virus, an arenavirus whose primary reservoir is the multimammate rodent, *Mastomys natalensis*. Consequent upon this, the Lassa virus was named after Lassa, a village in Borno State. These rodents thrive in human dwellings. (Olasoju, et al., 2024) (Happi & Happi, 2019); Fichet-Calvet & Rogers, 2009).

Although phylogenetic analyses trace the virus's origin in Nigeria to over a thousand years ago, human movement during the colonial period likely facilitated its spread to Sierra Leone, Liberia, and Guinea 300–500 years ago (Wiley, Lawrence, Letizia, & al., 2019). Civil conflicts, especially the 1991–2002 war in Sierra Leone, further displaced populations and contributed to virus expansion into Mali and Côte d'Ivoire.

Since 2016, Nigeria has experienced increasingly intense outbreaks. The 2020 outbreak recorded 6,732 suspected and 1,181 confirmed cases nationwide. In 2023, 1,270 confirmed cases and 227 deaths were recorded across 28 of 36 states, the deadliest outbreak in decades (Besson et al., 2024). Similar surges have been observed in Guinea and Liberia.

The endemic zone continues to expand, with new viral lineages emerging in Ghana, Togo, Benin, and Côte d'Ivoire (Garry, 2023). Evidence of human seropositivity and confirmed autochthonous infections suggests more widespread circulation than historically recognized.

3.2 Trends in Prevalence, Incidence and Mortality
Lassa fever is zoonotic which is transmitted via rodents to humans either by coming in contact with rats directly or indirectly (World Health Organization, 2023). Rodents are hunted and consumed for meat and pest control (Douno, Asampong, Magassouba, Fichet-Calvet, & Almudena, 2021), or as a part of community practices and social activities. Mode of transmission is through the consumption of rodents or exposure to rodent urine, saliva, blood, excreta and urine: for instance, via contaminated food or household items, or by inhalation of rodent excreta. Inadequate sanitation, unhygienic waste disposal and poor housing quality amplify the risk of exposure to rodent fluids (Besson, Pépin, & Metral, 2024).

Analysis of surveillance reports indicates a clear upward trend in incidence since 2015 (John-Ugwuanya et al., 2021). Annual confirmed cases in Nigeria surpassed 1,000 for the first time in 2018, compared to <150 annually before 2017. The 2018 outbreak alone recorded 633 confirmed cases with a 27% case fatality rate (CFR). (Garry, 2023; Besson, Pépin, & Metral,2024) (Dan-Nwafor, et al., 2019). Case fatality rates remain high, resulting in 15–20% among hospitalized symptomatic patients (Besson et al., 2024; Isiguzo & Iroezindu, 2019). Up to 50% during severe epidemics or in resource-limited settings (Balogun et al., 2020; Besson et al., 2024) while fatality per infection was 1–2%, considering asymptomatic infections.

The dynamics of LASV in 11 West African countries from 1969-2019 were studied. A total of 1811 samples were examined and 3166 were found to be positive (LASV) in the 34 articles that they reviewed. Among the studies conducted from 1969-1979, we noted 3 cases of LF in Nigeria. Prevalence of LASV in *Mastomys* species and humans varied from 0.7% to 24.00% and 5.3% to 40.3% respectively (Yessinou, et al., 2020).

3.3 Geographic Expansion and Cross-Border Spread
Originally restricted to Nigeria, Lassa fever has further spread to more West African countries in the past six decades. Apart from Sierra Leone, Liberia, and Guinea, Lassa fever now have the disease documented in Benin, Togo, Ghana, Burkina Faso, Mali (Safronetz, et al., 2013), and Côte d'Ivoire (Garry, 2023) (Yun & Walker, 2012). New viral lineages, including lineage V in Mali and Côte d'Ivoire, complicate regional control efforts (Happi et al., 2019; Garry, 2023). International spread has also grown, with 37 exported cases recorded since 1969, primarily to Europe and the United States (Besson et al., 2024; Isiguzo & Iroezindu, 2019). This

highlights the need for strengthened airport surveillance and cross-border collaboration.

3.4 Demographic and Behavioral Transitions

Some demographic factors were identified as having an association with both Lassa fever disease and Lassa fever associated death in Nigeria. Sex, occupation and certain clinical variables were significantly and independently associated with LF disease during the period under study (Olayinka, et al., 2022). While age, presentation with bleeding and central nervous system symptoms were independently, significantly associated with death from LF. Lassa fever affects all age groups, but most cases occur among young adults aged 21–40 (John-Ugwuanya et al., 2021; Balogun et al., 2020). In Ebonyi State, mean age was 29 years, and mortality risk increased among those aged ≥50 or unemployed (Ezenwa-Ahanene et al., 2024). In a cross-sectional study that was done in Edo State, it was reported that majority of the respondents (76.5%) lived in rural areas. More than two-thirds (69.9%) resided in brick houses, 54.8% reported presence of rodent entry points in their houses, and more than one-third were observed to have bushy or littered house surroundings. Ultimately the study revealed that urban residence, ethnicity, and poor housing were significantly associated with high Lassa fever transmission (Aigbiremolen, et al., 2023).

In Sierra Leone, a study that employed a qualitative method by conducting a total of 45 in-depth interviews (IDIs) in both districts, 15 of which were from Tonkolili and 30 were from Kenema District. Interviews with community members comprised all 15 IDIs strictly in Tonkolili. In Kenema, the interviewers surveyed were 15 community members and 15 IDIs were conducted with health workers from Keneta General Hospital that provide Lassa fever care. All the selected participants were 18 years and above, and they were selected based on the recommendation of the community leaders, health care workers and program staff working in the communities. The participants included individuals with or without a history of having Lassa fever, hunters, farmers, community leaders, traders, staff of community-based organizations, and some community- and facility-based health workers serving the selected communities. Over 80% of the respondents were from rural areas and poor, whose occupation were mainly farming activities without access to sophisticated produce drying tools and food storage that can safeguard their produce away from rodents. Food produce and cooking equipment are usually littered around every corner of their residence (Kumoji, et al., 2022) and depended mainly on hunting rodents as sources of meat (Douno, Asampong, Magassouba, Fichet-Calvet, & Almudena, 2021). Behavioral and socio-cultural practices such as poor food storage, bush burning, and specific funeral rites, besides, rodent hunting, continue to drive zoonotic and human-to-human transmission (Balogun et al., 2020; Besson et al., 2024).

3.5 Environmental and Climate Dynamics

Lassa fever is strongly seasonal, peaking during the dry season (November–March), when rodent–human contact increases due to bush burning and food scarcity (Besson et al., 2024; Ezenwa-Ahanene et al., 2024; Isiguzo & Iroezindu, 2019). Predictive modeling suggests climate change, deforestation, and land-use shifts may further expand reservoir habitats, potentially doubling spillover events in coming decades (Besson et al., 2024). Some regions now report all-year transmission, attributed to socio-ecological change (Mandi et al., 2025).

The survival of adult *M. natalensis* is a function of the volume of rainfall received in the past two to three months (Achigan, Codjia, & Bokonon-Ganta, 2003). Direct effects of density and rainfall, on survival, have been reported for *M. natalensis* ((Leirs, Verhagen, Verheyen, Mwanjabe, & Mbise, 1996);) and demonstrated a tendency for decreased survival in wet seasons among the adult population of *M. natalensis.* While there was no clear relationship observed between cumulative three- month rainfall and changes in density for the subadult part of the population (Redding, Gibb, & Dan-Nwafor, 2021).

IV. CONTROL AND PREVENTION STRATEGIES

As Lassa Fever Virus continues to emerge and re-emerge, it poses an enormous challenge to public health. Therefore, it becomes increasingly important to strengthen early warning mechanisms, improve treatment strategies, and build trust and engagement at the community level. In addition, the One Health approach which is anchored in the interconnectedness of human, animal and environmental health serves as a comprehensive framework for addressing complex disease threats. In addition, effective prevention and control of

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infectious diseases rely on a combination of strong surveillance systems, timely clinical management, active community participation, and integrated multi-sectoral collaboration (figure 1).

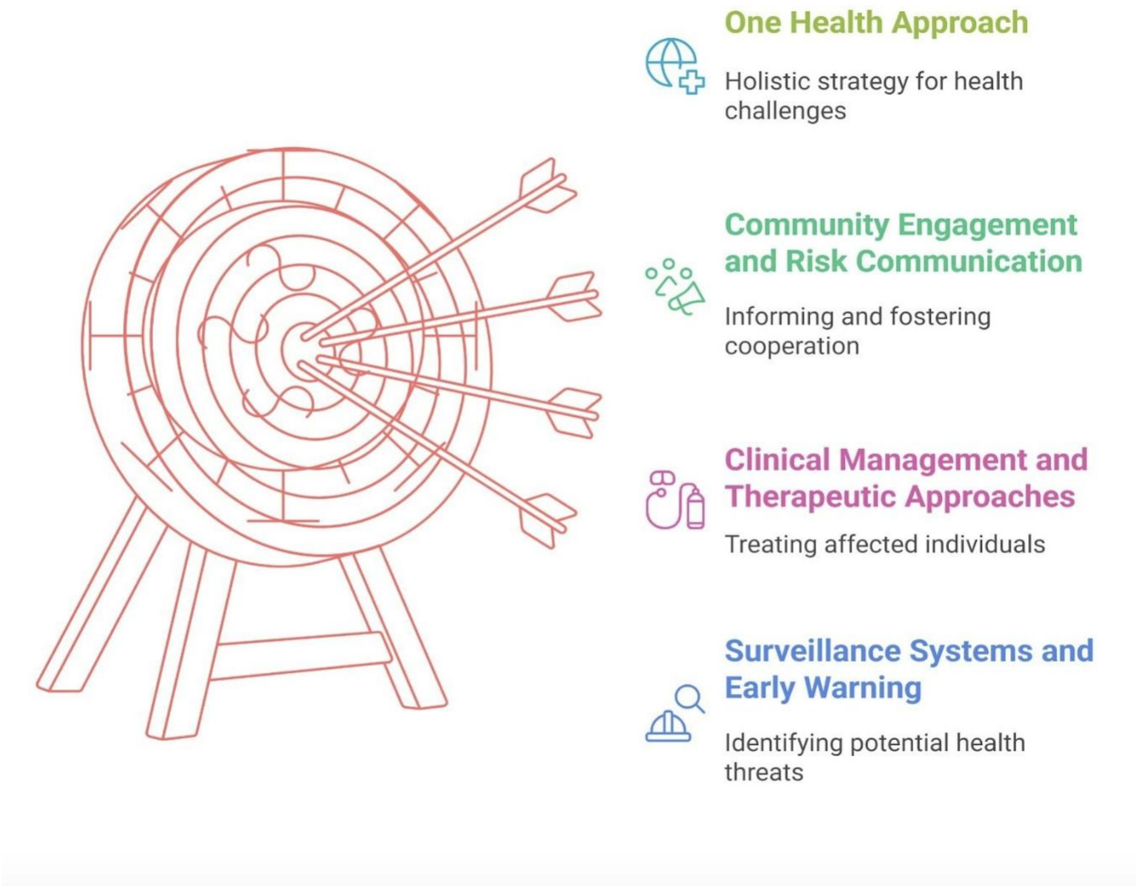

Figure 1: Integrated Health Management Strategies for Lassa Fever (Image designed Zakari Isiaka Osheku)

4.1 One Health Approach

A One Health approach is essential for addressing zoonotic transmission. So, Lassa fever cannot be defeated in isolation; there is a need for an integration across not only human and animal but also the environment. Achieving this helps and supports the health sector's improved prediction and spillover prevention (Eneh, et al., 2025); (Besson et al., 2024; Garry, 2023). Regional coordination under ECOWAS and Africa CDC remains critical.

4.2 Community Engagement and Risk Communication

Despite increased awareness, knowledge of prevention remains low: over one-third of Nigerians surveyed lacked adequate understanding of preventive measures (Al-Mustapha et al., 2024). Deep-rooted cultural practices continue to undermine public health messaging (Besson et al., 2024; Isiguzo & Iroezindu, 2019). Lassa fever exists in the community and as such there has to be a coordinated community participation on co-producing sustainable solutions in curtailing the spread of the disease through rodent control strategies and enhancement of food storage free from being exposed to rodents. Strategic community engagement becomes necessary by co-opting relevant stakeholders of the community such as community and religious leaders, influencers into the design of Lassa fever targeted interventions. Winning the trust and confidence of these relevant stakeholders from day one is central to the success of the program. Because they are at the forefront of any advocacy on rodent control or how to properly ensure food storage. By virtue of the level of influence they command in the community, they are effective tools for risk communication through media channels, faith and traditional homes because they are more trusted and grass-rooted. This ensures that the message reaches to every nook and cranny of the community (Omobowale, et al., 2024).

Community stakeholders are often considered as agents of addressing misconceptions and distrust using culturally sensitive messaging because of their influence and trust they exhibit in their surroundings. A lot of times, a couple of misconceptions and misbeliefs arise pertaining to disease aetiology, modes of transmissions or treatments or stigma which further leads to the denial of the existence of the disease or ascribing its causation to spiritual attacks. For instance, many do not believe that bush meat consumption could be responsible for the causation of Lassa fever.

4.3 Clinical Management and Therapeutic Approaches

Many treatment therapeutics exist for the management of Lassa fever. They include: supportive care and treatment with ribavirin. Supportive care for Lassa fever patients is inclusive of fluid management, renal support, and infection prevention which is often constrained by inadequate health systems infrastructures (Uppala, Karanam, Kandra, & Edhi, 2025).

Rivavirin is the first drug of choice for the treatment of Lassa fever. However, ribavirin is a reliable treatment for Lassa fever only if administered within six days of illness onset but this threshold is often not actualised due delays in diagnostics. (Garry, 2023; Yun & Walker, 2012). Ribavirin is administered orally or intravenously. Toxicity, limited availability, and high cost further restrict its use (Besson et al., 2024). Treating Lassa fever with ribavirin and favipiravir combined on confirmed cases of Lassa fever were proven to be very effective as the two patients recovered after taking the combined drugs. Other molecules have shown great potential for therapeutic activity against Lassa fever in an experimental study. For example, isavuconazole, an antifungal, was used in vitro against Lassa fever virus and it was found that isavuconazole inhibits the virus at EC50 of 1.2 μM. The drug targets stable signal peptide (SSP)-membrane fusion subunit (GP2), which inhibits cell-to-cell viral fusion. See Table 2.

Table 2: Results of the Study for the Management of Lassa Fever (Alli, Ortiz, Fabara, Patel, & Halan, 2021)
LF, Lassa fever; EICAR, 5-ethynyl-1-b-D-ribofuranosylimidazole-4-carboxamide; MPA, mycophenolic acid; SD, standard deviation; LFCP, Lassa fever convalescent plasma; LASV, Lassa virus; CFR, coronary flow reserve.

Author, Year, Country	Study Type	Intervention	Outcome/Conclusion
(McCormick, King, & Webb, 1986), Sierra Leone	Clinical trial	Use of IV ribavirin, oral ribavirin, and plasma	We concluded that ribavirin is effective in the treatment of Lassa fever and that it should be used at any point in the illness as well as for post-exposure prophylaxis (P = 0.0002).
(Frame, Verbrugge, Gill, & Pinneo, 1984), Nigeria	Clinical trial	Use of convalescent plasma	Most cases of LF who received plasma and survived showed a rapid response to therapy, in contrast with the gradual recovery in those who did not receive LFCP. Fifteen patients who received LASV convalescent plasma before the 10th day survived. Five of eight of those who received it after the 10th day died.
(Ilori, Furuse, & Ipadeola, 2019), Nigeria	Cross-secti onal study	Clinical features and treatment in an outbreak in Nigeria in 2018	Fatal outcomes were significantly associated with being elderly, no administration of ribavirin, and the presence of cough, hemorrhages, and unconsciousness. The p-value of the study is <0.05.
(Haas, Breuer, & Pfaff, 2003), Germany	Case report	Four cases were imported to Europa with LF. Two patients were treated with ribavirin.	The study indicates a low risk of transmission during the initial phase of symptomatic Lassa fever, even with high-risk exposures. The level of exposure was determined for 157 persons (68%), and 149 (64%) were tested serologically. High-risk or close contact was reported by 30 (19%) of

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			157 persons.
(Ajayi, Nwigwe, & Azuogu, 2013), Nigeria	Cross-sectional study	20 documented cases, 10 confirmed and 10 suspected, with LF during an outbreak in Nigeria	Patients who received ribavirin were less likely to die than those who did not ($p = 0.003$).
(Shaffer, Grant, & Schieffelin, 2014), Sierra Leone	Cross-sectional study	Clinical features and treatment in an outbreak in Nigeria in 2018. Comparison of early use of ribavirin vs late use of the drug	Even with ribavirin treatment, there was a high rate of fatalities underscoring the need to develop more effective and/or supplemental treatments for LF. The CFR in patients with Ag−/IgM−/IgG+ was significantly lower than that in Ag−/IgM−/IgG− patients ($p= 0.045$).
(Buba & Nguku, 2018), Nigeria	Cross-sectional study	Clinical features and treatment in an outbreak in Nigeria in 2016	Patients who commenced ribavirin were more likely to survive (odds ratio [OR] = 0.1; 95% confidence interval [CI] = 0.03, 0.50).
(Schmitz, Köhler, & Laue, 2002), Germany	Case report	Two case reports of patients traveling to Africa and been treated with ribavirin	Late administration of ribavirin probably contributed to the death of both patients.
(Raabe, Kann, & Ribner, 2017), Germany	Case report	Two case reports of patients with LF treated with ribavirin and favipiravir	Favipiravir and ribavirin treatment of epidemiologically linked cases of Lassa fever contributed to the recovery of the two reported secondary cases.
(Ölschläger, Neyts, & Günther, 2011), Germany	Comparative study	In-vitro studies of EICAR and MPA	The mechanism of ribavirin, MPA, and EICAR is based on depletion of GTP, which impedes the replication of Lassa and Ebola viruses. However, this is not the predominant mechanism by which ribavirin exerts its in-vitro antiviral effect on Lassa virus.
(Hulseberg, Fénéant, & Szymańska-de, 2019), United States	Comparative study	In-vitro studies of arbidol for LF	The study found that arbidol inhibits infection by authentic LASV, inhibits LASV GP-mediated cell-cell fusion and virus-cell fusion, and its findings suggest that arbidol inhibits LASV fusion, which may partly involve blocking conformational changes in LASV GP. The values in panel D indicate the average normalized infection in samples treated with 20 μM arbidol (±SD) from previous experiments, $p < 0.01$.
(Zhang, Tang, & Guo, 2020), China	Experimental study	Isavuconazole, an antifungal, was used in vitro against Lassa fever virus	It was found that isavuconazole inhibits the virus at EC50 of 1.2 μM. The drug targets stable signal peptide (SSP)-membrane fusion subunit (GP2), which inhibits cell-to-cell viral fusion.
(Fisher-Hoch, Gborie, Parker, & Huggins, 1992)	Retrospective study	Revision of side effects regarding the administration of IV ribavirin in patients infected with Lassa fever virus in Sierra Leone compared to placebo.	Ninety patients were analyzed in the study; 27% experienced rigors. Reduction of the hematocrit was seen in the second dose of treatment unrelated to the ribavirin.

4.4 Surveillance Systems and Early Warning

Surveillance is hampered by non-specific symptoms, delayed care-seeking, and weak health infrastructure (Balogun et al., 2020; Happi et al., 2019). Nigeria's adoption of IDSR and establishment of the Nigeria Centre for Disease Control (NCDC) have strengthened monitoring capacity (Asogun et al., 2025). Digital tools such as SORMAS have improved real-time reporting. Molecular laboratories have expanded beyond national reference centers, though coverage remains uneven.

Next-generation sequencing (NGS) has enhanced genomic surveillance, enabling tracking of viral evolution (Happi et al., 2019). Forecasting tools, e.g., quadratic models in Ebonyi, support resource allocation (Ezenwa-Ahanene et al., 2024).

V. THE ROLE OF AERIAL LOGISTICS IN EPIDEMIC RESPONSE

5.1 Concept of Aerial Logistics Systems

Unmanned Aerial Vehicles (UAVs), commonly known as drones, have rapidly been expanded in global health applications. Their ability to traverse difficult terrain and reach remote locations makes them suitable for outbreak response and sample transport (Mechan et al., 2023). We saw how more than 2.5 million doses, out of the 21 million doses, of COVID-19 vaccines were distributed in Ghana during the COVID-19 pandemic using unmanned aerial vehicles as part of the response strategy in containing the spread of coronavirus across Ghana. This act of using drones in improving access to health commodities at a time movements of people were restricted as a result of the lockdowns was innovative. This was a game changer absolutely not just in Ghana but across the world where technological innovations were deployed to tackle the medical logistical challenge of untimely supply of health commodities (Bu, Hernandez, Haruna, Abasi, & Kremer, 2023).

Qing, Hui, & Ning (2018) reported that it may be possible to apply UAVs for temperature monitoring in the surveillance of disease symptoms. Due to the high accuracy and noninvasive nature of UAVs, this technology could be used to monitor the activities and densities of rodent populations and to monitor changes in their mortality patterns, providing an early warning for natural focal diseases such as, not only plagues but also Lassa fever. With their increasing technical sophistication, UAVs also have the potential to perform population surveillance of vectors such as *Mastomys natalensis* and mosquitoes. If the optical resolution ultimately reaches an appropriate scale, it could be used for direct observation and monitoring of the vectors. Again, appropriate modifications could be made to existing models for use in environmental surveillance and spraying of pesticide. Drones are powerful tools used in the control of vectors and intermediate host and for environmental disinfection purposes or use in accurate fixed-point delivery of health commodities such as therapeutics, vaccines, personal protective equipment (PPEs), surgical devices and other health consumables needed for prevention or treatment of infectious diseases or during disease outbreak to deliver medicines like ribavirin during emergency, life-saving supplies or transport of samples from remote areas to PCR-powered laboratories in cities for investigation (Bakke, et al., 2006). UAV-based logistics represent a transformative opportunity for epidemic supply-chain resilience. Their success in other health emergency responses serves as a blueprint for Lassa integration.

Drone delivery substantially reduces turnaround times. In Rwanda, drone-based emergency deliveries reduced maternal mortality by 51% and blood product expiration by 67% (Kremer et al., 2023). UAV logistics have also been validated in austere environments such as combat zones, demonstrating reliability for high-risk medical missions (Lammers et al., 2023). For Lassa fever, early diagnosis is critical (Omeh et al., 2017). Drones can reduce multi-day overland transport to under one hour.

5.2 Challenges and Barriers

Unmanned Aerial Vehicles (UAVs), commonly known as drones, play a pivotal role in improving access to health commodities, particularly for hard-to-reach communities, by enabling rapid delivery within the shortest possible time (Knoblauch, et al., 2019). However, several challenges hinder their effective deployment. Regulatory barriers pose a major obstacle, as some countries restrict or deny UAV access to their airspace, thereby limiting smooth operations. Cost is another significant constraint: drones and their supporting infrastructure remain prohibitively expensive for many low- and middle-income countries with limited budgetary allocations. As a result, acquiring UAVs can seem almost unattainable. Furthermore, many of these countries lack the requisite technical expertise and specialized workforce needed to manufacture drones tailored to their unique operational needs. This combination of financial, regulatory, and technical challenges continues to impede large-scale adoption of UAVs for health service delivery (Singh, et al., 2025).

VI. CONCLUSION

Lassa fever continues to evolve epidemiologically. So, there is an urgent need to tame it before it becomes the next pandemic. Lassa fever with rising incidence, expanding geographic range, persistent high mortality across West Africa and with great potential to spread to other continents of the world. Traditional control strategies, while essential, remain inadequate in the face of systemic constraints. By integrating advanced technological innovations in unmanned aerial logistics will help with transport, surveillance and diagnostics. And these are fundamental for health system strengthening which represents a critical frontier for future disease preparedness and response. A comprehensive, multisectoral, One Health approach supported by rapid technologically advanced logistics remains crucial to reducing morbidity and mortality. In addition, it enhances regional health security against Lassa fever and other emerging viral hemorrhagic fevers.

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